Passing the USMLE: Clinical Knowledge
Passing the USMLE
Clinical Knowledge

Ahmad Wagih Abdel-Halim, MD
Clinical medical science is an ocean of information. A good physician is one who can successfully figure out in which direction to swim when he faces a difficult medical problem. Acquiring that skill requires a strong grip on the basic facts behind each pathology, its most common presentation, what to look for during examination, and the best way to diagnose the pathology and treat your patient.

Preparing for the USMLE is a daunting and time-consuming task, and the exam is a difficult experience for most examinees. For many years, USMLE examinees have longed for a single source to prepare for the exam that could provide them with all the necessary details in just one concise book. This single source would be rich with information, figures and tables, yet be easy to memorize.

This book serves as a refresher on basic medical science facts and how best to apply these facts to the major specialties of clinical medicine. Enriched with key words, tables, figures and diagrams, this text will eliminate the need for any other books during your preparation for the USMLE. Simple vocabulary and straightforward prose ensure that the information you read will be easily stored in your memory for the longest period of time. The ocean of medical information was distilled down to a stream of only the most pertinent, high-yield facts, and the figures were carefully chosen to illustrate important concepts and maximize learning.

With this source as your guide, passing the USMLE will be just another step in your medical career.

MICHIGAN, USA

AHMAD WAGIH ABDEL-HALIM
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MICHIGAN, USA

AHMAD WAGIH ABDEL-HALIM
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Endocrinology

Pituitary Gland

Parts and Actions

- Anterior pituitary: Releases FSH, LH, GH, TSH, ACTH and Prolactin (GH and prolactin are released from acidophil cells; everything else from basophil cells).
- Posterior pituitary:
  1. Supra-optic nucleus: Releases Anti-diuretic hormone (ADH) which acts on intercalated cells of the kidneys via V2 receptors, and on blood vessels via V1.
  2. Paraventricular nucleus: Releases oxytocin, which stimulates the contraction of the uterus, and muscles surrounding the mammary glands’ acini.

Hyperprolactinemia

- Introduction:
  1. Prolactin release is inhibited by dopamine and dopamine agonists.
  2. Normal serum prolactin level is less than 20 ng/mL (During pregnancy, a level up to 200 ng/mL is still considered normal).

- Causes:
  1. Physiological: Pregnancy and lactation.
  2. Pituitary: Chromophobe adenoma and Empty Sella Syndrome.
  4. Drugs: Anti-Psychotics; via inhibition of dopamine.

- Clinical picture:
  1. Amenorrhea and infertility.
  2. Galactorrhea: Milky nipple discharge.
  3. Headache, vomiting and Bitemporal Hemianopia: Due to high intracranial pressure.

- Diagnosis: Serum Prolactin level higher than 200 ng/mL. Also CT and MRI of brain to rule out pituitary adenoma and TSH to rule out hypothyroidism.

- Treatment: Dopamine agonists (First), e.g., Bromocriptine, or hypophysectomy.

Acromegaly

- Mechanism: Caused by excess GH after closure of epiphysis. If it occurs before closure, it is called Gigantism.
- Cause: Acidophil cell adenoma. In gigantism, it is mostly acidophil hyperplasia.
- Clinical picture: Large head, hands and feet, gapping of teeth, and glucose intolerance. Refer to Fig. 1.1.
Diagnosis:
2. Glucose suppression test is diagnostic: For confirmation if IGF is elevated.

Treatment:
1. Growth hormone antagonist, e.g., Somatostatin, bromocriptine.
2. Surgery, i.e., Hypophysectomy.

Hypopituitarism
- Causes: Tumor or injury; however a very important cause is infarction of the anterior pituitary in the postpartum period a.k.a. Sheehan’s syndrome.
- Clinical picture: In order of occurrence Hypo-gonadism, -thyroidism, and lastly -adrenalism.
- Diagnosis: Low sex hormones, thyroid and cortisol levels, along with low FSH, LH, TSH and ACTH. If the latter stimulatory hormones are elevated, this suggests polyglandular deficiency syndrome (Schmidt’s syndrome).
- Notes: Kallaman syndrome: Low GnRH, FSH and LH leading to anosmia, amenorrhea and associated with cleft lip/palate.

ADH Disorders
- Syndrome of inappropriate ADH secretion (SIADH): Excessive ADH secretion leading to oliguria with a high urinary Na content and osmolality. Treatment: Fluid restriction and removing the underlying cause. Hypertonic saline, lithium and demeclocycline are used for severe non-resolving cases.
- Diabetes insipidus: Either due to decreased ADH secretion (Central diabetes insipidus) or decreased sensitivity (Nephrogenic diabetes insipidus). This leads to polyuria with low urinary Na content and osmolality. Central DI is treated with DDAVP, and nephrogenic DI is treated with thiazide diuretics.
- Note: Normal serum osmolality = 280 mosm/L.

Thyroid Gland
Thyroxine Synthesis
- Iodide is uptaken into the cells: This is inhibited by Thiocyanate, Perchlorate and high iodine levels (Wolf Chaikoff effect).
- Oxidation by peroxidase enzyme: Inhibited by Propylthiouracil (PTU) and Methimazole.
- Organification and coupling: Inhibited by PTU and Methimazole.
- Deiodination: Performed by De-iodinase enzyme.
- T4 is converted to T3 (T3 is 3 times more potent than T4): Conversion is inhibited by PTU and Beta blockers.
- Binding to globulin: Free (unbound) form is the active one.

Regulation
- TRH from hypothalamus stimulates TSH release from pituitary.
- T3 performs negative feedback inhibition of TSH.

Actions of Thyroid Hormones
- Mechanism: Stimulate Na/K ATPase enzyme, which leads to increased oxygen consumption in all cells except the brain, gonads and the spleen.
- CVS: Increase stroke volume, heart rate and cardiac output.
- CNS: Maturation of the nervous system.
- Metabolic: Stimulate glycogenolysis, gluconeogenesis and lipolysis. So, high thyroxin levels lead to low cholesterol levels and vice versa.
- Blood: Increases 2,3 DPG, so increases O2 dissociation from hemoglobin.
- Notes:
  1. Calcitonin is released from parafollicular (C) cells of thyroid gland and it functions to decrease bone resorption, hence used to treat osteoporosis. Medullary carcinoma of the thyroid originates from C cells, which are derived from the 4th pharyngeal pouch.
  2. Thyroid and steroid hormones all act on nuclear receptors.
Thyrotoxicosis

- **Introduction:** Aka Graves disease, and is linked to HLA-DR3 and HLA-B8.
- **Mechanism:** Thyroid stimulating immunoglobulins (TSI), also known as long acting thyroid stimulators (LATS).
- **Clinical picture:** Heat intolerance, exophthalmia, sweating, tremors, increased appetite, weight loss and diarrhea.
- **On exam:**
  1. Exophthalmia, lid retraction and lid lag. Refer to Fig. 1.2.
  2. Thyromegaly: Moves up and down with deglutition.
  3. Tremors of extremities, and excessive sweating.
  4. Tachycardia and arrhythmia, e.g., atrial fibrillation.

- **Diagnosis:** Low TSH, and high T3 and/or T4.
- **Next step:** Thyroid ultrasound, and thyroid iodine uptake scan revealing a hot spot (Diffuse increased uptake is diagnostic of Grave’s disease).
- **Treatment:**
  1. Best is radioactive iodine: Hypothyroidism is a common complication.
  2. Surgery: Reserved for pregnant patients, or large compressive goiters.
  3. Medical: Methimazole or propylthiouracil. Beta blockers help alleviate the adrenergic symptoms, e.g., tachycardia, anxiety. *Note that methimazole is contraindicated during pregnancy as it can cause aplasia cutis.*

**Notes:**

1. Exophthalmia occurs due to edema, fat and round cell infiltration, all behind the eye, along with weakness of extra-ocular muscles.
2. Thyrotoxic crisis (Thyroid storm) is a fatal extreme hyperthyroidism characterized by altered mental status, fever, tremors and tachycardia. Treatment is urgent and includes all the following:
   - Cooling: Using ice. *Salicylates are contraindicated as they unbind thyroxine.*
   - PTU: Inhibits synthesis and peripheral conversion.
   - Beta blockers, e.g., Propranolol + Steroids: They both inhibit thyroxin release.

Hypothyroidism

- **Clinical picture:** Cold intolerance, constipation, fatigue, weight gain and dry skin.
- **On exam:** Delayed relaxation phase of deep tendon reflexes, and non-pitting edema on shin of tibia (Myxedema).
- **Diagnosis:** High TSH, and low T3 and/or T4.
- **Next step:** Check for anti-thyroglobulin, anti-microsomal and anti-thyroperoxidase antibodies to rule out Hashimoto thyroiditis.
- **Treatment:** Thyroxin replacement therapy.
- **Follow up:** Treatment takes 3–4 weeks to be completely effective. Follow up by measuring TSH. Recheck should be done 3–4 weeks after every dose adjustment.

**Notes:**

1. Cretinism is a neonatal form of hypothyroidism due to iodine deficiency during pregnancy. Newborn is *pale*, has *puffy face*, *pot belly* and *mental retardation*.
2. Myxedema coma is a fatal extreme hypothyroidism characterized by coma, hypothermia and muscle rigidity. Treatment: IV thyroxin.
3. Hypothyroid female patients tend to have Fe deficiency anemia due to high susceptibility for menorrhagia.

Thyroiditis

- **De Quervain thyroiditis:** Due to giant cell infiltration triggered by a viral infection. This leads to painful enlargement of thyroid. Patient presents with sore throat radiating to the ears. On exam: Tender thyromegaly and normal oropharynx.
- **Hashimoto’s thyroiditis:** Common in females and progresses to hypothyroidism. Commonly associated with autoimmune disorders, e.g., DM.

---

Fig. 1.2 Exophthalmia
Diagnosis of thyroiditis:
1. Diffuse low iodine uptake on thyroid scan.

Treatment: Self resolving. Thyroxin therapy for Hashimoto’s patients might be needed.

Thyroid Cancer
- Follicular: Metastasize through blood. Most common site for mets is the skull. So when you see a patient in the USMLE with thyroid cancer and red hot mass on his skull, it is mostly follicular thyroid cancer. Treatment: Surgery and radioactive iodine. Note: Hurthle cell carcinoma is a subtype of follicular carcinoma.
- Anaplastic: Big firm tumor common in the elderly, with poor prognosis. Treatment: Surgery and radiation therapy.
- Medullary: Arise from C cells and secretes calcitonin. Microscopy shows amyloid stroma. Treatment: Surgery. This tumor is radioresistant.

Solitary Thyroid Nodule
- If palpable: Fine needle aspiration (FNA) and biopsy is always needed.
- If not palpable: FNA should only be done if nodule is bigger than 1.5 cm.
- Note: Hot nodules are mostly toxic, and cold nodules are mostly malignant.

Thyroglossal Cyst
- Mechanism: Non-obliteration of a part of the thyroglossal duct.
- Clinical picture: Midline cystic neck swelling that moves up with tongue protrusion.
- Complication: Rupture leaving a thyroglossal fistula.
- Treatment: Excision via Sistrunk operation.

Parathyroid Gland

Actions of PTH (Released by Chief Cells)
- Bone: Increase activity of both osteoblasts and osteoclasts, with an end result of bone destruction to increase serum calcium.
- Kidney:
  1. Increases reabsorption of Ca and excretion of P.
  2. Stimulates hydroxylation of vitamin D, which also increases calcium absorption via Calbindin D-28.
- Intestine: Increase calcium absorption, and decrease P absorption.
- Note: Vitamin D is hydroxylated once in the liver (25-OH) then the kidneys (1-OH), in order to increase both serum Ca and P by stimulating intestinal absorption and bone resorption.

Regulation
- Serum calcium regulates release or inhibition of PTH.
- 1,25-OH vitamin D causes feedback inhibition on its own formation.
- Ultraviolet B light is essential for regulating the action of vitamin D. So, suspect vitamin D deficiency in patients living in prison or cold areas with not much sun.

Hyperparathyroidism
- Causes: Adenoma, hyperplasia or secondary to another cause (renal failure); the most common of all these is the adenoma.
- Clinical picture (Bones, Stones and Abdominal groans):
  1. Hypercalcemia: Causing constipation, polyuria, stones and fatigue.
  2. Osteitis fibrosa cystica: Causing bone pains and fractures.
  3. CNS: Altered mental status and corneal band keratopathy.
- Treatment: Calcium chelators, and surgery in severe cases.
- Treatment of symptomatic hypercalcemia: Infusing the patient with 3–4 L of normal saline then starting furosemide. Note that you have to fill the tank first.
- Notes:
  1. Pseudohypoparathyroidism a.k.a. Albright hereditary osteodystrophy is an X-linked dominant syndrome where PTH is abundant but organs are resistant to it, due to a defective Gs protein.
  2. MEN I and II must be ruled out in any case of hyperparathyroidism.

Multiple Endocrine Neoplasia (MEN)
- Type I (Wermer syndrome): Involves pituitary, pancreas and parathyroid glands (PPP).
- Type IIA (Sipple syndrome): know it as (TAP):
  1. Thyroid gland: Medullary carcinoma.
- Type IIb: Just like IIA except for parathyroid being replaced by neuroma (TAN).
Adrenal Gland

Parts and Actions

- **Zona glomerulosa**: Aldosterone, which increases Na absorption and K excretion.
- **Zona fasiculata**: Cortisol, acts like aldosterone, plus being anti-inflammatory by stimulating lipocortin and decreasing interleukin 2, eosinophils and lymphocytes.
- **Zona reticularis**: Dehydroepiandrosterone (DHEAS) and Androstenedione.
- **Note**: Cortisol stimulates gluconeogenesis and inhibits glycogenolysis, while glucagon stimulates both processes.

Regulation

- CRH from hypothalamus stimulates ACTH release from pituitary. ACTH stimulates cholesterol desmolase in the adrenal glands.
- Renin converts angiotensinogen to angiotensin I, which later converts to angiotensin II via Angiotensin Converting Enzyme (ACE). Angiotensin II is then converted to Aldosterone, which performs a negative feedback on renin.

Cushing Syndrome

- **Causes**:
  1. Cushing disease: Excessive secretion of ACTH.
  2. Adrenal adenoma or hyperplasia: Excessive secretion of cortisol (low ACTH).
  3. Ectopic ACTH secretion, e.g., Small cell cancer of the lung.
- **Clinical picture**: refer to Fig. 1.3.
  1. Moon face, buffalo hump and truncal obesity.
  2. Striae rubrae and thin limbs.
  3. Polycythemia and hirsutism.
- **Diagnosis**: Dexamethasone suppression test.
- **Treatment**: Ketoconazole.

Conn’s Syndrome

- **Introduction**: a.k.a. primary hyperaldosteronism.
- **Clinical picture**: Resistant hypokalemic hypertension and metabolic alkalosis.
- **Diagnosis**: High serum aldosterone/renin activity ratio and salt loading test.
- **Treatment**: Anti-aldosterone agent, e.g., Spironolactone.
- **Note**: These patients normally have polyuria, but at a certain aldosterone level, the kidneys do not respond to aldosterone anymore (Aldosterone escape phenomenon).

Pheochromocytoma

- **Introduction**: A rare neural crest remnant tumor arising from chromaffin tissue.
- **Rule of 10s**: 10% are extra-adrenal, 10% bilateral, 10% malignant.
- **Clinical picture**: Panic attack-like picture (Palpitations, chest pain, sweating) and labile resistant hypertension.
- **Diagnosis**: Elevated 24-h urine concentration of vanillylmandelic acid (VMA), metanephrines and free catecholamines.

Fig. 1.3 Cushing syndrome
• Next step: Tumor must be localized by performing a CT of the abdomen and/or a Metaiodobenzylguanidine (MIBG) scan if CT failed to localize the tumor.

• Treatment:
  1. Drug of choice is alpha blockers, e.g., Phenoxybenzamine.
  2. Surgical resection of the tumor.

• Note: A similar tumor in children is neuroblastoma, which arises from the sympathetic chain and is diagnosed just like pheochromocytoma. Suspect this in any child presenting with orbital ecchymosis and opsiclonus (eyes jumping into different directions persistently). Biopsy of this tumor shows Homer-Wright pseudo-rosettes; treatment is surgical.

Adrenal Insufficiency

• Types:
  1. Primary: Due to adrenal cortex dysfunction
  2. Secondary: Due to pituitary dysfunction.

• Clinical picture:
  1. Resistant hypotension and hypoglycemia.
  2. Primary cases may also have hyperpigmentation of mucous membranes due to high melanocyte stimulating hormone levels (MSH) as a response to elevated ACTH. Note that secondary cases do not have this feature.

• Diagnosis: Cosyntropin stimulation test.

• Treatment: Systemic steroids.

• Notes:
  1. Addisonian crisis: Fatal extreme hypoadrenalism that occurs due to severe stress, or sudden stoppage of long term steroid therapy.
  2. Waterhouse Friderichson syndrome: Adrenal insufficiency that occurs due to adrenal hemorrhage. Caused by Neisseria meningitidis. So, when you see a patient in the USMLE with meningitis who suffers sudden severe hypotension, you know what to think!

Diabetes Mellitus (DM)

• Definition: Impaired glucose tolerance, which has 2 types as seen in Table 1.1.

• Clinical picture: Polyuria, Polydypsia, Polyphagia and weight loss.

• Complications:
  1. Neuropathy, Nephropathy and lastly Retinopathy. The mechanism here is small vessel atherosclerosis due to non-enzymatic glycosylation and excessive conversion of glucose into sorbitol.
  2. DM can also cause large vessel atherosclerosis leading to stroke and Coronary Artery Disease (CAD).
  3. Oculomotor nerve III palsy affecting the action of extraocular muscles.

<table>
<thead>
<tr>
<th>Table 1.1 Types of DM.</th>
<th>DM-1</th>
<th>DM-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanism</td>
<td>Viral destruction of beta cells leading to absence of insulin secretion. Underlying mechanism is anti-insulin and anti-islet cell antibodies</td>
<td>Insulin resistance</td>
</tr>
<tr>
<td>Genetics</td>
<td>Weak, but linked to HLA DR3 and HLA DR4</td>
<td>Strong genetic predisposition but it is not HLA linked</td>
</tr>
<tr>
<td>Insulin level</td>
<td>Very low or absent</td>
<td>Normal</td>
</tr>
<tr>
<td>Obesity</td>
<td>Not common</td>
<td>Very common</td>
</tr>
<tr>
<td>Complications</td>
<td>Very common</td>
<td>Not common</td>
</tr>
<tr>
<td>Treatment</td>
<td>Insulin</td>
<td>Oral hypoglycemics or insulin</td>
</tr>
</tbody>
</table>

Congenital Adrenal Hyperplasia

• Mechanism: 21-alpha or 11-beta hydroxylase enzyme deficiencies, which are necessary for cortisol production. Some cases are linked to HLA BW47.

• Clinical picture: Hirsutism, virilization and precocious puberty due to increased ACTH-induced androgen production.

• Diagnosis: High serum 17-hydroxyprogesterone levels.

• Note: This should be your first suspicion when you see a newborn with ambiguous genitalia. The next step after confirming the diagnosis would be to check the patient’s electrolytes as they might have life threatening mineralo- or glucocorticoid deficiency.

Pancreas

Introduction

• Has exocrine and endocrine functions, the latter being regulated with:
  1. Alpha cells: Release glucagon.
  2. Beta cells: Release insulin.
Diagnosis: High fasting glucose above 126 mg is the test of choice.

Follow up: HbA1C gives an idea about control of blood sugar over the last 3 months (Target is below 6.5%). Fructosamine gives an idea about control of blood sugar over the last 3 weeks.

Notes:
1. Major risk factor for complications in DM is duration of disease.
2. Neuropathic leg ulcers occur mainly in the sole, caused by different organisms, but never by Clostridium. Treatment: Debridement.
3. Note: Most common cause of death in patients with DM-I is:
   - First decade of life: DKA.
   - Second decade: Renal failure.
4. Hypoglycemia is a common complication in patients with DM especially those patients:
   - On sulfonylureas, e.g., Glyburide.
   - Excessive exogenous insulin injection: High insulin and Low C-peptide serum levels.
   - Alcoholism: Due to impaired gluconeogenesis. Mechanism here is high NADH, converting pyruvate to lactate, and oxaloacetate to malate.
5. Glucagonoma: Malignant tumor which presents with hyperglycemia and migrating erythematous skin lesions. So when you see a patient in the USMLE with high blood sugars and unexplained fleeting rash, you know what to suspect!

Insulin

- Insulin is secreted from beta cells of the pancreas.
- Upon eating, glucose blocks K channels and open Ca channels in the beta cells, which leads to insulin secretion in a pulsatile fashion: an early big phase followed by a smaller one.
- Diabetic pancreas either does not release any insulin (DM Type I), or it releases it in one small phase (DM Type II).
- Insulin secreted in response to oral glucose is more than that in response to injected glucose; the secret lies in stimulation of GI enzymes by oral glucose.
- Actions of insulin:
  1. Increase cellular uptake of glucose everywhere except brain, kidney tubules and RBCs.
  2. Increase cellular uptake of amino acids and K, and increase lipogenesis.

Types of insulin:
1. Rapid and Short acting: Crystalline insulin. Used in emergencies. Onset of action = 1 h. Duration of action = 6 h.
2. Intermediate: Lente, Semilente, Neutral Protamine Hagedorn (NPH). Onset of action = 1×2 = 2 h. Duration of action = 6×2 = 12 h.

Side effects of insulin:
1. Skin allergy and lipodystrophy: Common at site of injection.
2. Somogyi phenomenon: High early morning blood sugar as rebound, due to a preceding drop of blood sugar. Treated by decreasing the evening insulin dose.
3. Dawn phenomenon: High early morning blood sugar which is not preceded by any drop. Occurs due to early morning catecholamine surge. Treated by increasing the evening insulin dose.

Oral Hypoglycemics

1. Sulfonylureas.
   - Mechanism: Increase insulin release and tissue sensitivity. This is achieved by blocking K channels and opening Ca channels in the beta cells of pancreas.
   - Metabolism: Takes place in the liver, and excretion is in the urine.
   - Examples and side effects:
     2. Chlorpropamide: Disulfiram like action and syndrome of inappropriate ADH (SIADH).
     3. Others: Glipizide, Tolbutamide.

2. Biguanides.
   - Mechanism: Inhibit hepatic gluconeogenesis.
   - Example: Metformin.
   - Side effects and contraindications:
     1. Alcoholism or IV dye + Metformin: High risk of lactic acidosis.
     2. Renal failure: Contraindication for using Metformin.

3. Thiazolidinediones.
   - Mechanism: Decrease insulin resistance.
   - Examples: Rosiglitazone, Pioglitazone.

4. Alpha glucosidase inhibitors.
   - Mechanism: Inhibit carbohydrate absorption.
   - Side effects: GI upset and flatulence.
   - Examples: Acarbose.
**Diabetic Ketoacidosis (DKA)**

- **Clinical picture:** Diffuse abdominal pain and vomiting with no obvious explanation.
- **Diagnosis:**
  1. High blood glucose and high anion gap metabolic acidosis.
  2. Ketones in urine and serum.
- **Treatment:** Aggressive hydration, insulin and potassium replacement.
- **Complications during treatment:**
  1. Rapid dropping of blood glucose causes cerebral edema.
  2. Insulin therapy leads to hypophosphatemia, which causes muscles paralysis.
- **Hyperosmolar coma:** Presents and looks just like DKA, minus the high anion gap, the acidosis and the ketones. Treated similarly.

**Others**

- **Thymoma:** Diseases associated with this benign tumor are Myasthenia Gravis, pure red cell aplasia, Systemic Lupus Erythematosus (SLE), mediastinal syndrome, polymyositis and neutrophilic agranulocytosis.
- **Pinealoma:** Germ cell tumor that presents with high intracranial pressure (Headache, nausea, vomiting, blurry vision), and treated by surgical resection and radiation therapy. Clinical picture: 3 (P)s: Precocious puberty, Papilledema and Parinaud syndrome (Paralysis of upward gaze of the eyes).

**Drug Induced Endocrinal Disorders**

- **Iodine and Thyroxin:** Hyperthyroidism.
- **Lithium:** Hypothyroidism and Diabetes insipidus.
- **Amiodarone:** Hypothyroidism or Hyperthyroidism.
- **Carbamazepine and Chlorpropramide:** SIADH.
- **Ketoconazole:** Adrenal insufficiency.
- **Metoclopramide:** Hyperprolactinemia.
- **Steroids:** Hyperglycemia and cushinoid features.

**Endocrinal Causes of Excessive Sweating**

1. Hypoglycemia: Also palpitations and confusion.
2. Acromegaly/Gigantism.
3. Hyperthyroidism.
4. Pheochromocytoma.

**Gastrointestinal System**

**Musculature and Nerve Supply**

- **Musculature:** The entire GI is made up of smooth muscles except the (UPS) which are made up of skeletal muscles: Upper third of esophagus, Pharynx and External anal Sphincter.
- **Local GI nerve plexuses:**

**Digestion**

- Swallowing center is located in medulla oblongata and it initiates peristalsis in the pharynx, which goes through 2 phases:
  1. 1st peristalsis: Mediated by gravity pushing food down the esophagus.
  2. 2nd peristalsis: Active peristalsis that follows to clear food remains left behind in the esophagus.
- Lower esophageal sphincter relaxation is mediated by contact with the food bolus, and this process is regulated by Vasoactive Intestinal Peptide (VIP).
- Once food reaches the stomach, receptive relaxation takes place, which is mediated by cholecystokinin (CCK).
- The stomach performs 3 slow waves/min; also motilin initiates migratory myoelectric complex every 60–90 min to clear the gastric food remains.
- Gastric emptying process is hastened by isotonic food, and is slowed down by CCK and presence of fat or excess hydrogen ions in the duodenum.
- The small intestine works in a magical way; the reason is that ileum starts performing peristalsis and the ileocecal valve relaxes once the food reaches the stomach. This is know as the Gastro-ileoal reflex.
- Na and glucose pass from intestinal lumen into intestinal cells by co-transport mechanism; then they pass into the circulation by facilitated diffusion.
- Amino acids and peptides are also absorbed by Na-cotransport. Fructose is the only monosaccharide absorbed in the intestine by facilitated diffusion without co-transport.

**Hormones and Mediators**

- **Gastrin:** Secretion is stimulated by Phenylalanine and tryptophan and has these actions:
  1. Stimulates HCL secretion.
  2. Hypertrophy of gastric and intestinal mucosa.
- **Cholecystokinin (CCK):** Secreted by I cells of duodenum and jujunum, which are stimulated by free...
fatty acids and monoglycerols, and has these actions:
1. Contracts gall bladder and relaxes sphincter of Oddi.
3. Delays gastric emptying, and stimulates growth of exocrine pancreas.

- **Secretin**: Secreted by S cells of duodenum, and it stimulates pancreatic bicarbonate secretion.
- **Somatostatin**: Secreted by D cells of pancreas, and it inhibits all GI hormones.
- **Histamine**: Stimulates HCL secretion (Remember H2 blockers?).
- **Gastro-Intestinal Peptide (GIP)**: Stimulates pancreatic insulin secretion. That is the reason why oral glucose stimulates insulin secretion in big amounts compared to IV glucose.
- **Vasoactive Intestinal Peptide (VIP)**: Mediator of pancreatic cholera, stimulates gastric HCL and pancreatic bicarbonate secretion, and also regulates relaxation of lower esophageal sphincter.

**Secretions**

**Saliva**
- Hypotonic solution that is rich in K and HCO₃, and deficient in Na and Cl.
- **Aldosterone** regulates the Na/K transfer in and out of salivary ducts.
- Parasympathetic stimulation via cranial nerves VII and IX causes the saliva to be abundant and watery.
- Sympathetic stimulation via cAMP system causes saliva to be scanty and viscid.
- Lingual lipase cleaves triglycerides to monoglycerols and free fatty acids.
- Lingual amylase (Ptyalin) is responsible for starch digestion. Works on alpha 1-4 bonds.

**Gastric Secretions**
- Parietal cells of stomach secrete HCl and intrinsic factor. Intrinsic factor binds to vitamin B12 all the way to the ileum where only B12 gets absorbed (Without intrinsic factor). Ileal resection leads to vitamin B12 deficiency, steatorrhea and recurrent oxalate stones.
- In pernicious anemia, there is autoimmune destruction of parietal cells and intrinsic factor and higher risk of developing gastro adenocarcinoma.
- Low HCl content of the stomach puts it at risk of infection with Salmonella.
- Chief cells secrete pepsinogen, which further breaks down to pepsin.
- G cells secrete gastrin, which stimulates HCl secretion by parietal cells.

**Pancreatic Secretions**
- It is isotonic fluid with high HCO₃ and low Cl content.
- Pancreatic amylase: For starch digestion to oligosaccharides and maltose.
- Pancreatic lipase: For fat digestion. Elevated in pancreatitis.
- Pancreatic proteases, e.g., Elastase, Trypsin and Chymotrypsin: For protein digestion.
- Trypsinogen, which is then converted to trypsin by duodenal enterokinase.
- Trypsin (as well as Thrombin) acts on the arginine-glycine bond.
- Bentiromide is used to assess the pancreatic function by measuring the duodenal chymotrypsin and its ability to cleave Para-Amino Benzoic Acid (PABA).
- Note: All pancreatic enzymes are released in an inactive form to protect the pancreas from digesting itself.

**Bile**
- Secreted by the liver and stored in the gall bladder.
- Composition: Mainly water, plus bile salts, cholesterol and bilirubin.
- Bilirubin can cause jaundice of the skin and sclera and is of 2 types:
  1. Direct (Conjugated): Passes in the urine and stools.
  2. Indirect (Unconjugated): Incapable of passing into urine or stools, but can cross blood brain barrier. That is the bilirubin form that causes kernicterus in neonatal jaundice.
- Note: Amount of secretions:
  1. Salivary: 1.5 L/day.
  2. Gastric: 2.5 L/day.
  3. Pancreatico-biliary: 1 L/day.
  4. Succus entericus: 3 L/day.

**Dysphagia**
- Causes: Internal obstruction, e.g., tumor, or external compression, e.g., tumor, enlarged left atrium or lymph nodes.
- First thing to do: Barium swallow, then esophago-gastro-duodenoscopy (EGD) if the barium swallow was inconclusive. Why not EDG to begin with? Risk of perforation.
**Note**: Oropharyngeal dysphagia usually occurs after a major cerebrovascular accident (CVA) and is evaluated by videoesophagography.

**Keywords for dysphagia**:
1. Dysphagia mainly to liquids: *Achalasia*.
2. Dysphagia mainly to solids: *Tumor*, e.g., Malignancy.
3. Dysphagia + regurgitation of undigested food: *Zenker's diverticulum*.
4. Dysphagia + long standing GERD: *Esophageal strictures*.
5. Dysphagia + tight shiny skin: *Scleroderma*.

**Esophageal Varices**
- **Definition**: Dilated porto-systemic shunts between left gastric and azygos veins, mostly due to portal hypertension.
- **Clinical picture**: Patient with liver cirrhosis vomiting bright red blood.
- **Treatment**: Sandostatin, and EGD to perform banding or sclerotherapy.
- **Note**: Balloon tamponade is only used if above measures fail.

**Achalasia**
- **Definition**: Abnormal peristalsis and incomplete relaxation of lower esophageal sphincter, due to loss of Auerbach plexus.
- **Clinical picture**: Intermittent dysphagia, more to liquids, and regurgitation of meals.
- **Diagnosis**:
  1. Barium swallow shows *Bird’s beak sign*. Refer to Fig. 1.4.
  2. Esophageal manometry shows high intra-esophageal pressure (>25 mmHg).
- **Treatment**: Myotomy (best), dilatation or botulinum toxin injection.
- **Postmortem**: Brown spots of digested hemoglobin could be seen in the esophageal wall, a.k.a. *Leopard spots*.

**Diffuse Esophageal Spasm**
- **Clinical picture**: Chest pain, related to meals. Often confused with angina.
- **Diagnosis**: Barium swallow shows *corkscrew esophagus*.
- **Treatment**: Calcium channel blockers to relax the smooth muscles.

**Plummer Vinson Syndrome**
- **Clinical picture**: Esophageal webs, atrophic glossitis, iron deficiency anemia.
- **Complication**: Esophageal squamous cell cancer.
- **Treatment**: Dilatation and iron therapy.

**Peptic Ulcer Disease (PUD)**
- **Mechanism and location**:
  1. Gastric: Lesser curvature, due to impaired protective layer.
  2. Duodenum: Duodenal bulb, due to hyperacidity or *Helicobacter Pylori* infection; which is a Gram negative rod normally residing in the antrum.
- **Clinical picture**:
  1. Gastric ulcer: Epigastric pain that increases immediately after eating.
  2. Duodenal ulcer: Epigastric pain that gets better with eating, but gets worse an hour later.
- **Complications**:
  1. Perforation of an ulcer in the posterior duodenal wall leads to injury of the *gastro-duodenal artery*, so suspect in any patient with Duodenal ulcer who suddenly develops severe abdominal pain and becomes hemodynamically unstable.
2. Perforation: Presents with severe abdominal pain. Patient has tympanic abdomen on percussion and upright abdominal X-ray shows air under diaphragm.

- **Treatment:**
  1. Proton pump inhibitor (PPI) for 6 weeks; if no improvement perform EGD and test for H. Pylori by antral biopsy (Clo test), urease breath test or stool antigens. Clo test depends on a urea rich medium that changes its color once the H. pylori’s urease cleaves the urea into ammonia.
  2. Surgery: Vagotomy or gastrectomy, e.g., Billroth surgery. Complications of Billroth include abdominal distention and hypotension followed by reactive hypoglycemia induced by meals aka Dumping syndrome.

- **Treatment of H. Pylori:**
  1. Amoxicillin, clarithromycin, and proton pump inhibitor for 2 weeks.
  2. If the patient has penicillin allergy, the second preferred combination is Tetracycline, Metronidazole and Bismuth for 2 weeks.

GERD: Long standing Gastro-esophageal Reflux Disease (GERD) may result in replacement of the distal esophageal stratified squamous epithelium with gastric columnar epithelium. This is known as Barrett’s esophagus and is associated with high risk of adenocarcinoma. Any other carcinoma in the esophagus is a squamous cell carcinoma, where smoking and alcohol are 2 major risk factors. Patients with esophageal cancer have dysphagia, more to solids (unlike achalasia).

- **Notes:**
  1. Barrett’s esophagus treatment: Cisapride + Proton pump inhibitor.
  3. Zollinger Ellison syndrome:
    - It is hypergastrinemia due to either antral G cell hyperplasia or a gastrinoma in the pancreas.
    - Clinical picture: Recurrent peptic ulcers and Chronic diarrhea.
    - Diagnosis: Elevated fasting serum gastrin + Positive secretin stimulation test.
    - Treatment: Somatostatin + PPI + Surgical resection of the gastrinoma.
  4. Vitamin C inhibits reduction of nitrite to nitrosamine, which decreases the risk of atrophic gastritis and stomach cancer.
  5. In duodenal ulcers, there is hypertrophy of Brunner glands.

Celiac Sprue

- **Mechanism:** Gluten associated disease that causes atrophy of the small intestinal villi and malabsorption.
- **Inheritance:** HLA DQ2 associated.
- **Clinical picture:**
  1. Chronic osmotic diarrhea and low albumin, iron and calcium levels in blood.
  2. Vesiculo-papular skin lesions known as Dermatitis Herpetiformis.

- **Diagnosis:**
  1. Abnormal D-Xylose test.
  2. High serum level of IgA anti-endomysial and Anti-gliadin antibodies (Most sensitive test) and Tissue Transglutaminase antibodies (TTG).
  3. Confirm diagnosis by small intestine biopsy.

- **Complication:** If an elderly patient with celiac sprue who has been stable for a long time deteriorates suddenly, suspect T cell lymphoma of small intestine.

- **Treatment:** Gluten free diet.

Inflammatory Bowel Disease IBD (refer to Table 1.2, Figs. 1.5 and 1.6)

Irritable Bowel Syndrome (IBS)

- **Introduction:** Common in middle-aged patients with stressed personalities.
- **Clinical picture:** At least 3 months of unexplained abdominal pain with diarrhea or constipation or both, mainly associated with eating, and relieved by bowel movements.
- **Diagnosis:** The key here will be the stressed out personality and normal workup.
- **Treatment:**
  2. Diarrhea predominant form: Alosetron Note: Tegaserod and Alosetron are falling out of favor currently due to life threatening adverse
effects, so treatment of IBS is back to be entirely symptomatic, i.e.: laxatives and anti-diarrheals.

**Diarrhea**

- **Definition**: Increase in amount or frequency of bowel movements of a person compared to his usual habit.

---

**TABLE 1.2 Inflammatory bowel diseases.**

<table>
<thead>
<tr>
<th></th>
<th>Crohn’s Disease</th>
<th>Ulcerative Colitis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Location</strong></td>
<td>Anywhere except the rectum; most common in ileocecal segment</td>
<td>Anywhere in the colon; most common in the rectum</td>
</tr>
<tr>
<td><strong>Extent of lesions</strong></td>
<td>Skip lesions and cobblestoning</td>
<td>Diffuse</td>
</tr>
<tr>
<td><strong>Depth of lesions</strong></td>
<td>Deep, causing fistulas and abscesses</td>
<td>Superficial</td>
</tr>
<tr>
<td><strong>Effect of smoking</strong></td>
<td>Worsens symptoms</td>
<td>Improves symptoms</td>
</tr>
<tr>
<td><strong>Symptoms</strong></td>
<td>Abdominal pain, diarrhea and mass in the RLQ of abdomen</td>
<td>Abdominal pain and bloody diarrhea</td>
</tr>
<tr>
<td><strong>Barium enema</strong></td>
<td>String sign</td>
<td>Loss of colonic haustations</td>
</tr>
<tr>
<td><strong>Treatment</strong></td>
<td>Sulfasalazine, mesalamine or steroids</td>
<td>Sulfasalazine, mesalamine or steroids</td>
</tr>
<tr>
<td></td>
<td>Fistula: Treated by Metronidazole or Infliximab. If failed, perform fistulotomy</td>
<td></td>
</tr>
<tr>
<td><strong>Malignant</strong></td>
<td>High, need annual colonoscopy</td>
<td>High, need annual colonoscopy</td>
</tr>
<tr>
<td><strong>transformation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Extra-intestinal</strong></td>
<td>Possible, but not as common as in ulcerative colitis.</td>
<td>Arthritis, Scleritis, uveitis, pyoderma gangrenosum and sclerosing cholangitis.</td>
</tr>
<tr>
<td><strong>manifestations</strong></td>
<td></td>
<td>If any patient with IBD develops jaundice, do ERCP to rule out sclerosing cholangitis</td>
</tr>
<tr>
<td><strong>Microscopy</strong></td>
<td>Non-caseating granuloma</td>
<td>Crypt abscesses and ulcers</td>
</tr>
</tbody>
</table>

**Fig. 1.5 String sign of Crohn’s disease**

**Fig. 1.6 Ulcerative colitis**

- **Types:**
  1. *Osmotic: Related to meals,* and does not occur if the patient is fasting. Indicates a malabsorption or motility disorder.
  2. *Secretory:* Mediated by toxins, thus not related to meals, and **not resolved by fasting**.

- **Giardiasis:** Targets the duodenum and upper jejunum. Causes *watery diarrhea with excessive mucus*. Diagnosis: Stool analysis for ova and parasites to identify Giardia Lamblia trophozites and/or cysts. Treatment: Metronidazole.

- **Rotavirus:** Most common cause of diarrhea in children. Most common during the winter months and causes *watery diarrhea.*
- **Campylobacter jejuni**: Causes bloody diarrhea. Treatment: Erythromycin. Note: Infection is highly associated with subsequent Guillain-Barre syndrome.
- **Cryptosporidium parvum**: Causes watery diarrhea in patients with HIV.

### Colon Cancer

**Introduction**: Polyps suggestive of malignancy are bigger than 1 cm and have a villous component, e.g., villous, tubulovillous. A benign polyp can turn malignant due to mutation of DDC and p53 genes.

**Risk factors**:
1. Old age, low fiber and high fat diet.
2. IBD.
3. FAP and HNPCC.
4. High risk polyps: If bigger than 1 cm in diameter, or has a villous component.

**Screening**:
1. Starting age 40 by performing annual digital rectal exam.
2. Starting age 50 by checking for occult blood in stools annually along with colonoscopy every 10 years (or sigmoidoscopy every 5 years). Start earlier in high risk groups.

**Location**: Most common site is the rectosigmoid area.

**Metastases**: Most common site of metastasis is the liver.

**Clinical picture**:
1. Asymptomatic or altered bowel habits, e.g., Constipation, bleeding per rectum.
2. Anemia and weight loss. Any elderly with unexplained iron deficiency anemia must get a colonoscopy to rule out colon cancer.

**Diagnosis**:
1. Colonoscopy and biopsy is diagnostic.
2. Barium enema shows apple core sign. Refer to Fig. 1.7.
3. Elevated serum Carcinoembryonic antigen (CEA). It is used mainly for the purpose of following up on the tumor response to treatment and to detect recurrence.

**Treatment**: Surgery, radiation and chemotherapy.

### Familial Adenomatous Polyposis (FAP)

**Mechanism**: FAP is an autosomal dominant disease that occurs due to mutation of APC gene on chromosome 5. Polyps in this disease get bigger due to mutation in the ras gene.

**Clinical picture**: Lower abdominal pain and bleeding per rectum.

**Diagnosis**: Colonoscopy or barium enema with double contrast.

**Treatment**: Total proctocolectomy by age 20, as it has a 100% potential of transformation into colon cancer.

**Notes**:
1. Peutz Jeger syndrome: Colonic polyps + Lips and oral hyperpigmented lesions.
Diverticular Disease

- **Definition**: It is an outpouching of mucosa and submucosa in the colon, mostly in the sigmoid portion, *never in the rectum*.
- **Clinical picture**: LLQ abdominal pain and bleeding per rectum.
- **Diagnosis**: Barium enema, CT abdomen or colonoscopy. They show the saw tooth appearance.
- **Complications**:
  1. Painless bright red bleeding per rectum: Diverticular disease is the most common cause of lower GI bleeding in the elderly. Bleeding stops spontaneously.
  2. Diverticula can become infected, leading to *diverticulitis*. It is best treated by ciprofloxacin and metronidazole.

Notes:

1. Bleeding in diverticular disease occurs due to rupture of a blood vessel around the neck of a diverticulum. *Again, this bleeding stops spontaneously.*
2. Surgery, e.g., *Sigmoidectomy* is indicated only in severe complicated cases of diverticular disease, e.g., Recurrent attacks, perforation, abscess formation.
3. AV malformations are another common cause of painless bright red bleeding per rectum. They are most common in the *cecum and ascending colon*. Diagnosis: Angiography or colonoscopy. Treatment: Electrocoagulation, vasopressin, or segmental colectomy in severe resistant cases.
4. GI bleeding as a rule is either upper (*Proximal to ligament of Treitz*) causing *melena* (Black tarry stools), or lower (*Distal to ligament of Treitz*) causing bright red bleeding per rectum.

Acute Pancreatitis

- **Causes** in descending order: Alcohol, gallstones or hypertriglyceridemia. Other less common causes are mumps and pancreas divisum. In pancreas divisum, the *accessory duct* becomes the main duct of the pancreas as the primary (main) duct is very small.
- **Clinical picture**: Epigastric abdominal pain radiating to the back, and is decreased by leaning forwards.
- **Physical exam**: Not conclusive except for hemorrhagic types, which may show bruising around the umbilicus (Cullen’s sign) or in the left flank (Grey Turner sign). *Remember Cullen’s by imagining a bruise Curving around the belly button.*
- **Diagnosis**:
  1. High serum lipase (specific) and amylase (non specific).
  2. CT of the abdomen: Shows edema of the pancreas with stranding of its fat.
  3. Abdominal X-ray shows *Sentinel loop* or *Colon cut-off* signs.
  4. Ultrasound of the gall bladder if gall stones are the suspected cause.
- **Complications**: Hypocalcemia, DIC and Pseudocyst formation. Pseudocyst presents as an epigastric fixed *cystic* swelling which is easily visualized by ultrasound or CT scan. Barium meal in lateral view shows *semilunar stomach* with widened vertebrogastric space. Treatment of pseudocyst is conservative, and internal drainage is indicated only if >6 cm in diameter or if it lasts >6 months.
- **Treatment**: Bowel rest, aggressive hydration and pain control.
- **Note**: Persistent fever and toxemia after treatment is suggestive of pancreatic abscess and repeat CT of the abdomen should be the next step.

Chronic Pancreatitis

- **Introduction**: Occurs due to repeated attacks of pancreatitis.
- **Diagnosis**:
  1. X-ray of the abdomen shows *calcifications*.
  2. ERCP pancreatogram shows *chain of lakes* appearance of pancreatic duct.
- **Clinical picture**:
  1. Recurrent attacks of abdominal pain and acute pancreatitis.
  3. *Hyperglycemia*.
- **Treatment**: Pancreatic enzymes replacement.
- **Note**: In both acute and chronic pancreatitis, D-xylose test is *normal*.

Pancreatic Cancer

- **Introduction**: Very aggressive malignancy, not curable even with chemotherapy. Lifetime expectancy is less than 6 months in most cases.
- **Clinical picture**:
  1. Epigastric pain radiating to the back, decreased by leaning forwards.
  2. *Painless obstructive jaundice* and weight loss.
Diagnosis: CT of abdomen and high level of serum CA 19-9; confirmed with biopsy.
Complications: Migratory thrombophlebitis aka Trousseau syndrome.
Treatment: Palliative surgery, best is pancreatico-duodenectomy (Whipple’s).

Hepatology

Introduction

- Liver is the body’s heaviest visceral organ (1000–1500 g).
- Main blood supply is through portal vein, and to a lesser extent the hepatic artery.
- Glancing at the hepatic lobule, the space of Disse is located between the blood sinusoids and hepatocytes. It contains Ito (stellate) cells, which serves for synthesizing collagen and storing vitamin A.
- Also in the walls of sinusoids lie the Kupffer cells which serve as the liver macrophages.
- Functions of liver: Storage of energy in the form of glycogen, and synthesizing plasma proteins, fat and bile salts (for absorption of fat).
- Liver function tests:
  1. **AST (SGOT)**: Inside mitochondria, has a short half life and is not specific.
  2. **ALT (SGPT)**: In the cytoplasm, has a long half life and is liver specific.
  3. **Alkaline phosphatase**: Present in hepatocytes membranes and in bones. Elevation is suggestive of biliary obstruction.
  4. **Gamma Glutamyl Transferase (GGT)**: Specific to the liver, especially alcoholic liver disease.
  5. **Bilirubin**: Indirect is the majority (0.8 mg) and it cannot pass in the urine or stools, but it can cross blood brain barrier. Direct (0.2 mg) can pass into urine and stools but cannot cross the BBB, and is more suggestive of biliary obstruction.
  6. **Albumin (4–5 g)**: Best indicator of the **chronicity** of liver disease.
  7. **Prothrombin time (PT)**: Best indicator of the **severity** and **prognosis** of liver disease.
  8. **Globulins (2–3 g)**: IgG is elevated in chronic hepatitis, IgA in alcoholic liver disease and IgM in biliary cirrhosis.
  9. **Alpha fetoprotein** (Normal <25 ng/ml): Hepatoma marker, but can also rise in pregnancy.

<table>
<thead>
<tr>
<th>Table 1.3 Hepatitis A, B and C.</th>
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<tbody>
<tr>
<td><strong>Hepatitis A</strong></td>
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<tr>
<td><strong>Type</strong></td>
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<tr>
<td><strong>Incubation period</strong></td>
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<tr>
<td><strong>Transmission</strong></td>
</tr>
<tr>
<td><strong>Carrier state</strong></td>
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<tr>
<td><strong>Chronicity</strong></td>
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<tr>
<td><strong>Malignancy</strong></td>
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<tr>
<td><strong>Serology</strong></td>
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<tr>
<td><strong>Prevention</strong></td>
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</tr>
</tbody>
</table>

Hepatitis

- **Definition**: Inflammation of the hepatic tissue.
- **Causes**: Hepatitis virusus A, B, C, D, E, F, G, CMV, EBV, Alcohol.
- Refer to Table 1.3 for Hepatitis A, B and C viruses. Note that hepatitis D and E are weak viruses.

- **Diagnosis**: CT of abdomen and high level of serum CA 19-9; confirmed with biopsy.
- **Complications**: Migratory thrombophlebitis aka Trousseau syndrome.
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- Refer to Table 1.3 for Hepatitis A, B and C viruses. Note that hepatitis D and E are weak viruses.

Table 1.3 Hepatitis A, B and C.

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<tr>
<th></th>
<th>Hepatitis A</th>
<th>Hepatitis B</th>
<th>Hepatitis C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>RNA Picornavirus</td>
<td>DNA Hepadnavirus</td>
<td>RNA Flavivirus</td>
</tr>
<tr>
<td>Incubation period</td>
<td>2–6 weeks</td>
<td>2–6 months</td>
<td>Variable</td>
</tr>
<tr>
<td>Transmission</td>
<td>Feco-orally</td>
<td>Parenterally</td>
<td>Parenterally</td>
</tr>
<tr>
<td>Carrier state</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Chronicity</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Malignancy</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Serology</td>
<td>• HA IgM: Recent infection</td>
<td>• HBs antigen: Active infection</td>
<td>• HBc antibodies: Old infection or vaccination (Patient is immune)</td>
</tr>
<tr>
<td></td>
<td>• HA IgG: Old infection</td>
<td></td>
<td>• HBc antigen: Present only in hepatocytes; not serum</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• HBs antigen: Active infection</td>
<td>• HBc IgM: Active infection (Patient is in window gap)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• HBc IgG: Old infection</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• HBc antigen: Active viral replication and high contagiousity</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• HBe antibody: Old infection</td>
</tr>
<tr>
<td>Prevention</td>
<td>• Vaccine available</td>
<td>• Vaccine (Inactivated HBs antigens) is available (Given at 0, 1 and 6 months)</td>
<td>No vaccine or immunoglobulin</td>
</tr>
<tr>
<td></td>
<td>• Immunoglobulin can be given within 72 hours after exposure</td>
<td>• Immunoglobulin can be given within 7 days after exposure</td>
<td></td>
</tr>
</tbody>
</table>
Hepatitis D can cause superinfection in a patient already infected with Hepatitis B. Hepatitis E can cause fulminant infection only during pregnancy.

- **Clinical picture**:
  1. Fever, headache and generalized fatigue.
  2. Right upper quadrant pain: Mild tender hepatomegaly on exam.
  3. Jaundice: Best seen in sclera and palate. Sclera stays jaundiced for a while after disease resolution. The reason being the high affinity of collagen fibers of the sclera to bilirubin.

- **Complications**:
  1. Chronicity, fulmination or relapse.
  2. Immune mediated due to HBs antigens: Glomerulonephritis and vasculitis, e.g., Polyarteritis nodosa.

- **Pathology**: Lymphocytic infiltration of the liver (Centrizonal and portal tract).

- **Treatment**:
  1. Hepatitis A: Supportive and bed rest.
  2. Hepatitis B: Interferon and Lamivudine.
  3. Hepatitis C: Interferon and Ribavirin.

- **Notes on treatment**:
  1. Interferon causes flu-like symptoms and immune disorders, e.g., Thyroiditis, Bone marrow depression, hemolytic anemia and Guillain Barre syndrome.
  2. Sudden rise of AST and ALT after starting treatment is a sign of successful therapy. This occurs due to destruction of the virally infected hepatocytes.

- **Other forms of hepatitis**:
  1. Chronic active hepatitis: Pathology shows piecemeal and bridging necrosis, and rosette formation in the hepatocytes.
  3. Alcoholic hepatitis: Pathology shows perivenular ballooning and necrosis along with Mallory bodies. Labs shows AST:ALT ratio of more than 2, elevated IgA and elevated GGT.
  4. Acute fatty liver of pregnancy: Severe hepatitis and liver failure during pregnancy, could be caused by hepatitis E virus infection.
  5. Cholestasis of pregnancy: Benign condition presenting with pruritus during the 3rd trimester and it resolves spontaneously after delivery. There is high Alkaline phosphatase and direct bilirubin.

  7. Reye’s syndrome: Treatment of viral illness in children with aspirin causes this disease; manifested by hepatomegaly, jaundice, hypoglycemia and hyperammonemia.

### Liver Cirrhosis

- **Definition**: Fibrosis and nodule formation of the liver as a sequel of a primary disease, mostly hepatitis.
- **Pathologically**: divided into 2 types:
  1. Micronodular (<3 mm): as in alcoholism (AST:ALT >2).
  2. Macronodular (>3 mm): as in hepatocellular carcinoma.
- **Other causes**:
  1. Hemochromatosis:
    - **Mechanism**: Congenital (HFE gene AR mutation) or acquired iron overload, e.g., Repeated blood transfusions.
    - **Clinical picture**: Liver cirrhosis, Bronzecolored skin in exposed areas, Cardiomyopathy and hyperglycemia, hence the term Bronze diabetes.
    - **Diagnosis**: High iron, ferritin and transferrin. Biopsy of the liver stains with Prussian blue due to high iron content.
    - **Treatment**: Phlebotomy and iron chelation therapy.
  2. Wilson’s disease:
    - **Mechanism**: Genetic ceruloplasmin deficiency (AR).
    - **Clinical picture**: Liver cirrhosis, Renal tubular damage, Kayser-Fleischer rings in corneas (Refer to Fig. 1.8) and basal ganglia injury causing wing beating tremors and extra-pyramidal symptoms.
    - **Diagnosis**: Low serum ceruloplasmin, and high copper levels in liver and urine. These patients also have glucosuria and amino aciduria.
    - **Treatment**: Copper chelating agents, e.g., Penicillamine (Causes B6 deficiency).
    - **P.S.**: Think of Wilson’s in a patient suffering recurrent attacks of hepatitis with negative hepatitis serology.

- **Clinical picture of liver cirrhosis and failure**: Hepatosplenomegaly and:
  1. Wasting of temporalis muscles.
2. Parotid enlargement.
3. Jaundice and Fetor hepaticus (Malodorous breath due to mercaptans).
5. Palmar erythema and flapping tremors (Asterixis).
7. Female hair distribution: Due to androgen deficiency.
8. Hyperdynamic circulation: Due to vasodilator effect of toxins.
9. Pancytopenia: Due to hypersplenism.

- **Portal hypertension:** Patients with cirrhosis are at risk of portal hypertension (>20 mmHg), which leads to hepatosplenomegaly, gastropathy, ascites and opening of proto-systemic shunts:
  1. Esophageal varices: Shunting of left gastric veins with azygos veins.

- **Pathology:** Liver shows Mallory bodies, fatty change, intrahepatic cholestasis and fibrosis around the central vein.

- **Treatment:** Correcting cause of cirrhosis, plus beta blockers for portal HTN.
- **Notes:**
  1. Cirrhotic patients have low serum albumin and high beta and gamma globulin.
  2. Child’s classification of liver diseases. Refer to Table 1.4.

### Hepatic Encephalopathy

- **Definition:** Neuropsychiatric complication of liver cell failure.
- **Clinical picture:** A cirrhotic patient with reversed sleep rhythm and confusion, progressing to lethargy and stupor and may be coma and death.
- **Diagnosis:** Elevated serum ammonia level.
- **Treatment:**
  1. Lactulose and enemas: To wash out intestinal contents. Lactulose is preferred as it is a non-absorbable disaccharide.
  2. Neomycin or metronidazole: To kill intestinal flora metabolizing proteins.

### Ascites

- **Definition:** Accumulation of fluid in the peritoneum.
- **SAAG:** Serum/ascitic albumin gradient (SAAG) >1.1 is indicative of cirrhosis, while <1.1 is indicative of TB, malignancy or pancreatitis.
- **Nature:** How to know if the fluid is exudate or transudate? Refer to Table 1.5.
Treatment:
1. Salt and fluid restriction, Spironolactone and Furosemide. In huge symptomatic ascites, paracentesis should be performed.
2. In case of recurrent ascites refractory to medical treatment, Transjugular Intrahepatic Portosystemic Shunt (TIPSS) should be performed. It is also indicated for recurrent bleeding esophageal varices.

Spontaneous Bacterial Peritonitis (SBP)
- Definition: A complication of ascites due to E. coli or less likely Klebsiella.
- Clinical picture: Ascites, plus diffusely red warm and tender abdomen.
- Diagnosis: Paracentesis, showing neutrophil count of >250/mm³ is diagnostic.
- Treatment: Drug of choice is 3rd generation cephalosporin, e.g., Cefotaxime.

Biliary Cirrhosis
- Prevalence: Common in middle-aged females.
- Causes: Primary, or secondary to biliary obstruction.
- Clinical picture: Middle-aged female with:
  1. Liver cirrhosis, itching, dark urine and clay colored stools, and negative past history for hepatitis or alcoholism.
  2. Vitamin K and Vitamin D deficiency.
- Diagnosis:
  1. Primary: High levels of anti-mitochondrial antibodies.
  2. Secondary: Ultrasound of liver, if that shows dilatation of intrahepatic ducts, ERCP should be done next to manage the extrahepatic obstruction.
- Treatment: Ursodiol, and relieving the obstruction if any. The only curative treatment is liver transplant.

Hepatocellular Carcinoma (Hepatoma)
- Definition: Highly malignant tumor that might be predisposed by hepatitis virus B or C, cirrhosis, hemochromatosis or aflatoxins from Aspergillus flavus.
- Clinical picture: Patient with cirrhosis or hepatitis with sudden deterioration, flare up of symptoms and weight loss of unexplained reason.
- Diagnosis:
  1. Definitive diagnosis is established by liver biopsy.
  2. Elevated serum alpha-fetoprotein.
  3. CT and MRI shows the hepatic lesions.
- Treatment: Surgery, radiation and chemotherapy.
- Notes:
  1. Fibrolamellar carcinoma is a liver cancer with good prognosis that occurs in young age. The trick here is that alpha-fetoprotein will be within normal values.
  2. cavernous hemangioma is a benign vascular swelling in the liver, more common in females using oral contraceptive pills (OCPs). Complication: Rupture and bleeding. Diagnosis: Angiography. Treatment: Stop OCPs and observe.

Jaundice
- Definition: Yellowish discoloration of skin and mucous membranes due to hyperbilirubinemia.
- Causes of indirect hyperbilirubinemia: Hemolysis, and congenital as discussed below. Indirect bilirubin is elevated, so urine and stool color is normal.
- Causes of direct hyperbilirubinemia: Biliary obstruction, and congenital as below. Direct bilirubin is elevated, so urine is tea colored and stools are clay colored.
  1. First thing to do in obstructive jaundice is hepatobiliary ultrasound. If there is dilatation of intrahepatic and/or extrahepatic biliary tree, that means there is extrahepatic biliary obstruction and Endoscopic Retrograde Cholangiopancreatography (ERCP) should be the next step.
  2. Palpable gall bladder in obstructive jaundice is suggestive of malignancy (Courvoisier sign).
- Hepatocellular jaundice occurs due to 2 defects; defective uptake and conjugation resulting in high indirect bilirubin, and defective excretion resulting in high direct bilirubin. This leads to dark urine and dark stools.

Congenital Hyperbilirubinemia
- Crigler Najjar syndrome: Occurs due to deficiency of UDP glucuronoyl transferase. The bilirubin elevated is mainly indirect, so kernicterus is a risk.
- Gilbert syndrome (AR): Occurs due to presence of only a small amount of UDP glucuronoyl transferase plus defective uptake, so indirect bilirubin rises only
if the patient fasts or experiences severe stress or exercise.

- **Dubin Johnson syndrome (AR):** Occurs due to defective hepatic excretion. The bilirubin elevated here is direct bilirubin, and macroscopically the liver is brown or black. There is a high coproporphyrin I/coproporphyrin III ratio.
- **Note:** Last place for jaundice to disappear is the sclera, the reason being its high elastin content, which has high affinity to bilirubin.

### Drug Induced Hepatotoxicity

- **Cholestatic picture (High Alk.Phos, High direct bilirubin):** Anabolic steroids, OCP.
- **Hepatitis like picture:** INH, Halothane, Phenytoin and Alpha methyl dopa. Confirmed by the presence of anti-histone antibodies.
- **Acute hepatic necrosis:** Acetaminophen (Treated with N-acetylcysteine).
- **Adenomas:** Oral Contraceptive Pills (OCP).

### Hematology

#### Red Blood Cells (RBCs)

- **RBCs:** Biconcave with no nucleus, and their half life is around 120 days. RBCs count is 5–6 million/mm³ in males and 4–5 million/mm³ in females.
- **Hemoglobin:** In adults is HbA (2 alpha and 2 beta chains) and its normal values are 13–17 g/dL in males and 12–16 g/dL in females.
- **Hematocrit:** Also known as the Packed Cell Volume (PCV). It is the volume of packed RBCs in 100 cc of blood and is around 40–50% on average, and of course slightly less in females (Females lose blood in menstruation).
- **Erythrocyte Sedimentation Rate (ESR):** Rate of sedimentation of RBCs in a tube due to rouleaux formation. It is normally below 20 mm/h. ESR above 100 mm/h indicate severe infection, malignancy or connective tissue disease or multiple myeloma.
- **Mean Corpuscular Volume (MCV):** Volume of a red blood cell = 78–100 fL.
- **Mean Corpuscular Hemoglobin (MCH):** Amount of Hb per cell = 27–32 pg.
- **Mean Corpuscular Hemoglobin Concentration (MCHC) =** Hb concentration/Hematocrit = 33%.
- **Anemia:** Hb <13 in males, <12 in females, <11 in pregnant. Anemia is associated with increase in pulse pressure.
- **Abnormal forms of hemoglobin:** Detected by multiple wavelength co-oximetry, most common toxicities are:
  1. Carboxyhemoglobin: Common in old houses with fireplaces, treated with 100% or hyperbaric oxygen.
  2. Methemoglobinemia: Common in Lidocaine toxicity and is treated with methylene blue.
- **Abnormal cell forms:**
  1. Reticulocytes: 0.2–2% of RBCs. They are the immature form of RBCs and the first cell to rise after starting iron therapy in iron deficiency anemia.
  4. Basophilic stippling: Common in lead poisoning. Refer to Fig. 1.9.
  5. Tear drop RBCs: Common in myelofibrosis.
  7. Schistocytes: Common in hemolysis. Refer to Fig. 1.10.
  9. Auer rods: Seen on peripheral smear in acute myelogenous leukemia (AML). Refer to Fig. 1.11.

#### White Blood Cells (WBCs)

- **Normal count:** 4,000–11,000/mm³.
- **Embryology:** Develop from blast cells (N <3% in the blood).

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10. **Howell Jolly bodies:** Common in patients with absent or non-functioning spleen.
• **Neutrophils:** 70% of WBCs and perform phagocytosis and chemotaxis and contain azurophilic granules.

• **Lymphocytes:** 20% of WBCs and are divided into T and B cells.

• **Eosinophils:** 5% of WBCs and are elevated in allergic and parasitic conditions.

• **Basophils:** 2% of WBCs and are linked to IgE, hence elevated in allergic conditions. They contain heparin and histamine within their granules.

• **Monocytes:** 3% of WBCs and convert to macrophages once they reach any tissue.

**Note:** Neutrophils and monocytes exist vessel walls by a process known as **Diapedesis**, which is usually preceded by sticking to the blood vessel wall through a process known as **Pavementation**.

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**Platelets**

- **Normal count:** 150,000–400,000/mm³.
- **Embryology:** Develop from megakaryocytes in the bone marrow.
- **Function:** Coagulation and as antigen recognition cells.
- **Hemostasis:** Upon blood vessel injury, vasoconstriction occurs due to effect of Thromboxane A2. Also release of Von Willebrand factor (vWF) causes **platelet adhesion**. Platelets release ADP to induce **platelet aggregation** and a platelet plug is formed.

**Notes:**

1. First thing to do in low platelet count is to repeat the test, then examine a peripheral smear.
2. Alcohol inhibits Thrombopoietin in the liver and causes transient thrombocytopenia that lasts
around 7 days. However, alcoholism can also cause hypersplenism which causes permanent pancytopenia.

Coagulation Cascade

- **Extrinsic**: Rapid, starts with tissue injury and release of tissue thromboplastin (Factor VII), which activates factor X in the presence of calcium. **Reflected by** prothrombin time (PT) **which is normally 10–15 seconds.**
- **Intrinsic**: Starts with contact with a foreign object. Factors activated in order are: XII → XI → IX → X. **Reflected by** activated partial thromboplastin time (APTT) **which is normally 30–40 seconds.**
- **Common pathway**: Starts with factor X activating conversion of prothrombin to thrombin. Thrombin converts fibrinogen to fibrin and platelet plug forms.
- **Platelet abnormalities**: Lead to petechiae and purpura.
- **Clotting factors abnormalities**: Lead to big bleeds, e.g., Joints, Intracranial etc.
- **Causes of isolated high PT**: Warfarin.
- **Causes of isolated high PTT**: Hemophilia, Von Willebrand disease and Antiphospholipid antibody syndrome.
- **Causes of elevated PT and PTT**: DIC, Liver disease and Vitamin K deficiency.
- **When blood clots inside a test tube**, the supernatant contains mainly plasma rich in vitamin K dependent clotting factors (II, VII, IX and X).
- **Assessment of intra-operative bleeding risk**: Best way is to ask the patient if he had any previous prolonged bleeding episodes during any procedure, e.g., Tooth extraction.

Iron Deficiency Anemia

- **Introduction**: Normal iron requirement is 10 mg/day, out of which only 1 mg is absorbed in the ferrous form. Absorption occurs in the duodenum and is stimulated by vitamin C and inhibited by phosphates.
- **Causes**: Decreased intake or increased loss, e.g., Bleeding or Ankylostoma infection.
- **Clinical picture**: Fatigue, pallor and craving for ice (Pica).
- **On exam**: Spooning of the nails aka Koilonychia.
- **Diagnosis**: Low iron, ferritin, MCV and MCH and High Total iron binding capacity (TIBC). Refer to Fig. 1.12.
- **Treatment**: Iron therapy.
- **Follow up on response**: Reticulocytes are the first cells to be elevated (after around one week) and are a marker of response to therapy which should be continued for at least 6 months.

**Notes**:

1. Iron deficiency anemia is the most common form of anemia in females.
2. Side effects of iron therapy: GI upset, constipation and black stools (not melena).
3. Any elderly with iron deficiency anemia must get a colonoscopy to rule out colon cancer.
4. Ferritin is an active phase reactant, so in inflammatory conditions, it will be elevated, even in patients with iron deficiency anemia.
5. Anemia of chronic disease: Normocytic normochromic with low iron and normal ferritin. However, 25% of cases have microcytic hypochromic picture.
6. Sideroblastic anemia is an X-linked recessive microcytic hypochromic anemia that leads to deposition of iron studded normoblasts in the
Megaloblastic Anemia

- **Introduction:** Due to Folic acid or Vitamin B12 deficiency. Normal requirement of folic acid is 50 mcg/day, while that of B12 is 1 mcg/day.
- **Causes:** Decreased intake, intrinsic factor deficiency or *Diphyllobothrium latum* infection (fish tapeworm). The latter causes B12 deficiency.
- **Clinical picture:** Fatigue, pallor and possibly neurological symptoms.
- **Diagnosis:**
  1. High MCV and MCH, Low B12 and/or Folic acid.
  2. Folic acid deficiency: Positive **Fromiminoglutamic acid (FIGLU)** test, done using Histidine.
  3. B12 deficiency: Positive **Schilling test**, Hypersegmented neutrophils on peripheral smear (Refer to Fig. 1.13), and elevated serum **homocysteine and methylmalonic acid**.
- **Treatment:** Replacement therapy.
- **Notes:**
  1. Liver stores of B12 last for 3–5 years, so B12 deficiency is not common.
  2. Vitamin B12 is abundant in meat products, so deficiency of B12 is more common among vegetarians. Meat-eaters (who eat no vegetables), on the other hand, are more likely to suffer from vitamin C deficiency.
  3. B12 deficiency can lead to **pancytopenia** and neurological manifestations. Look up Subacute Combined Degeneration in neurology.
  4. **Pernicious anemia** is a form of B12 deficiency that occurs due to antibodies against intrinsic factor and gastric parietal cells, and is associated with other immunological diseases.

Hemolytic Anemia

- **Clinical picture:** Fatigue, jaundice of skin and sclera, and normal colored urine.
- **Diagnosis:**
  1. High **indirect bilirubin** and **low haptoglobin**.
  2. Peripheral smear: **Schistocytes**.
  3. Coombs test: positive in autoimmune hemolytic anemia as follows:
    - **Ig G:** Positive direct Coomb’s test due to SLE, Lymphoma or Lupus (LLL).
    - **Ig M:** Positive **Indirect Coomb’s test** due to viral infections, e.g., Mycoplasma.
- **Notes:**
  1. Drugs, e.g., Amphotericin B and penicillin can cause hemolysis.
  2. Intravascular hemolysis causes increased urinary hemosiderin.

Aplastic Anemia

- **Causes:** Bone marrow destruction, e.g., Benzene, chemotherapy or radiation, or infection with *parvovirus B19*.
- **Clinical picture:**
  1. Anemia: Fatigue and pallor.
  2. Leukopenia: Repeated infections.
  3. Thrombocytopenia: Bleeding.
- **Diagnosis:** Bone marrow biopsy reveals empty marrow.
- **Treatment:** Treat the cause, bone marrow transplantation, and rule out 2 diseases that present similarly:
  1. B12 deficiency: Severe cases lead to pancytopenia.
  2. Hypersplenism: Occurs with liver cirrhosis and leads to pancytopenia.
- **Note:**
  1. Antilymphocyte or antithymocyte globulins could be used to treat aplastic anemia; however, **serum sickness** is always a concern during therapy.
  2. Most common cause of acquired aplastic anemia is **drug-induced**.

Hypersplenism

- **Definition:** Pancytopenia that is reversible by splenectomy.
- **Clinical picture:** Fatigue, infections and bleeding.
Diagnosis:
1. Low hemoglobin, WBCs and platelets.
2. Chromium 51 labelled RBCs: Shows excessive spleen uptake.

Treatment: Splenectomy.

Thalassemia

Mechanism: Absent alpha or beta chains of hemoglobin, and is common in Mediterranean population, and that is a key in the USMLE.

Defect in alpha chain: Alpha thalassemia could be due to defect in 1 locus causing alpha thalassemia trait, 2 loci (alpha th. Minor), 3 loci (Hemoglobin H) or all the 4 loci (Hemoglobin Barts) which causes hydrops fetalis. Common in asians.

Defect in Beta chain causes Beta thalassemia minor, intermedia or major aka Cooley’s anemia.

Clinical picture and diagnosis:
1. Microcytic hypochromic anemia.
2. Target cells on peripheral blood smear. Refer to Fig. 1.14.
3. Hb electrophoresis: Hemoglobin F in Cooley’s anemia (Hgb A2 in Beta thalassemia minor).
4. Chipmunk facies, and hair on end appearance on bone X-rays due to extramedullary hematopoeisis.

Treatment: Blood transfusion, folic acid and bone marrow transplantation.

Sickle Cell Disease

Mechanism: Replacement of glutamic acid with valine in position 6 of beta chain of Hb.

Risk factors: Patients present in sickle cell crisis usually induced by infections or hypoxia.

Clinical picture:
1. Diffuse dactylitis, abdominal pain and shortness of breath, mostly due to microinfarctions by sickle cells.
2. Multiple infections due to functional asplenia: So these patients have to be vaccinated against H.influenza B, Strept. Pneumococci and Neisseria Meningitidis.
3. Normocytic normochromic anemia.
4. Sickle cells on peripheral smear. Refer to Fig. 1.15.
5. Hb electrophoresis: Hemoglobin S.

Complications:
1. Aplastic anemia: Due to parvovirus B19 infection.
2. Osteomyelitis: Salmonella is more common in this population, but the most common organism is still Staphylococcus aureus.

Treatment:
1. Supportive: Warming, fluids, analgesics and oxygen if needed.
2. Exchange transfusion: Only if there is severe dyspnea or priapism.
3. Hydroxyurea: It increases HbF and decreases HbS.

Notes:
1. Sickle cell deficiency is a predisposing factor for folic acid deficiency.
2. Sickle cell patients are resistant to infection by Plasmodium falciparum.
Spherocytosis

- **Mechanism:** Defect in RBC membrane, namely spectrin.
- **Clinical picture and diagnosis:**
  1. Extravascular hemolytic normocytic normochromic anemia.
  2. Spherocytes on peripheral smear (MCHC >33%). Refer to Fig. 1.16.
  3. Positive osmotic fragility test.
  4. Gall stones and splenomegaly.
- **Treatment:** Splenectomy.
- **Notes:**
  1. Remember 3 vaccines before surgery: H. Influenza B, Streptococcus pneumoniae and Meningococci. *Also remember that pneumococci is the most fatal.*
  2. Postsplenectomy patients have chronic low Immunoglobulin M levels.

G6PD Deficiency

- **Mechanism:** Absent RBC membrane enzyme; common in African Americans.
- **Clinical picture and diagnosis:**
  1. Hemolysis after ingestion of fava beans, sulfa or antimalarial medications.
  2. Low G6PD levels in RBCs few days after the hemolysis episode.
  3. Heinz bodies and Bite cells in the peripheral smear.
- **Treatment:** Supportive and avoiding the inducing agent.

Paroxysmal Nocturnal Hemoglobinuria (PNH)

- **Mechanism:** Absent Decay Accelerating Factor (DAF) in the RBC membrane, which leads to activation of complement C3 to attack the RBCs (Intravascular hemolysis).
- **Clinical picture:**
  1. Blood in the urine *only upon awakening in the morning*, but not throughout the day (That is the key for the whole case).
  2. Leukopenia: Recurrent infections.
  3. Platelets: Decreased count, yet increased aggregation leading to thromboembolic events.
• Diagnosis: *Ham test* and *sucrose lysis test*: Hemolysis occurs at pH of < 6.2. Recently, we check for *CD55* and *CD59* levels.

• Treatment: Steroids.

### Hemophilia

• **Mechanism:** XLR disease due to deficiency of clotting factors VIII (A) or IX (B).

• **Clinical picture:**
  1. Bleeding since birth, e.g., Cephalhematoma, bleeding after circumcision.
  2. Multiple ecchymosis and big joints hemorrhagic effusion.
  3. Retroperitoneal hematoma: Patients can only present with femoral neuropathy (*Unilateral leg pain, weakness and numbness*).

• **Diagnosis:** Prolonged PTT, Normal PT, and Low factor VIII and/or IX.

• **Treatment:** Desmopressin DDAVP (Factor VIII rich substance).

### Idiopathic Thrombocytopenic Purpura (ITP)

• **Mechanism:** Immunologically generated antibodies IgG against platelets, mostly following a recent flu like illness.

• **Clinical picture:** Repeated prolonged bleeding episodes.

• **Diagnosis:** Low platelet count, and elevated IgG against platelets.

• **Treatment:** Steroids, if failed, consider rituximab or splenectomy.

• **Note:**
  1. Evans syndrome: *ITP* + *Autoimmune hemolytic anemia*.

### Von Willebrand Disease (VWD)

• **Mechanism:** Autosomal dominant disorder that affects the platelets adhesion process, while the platelet count and aggregation are both normal.

• **Clinical picture:** Repeated *easy bruising* and prolonged bleeding after injuries.

• **Diagnosis:** Prolonged PTT, normal PT, prolonged bleeding time, *Low vwf and defective vwf activity on ristocetin platelet study*.

• **Treatment:** Desmopressin (DDAVP) or factor VIII (Both rich in vwf).

### Disseminated Intravascular Coagulopathy (DIC)

• **Mechanism:** It is a process that involves consumption of the clotting factors to end up with bleeding.

• **Causes:** Sepsis, Malignancy, Leukemia or pulmonary embolism. Most common DIC associated leukemia is *Acute progranulocytic leukemia*.

• **Clinical picture:** Extensive bleeding or thrombosis.

• **Diagnosis:**
  1. Low platelets and elevated LDH.
  2. Prolonged *PT* and *PTT*.
  3. Low fibrinogen and elevated Fibrin degradation products (FDP).

• **Treatment:** Treat the cause. If the patient is actively bleeding, transfuse with fresh frozen plasma (FFP).

### Antiphospholipid Antibody Syndrome

• **Mechanism:** Immunologically derived antibodies against enzymes of the coagulation pathways.

• **Clinical picture:**
  1. Multiple unprovoked thromboembolic events, e.g., Deep venous thrombosis, myocardial infarction, cerebrovascular accidents.
  2. *Recurrent unprovoked abortions* (This is the key for the case).

• **Diagnosis:**
  1. Prolonged PTT, normal PT.

• **Treatment:** Life long anti-coagulation, e.g., warfarin.

### Thrombotic Thrombocytopenic Purpura (TTP)

• **Mechanism:** Lack of ADAM-TS13; which is a vwf cleaving factor.

• **Clinical picture:** Pentad:
  1. Microangiopathic hemolytic anemia: Diagnosed by *schistocytes*.
  2. Thrombocytopenia.
  3. Renal failure.
  4. Neurological symptoms.
  5. Fever.

• **Diagnosis:** Schistocytes on the peripheral blood smear.
• **Treatment**: Life threatening disease, urgent plasmapheresis is required.

• **Note**: Hemolytic uremic syndrome (HUS): Caused by *E. coli-0157-H7*, which causes bloody diarrhea followed by TTP like picture minus the fever and neurological symptoms. Diagnosis and treatment is the same as TTP. Chemotherapy combinations containing Mitomycin can also induce HUS.

### Myeloproliferative Disorders

#### Introduction

- Biggest complication of following disorders is transformation into leukemia.

#### Polycythemia

- **Definition**: It is excessive RBCs causing hyperviscosity syndrome.
- **Causes**: Primary (*Polycythemia vera*), or secondary to hypoxia, smoking or erythropoietin secreting tumor, e.g., Renal cell cancer.
- **Clinical picture**:
  1. Plethora, facial flushing and itching: Gets worse after a warm shower.
  2. Elevated B12, basophils and uric acid levels.
  3. Splenomegaly.
- **Diagnosis**:
  1. High RBC mass and hematocrit (>48 in females and >52 in males).
  2. Erythropoietin level: Low in 1ry cases and high in 2ry ones.
- **Treatment**: Treat the cause, phlebotomy and Hydroxyurea.

#### Myelofibrosis

- **Definition**: Fibrosis of the bone marrow.
- **Clinical picture**: Pancytopenia and hepatosplenomegaly.
- **Diagnosis**: Dry bone marrow tap, and tear drop RBCs on peripheral smear. Refer to Fig. 1.17.
- **Treatment**: Hydroxyurea and bone marrow transplant.

#### Thrombocytosis

- **Causes**: Could be primary, i.e., Count >1,000,000, or reactive to iron deficiency or infection (<1,000,000).
- **Clinical picture**: Thrombosis or bleeding.
- **Treatment**: Treat the cause and Hydroxyurea.

#### Henoch Schonlein Purpura

- **Mechanism**: Post-streptococcal vasculitis that is more common in children.
- **Clinical picture**:
  1. Abdominal pain.
  2. Hematuria: Due to glomerulonephritis.
  3. Purpuric rash on buttocks and lower extremities. Refer to Fig. 1.18.
- **Diagnosis**: Skin biopsy show IgA deposits.
- **Treatment**: Self resolving.

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**Fig. 1.17 Tear drop RBCs**
Multiple Myeloma

- **Mechanism**: Plasma cell malignancy leading to IgG spike on protein electrophoresis.
- **Clinical picture**:
  1. Bone pains: *The key symptom*. If you hear about any elderly complaining of bone pains in the USMLE, look for multiple myeloma. It occurs due to osteolytic “punched out” bone lesions, which develop due to release of Osteoclast Activating Factor (*OAF*).
  2. Anemia and Thrombocytopenia.
  3. *Hypercalcemia* and renal failure resulting in nitrogen retention.

- **Diagnosis**:
  1. High serum protein, mainly IgG (*Monoclonal spike*).
  2. High urine protein, a.k.a. *Bence Jones proteinuria*.
  3. High serum calcium.
  4. *Rouleaux formation* of RBCs on peripheral smear.
  5. Plasma cell content of the bone marrow >10%. *Plasma cells have a “Cartwheel” or “Clockface” nucleus, and are basophilic due to their high content of rough endoplasmic reticulum and golgi apparatus. Refer to Fig. 1.19.*

- **Treatment**: Chemotherapy (Melphalan) or bone marrow transplant.

- **Note**: Bone lesions in multiple myeloma are osteolytic lesions, so they are best visualized by a *skeletal survey* and not a bone scan (Misses lytic lesions)

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Leukemia

- **Definition**: Abnormal uncontrolled proliferation of WBCs.
- **Causes**: Genetic, benzene, alkylating agents and Human T-cell leukemia virus (HTLV).
- **Clinical picture**:
  1. Low RBCs and Hb: Fatigue and pallor.
  2. Low platelets: Bleeding.
  3. High WBCs:
Hepatosplenomegaly and lymphadenopathy: Through infiltration of white pulp in all types, except hairy cell leukemia targeting red pulp.

- Skin: Greenish nodules in acute myeloid leukemia (AML).
- Bones: Fractures.
- CVS: Cardiomyopathy and effusion.
- Renal: Acute Tubular Necrosis (ATN).

**Diagnosis:**
1. High WBC count with >90% blasts.
2. Low RBCs and low platelets.

**Treatment:**
1. AML: Cytosine arabinoside (ara-c) and Doxorubicin.
2. ALL: Prednisone, Vincristine and Doxorubicin.
3. CML: Imatinib (Tyrosine kinase inhibitor).
4. CLL: No need to treat unless symptomatic. Treatment: Fludarabine.

**Notes:**
1. Auer rods are specific to AML. t15:17 is associated with a good prognosis in AML (M3 subtype).
2. Positive Common Acute Lymphoblastic Leukemia (CALLA) antigen and Terminal Transferase Detection (TdT) favor the prognosis of ALL and vice versa.
3. Philadelphia chromosome t9:22 is a poor prognostic indicator for ALL and is a good one for CML.
4. CML is associated with high basophil, uric acid and B12 levels, and low leukocyte alkaline phosphatase levels.

**Lymphoma**

**Clinical picture:**
1. Painless enlargement of lymph nodes (Discrete and rubbery), hepatosplenomegaly, fever and pruritis.
2. B symptoms: Night fever, night sweats, loss of weight and loss of appetite.

**Types:**
1. Hodgkin’s:
   - Bimodal age distribution (20s and 60s).
   - Best prognosis is lymphocyte predominance and worst is lymphocyte depletion lymphoma. The latter has the highest amount of Reed Sternberg cells.
   - Diagnosis: Lymph node biopsy; Reed Sternberg cell is diagnostic. Refer to Fig. 1.21.
   - Treatment: ABVD (Adriamycin, Bleomycin, Vinblastine, Dacarbazine).
   - Note: Treatment of lymphomas can cause Tumor lysis syndrome characterized by high serum (KUP): K, Uric acid and Phosphorus and low Calcium. Aggressive fluid and bicarbonate infusion and allopurinol during therapy is essential to prevent renal failure.
2. Non-Hodgkin’s:
   - More common in the elderly.
   - Most common type is large B cell lymphoma.
   - Burkitt lymphoma is a non-Hodgkin lymphoma caused by Epstein Barr virus (EBV) and it causes mandibular tumor in African children population. American Burkitt’s lymphoma (18;14) presents with intestinal obstruction, especially in young adult females with breast cancer.
   - Note: Hemorrhagic cystitis caused by cyclophosphamide can be prevented by MESNA.

Common Blood Transfusion Reactions
- Hemolysis: Due to ABO incompatibility.
- Febrile non-hemolytic reaction: Due to antibodies against WBCs or HLA.
- Treatment: Stop the transfusion and send the blood for typing and cross matching, plus supportive therapy with acetaminophen and Diphenhydramine.
- Note:
  1. Banked blood is deficient in clotting factors V and VIII, and it shifts the O₂-Hemoglobin dissociation curve to the left.
  2. Most common virus transmitted by blood transfusion: CMV.

Renal System
Introduction
- Function: Kidneys filter the blood, secrete erythropoietin, activate vitamin D by adding the 1-hydroxyl group and regulate the renin angiotensin aldosterone system. Renal blood flow constitutes around 25% of the cardiac output.
- Autoregulation: Between 80 and 200 mmHg is accomplished by changing the renal vascular resistance, which is regulated by Lacis cells of the macula densa in the distal convoluted tubules.
- Glomerular basement membrane: Formed of (FFF) as follows: Foot processes of podocytes, Fenestrated endothelium of glomerular capillaries, Fused basement membrane (This is the charged part of the membrane).
- TBW: Total body water constitutes 60% of total body weight, intracellular fluid constitutes 40% and extracellular fluid 20%.
- Threshold of glucosuria: Plasma concentration of glucose at which it starts to appear in the urine. It is equal to 250 mg.
- Tm for glucosuria: Represents full nephron saturation for glucose (N = 350 mg).
- Renal clearance: It is the volume of plasma from which a certain substance is cleared in a certain period of time. If clearance of a substance is less than GFR, there is net reabsorption of that substance, and vice versa.
- GFR depends on 4 factors: High glomerular hydrostatic pressure, high Bowman oncotic pressure, normal renal blood flow and normal capillary permeability.
- Loop of Henle:
  1. Proximal convoluted tubule (Rich in mitochondria): Performs obligatory water absorption, and it also absorbs 2/3 of sodium, most of the glucose and amino acids in the tubular fluid.
  2. Descending limb of loop of Henle: Counter current effect leading to increased concentration of the fluid by at least 3 times.
  4. Distal convoluted tubule:
     2. Calcium excretion through the action of parathyroid hormone.
  5. Collecting duct:
     1. Principal cells: Na/K exchange through action of Aldosterone.
     2. Intercalated cells: H/K exchange through action of ADH on V₂ receptors.

Fluid Measurements
- Extracellular fluid: Using mannitol.
- Plasma: Using Evans blue.
- Glomerular filtration rate (GFR): Using creatinine or inulin clearance = 125, calculated by the famous equation C = U × V/P.
- Effective renal plasma flow: Using Paraaminohippuric acid, which normally has a very high clearance.

Acid-base Balance
- Main acid base buffers are:
  1. Carbonic acid-Bicarbonate system.
  3. Lungs: Acidosis causes hyperventilation to wash away CO₂, and vice versa.

- K and H follow each other, so hypokalemia causes alkalosis and vice versa.
- Major extracellular buffer is HCO₃, while the major intracellular one is Hemoglobin.
- Anion gap = Na – (Cl + HCO₃) = 8 – 16.
- Know this equation by heart: pH = HCO₃/CO₂.

**Metabolic Acidosis (Low pH, Low HCO₃, Low CO₂)**

- **Normal anion gap:** Diarrhea and Renal tubular acidosis (RTA).
- **High anion gap:**
  1. Salicylate toxicity: Starts with respiratory alkalosis first.
  2. Alcohol toxicity: Mainly ethylene glycol (Antifreeze) and methanol (Wood alcohol). The former is converted to oxalate crystals in the kidneys, while the latter is converted into formaldehyde and formic acid, causing blindness.
  3. Renal failure.

- **Clinical picture:** Hyperventilation and Hyperkalemia.
- **Treatment:** HCO₃ and treatment of the cause. Note that in DKA, fluids and insulin therapy are enough to correct the pH; the only indication to give HCO₃ is pH <7.
- **Note:** Oil of wintergreen is a rich source of salicylates.

**Metabolic Alkalosis (High pH, High HCO₃, High CO₂)**

- **Causes:**
  1. Loss of fluids to the point of dehydration aka contraction alkalosis.
  2. Loss of acid, e.g., Vomiting, or ingestion of excessive HCO₃.

- **Clinical picture:** Hypokalemic alkalosis, which results in tetany.
- **Treatment:** Normal saline and treatment of the cause. In resistant cases, acetazolamide could be used (Causes metabolic acidosis and alkaline urine).

**Respiratory Acidosis (Low pH, High HCO₃, High CO₂)**

- **Causes:**
  1. Slow breathing, e.g., Respiratory failure, COPD.
  2. Clinical picture: High CO₂ causing lethargy (CO₂ narcosis), full bounding pulse and tremors.
  3. **Treatment:** O₂ + CO₂, as pure O₂ will cause further respiratory center depression.

**Respiratory Alkalosis (High pH, Low HCO₃, Low CO₂)**

- **Causes:** Fast breathing, e.g., Salicylate poisoning, Mid brain lesion.
- **Clinical picture:** Hyperventilation leading to tetany and seizures.
- **Treatment:** Rebreathing mask, e.g., Paper bag.

**Electrolytes**

- Refer to Table 1.6 for electrolytes imbalance.

**Nephrotic Syndrome**

- **Pathology:** Heavy proteinuria (>3.5 g/day), hyperlipidemia and - lipiduria.
- **Causes:** DM, HTN and Amyloidosis.
- **Clinical picture:** Generalized edema that starts from the face downwards.
- **Types of nephrotic syndrome:**
  1. Minimal change disease (Lipoid nephrosis): Foot processes effacement. Responds to steroids. It is the most common form of idiopathic nephrotic syndrome in children and young adults.
  2. Membranous glomerulonephritis (GN): Spike and dome appearance. High risk of malignancy and DVT, so if you get a nephrotic patient in the USMLE having DVT, renal vein thrombosis or malignancy, it is most likely membranous GN. It is the most common form of idiopathic nephrotic syndrome in Caucasians.
  3. Focal segmental sclerosis: Shows segmental sclerosis. Common in HIV. It is the most common form of idiopathic nephrotic syndrome in African Americans.
  4. DM: Kimmelstiel-Wilson syndrome. First sign of diabetic nephropathy is glomerulosclerosis, which is detected by checking for microalbuminuria.
  5. SLE: Wire loop lesions with subendothelial deposits.
  6. Amyloidosis: Diagnosed by Congo red staining of abdominal pad of fat or peripheral nerve. Treatment: Colchicine.


**Nephritic Syndrome**

- **Clinical picture and pathology:** Proteinuria (<3 g/day), Hematuria and HTN.
- **Causes:** Mostly infectious, e.g., Group A beta hemolytic streptococcus.
- **Types of glomerulonephritis:**
  1. **Acute post-streptococcal:** Lumpy bumps deposits and subepithelial humps.
  2. **Goodpasture:** Linear deposits. Discussed in Rheumatology.
  3. **Rapidly progressive:** Crescent moon-shaped deposits.
  4. **Membranoproliferative:** Tram track deposits.
  5. **IgA nephropathy (Berger disease):** Mesangial Ig A deposits.

- **Note:** GN with low serum complement levels are (PMS): Post-streptococcal, Membranoproliferative and SLE.
- **Note:** One of the markers of any GN is the presence of RBC casts in the urine.

**Urinary Tract Infection (UTI)**

- **Cause:** Most commonly caused by *E. Coli* and Klebsiella.
- **Clinical picture:** Dysuria, urinary frequency, urgency, and even hematuria.
- **On exam:** Costovertebral angle tenderness is alarming for pyelonephritis.
- **Diagnosis:** Urine analysis showing more than 5 WBCs/hpf with bacteria is diagnostic of UTI, however if it shows more than 5 WBCs/hpf without any bacteria, this is known as sterile pyuria. *Causes of sterile pyuria: Interstitial nephritis, TB or nephrolithiasis.*

- **Treatment:**
  1. Complicated UTI, e.g., Pyelonephritis: *IV ampicillin and gentamycin.*
  2. Uncomplicated UTI: Oral ciprofloxacin or SMX/TMP (Bactrim).

- **Notes:**
  1. UTI in polycystic kidney is best treated with SMX/TMP or tetracycline due to their high lipid solubility.
  2. Chronic or recurrent UTI in females could occur due to colonization of the vaginal introitus by fecal material.
  3. UTI during pregnancy occurs without symptoms, however it must be treated or pyelonephritis would be a sequel in 40% of cases.
  4. UTI in diabetic patients can trigger acute papillary necrosis.
  5. Upper UTI (Pyelonephritis) could be differentiated from lower UTI (Cystitis, Urethritis) by presence of WBC casts in the urine in the former. Upper UTI is caused by organisms releasing *Hemolysin,* and is treated for 10–14 days, while lower UTI treatment course is 3 days long.
  6. Treatment failure of UTI: Caused by non-compliance or resistance to treatment. *Next thing to do:* Urine culture and sensitivity.

### Interstitial Nephritis
- **Definition:** Inflammation mediated infiltration of interstitial tissues with neutrophils.
- **Causes:** Mostly drugs, e.g., Ampicillin, *methicillin,* cephalosporins.
- **Clinical picture:** Fever, rash and acute renal insufficiency.
- **Diagnosis:** Elevated creatinine, sterile pyuria and most importantly *eosinophiluria.*
- **Treatment:** Stop the offending drug.

### Polycystic Kidney Disease (PKD)
- **Mechanism:** Genetic disease due to mutation of *PKD1* gene. Inherited as AD in adults and AR in children.
- **Clinical picture:** Patients, children or adults, might present with hematuria, proteinuria, HTN or even chronic kidney disease.

### Chronic Kidney Disease (CKD)
- **Causes:** Most common causes are *DM* and *HTN.*
- **Clinical picture:**
  1. Anemia, increased capillary fragility, platelet and lymphocyte dysfunction.
  2. GI: Nausea, vomiting and ammonia-like odor in the breath.
  3. CVS: Hypertension, cardiomyopathy and uremic pericarditis.
  4. Endocrine: Hypothyroidism, hypocalcemia and hyperkalemia.
  5. Renal osteodystrophy: Osteitis fibrosa cystica + Osteomalacia + osteoporosis.
  6. CNS: Motor, sensory and autonomic neuropathy.
  7. Skin: Itching, and earthy colored skin. Due to calcium deposition in skin.

### Acute Renal Failure
- **Pre-renal:** e.g., Hypovolemia, congestive heart failure: *BUN/Cr ratio of more than 20 and fractional excretion of sodium FeNa < 1%.*
- **Renal:** e.g., Intravenous contrast, rhabdomyolysis or toxic drugs as aminoglycosides: *BUN/Cr < 20 and FeNa > 2%.* Urine shows epithelial or granular muddy casts indicating Acute Tubular Necrosis (*ATN,*). *Postrenal:* e.g., Obstructive uropathy. *Note that post-obstructive diuresis results in dilute and alkaline urine.*
- **Note:**
  1. ATN starts with an oliguric phase for 2–4 weeks, followed by polyuric phase (*Low serum Na and K*) and finally a post-diuretic phase.
  2. Rhabdomyolysis is diagnosed by elevated serum CPK (*In thousands*) and elevated urine myoglobin. Treatment: Fluids and bicarbonate drip.
8. Urine: Oliguria (<400 cc/day) or anuria (<100 cc/day), and low fixed urine specific gravity (Isothenuria).

- **Pathology:** Urine shows waxy casts.
- **Treatment:**
  1. Treat the cause, electrolyte and hormonal imbalance.
  2. Calcium replacement.
  3. Prepare the patient for hemodialysis once the glomerular filtration rate is less than 15. Peritoneal dialysis is not preferred due to high risk of infection and visceral injury.

---

### Nephro- and Uretero-Lithiasis

- **Types:**
  1. The most common are calcium oxalate stones which are radiopaque and recurrent
  2. Magnesium ammonium phosphate (MAP) stones, a.k.a. struvite stones, are common in females with recurrent UTI secondary to urea-splitting organisms such as *Proteus mirabilis*.

- **Clinical picture:** Colicky flank pain radiating to the groin and inner thigh, dysuria and even hematuria.
- **Diagnosis:** Test of choice is Spiral CT of the abdomen and pelvis. Abdominal X-ray KUB view; however, shows most urinary stones. Refer to Fig. 1.22.

- **Notes:**
  1. A stone in the uretero-vesical junction is the most common cause for ureteral dilatation.
  2. Uric acid stones are common after the use of uricosuric drugs or in case of tumor lysis syndrome. They are radiolucent.
  3. Cystine stones can form in cystinuria, which is screened for by nitroprusside test and treated with penicillamine.

---

### Renal Tubular Acidosis (RTA)

- Refer to Table 1.7.

---

### Renal Artery Stenosis (RAS)

- **Causes:** Fibromuscular dysplasia in young, and atherosclerosis in elderly.
- **Clinical picture:** Resistant hypokalemic hypertension.
- **On exam:** Continuous systolic and diastolic bruit on auscultation to epigastrium.
- **Screening:** Captopril provocation test.
- **Diagnosis:** Gold standard is angiography, however practically we use Magnetic Resonance Angiography (MRA) or duplex ultrasound.
- **Treatment:** Significant stenosis is corrected by stent placement.
- **Notes:**
  1. ACEI is the drug of choice to control HTN in cases of unilateral RAS.
  2. ACEI are absolutely contraindicated in bilateral RAS, and in unilateral stenosis in one kidney when the other kidney absent or non-functioning.
  3. The kidney whose artery is stenosed is smaller in size compared to the healthy kidney.
  4. Renal vein of the stenosed side has higher renin level than the healthy side.
5. Fibromuscular dysplasia mainly affects the media of the blood vessel.

**Urinary Incontinence**

- **Introduction**: Pathological process, even in the elderly.
- **First step**: First thing to order in a patient with urinary incontinence is urine analysis to rule out infection.
- **Types**: Has 3 main types:
  1. **Urge incontinence**:
     - The most common form of incontinence.
     - Occurs mainly due to detrusor overactivity.
     - Treatment: Frequent, scheduled voiding and antimuscarinic medication, such as oxybutynin or imipramine.
     - Always ask about history of sexual abuse in these patients.
  2. **Stress incontinence**:
     - Occurs due to defect in the urinary outlet, whether a sphincter problem or hypermobile bladder neck.
     - Incontinence occurs with any increase in intraabdominal pressure, such as coughing or laughing.
     - Treatment: Pelvic floor exercises and topical steroids into the external meatus; also alpha blockers such as phenolamine.
     - In stress incontinence the flow rate, residual volume and bladder compliance are all normal.
  3. **Overflow incontinence**:
     - Occurs due to an obstruction (e.g., Benign prostatic hypertrophy) or anticholinergic medication overuse.
     - Normal urge to urinate is lost and small amounts of urine leak spontaneously on intermittent basis.
     - More common among elderly males.
     - Treatment: Identify and correct the underlying cause.

**Neurogenic Bladder**

- Refer to Table 1.8.

**Drug-Induced Nephropathy**

- **Acute renal failure**: Diuretics, antibiotics causing interstitial nephritis.
- **Chronic kidney disease**: Analgesics (Cause glutathione and prostaglandin depletion).
- **Nephrotic syndrome**: NSAIDs, Gold, Penicillamine.
- **ATN**: Aminoglycosides, IV contrast.

**Nephrology Notes**

- **Causes of hematuria**: SHITTT: Stones, Hematological disease, Infection, Tumor, Trauma, Treatment (Anticoagulants, Cyclophosphamide).
- **Blood Urea Nitrogen**: Not as specific as creatinine for the kidney function. BUN is elevated in upper GI bleeding, steroids or after a high protein diet.
- **DM**: The first indicator of diabetic nephropathy is microalbuminuria representing glomerulosclerosis. This could be treated by ACEI. If you see a patient in the USMLE on ACEI and urine microalbumin is still high, increase the ACEI dose. If the patient

<table>
<thead>
<tr>
<th>Type</th>
<th>Mechanism</th>
<th>Acid base</th>
<th>Serum K</th>
<th>Urine pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type I (Distal)</td>
<td>Due to decreased H secretion in the distal tubules</td>
<td>Normal anion gap</td>
<td>Low</td>
<td>&gt;5.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>metabolic acidosis</td>
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</tr>
<tr>
<td>Type II (Proximal)</td>
<td>Due to decreased HCO3 absorption in the proximal tubules</td>
<td>Normal anion gap</td>
<td>Low</td>
<td>&lt;5.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>metabolic acidosis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type IV</td>
<td>Due to decreased cation exchange in the distal tubules, mostly due to low aldosterone level</td>
<td>Normal anion gap</td>
<td>High</td>
<td>&lt;5.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>metabolic acidosis</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 1.8 Neurogenic bladder.</th>
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</thead>
<tbody>
<tr>
<td><strong>Spastic neurogenic bladder</strong></td>
</tr>
<tr>
<td>Lesion</td>
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<tr>
<td>Bladder wall</td>
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<td>Bladder wall</td>
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</table>
cannot tolerate the ACEI (e.g., due to cough caused by bradykinins accumulation in the lungs), switch to Angiotensin Receptor Blocker (ARB).

- Bartter syndrome: Also known as Juxta-glomerular hyperplasia. There is resistance to angiotensin, accordingly, hyponatremia ensues. The low Na stimulates the renin-angiotensin-aldosterone system which leads to hypokalemia. Treatment: Prostaglandin blockage, e.g., Indomethacin. (PG stimulates renin).
- Urethral Diverticulum: Suspect it in any female patient presenting with a (DDD) triad: Dysuria, Dribbling and Dyspareunia.
- Indications of urgent hemodialysis: Fluid overload, resistant hyperkalemia, resistant metabolic acidosis and uremic pericarditis.

Rheumatology

Rheumatoid Arthritis

- Mechanism: Immunologically mediated T lymphocyte inflammatory synovitis. Linkage to HLA-DR4 has been suggested.
- Clinical picture:
  1. Symmetrical small joint pains: Mainly metacarpophalangeal (MCP) and proximal interphalangeal (PIP), never the distal ones.
  2. Morning stiffness for at least 1 h, that gets better towards the end of the day (Osteoarthritis gets worse with exercise; not better).
- Diagnostic criteria (At least 4 criteria for at least 6 weeks duration):
  1. Morning stiffness for at least 1 h.
  2. Symmetrical involvement of joints.
  3. Arthritis of 3 or more joints.
  4. Arthritis of the hand joints.
  5. Positive Rheumatoid factor.
  6. Rheumatoid nodules.
  7. X-ray changes, e.g., Erosions, Loss of joint space.
- Complications:
  1. Joint deformities: Ulnar deviation and Swan neck deformity. Refer to Fig. 1.23.
  2. Joint subluxation: Most dangerous is atlantoaxial joint. So when you get a patient with RA in the USMLE having any neurological issues in his neck or upper extremities, you know what to think!
- Diagnosis:
  1. Positive rheumatoid factor (RF): An IgM directed against serum IgG.
  2. Positive antineutrophil cytoplasmic antibody (ANA) and anti-cyclic citrullinated peptide antibody (Anti-CCP).
  3. Low synovial complement with normal serum complement levels.
- Treatment:
  1. NSAIDs, e.g., acetaminophen, phenacetin, salicylates and indomethacin.
  2. Steroids: Provide relief and may slow the progression of the disease.
  3. Anti-Tumor Necrosis Factor (TNF): e.g., Infliximab, Adalimumab and Etanercept. Side effects: Overwhelming infections, so annual PPD is necessary.
  4. Disease modifying anti-rheumatoid drugs (DMARDs): Now the first line of therapy once there is any X-ray changes in the joint:

Fig. 1.23 Swan neck deformity
- Methotrexate: *Immunosuppressant and folic acid antagonist*. Side effects: Bone marrow depression and elevated liver enzymes.
- Hydroxychloroquine: *Antimalarial drug that acts by stabilizing the lysosomes*. Side effects: Retinopathy, Renal failure and hemolysis in G6PD deficiency.
- Sulfasalazine: Works through the sulfapyridine portion, whereas in inflammatory bowel disease it works through the 5-aminosalicylic portion. Side effects: *Reversible infertility in males*.
- Gold salts: Taken up by macrophages and lysosomes and stop bone destruction. Side effects: Rash and stomatitis. Antagonist: Dimercaprol.
- Penicillamine: *Analogue of cysteine*. Also used in Wilson disease as a copper chelator.

**Notes:**

1. *Psoriatic arthritis*: Occurs in patients with psoriasis; is characterized by *DIP involvement* (Sausage digits) and (*Pencil in cup appearance*) on hands X-ray.
2. *Sjogren syndrome*: A subtype of RA in which patients have arthritis plus *dry secretions*, i.e., Dry eyes, dry mouth, etc. Diagnosis: Anti-Ro (Anti-SSA), anti-La Anti-SSB and anti-salivary duct antibodies. Complication: Lymphoma.
3. *Juvenile rheumatoid arthritis*: Occurs in children and is associated with fever, rash, irido-cyclitis, pericarditis and negative RF. Treatment: NSAIDs.
4. *Felty syndrome*: RA + Hypersplenism due to lymphocyte infiltration. Suspect it when you see a patient in the USMLE with RA and pancytopenia.

**Osteoarthritis**

- **Mechanism**: Wear and tear
- **Clinical picture**:

  1. Morning stiffness: *Lasts less than 30 min*.
  2. Arthritis gets *worse* by exercise towards the end of the day.
  3. The distal interphalangeal joints (DIP) *are commonly involved here*.
  4. Deformities: Proximal interphalangeal joints can swell up and form *Bouchard nodes*, while the DIP can form *Heberden nodes* (*Genetically determined*).

  - **Diagnosis**: X-ray of joints shows *subchondral bone formation and osteophytes*.
  - **Treatment**: Physical therapy, NSAIDs, glucosamine and chondroitin sulfate.

**Systemic Lupus Erythematosus (SLE)**

- **Introduction**: A systemic connective tissue disease, mainly in females (*F:M = 9:1*). It is more common in females due to alleles existing on *class II MHC*.
- **Clinical picture**:

  1. Photosensitivity and rash: Could be discoid or the famous *butterfly malar rash*. Refer to Fig. 1.24.
  2. Painless oral ulcers.
3. -itis: Serositis, arthritis and wire loop glomerulonephritis due to immune complex deposition.
4. Anemia, lymphopenia and thrombocytopenia (RA does not cause that!).

- **Complications:**
  1. Libman Sacks endocarditis, where vegetations do not embolize.
  2. Lupus nephritis: It has 5 types; the most aggressive is type IV (Diffuse proliferative GN). Treatment: Steroids + Cyclophosphamide.

- **Diagnosis:**
  1. Positive ANA, anti-double stranded DNA antibodies (dsDNA) and anti-smith antibodies.
  2. Low serum complement factors C3 and C4.
  3. False positive work up for syphilis, e.g., VDRL and RPR.

- **Notes:**
  2. Most common cardiac manifestation of SLE is pericarditis.
  3. Most specific ocular manifestation of SLE is retinal cytoid bodies.
  4. Drugs, e.g., INH. Hydralazine and Procainamid e can cause lupus-like syndrome, and is diagnosed by positive anti-histone antibodies.
  5. Neonatal lupus can cause heart block and is diagnosed by positive anti-Ro antibodies, so keep your eyes open in the USMLE for this neonate with heart block whose mother has been having this weird rash and joint pains.

- **Treatment:** NSAIDs and steroids.

---

### Polyarteritis Nodosa (P.A.N.)

- **Mechanism:** Necrotizing vasculitis affecting medium sized vessels, causing fibrinoid necrosis and tiny aneurysms formation.
- **Causes:** Multiple, most common being hepatitis B infection.
- **Clinical picture:**
  1. Skin: Purpura and skin ulcers.
  3. Renal: Renal hypertension due to involvement of arcuate artery, and crescentic necrotizing glomerulonephritis.
  4. CVS: Coronary artery disease (CAD).
  5. CNS: Cerebrovascular accidents (CVA).

- **Diagnosis:** Kidney biopsy and positive P-ANCA.
- **Treatment:** Steroids.
- **Note:**
  1. Suspect P.A.N. if you see a young patient in the USMLE with hepatitis B and multiple elderly diseases (CAD, CVA, Renal failure).
  2. Churg Strauss vasculitis is another necrotizing vasculitis characterized by AAA: Asthma, Allergic rhinitis and eosinophilia.

### Ankylosing Spondylitis

- **Mechanism:** Inflammatory arthropathy that is linked to HLA-B27, usually following a prostate infection especially with Klebsiella.
- **Clinical picture:** Back pain due to sacroiliitis, uveitis and pulmonary fibrosis.
- **X-ray of the back:** Bamboo spine.
- **P.S.:** If you hear a murmur in this patient, it is mostly a diastolic murmur for aortic regurgitation.
- **Treatment:** Similar to RA.

### Reiter’s Syndrome

- **Mechanism:** Rheumatologic disease that follows non-gonococcal infections.
- **Clinical picture:** Uveitis, circinate balanitis and big joint fleeting arthritis.
- **Diagnosis:** Elevated ESR, negative rheumatoid factor and positive HLA-B27.
- **Notes:**
  1. These patients might also have aortic regurgitation murmur and lung fibrosis.
  2. Reactive arthritis: Common after infection with salmonella, shigella, campylobacter, gonococci and chlamydia. It affects big joints, is fleeting in nature and associated with tenosynovitis, e.g., DeQuervain tenosynovitis.

### Temporal Arteritis

- **Mechanism:** Giant cell vasculitis that mainly affects the elderly.
- **Clinical picture:**
  1. Temporal headache with tender, palpable and pulseless temporal artery.
  2. Jaw claudications, especially upon eating.
- **Complications:** Blindness due to ischemic optic neuropathy secondary to the involvement of posterior ciliary branches of ophthalmic artery.
Diagnosis: Elevated ESR (>40 mm/hour). Temporal artery biopsy shows infiltration with plasma cells and giant macrophages.

Treatment: High dose systemic steroids is the first next step (Even before the biopsy).

**Wegener Granulomatosis**

- **Mechanism:** Focal necrotizing vasculitis and granuloma formation.
- **Clinical picture:**
  1. Upper airway involvement, e.g., Sinusitis, epistaxis and saddle nose.
  2. Lower airway involvement, e.g., Cough, hemoptysis and lung cavitation.
  3. Renal involvement, e.g., Proteinuria and hematuria.
- **Diagnosis:** Positive anti-neutrophil cytoplasmic antibodies (C-ANCA).
- **Treatment:** Steroids and Cyclophosphamide.
- **Notes:**
  1. Polymyositis could exist alone, and is diagnosed by high anti-Jo-1 antibodies.
  2. Dermatomyositis is well known to be highly associated with malignancy, so when you see any patient with this disease, you must screen him/her for malignancy.

**Takayasau Disease**

- **Mechanism:** Vasculitis affecting the big vessels, e.g., aorta and its major branches.
- **Clinical picture:** Decreased pulse on one extremity plus claudications.
- **Diagnosis:** Angiography.
- **Treatment:** Steroids.
- **Note:** Do not confuse this with Kawasaki disease, where patients have mucocutaneous lesions, cervical lymphadenopathy and aneurysms of the coronary arteries. Treatment here is aspirin and immunoglobulin therapy.

**Behcet Syndrome**

- **Clinical picture:** Disease of unknown etiology causing three major recurrent symptoms: Recurrent iritis, Recurrent painful oral ulcers and Recurrent painful genital ulcers.
- **Treatment:** Steroids.

**Dermatomyositis**

- **Mechanism:** Immune mediated infiltration of the connective tissue with inflammatory cells.
- **Clinical picture:**

  1. Dermato-: Heliotrope eyelids (Purple rash) and Gottron papules over metacarpophalangeal and proximal interphalangeal joints. Gottron papules is the most specific sign of Dermatomyositis.
  2. -myositis: Proximal bilateral symmetrical muscle weakness and tenderness.
  3. Others: Arthralgia, cardiomyopathy and malignancy. If you see a patient in the USMLE with muscle pains, rash described above and any kind of cancer, think of dermatomyositis.

**Gout and Pseudogout**

**Introduction**

- Normally, 2/3 of the uric acid is excreted by the kidneys and 1/3 by GI tract.
- Hypouricemia can occur in pregnancy and in patients with Fanconi syndrome (Glucosuria, aminoaciduria, phosphaturia and uricosuria).

**Gout**

- **Mechanism:** Deposition of monosodium urate crystals. This could be idiopathic or secondary, e.g., Lesch Nyhan syndrome (Rypoxanthine guanine phosphoribosyl transferase enzyme “HGPRT” deficiency) or renal failure.
- **Clinical picture:**
  1. Arthritis is an asymmetrical, painful, warm joints. The first metatarsophalangeal joint is a classic site, a.k.a. Podagra.
  2. Chronic cases are associated with formation of tophi and renal failure.
- **Diagnosis:**
  1. Joint aspiration showing needle shaped strongly negative birefringent crystals.
  2. Serum uric acid more than 7 mg%. Joint aspiration remains the test of choice.
- **Prevention:** Low purine diet and avoidance of alcohol.
Treatment of acute gout: Treatment of choice is oral indomethacin. You can also use Colchicine; it depolymerizes tubulin and decreases leukocyte entry into the cells. Side effects of colchicine are diarrhea and GI upset. Long term use may cause aplastic anemia.

Treatment of chronic gout:
1. Allopurinol: Converts inside the body to Alloxanthine which inhibits xanthine oxidase. Xanthine oxidase typically regulates the conversion of hypoxanthine to xanthine, and the conversion of xanthine to uric acid. Indications: High serum plus high urinary uric acid levels.
2. Probenecid: Blocks uric acid reabsorption in proximal convoluted tubule. Indications: High serum plus low urinary uric acid level. Sulfinpyrazone is another drug that acts exactly like Probenecid.

Pseudogout
- Mechanism: Deposition of calcium pyrophosphate.
- Clinical picture: Same as gout.
- Diagnosis: Joint aspiration. Crystals are rhomboid shaped with weakly positive birefringence.
- Treatment: NSAIDs.

Scleroderma
- Limited: CREST: Calcinosis of the skin, Raynaud phenomenon, Esophageal diverticulae and dysmotility, Sclerodactyly and Telangiectasis.
- Diffuse: Involves all systems.
- Diagnosis: Positive Anti-Scl 70 and Anticentromere antibodies.
- Treatment: Supportive.
- Notes:
  1. Suspect it in the USMLE when you see a patient with shiny tight skin and bad uncontrollable GERD and dysphagia.
  2. Scleroderma renal crisis: If you see a patient in the USMLE with scleroderma and renal failure, ACEI is the treatment of choice.

Polymyalgia Rheumatica
- Mechanism: Giant cell vasculitis.
- Clinical picture: Disease of the elderly, who present with early morning pain and stiffness of shoulders and hips.
- Diagnosis: Elevated ESR (>40 mm/hour).
- Treatment: Steroids.

Osteoporosis and Osteomalacia
- Osteoporosis: Loss of bone mass, with the remaining bone being of normal density. Could be postmenopausal (type 1) or senile (type 2), and puts the patients at risk of fractures, e.g., Compression vertebral fracture, fracture neck of femur. These patients have normal serum calcium and alkaline phosphatase.
- Osteomalacia: Normal bone mass, but the bone density is significantly decreased. These patients have low serum calcium and high alkaline phosphatase. Bone X-ray in these patients shows pseudo-fractures (Looser’s zones).
- Diagnosis: Dual Energy X-ray Absorptiometry (DEXA scan).
- Treatment: Calcium and vitamin D, Calcitonin and Bisphosphonates which act by inhibiting the osteoclasts, e.g., Alendronate.
- Note:
  1. Smoking and alcohol increase the risk of osteoporosis twofold.
  2. Most common side effect of Bisphosphonates is Erosive esophagitis.
  3.Raloxifen is a Selective Estrogen Receptor Modulator (SERM) that acts like estrogen on bones (Prevents osteoporosis), and acts as an estrogen blocker on breast and endometrium (Decreases risk of cancer). Ideal for postmenopausal.

Paget’s Disease of the Bone
- Mechanism: Rapid bone turnover, mostly due to infection, e.g., Paramyxovirus.
- Clinical picture: Presents in the USMLE with a patient having frequent bone fractures and deformities, and his hat recently does not fit anymore (Due to frontal bossing).
- Diagnosis:
  1. X-ray of bones: Thick bone cortex and trabeculae.
  2. High serum alkaline phosphatase and urinary hydroxyproline, everything else is within normal limits.
- Treatment: Bisphosphonates, e.g., Alendronate.

Septic Arthritis
- Causes: Staphylococci (Most common), Streptococci or H. Influenza B.
- **Clinical picture:** Red, warm, tender and swollen joint.
  - **Diagnosis:**
    1. Arthrocentesis should be the first next step.
    2. High WBC in serum and synovial fluid, elevated ESR and CRP.
  - **Treatment:** Arthrocentesis and systemic antibiotics.

**Fibromyalgia**

- **Introduction and clinical picture:** Syndrome of unclear etiology, with pain and tenderness in at least 11 out of the following 9 × 2 = 18 points (all bilaterally):
  1. Occiput: At insertion site of suboccipital muscles.
  2. Lower neck: At the level of C7.
  3. Trapezius muscle: In the middle of superior border of the muscle.
  5. 2nd rib: At the costo-chondral junction.
  6. Lateral epicondyle: Just distal to it.
  7. Upper outer quadrants of the buttocks.
  8. Greater trochanters.
  - **Treatment:** TCAs or SSRI. Recently, drug of choice is Duloxetine.

**Cardiovascular System**

**Introduction**

- **Arteries:** Contain stressed volume of the circulation, and arterioles is where there is maximal resistance to blood flow.
  - **Veins:** Contain the non-stressed volume of the circulation, and most of our blood is contained within the venous system.
  - **Capillaries:** Have the largest surface area of the entire vascular system, and blood flow through them is regulated by pre-capillary sphincters.
  - The lower the surface area of a blood vessel, the faster the blood flow, i.e., Capillary blood flow is very slow due to the large surface area.
  - Adding resistance in parallel decreases the peripheral resistance, and increases blood flow.
  - Turbulence is highest in big vessels with high blood velocity, e.g., Aorta.
  - **Local autoregulation:** Done by the heart, brain and muscles. The most important vasodilator of cerebral circulation is CO2.
  - **Active Hyperemia:** Blood flow to organs is directly proportional to its metabolic activity.
  - **Reactive hyperemia:** Increased blood flow to an organ after temporary occlusion of its circulation.
  - **Pulse pressure:** Difference between systolic and diastolic blood pressure; determined by stroke volume and compliance of large arteries; that is the reason atherosclerosis causes wide pulse pressure.

**Electrocardiogram Waves (Refer to Fig. 1.25)**

- **P wave:** Atrial depolarization.
- **P-R interval:** Atrio-ventricular conduction.
- **QRS:** Ventricular depolarization.
- **S-T interval:** Isoelectric.
- **T wave:** Ventricular repolarization.
  - **Notes:** Conduction a.k.a. Dromotropism is fastest in purkinje fibers, and is slowest across the AV node.
**Action Potentials**

**Action Potential of Purkinje Fiber (Refer to Fig. 1.26)**

- **Phase 0** (Depolarization): Due to Na influx. Inhibited by Quinidine.
- **Phase 1** (Partial repolarization): Due to K efflux.
- **Phase 2** (Plateau): Due to K efflux and Ca influx.
- **Phase 3** (Repolarization): Due to K efflux.
- **Phase 4** (Forward current): Due to Na influx.

**Action Potential of Sinoatrial Node (Pacemaker) (Refer to Fig. 1.26)**

- **Stage 4**: Mediated by Na influx.
- **Stage 0**: Mediated by Ca influx.
- **Stage 3**: Mediated by K efflux.

**Cardiac Cycle (refer to Figs. 1.27 and 1.28)**

- The following few points show how changing certain variables can shift the cardiac cycle curve shown on Fig. 1.28.
- Increased Preload, i.e., Venous return causes right shift of curve.
- Increased Afterload, i.e., Peripheral resistance causes upward shift of curve.
- Increased Contractility, i.e., Inotropy causes left shift of curve.
- Note: Preload = EDV, and Afterload = Diastolic BP.

**Heart Sounds**

- **S1**: Due to closure of AV valves, i.e., mitral and tricuspid.
- **S2**: Due to closure of semilunar valves, i.e., Aortic and pulmonary.
- **S3**: Due to ventricular filling. Prominent in CHF.
- **S4**: Due to high atrial pressure caused by atrial contraction. Prominent in ventricular diastolic dysfunction.

**Heart Murmurs**

- Aortic stenosis: Systolic ejection diamond shaped murmur on the base, radiating to the carotids.
- Aortic regurgitation: Blowing diastolic murmur on base, along with wide pulse pressure, water hammer pulse and strong carotid and capillary pulsations.
- Mitral stenosis: Diastolic rumbling murmur on the apex with opening snap.
- Mitral regurgitation: Pansystolic murmur on the apex.
- Mitral prolapse: Midsystolic click with late systolic murmur.
- Notes:
  1. Mitral stenosis murmur that changes with position in a female patient who also has positional syncope are signs of left atrial myxoma.
  2. Most common cause of valve lesions is wear and tear.
  3. Valve replacement is done using tissue valves in elderly (Side effect: Calcification), and mechanical valves otherwise (Side effect: Thrombosis and hemolysis). Only patients with mechanical valves require life long anticoagulation with warfarin to a target INR of 2.5–3.5.

**Jugular Vein Waves (refer to Fig. 1.25)**

- **A**: Due to atrial contraction.
- **C**: Due to right ventricle contraction, causing mitral bulge inside the atrium.
- **V**: Due to high atrial pressure.
**Important Equations**

- **Stroke volume** = \( \text{End Diastolic Volume (EDV)} - \text{End Systolic Volume (ESV)} \).
- **Ejection Fraction (EF)** = \( \frac{\text{SV}}{\text{EDV}} \geq 50\% \).
- **Cardiac output (CO)** = \( \frac{\text{Stroke Volume (SV)}}{\text{Heart Rate (HR)}} \).
- **Fick equation**: \( \text{CO} = \frac{\text{Rate of oxygen consumption}}{\text{Difference between arterial and venous oxygen contents}} \).
- **Mean arterial pressure** = \( \text{CO} \times \text{Peripheral resistance (PR)} \).

**Hypertension**

- **Definition**: Persistently elevated blood pressure beyond 140/90 on at least 3 separate occasions.
- **Types**: Hypertension could be only systolic, e.g., thyrotoxicosis, diastolic, or both.
- **Cause**: HTN could be idiopathic (essential) or secondary to a cause, e.g., Pheochromocytoma, Hyperaldosteronism, Renal artery stenosis.
- **Physiology**: Blood pressure is controlled by baroreceptors in aortic arch and carotid sinus, signaling the CNS via vagus and glossopharyngeal nerves respectively.
- **Clinical picture**: Headache, blurry vision, nausea and vomiting.
- **Complications of HTN**: Left ventricular hypertrophy, CAD, CVA (Mostly Basal ganglia), Renal failure, Copper wiring and A-V nicking of retinal vessels.
- **Treatment**: Classes listed below in details.

---

**Fig. 1.27** Cardiac cycle

- **Y descent**: Drop in atrial pressure during ventricular filling.
- **X descent**: Ventricular ejection phase.

**Fig. 1.28** Cardiac cycle.

- A-B: Isovolumetric contraction phase.
- B: Aortic and pulmonary valves open.
- B-C: Ventricular ejection phase, i.e., Stroke volume.
- C: Aortic and pulmonary valves close.
- C-D: Isovolumetric relaxation phase.
- D: AV valves open.
- D-A: Ventricular filling phase.
- A: AV valves close.
1. **Diuretics**

**Hydrochlorothiazide**
- **HCTZ is recommended as the first line of therapy for any HTN patient.**
- **Mechanism:**
  1. Decreases NaCl absorption at the level of distal convoluted tubules.
  2. Vasodilation through release of prostaglandins. This leads to a decrease in peripheral resistance (PR) and cardiac output (CO). \( \text{Note that blood pressure} = \text{CO} \times \text{PR} \).
- **Indications:**
  1. CVS: Hypertension, CHF.
  2. Renal: Nephrogenic diabetes insipidus. Metalozone is used in nephrotic syndrome.
- **Side effects:**
  1. 2 Hypos: Hypotension and hypokalemia.
  2. 3 Hypers: Hypercalcaemia, hyperuricemia and hyperglycemia.
- **Contraindications:** Severe recurrent gout attacks and hypercalcaemia.
- Beside HCTZ, other thiazides include Chlorthalidone and Indapamide.

**Furosemide**
- **Mechanism:** Loop diuretic that acts by inhibiting Na/K/2 Cl cotransport at the level of thick ascending limb of loop of Henle.
- **Indications:**
  1. Urgent HTN and fluid overload situations, e.g., Pulmonary edema.
  2. Hypercalcaemia.
- **Side effects:** Ototoxicity, Nephrotoxicity, Hypocalcemia and Hypokalemia.
- **Note:** Bumetanide and Torsemide are stronger loop diuretics.

**K Sparing Diuretics**
1. **Spironolactone:**
   - K sparing, anti-aldosterone diuretic that acts via canrenone.
   - Indications: HTN secondary to hyperaldosteronism, and CHF.
   - Side effects: Gynecomastia and hyperkalemia.
2. **Amiloride and Triameterene:**
   - Act by blocking Na channels in collecting ducts.
   - Side effects: Leg cramps and hyperkalemia.

**Carbonic Anhydrase Inhibitors**
- **Mechanism:** Inhibit reabsorption of HCO3 in the proximal convoluted tubules. The result is hyperchloremic metabolic acidosis with alkaline urine.
- **Indications:**
  1. Open angle glaucoma.
  2. Mountain sickness syndrome (Cerebral and pulmonary edema and nausea).
- Examples: Acetazolamide aka Diamox.

2. **Centrally acting medications**

**Alpha Methyl Dopa**
- **Mechanism:** Decreases sympathetic outflow from the CNS.
- **Indication:** Hypertension during pregnancy.

**Clonidine**
- **Mechanism:** Decreases sympathetic outflow from the CNS.
- **Side effects:** Fluid retention.
- **Precautions:** Sudden stoppage leads to rebound hypertension.

3. **Vasodilators**
- **Hydralazine:** Also used in CHF. Side effects: Reflex tachycardia and lupus-like syndrome.
- **Minoxidil:** Notorious side effect is hypertrichiosis.
- **Sodium nitroprusside:** Used as a drip in hypertensive emergencies. Major side effect is cyanide poisoning which is treated by nitrates and thiosulfate.

4. **Calcium Channel Blockers (CCB)**

**Nifedipine**
- **Mechanism:** Coronary and peripheral vasodilator.\( \text{Does not have any inotropic or chronotropic actions.} \)
- **Side effects:** Hypotension, flushing and headache.

**Verapamil**
- **Mechanism:** Negative inotropy and chronotropy. Its effects on the coronary arteries is very mild.
- **Side effects:** Constipation and increase risk of digoxin toxicity.
Diltiazem
- **Mechanism**: Vasodilator, negative inotropy and chronotropy.
- **Indications**: Anti-angina, and rate control in arrhythmias, e.g., Atrial Fibrillation.
- **Note**: Nifedipine causes reflex tachycardia, while verapamil and diltiazem cause bradycardia.

5. Alpha blockers

Phenoxybenzamine
- **Introduction**: Non-competitive irreversible alpha blocker.
- **Mechanism**: Antagonizes the effect of epinephrine and NE on blood pressure.
- **Indications**: Treatment of hypertension secondary to pheochromocytoma.
- **Side effects**: Hypotension and tachycardia.
- **Contraindications**: Coronary artery disease.
- Phentolamine is another reversible alpha blocker used to diagnose pheochromocytoma.

Prazosin, Terazosin and Doxazosin
- Metabolites pass in the urine, except doxazosin’s which pass in stools.
- **Indications**: Hypertension and benign prostatic hypertrophy.
- **Side effects**: Hypotension known as first dose syncope. Prevented by starting the patient on only third of the dose and increasing it gradually, also make sure that the patient takes the pill at bedtime.

Yohimbine
- Alpha-2 antagonist used to treat impotence.

6. ACEI and ARBs: Discussed later.

7. Beta Blockers: Discussed later.

Hypertensive encephalopathy: Sudden marked elevation of blood pressure leading to neurological manifestations and loss of consciousness due to brain edema. Treatment: Sodium nitroprusside to control blood pressure rapidly.

Drugs of choice: Again, remember that HCTZ is the drug of choice to start in any patient with HTN, except for the following particular scenarios:

1. HTN plus DM: ACEI or ARB to delay progression of diabetic nephropathy.
2. HTN plus severe COPD or asthma: Calcium channel blocker.
3. HTN in African Americans: Diuretics or calcium channel blockers.
4. HTN in elderly: Diuretics or calcium channel blockers.
5. HTN in pregnancy: Alpha methyl dopa or Hydralazine.
6. HTN 2ry to Hyperaldosteronism: Spironolactone.

Congestive Heart Failure (CHF)
- **Mechanism**: Failure of the heart to pump out enough blood.
- **Starling’s law**: Force of contraction is directly proportional to length of muscle fiber, until a certain limit, at which muscles undergo dilatation and failure.
- **Types**:
  1. Systolic: Low EF. Caused by myocardial infarction, alcohol and illicit drugs.
  2. Diastolic: Normal EF and decreased ventricular compliance. Caused by long-standing hypertension and is characterized by S4.
  3. High output CHF, e.g., Thyrotoxicosis.
  4. Low output CHF: Most cases of CHF fall in this category.
- **Clinical picture**: Refer to Table 1.9.
- **Diagnosis**:
  2. **CXR**: Butterfly shaped pulmonary venous congestion on chest X ray + Kerley A and B lines. Refer to Fig. 1.29.
  3. **EF <50%** on echocardiogram.

<table>
<thead>
<tr>
<th>Table 1.9 Congestive heart failure.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Left ventricular failure</strong></td>
</tr>
<tr>
<td>Symptoms</td>
</tr>
<tr>
<td>Dyspnea</td>
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<tr>
<td>Orthopnea</td>
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<tr>
<td>Paroxysmal Nocturnal Dyspnea (P.N.D.)</td>
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<tr>
<td>Frothy blood tinged sputum</td>
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<tr>
<td>Signs</td>
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<tr>
<td>Bilateral basal crackles</td>
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<tr>
<td>Pulsus alternans</td>
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<tr>
<td>S3 gallop</td>
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</table>
4. Elevated serum B-Type Natriuretic Peptide (BNP) above 400 pg, due to stretch of ventricles.

- **Treatment**: Heart failure is treated by 4 classes of medications, as follows:

1. **Diuretics**
   - Low cardiac output leads to decreased renal blood flow, which leads to stimulation of the renin angiotensin aldosterone system, and ultimately salt and water retention.
   - **Examples**: Furosemide, Hydrochlorothiazide.
   - Spironolactone is a K-sparing anti-aldosterone diuretic that is beneficial in severe CHF, and has been proven to reduce morbidity and mortality.

2. **Vasodilators**
   - Venodilation leads to decreased pre-load, while arteriodilation leads to decreased after-load.

3. **Inotropics**
   - **Digoxin**
     - **Mechanism**: Inhibits Na-K ATPase, which leads to increased intracellular Na and Ca. This leads to increase myocardial contractility.
     - **Indications**:
       1. Left sided systolic dysfunction (not right and not diastolic).
     - **Bioavailability of oral digoxin**: 50–75%.
     - **Side effects**: Bradycardia and Gynecomastia.
     - **Elimination**: Excreted in the urine.
     - **Toxicity**: Hypokalemia, nausea and vomiting, yellow vision and haloes.
     - **Toxicity risk is increased in the presence of hypokalemia, hypomagnesemia, hypercalcemia, diuretics or quinidine.**
     - **Treatment of toxicity**: Potassium and digoxin binding fragments (Digibind).
     - **Digitoxin**: Has longer half life and more affinity, and is excreted in bile.
     - **Note**: Digoxin and digitoxin have been proven to decrease the frequency and duration of hospitalization secondary to CHF; however they do not decrease mortality.

4. **Angiotensin Converting Enzyme Inhibitors (ACEI)**
   - **Mechanism**:
     1. Prevent conversion of angiotensin I to angiotensin II. This leads to inhibition of aldosterone formation, and decreases preload and afterload.
     2. ACEI has also been proven to decrease remodeling of the myocardium and to delay progression of diabetic nephropathy.
   - **Side effects**:
     1. Hypotension.
     2. Hyperkalemia and elevated creatinine.

5. **Phosphodiesterase Inhibitors**
   - **Mechanism**:
     1. Inhibit phosphodiesterase enzyme, which in turn leads to increased cAMP. cAMP activates Ca channels by phosphorylation, leading to Ca influx.
     2. Inodilators: These drugs act as vasodilators and inotropics.
Examples: Amrinone, Milrinone.

4. Beta blockers

- **Mechanism:**
  1. Negative inotropic and negative chronotropic action, leading to decreased myocardial oxygen consumption.
  2. Block the renin-angiotensin aldosterone system.
- **Side effects:** Bradycardia, Hypotension, sexual dysfunction and fatigue.
- **Contraindications:**
  1. Vasospastic (Prinzmetal) angina: Allows unopposed vasoconstrictor alpha action.
  2. Diabetes mellitus (Relative contraindication): Masks the signs of hypoglycemia. Besides, can cause fasting hypoglycemia by inhibiting glycogenolysis.
  3. Severe asthma and COPD (Relative contraindication): Might worsen the bronchospasm.
- **Precautions:** Sudden stoppage leads to rebound tachycardia and arrhythmia.
- **Examples:** Carvedilol, Metoprolol.

Atherosclerosis

- **Introduction:** Disease of the large and mid-sized arteries.
- **Predisposing factors:** Smoking, old age and DM.
- **Complications:** Myocardial infarction (MI), Cerebrovascular accidents (CVA).
- **Pathology:** Starts with fatty streaks and foam cell formation (Where macrophages phagocytose oxidized LDL), then a plaque is formed. The end point is interfering with blood flow to an organ and causing an infarct, which is either:
  1. Red: Made of blood, e.g., Lungs, GI.
  2. Pale: As in MI and CVA.

Myocardial Infarction

- **Clinical picture:** Crushing substernal chest pain radiating to left shoulder, along with diaphoresis, nausea and dizziness.
- **Risk factors:** Male >55, Female >65, smoking, dyslipidemia, family history. So you can tell that age is the most important risk factor.

- **Diagnosis:**
  1. Elevated troponin-I and CK-MB, and \( LDH1 > LDH2 \) flip ratio.
  2. EKG shows changes in the ST segments or T waves.
- **Markers:** Myoglobin is the first to rise \((After 1\ h)\), and troponin is the last to disappear \((Rises after 3\ h\ and\ lasts\ for\ 10\ days)\).
- **Treatment:**
  2. Second step: Heparin drip, aspirin, beta-blockers, ACEI and statins.
  3. If patient is unstable or has \( ST\ elevation\ MI (STEMI)\), urgent heart catheterization is done. If heart catheterization is more than 90 min away, thrombolytic therapy is indicated, e.g., Tissue plasminogen activator (tPA).
  4. Glycoprotein IIb/IIIa inhibitors are indicated in Non-ST elevation MI (NSTEMI) and after stent placement, as they inhibit platelet aggregation and fibrinogen production.
- **Pathologically:** Coagulative necrosis in the myocardium starts within hours:
  1. Day 1: Neutrophils migration occurs.
  2. Week 1: Granulation tissue formation.
  3. Week 3 after the MI: Myocardial scar is complete.
- **Angina:** Chest pain that occurs to myocardial ischemia and has 3 types:
  1. Stable angina: Due to uncomplicated atheroma.
  2. Unstable angina: Due to a complicated plaque, i.e., rupture.
  3. Prinzemetals angina: Due to coronary vasospasm. Shows \( ST\ elevations\), and beta blockers are contraindicated, as allows full uninhibited alpha action on blood vessels.
- **Complications:**
  1. Arrhythmia and heart failure.
  2. Rupture of interventricular septum or papillary muscles: Rupture of papillary muscles and/or chordae tendineae of mitral valve is the most common, and its presents in the USMLE with an MI followed by the appearance of new mitral regurgitation murmur and sudden onset pulmonary edema. \*Note that papillary muscles attach posteriorly and are supplied by right coronary artery.
  3. Ventricular aneurysm: Suspected by persistent \( ST\ elevation\) after resolution of MI. A thrombus can form inside the aneurysm and embolization can ensue.
4. Dressler syndrome: Pericarditis that might occur few weeks after resolution of the MI, and is treated with steroids.

- **Notes:**
  1. Chest pain that starts days after the MI indicates pericarditis or re-infarction.
  2. MI is the most common complication after carotid endarterectomy.
  3. Most common cause of death in MI is arrhythmia.
  4. Cessation of smoking for 5 years decreases risk of MI by 50%.
  5. Indications for bypass surgery: Left main coronary artery involvement, or 3+ vessel disease. Anything else could be treated with stenting.

**Pericarditis**

- **Causes:** Multiple, but mostly viral.
- **Clinical picture:** Chest pain, worse on lying flat and relieved by sitting up or leaning forwards.
- **On exam:** Friction rub.
- **EKG:** Diffuse PR depressions and ST elevations with normal troponins. Refer to Fig. 1.30.
- **Treatment:** Non-steroidal anti-inflammatory medications (NSAIDs).

**Pericardial Effusion and Tamponade**

- **Mechanism:** If any amount of fluid collects rapidly between the visceral and parietal layers, tamponade occurs.
- **Clinical picture:**
  1. Hypotension.
  2. Distant heart sounds.
  3. Inspiratory drop of blood pressure aka Pulsus paradoxus.
  4. Inspiratory filling of jugular veins aka Kussmaul’s sign.
- **Diagnosis:**
  1. Echocardiogram confirms and evaluates degree of effusion.
  2. CXR: Flask shaped heart.
- **Treatment:** Urgent pericardiocentesis.
- **Notes:**
  1. Malignant effusions are hemorrhagic, and uremic effusions are serous.
  2. During pericardiocentesis, internal mammary artery is at risk of injury.
  3. In tamponade, the left atrial pressure is equal to right atrial pressure and is equal to right ventricular end diastolic pressure.
  \[ \text{LAP} = \text{RAP} = \text{RVEDP} \].

**Rheumatic Fever**

- **Mechanism:** Post-group A beta-hemolytic streptococcal infection, due to cross sensitivity between streptococcal antigen and cardiac tissue.
- **Clinical picture:** Unique CCASE that you can never forget once you see a patient with fever plus 2 or more of Jones criteria:
  1. Chorea: Known as Sydenham chorea.
  2. Carditis: Valve lesions, mitral being most common.
  3. Arthritis: Migratory and fleeting.
  4. Subcutaneous nodules.
  5. Erythema marginatum on the trunk and proximal extremities.
- **Diagnosis:** High ESR and Anti-streptolysin O titers (ASLO).
- **Complication:** Most common is mitral stenosis.
- **Pathology:**
  1. Aschoff bodies: Central fibrinoid necrosis surrounded by fibrosis.
  2. Antischkow cells.
- **Treatment:** Penicillin. If allergic to PCN, give erythromycin.

**Endocarditis**

- **Causes:**
  1. Streptococcus viridans: Most common cause. Responsible for subacute cases.
  2. Staphylococcus aureus: Has rapid onset, more aggressive and common in IV drug users.

![Fig. 1.30 EKG changes in pericarditis](image-url)
3. Abacterial: also known as marantic endocarditis, e.g., renal failure, cancer.

- **Valves involved:**
  1. Just like rheumatic fever, the most common is mitral valve.
  2. Tricuspid valve is more common to be involved in IV drug users.

- **Clinical picture:**
  1. Fever and sepsis in a patient with a new murmur.
  2. Osler nodes: Tender nodular lesions on fingers.
  5. Splinter hemorrhage: Linear hemorrhage under the nails.

- **Diagnosis:**
  1. Positive blood cultures: First thing to order when you suspect this disease.
  2. Trans-esophageal echocardiogram: To diagnose valvular vegetations.

- **Treatment:** Broad spectrum antibiotics for 4-6 weeks, e.g., PCN + aminoglycoside. Treatment aims at sterilizing the vegetations, and decreasing risk of septic emboli.

- **Note:** Antibiotic prophylaxis before procedures aims at decreasing the risk of endocarditis. Amoxicillin (2 g) is given orally to any patient with heart murmur at least 1 h before most procedures. Clindamycin or azithromycin are given in case of a penicillin allergy.

### Hypertrophic Obstructive Cardiomyopathy (HOCM)

- **Mechanism:** Familial disease (AD) characterized by disproportionate thickening of the interventricular septum leading to subaortic stenosis, hence also known as Idiopathic Hypertrophic Subaortic Stenosis (IHSS).

- **Clinical picture:**
  1. Syncope or sudden death on exertion, so always think of this in USMLE for a young patient who suddenly collapsed during exercise.
  2. Aortic stenosis murmur, which is decreased by anything that increases the venous return, e.g., squatting, laying supine, hand grip etc....

- **Complications:** Fatal arrhythmia, e.g., Ventricular fibrillation

- **On exam:** Pulsus bisferious.

- **Diagnosis:** Echocardiogram.

- **Treatment:** Beta blockers and vasodilators. An implantable cardioverter defibrillator (AICD) is also indicated for any patient with HOCM.

- **Contraindication:** Inotropic agents, e.g., Digoxin.

- **What to advise your HOCM patient:** All family members should be evaluated for HOCM.

### Coarctation of the Aorta

- **Types:**
  1. Preductal: Proximal to the origin of the left subclavian artery origin; usually associated with patent ductus arteriosus.
  2. Postductal: More common, and is distal to the origin of the left subclavian artery origin. Clinically there is higher flow and pressure into the upper half of the body, and lower flow into the lower half, and blood takes a detour through the intercostal arteries to be able to reach the superior epigastric. This leads to dilated intercostal arteries and rib notching mainly posteriorly, which is pathognomonic for this disease.

- **Clinical picture:**
  1. Significant difference between blood pressure in the upper and lower extremities.
  2. Systolic murmur over the left 3rd interscapular area, along with machinery murmur over the collaterals.

- **A common finding in coarctation of aorta is bicuspid aortic valve, and you can easily hear the systolic ejection click on the apex.**

- **Diagnosis:** Aortography is diagnostic. Rib notching on chest X-ray can be seen.

- **Treatment:** Surgical correction.

- **Note:** Think about coarctation in any case presenting with Turner syndrome.

### Aortic Dissection

- **Clinical picture:**
  1. Chest pain radiating to the back mainly in-between the scapulae.
  2. Significant difference between the blood pressure readings of left and right upper extremities.

- **Diagnosis:**
  1. CXR: Wide mediastinum is suggestive of dissection.
2. Diagnosis is confirmed by:
   - Gold standard: Aortography.
   - Emergency situations: Trans-esophageal Echocardiogram.
   - Non-emergency situations: MRI.
   - Practically: Spiral CT of the chest.

Treatment:
2. Dissection of descending aorta: Medically, by lowering blood pressure using beta-blockers as drug of choice. Avoid inotropic agents and vasodilators (e.g.: Nitroprusside) without initial beta blockade, as this will worsen the dissection.

Aortic Aneurysm
- **Introduction:** Aortic arch aneurysm can compress on the trachea if it was huge and the pulsations could be felt at the sternal notch, however most aortic aneurysms are below the level of renal arteries, and are secondary to atherosclerosis and HTN. Abdominal Aortic Aneurysm (AAA) is discussed below.
- **Clinical picture:** Abdominal pain radiating to the back.
- **On exam:** Pulsatile abdominal mass.
- **Diagnosis:** Aortography or ultrasound of the abdomen.
- **Treatment:** Abdominal aortic aneurysm is treated surgically only if they exceed 5 cm in diameter (or 6 cm in thoracic ones). If smaller, you only need to control risk factors and follow up by ultrasound every 6 months.
- **Note:** True aneurysms are formed of intima, media and adventitia, while false ones are formed only of adventitia.

Arrhythmias

**Sinus Tachycardia**
- **Definition:** Regular, HR >100, caused by exercise, fever or anxiety.
- **Treatment:** treat the cause.

**Supraventricular Tachycardia (SVT)**
- **Definition:** Regular, HR>100, caused by exercise, fever or anxiety.
- **EKG:** Deformed P waves and short PR intervals. Refer to Fig. 1.31.
- **Treatment:** IV Adenosine and treat the cause.

**Ventricular Tachycardia**
- **Definition:** Regular, A-V dissociation present, caused by fluid shifts and ischemic heart disease.
- **EKG:** Wide complex tachycardia. Refer to Fig. 1.32.
- **Signs:** Cannon neck vein waves.
- **Treatment:** DC cardioversion is the first step, followed by epinephrine, amiodarone and lidocaine.
- **Note:** Torsades de Pointe is a multifocal V. tach.-treated as above plus magnesium sulfate and overdrive pacing.
Atrial Flutter

- **Definition:** Regular, HR > 100 (Atrial rate = 300–400).
- **EKG:** Saw-tooth appearance. Refer to Fig. 1.33.
- **Signs:** Neck vein pulsations > Radial pulsations.
- **Treatment:** Rate control, e.g., Digoxin, Beta blockers or CCB, and anticoagulation with warfarin for an INR target of 2–3.

Atrial Fibrillation

- **Definition:** Irregularly irregular, HR > 100.
- **Causes:** Ischemic heart disease, thyrotoxicosis, pulmonary embolism or in most cases without any cause (Lone A. Fib.).
- **Signs:** Absent neck (a) waves, and pulsus deficit of more than 10/min.
- **EKG:** Irregularly irregular, absent P waves. Refer to Fig. 1.34.
- **Complication:** Left atrial thrombus, which might embolize and cause CVA.
- **Treatment:** Rate control, e.g., Digoxin, Beta blockers or CCB, and anticoagulation with warfarin for an INR target of 2–3. DC cardioversion is done only if the patient is hemodynamically unstable.

Extrasystole

- **Definition:** Regularly irregular, HR variable.
- **Signs:** Pulsus deficit < 10/min and normal neck vein waves.
- **Treatment:** No need to treat unless they are ventricular or multifocal, then beta blockers or CCB are warranted.

Wolff Parkinson White (WPW) Syndrome

- **Mechanism:** Premature atrial or ventricular contraction leading to re-entrant tachycardia that follows an accessory pathway (Wolff Parkinson White bundle).
- **Clinical picture:** Recurrent dizziness episodes mostly in young adults.
- **EKG:** Short P-R and slurred upstroke (J wave) before QRS complex.
- **Treatment:** Radiofrequency ablation of the accessory tract.

Heart Block

- **1st degree:** PR interval of more than 0.21 seconds without any dropped beats.
- **2nd degree:** Divided into 2 different types:
1. Mobitz I (Wenckbach): Increasingly prolonged PR followed by a dropped QRS. Refer to Fig. 1.35.
2. Mobitz II: Dropped QRS without any preceding PR prolongation. Refer to Fig. 1.36.

- **3rd degree**: Complete AV dissociation with *cannon neck vein* (a) waves. Refer to Fig. 1.37.

**Treatment:**

1. 1st degree: Adjust medications and watch closely
2. 2nd and 3rd degrees: Atropine and pacemaker placement. *Remember: Pacing is also needed in Torsades de Pointe and Left bundle branch block.*
**Ventricular Fibrillation**
- **Definition**: Emergency, caused by electrolyte imbalance or ischemic heart disease.
- **EKG**: Broad bizarre irregular fine waves. Refer to Fig. 1.38.
- **Treatment**: Similar to V. tach.

**Pulseless Electrical Activity (PEA)**
- **Definition**: Formerly known as Electro-mechanical Dissociation (EMD).
- **Causes**: Pneumothorax or cardiac tamponade.
- **Diagnosis**: Normal electrical activity on the monitor with absent pulses on exam.
- **Treatment**: IV fluids, epinephrine and atropine. DC cardioversion is contraindicated.

**Hypothermic Arrhythmia**
- **EKG**: Osbourne (J) waves and ventricular fibrillation.
- **Note**: Other complications of hypothermia include rhabdomyolysis and pontine myelinolysis.

**Asystole**
- **Known as Flat line**, caused by hypotension or electrolyte imbalance or ischemic heart disease. **Treatment**: Similar to PEA.

**Shock**
- **Definition**: Systolic blood pressure below 90, or mean arterial pressure below 60.
- **Pathophysiology**:
  1. **Compensated stage**: Contraction of pre-capillary sphincters to maintain circulation.
  2. **Cell distress stage**: Anaerobic metabolism due to opening of A-V shunts.
  3. ** Decompensated stage**: Contraction of post-capillary sphincters and relaxation of pre-capillary ones, leading to capillary sludge and DIC.
- **Types**: Refer to Table 1.10 for defining parameters obtained through Swan-Ganz catheter placed through the internal jugular vein into the pulmonary artery.
- **Treatment**:
  1. **Hypovolemic**, e.g., Dehydration, bleeding: Aggressive hydration ± vasopressors and treat the cause.
  2. **Distributive**, e.g., Septic: Aggressive hydration and antibiotics ± vasopressors (Septic shock has 2 phases: Warm shock with cutaneous vasodilation, followed by Cold shock with diffuse vasoconstriction).
3. **Cardiogenic**, e.g., MI: Dobutamine infusion and treat cause. Do not give too much fluids in this type of shock.

4. **Obstructive**, e.g., Pulmonary embolism, pneumothorax: Treat the cause + Hydration ± vasopressors.

### Dyslipidemia

**Goal:**
1. Total cholesterol below 200 mg/dl.
2. Triglycerides below 150 mg/dl.

3. LDL below 160 mg/dl if no risk factors, below 130 if up to 2 risk factors, and below 70 if 3 or more risk factors and/or CAD.

4. HDL above 40 mg/dl in males, and above 50 in females.

- Refer to Table 1.11 for details on medications.

### Neurology

#### Cerebral Cortex (refer to Fig. 1.39)

**Frontal Lobe**

- **Areas 4, 6:** Injury causes *contralateral spastic paresis*.

### Table 1.10 Types and Swan-Ganz parameters of all 4 types of shock. PCWP: Pulmonary capillary wedge pressure. SVR: Systemic vascular resistance. CO: Cardiac output.

<table>
<thead>
<tr>
<th>Type</th>
<th>PCWP</th>
<th>SVR</th>
<th>CO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypovolemic</td>
<td>Low</td>
<td>High or normal</td>
<td>Low</td>
</tr>
<tr>
<td>Distributive</td>
<td>High or normal</td>
<td>Low</td>
<td>High initially then low</td>
</tr>
<tr>
<td>Cardiogenic</td>
<td>High or normal</td>
<td>High or normal</td>
<td>Very low</td>
</tr>
<tr>
<td>Obstructive</td>
<td>High or normal</td>
<td>High or normal</td>
<td>Low</td>
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</tbody>
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### Table 1.11 Cholesterol lowering medications.

<table>
<thead>
<tr>
<th>Class</th>
<th>Examples</th>
<th>Mechanism</th>
<th>Indications</th>
<th>Side effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statins</td>
<td>Atorvastatin</td>
<td>Inhibit HMG-coA reductase enzyme, which normally converts HMG-coA to</td>
<td>• High total cholesterol</td>
<td>• Elevated liver enzymes</td>
</tr>
<tr>
<td></td>
<td>Simvastatin</td>
<td>mevalonic acid</td>
<td>• High LDL</td>
<td>• Myositis; patient presents with muscle aches and elevated serum creatine</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>phosphokinase CPK</td>
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<tr>
<td>Fibrates</td>
<td>Clofibrate</td>
<td>• Stimulate lipoprotein lipase enzyme</td>
<td>• High TG</td>
<td>• Cholesterol gall stones</td>
</tr>
<tr>
<td></td>
<td>Gemfibrozil</td>
<td>• Stimulate cholesterol excretion in bile and stools</td>
<td>• Type III dyslipidemia</td>
<td>• Malignancy; especially due to Clofibrate</td>
</tr>
<tr>
<td>Bile acid</td>
<td>Cholestyramine</td>
<td>Inhibit enterohepatic circulation, so the liver uptakes LDL and</td>
<td>• Type II dyslipidemia</td>
<td>• Deficiency of fat soluble vitamins: A, D, E and K</td>
</tr>
<tr>
<td>sequestrants</td>
<td>Colestipol</td>
<td>cholesterol from circulation to synthesize bile</td>
<td>• Itching in obstructive jaundice</td>
<td>• Flushing and pruritis: prevented by taking an aspirin half hour before each</td>
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<tr>
<td>Niacin</td>
<td>Niacin</td>
<td>Inhibit triglyceride lipolysis in adipose tissue</td>
<td>• Low HDL</td>
<td>• Hyperuricemia</td>
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<td></td>
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<td>• Type IIb dyslipidemia</td>
<td>• Hyperglycemia</td>
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<tr>
<td>Probucol</td>
<td>Probucol</td>
<td>Inhibit oxidation of cholesterol and LDL, thus prevent foam cell</td>
<td>• Atherosclerosis</td>
<td>• Probucol prolongs Q-T interval</td>
</tr>
<tr>
<td></td>
<td></td>
<td>formation</td>
<td>• Type II dyslipidemia</td>
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</tbody>
</table>
Area 8: Injury causes ipsilateral eye deviation.
Areas 44, 45 (Inferior temporal gyrus): Injury causes expressive (a.k.a. Broca’s) aphasia, in which the patient understands but cannot articulate.
Areas 9, 10, 11, 12: Injury causes sphincter and gait disturbances.

Temporal Lobe
Areas 41, 42: Injury causes sensorineural hearing loss.
Area 22 (Superior temporal gyrus): Injury causes receptive (a.k.a. Wernicke’s) aphasia, in which the patient cannot understand language or symbols. The patient can articulate, but does not make any sense. That is why it is known as Fluent aphasia.
Anterior temporal lobe: Injury causes Kluver-Bucy syndrome, which presents with hypersexuality and hyperphagia.
Inferomedial occipitotemporal cortex: Injury causes prosopagnosia, where the patient cannot recognize faces.

Parietal Lobe
Sensory cortex areas 3, 1, 2: Injury causes contralateral hemihyperesthesia.
Superior parietal areas 5, 7: Injury causes contralateral sensory neglect.
Inferior parietal area: Injury causes Gerstmann syndrome, which is full of Dys, i.e., Dyslexia, Dysgraphia, Dyscalculia.

Occipital Lobe
Unilateral injury: Causes contralateral hemianopsia.
Bilateral injury: Causes complete blindness.

Alzheimer’s Disease
Introduction: Most common cause of dementia in the elderly, with multi-infarct dementia ranking second.
Mechanism: Decreased Choline Acetyltransferase (CAT) enzyme responsible for acetylcholine synthesis, and loss of cholinergic neurons in the forebrain.
Genetics: Abnormality in chromosomes 1, 14 and 21 has been suggested, also the presence of at least one copy of E4 gene on chromosome 19.
Clinical picture: Gradual steady dementia. Multi-infarct dementia is stepwise. In both cases, recent memory is the first thing to be affected, followed by language (Patient cannot find the words), and finally spatial ability (Deals with figures and perception of dimensions of objects).
CT head: Ventricular dilatation and cortical atrophy.
Pathology: Amyloid plaques, Hirano bodies and Neurofibrillary tangles. Also, degeneration of the nucleus of Meynert.
Treatment: Cholinesterase inhibitors, e.g., Donepezil.
Notes:
1. Pick’s disease: Another cause of dementia that affects the frontal and temporal lobes, and is well known for the intracytoplasmic inclusion bodies known as Pick bodies.
2. Normal pressure hydrocephalus: Another cause of dementia with the unique triad: Dementia, wide based ataxia and urinary incontinence.

**Glioblastoma Multiforme**

- **Introduction**: Most common primary brain tumor.
- **Pathologically**: Grade IV astrocytoma with poor prognosis. Pseudopalisading of cancer cells around a central area of hemorrhage and necrosis is seen on histology.
- **Clinical picture**: High intracranial pressure, i.e., Early morning headache, vomiting and blurry vision due to papilloedema.
- **Diagnosis**: CT or MRI of the brain shows a mass with necrotic center surrounded by edema. Also known as Butterfly glioma. Refer to Fig. 1.40.
- **Notes**:
  1. Brain tumors in adults are mainly supratentorial, with metastatic tumors being the most common brain tumor.
  2. Brain tumors in children are mainly infratentorial, with astrocytoma being the most common tumor.
  3. Metastatic brain tumors show a ring enhancement on the CT scan.

**Pseudotumor Cerebri**

- **Mechanism**: Elevated intracranial pressure without a space occupying lesion.

- **Age group**: Adolescent overweight females.
- **Causes**: Vitamin A toxicity, tetracyclines, steroid withdrawal and OCPs.
- **Clinical picture**: Early morning headache, vomiting and blurry vision due to papilloedema.
- **Diagnosis**: Diagnosis of exclusion, CT brain and LP are normal.
- **Complication**: Long-standing untreated cases can lead to permanent blindness.
- **Treatment**:
  1. Treat the cause.
  2. Steroids and acetazolamide: To decrease intracranial pressure.
  3. Resistant cases: Shunt operation.

**Cavernous Sinus Thrombosis**

- **Causes**: Progression of infection from the sinuses or the orbit.
- **Clinical picture**: Conjunctival congestion, with proptosis, fever, chills and ophthalmoplegia.
- **Treatment**: Antibiotics. Surgical drainage is reserved for resistant cases.
- **Note**: Always look for other clues in any patient with “Pink eye.”

**Meningitis**

- **Definition**: Infection of the meninges, whether by bacteria or viruses.
• **Cause:** Most common organisms differ with age and condition:
  1. **Newborn group:** Group B streptococcus.
  2. **Children:** Streptococcus pneumoniae.
  3. **Adults:** Neisseria meningitidis.
  4. **Elderly:** Streptococcus pneumoniae.
  5. **HIV patients:** Cryptococcus neoformans, a form of yeast with extracapsular halo, found in pigeon’s droppings, diagnosed by *india ink* staining and cultured on *Sabouraud agar*.

• **Clinical picture:**
  1. Fever, headache, photophobia, and neck stiffness.
  2. On exam: Stiff neck, positive Kerning’s and Brudzinski’s signs.

• **Diagnosis:** Lumbar puncture. *Agglutination test to detect soluble antigens in CSF* is the most sensitive and specific test to diagnose meningitis.
  1. CSF in bacterial meningitis would show high protein content, high pressure, high WBC count, and low glucose level.
  2. CSF in viral meningitis would show only high protein content, high pressure and high lymphocyte count with normal glucose level. *TB meningitis’ CSF will show the exact thing like viral’s CSF except that the glucose level will be very low.*

• **Complications:**
  1. Adrenal hemorrhage a.k.a. *Waterhouse-Friedrichson syndrome*, which could be seen as *Shell-like calcifications* on the X-ray.
  2. Encephalitis: Shown on EEG as *Sharp triphasic complexes*. Herpes encephalitis is unique in causing olfactory hallucinations and showing mononuclear pleocytosis and RBCs in the CSF.
  3. Fulminant meningococccemia: High fever, sepsis and purpura fulminans.

• **Treatment:**
  1. Drug of choice is *3rd generation cephalosporin* + Vancomycin.
  2. Treatment of *Cryptococcus neoformans*: Amphotericin B + Flucytosine.

• **Prophylaxis for close contacts:** Drug of choice is *Rifampicin*.

• **Notes:**
  1. **Oligodendrogliomas** arise from frontal lobes; slow growing tumors and very commonly show calcifications.
  2. *Psammoma bodies could be seen in (PMS): Papillary carcinoma of thyroid, Meningioma, Serous ovarian cyst.*

**Meningiomas**

• **Introduction:** Arise from the *arachnoid villi* of meninges: 90% of them are benign, and 90% are supratentorial.

• **Clinical picture:** Asymptomatic, or present with a focal deficit.

• **Diagnosis:** CT or MRI of the brain. Confirmation of diagnosis by biopsy.

• **Treatment:** Surgical only if symptomatic.

• **Pathological clue:** Suspect meningioma on the exam if a case is presented with intracranial hypertension along with *psammoma bodies*.

• **Notes:**
  1. **Oligodendrogliomas** arise from frontal lobes; slow growing tumors and very commonly show calcifications.
  2. *Psammoma bodies could be seen in (PMS): Papillary carcinoma of thyroid, Meningioma, Serous ovarian cyst.*

**Hydrocephalus**

• **Communicating:** Obstruction is in the *subarachnoid space*.

• **Non-communicating:** Obstruction is before the CSF reaches the subarachnoid space. There is an anatomical obstruction as follows:
  1. **Congenital aqueductal stenosis:** *X-linked hydrocephalus* causing dilatation of *lateral* and *third ventricles*. Refer to Fig. 1.41.

![Fig. 1.41](image-url)

**FIG. 1.41** Hydrocephalus secondary to obstruction of aqueduct of Sylvius by a tumor

• **Notes:**
  1. **TB meningitis** causes injury of cranial nerves *III, VI, VII* and *VIII* only.
  2. If you face a case in the exam with meningitis, along with extremely elevated amylase level with no clear abdominal source, think of *acute viral parotitis as the culprit.*
2. **Dandy-Walker deformity**: Obstruction in the foramina of Luschka and Magendie, which leads to dilatation of the 4th ventricle, along with an atrophied cerebellum and occipital meningocele. Refer to Fig. 1.42.

- **Remember**: If a hydrocephalus question mentions:
  1. Dilated third and lateral ventricles: Obstruction is at the aqueduct.
  2. Dilated 4th ventricle and normal 3rd and lateral ventricles: Dandy-Walker.

- **Normal pressure hydrocephalus**: Occurs due to failure of the arachnoid villi to absorb the CSF. Patients are usually elderly with a slow progression of symptoms or just had a recent traumatic brain injury and intracranial hemorrhage. They present with a triad of Dementia, Urinary incontinence and Ataxia.
- **Treatment of hydrocephalus**: Surgical placement of a shunt.

**Arnold-Chiari Malformation**

- **Mechanism**: Elongation of the cerebellum and medulla oblongata through the foramen magnum. Cranial nerves compressed are IX, X and XI.
- **Clinical picture**: Stridor, dysphagia, vocal cord paralysis and hydrocephalus. Arnold with big head who cannot talk, breathe or eat.
- **Treatment**: Surgical decompression and placement of a shunt.

**Cerebrovascular Accident (CVA) (refer to Fig. 1.43)**

- **Introduction**: Also known as stroke; this could be ischemic or hemorrhagic.
- **Risk factors**:
  1. Ischemic stroke is common in patients with arrhythmia, e.g., Atrial fibrillation.
  2. Hemorrhagic stroke is common in patients with head injury, e.g., Falls.
  3. Amyloid deposition in intracranial vessels of the elderly could be a risk factor.
- **Clinical picture**:
  1. **Middle Cerebral Artery (MCA) stroke**: Slurred speech, contralateral hemiplegia and hemihypoesthesia. Common with internal capsule (Lacunar) stroke. Note that MCA is the mother artery of lenticulostriate artery.
  2. **Anterior Cerebral Artery (ACA) stroke**: Contralateral hemiplegia and hemihypoesthesia, more pronounced in the lower extremity.
  3. **Posterior Cerebral Artery (PCA) stroke**: Contralateral homonymous hemianopia with macular sparing.
  4. **Vertebrobasilar stroke**: Vertigo, vertical nystagmus and incoordination signals suggestive of cerebellar injury, e.g., Ataxia, dysmetria (e.g., Finger to nose test), and intention tremors.
5. Right parietal lobe infarction: (Neglect syndrome) Patients have sensory neglect to left side of the body but move it normally; they also have visual field defects.

6. Left parietal lobe infarction: Patients have speech and language abnormalities.

- **Diagnosis:** CT of the head is diagnostic, but most ischemic cases won’t develop changes until after 48 h.
- **What to order:**
  1. Repeat CT head in 24–48 h.
  2. Carotid Doppler.
  3. Echocardiogram and EKG.
- **Treatment:** Never drop the blood pressure too quickly; it is usually high to maintain cerebral perfusion; *Cushing reflex* is hypertension and bradycardia.
  1. Ischemic cases: Thrombolytic therapy with tPA if patient presented within the first 3 h after onset of CVA. Other options include antiplatelet agents, e.g., aspirin, dipyridamole, Clopidogrel.
  2. Hemorrhagic cases: Treated conservatively unless hemorrhage is severe (e.g., *causing midline shift*), then surgical drainage is necessary.

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**Intracranial Hemorrhage**

- **Clinical picture:** Patient has trauma followed by headache, photophobia, nausea and vomiting.
- **Epidural:** Convex-shaped. Bleeding is from middle meningeal artery, which runs between the 2 roots of auriculotemporal nerve. Refer to Fig. 1.44.
- **Subdural:** Crescent-shaped and is the most common traumatic intracranial injury. Bleeding is from bridging superior cerebral veins. Refer to Fig. 1.45.
- **Subarachnoid:** Patient has the worst headache of his life and fundus exam might show retinal hemorrhage. Most common cause is trauma followed by rupture of an aneurysm, mostly in communicating arteries. Diagnosis: Lumbar puncture is the test of choice. CT head can also be used but it is less sensitive; refer to fig. 1.46.
- **Notes:**
  1. Anterior communicating artery connects the anterior cerebral arteries with each other. Injury (e.g., rupture of aneurysm): Subarachnoid hemorrhage and bitemporal lower quadrantanopia. The most common location of Berry aneurysms is the *at the bifurcation* of the anterior communicating artery.
  2. Posterior communicating artery connects the middle cerebral with posterior cerebral arteries. Injury:

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Subarachnoid hemorrhage and injury of third cranial nerve. Suspect in a patient presenting with the worst headache of his life plus ptosis and diplopia.

- **Note:** Any intracranial process causing midline shift, e.g., hemorrhage or mass, is managed using...
dexamethasone, diamox, mannitol and inducing a hyperventilation state if the patient is on mechanical ventilation.

**Concussion**
- **Mechanism:** Temporary loss of consciousness *due to failure of neurological signaling.*
- **Causes:** Mechanical brain injury, e.g., Car accident.
- **Phases:**
  2. Lucid interval: Full consciousness is regained, but a hematoma is building up.
  3. Compression: Due to the compressive effect of the hematoma.
- **Complication:** Recent memory loss; regained gradually over up to 6 months.
- **Diagnosis:** Clinical. *All radiology work up is normal.*
- **Treatment:** Conservative. Resolves spontaneously.

**Spina Bifida**
- **Mechanism:** Defect in the vertebral column that allows contents of spinal canal to herniate outside the body; common in the lumbar sacral spine area.
- **Prevention:** Folic acid supplementation during pregnancy.
  - *Screening:* Ultrasound (US) in the first trimester shows Lemon sign.
  - *Treatment:* Surgical.
  - **Notes:**
    1. Hypertrichosis in the lower lumbar area could be a sign of spina bifida occulta.
    2. If the same defect occurs in the back of the skull, it is called Encephalocele.

**Craniopharyngioma**
- **Introduction:** Most common cause of hypopituitarism in children.
- **Mechanism:** Remnant of Rathke’s pouch, resulting in an anterior pituitary tumor.
- **Clinical picture:**
  1. *Headache, nausea, vomiting* and *bitemporal hemianopia.*
  2. Growth hormone, ADH and gonadotrophin deficiency.
- **Treatment:** Excision of the tumor.

**Cerebellar Lesions**

**Cerebellar Anterior Vermis Syndrome**
- Common in *alcoholics.*
- **Clinical picture:** *Lower extremity incoordination.*

**Cerebellar Posterior Vermis Syndrome**
- Common in *children,* a classic cause is *medulloblastoma.*
- **Clinical picture:** *Truncal and upper extremity incoordination.*

**Cerebellar Tumors**
- Most *midline tumors are Medulloblastoma.*
- Most lateral ones are *Astrocytoma.*
- The most common brain tumors in children are *posterior fossa tumors,* mainly *infratentorial,* with *Astrocytoma* being the most common.
- **Clinical picture:** *Incoordination, ataxia, nystagmus and high intracranial pressure.*
- **Treatment:** Surgical resection and possibly radiation and chemotherapy.

**Hypothalamus Lesions**
- As a rule, the *posterior part of hypothalamus regulates the sympathetic system,* while the anterior part regulates the parasympathetic.
- Supraoptic nucleus regulates *ADH secretion.*
**Basal Ganglia Lesions**

**Parkinson’s Disease**

- **Mechanism:** Depletion of dopamine-producing neurons in the substantia nigra, interfering with the transmission of movement signals to the striatum.
- **Causes:** Combination of genetic and environmental factors. However, it could result from use of illegal drugs contaminated with MPTP (1-methyl-4-phenyl-1,2,3,6-tetrahydropyridine), or Metoclopramide.
- **Clinical picture:** (5R) main symptoms:
  1. Rigidity, mostly cogwheel.
  2. Resting tremors.
  3. Hyporeflexia or Areflexia.
  4. Bradykinesia.
  5. Others: Shuffling gait, mask face and Micrographia.
- **Microscopy:** Lewy bodies, and degeneration of substantia nigra.
- **Treatment:**
  1. Levodopa (L-dopa) plus carbidopa: It is the mainstay of treatment. L-dopa is preferred over dopamine as it is lipophilic and can easily cross the blood-brain barrier. Carbidopa is added as it decreases the peripheral effects and metabolism of L-dopa.
  2. Other drugs that can be used are newer dopamine agonists, anticholinergics (to decrease tremors) and MAO-B inhibitors.

**Huntington’s Chorea**

- **Mechanism:** Atrophy of the caudate nucleus and degeneration of its cholinergic and GABAergic neurons.
- **Genetics:** Inherited as an autosomal dominant disease on chromosome 4.
- **Clinical picture:** Dementia, hypotonia and choreoathetoid movements due to hyperactive N-Methyl D-Aspartate (NMDA) and glutamate.
- **Diagnosis:** Brain CT or MRI shows:
  1. Atrophy of frontal and temporal gyri and caudate nucleus.
  2. Dilated anterior horns of lateral ventricles.
- **Notes:**
  1. Chorea is sudden purposeless movements, while athetosis is slow, distal writhing movements.
  2. Huntington’s patients usually have low substance P levels in the CNS.
  3. If you see a case with chorea in the exam, look for these clues:
    - If the patient has rheumatic fever picture: Sydenham’s chorea.
    - If the patient is pregnant and in her 2nd trimester: Chorea gravidarum.
    - If the patient has a strong family history: Huntington’s chorea.

**Tardive Dyskinesia**

- **Definition:** Movement disorder in patients using antipsychotics or metoclopramide for an extended period of time.
- **Clinical picture:** Repetitive chorea-like movements of the face, tongue and neck.

**Hemiballismus**

- **Mechanism:** Vascular lesion injuring the subthalamic nuclei.
- **Clinical picture:** Sudden, aggressive flinging movements on the contralateral arm, i.e., Similar to swinging a baseball bat.

**Midbrain Lesions**

**Parinaud Syndrome (Dorsal)**

- **Most common cause is a pinealoma. Lesions may be located in various locations:**
1. Superior colliculi: Causes *paralysis of upward, downward and convergent gaze*.

2. Aqueduct of Sylvius: Causes *non-communicating hydrocephalus*.

**Benedikt Syndrome (Paramedian)**
- Ipsilateral oculomotor nerve palsy.
- Contralateral medial leminiscus injury.
- Contralateral cerebellar ataxia.

**Weber’s Syndrome (Medial)**
- Ipsilateral oculomotor nerve palsy.
- Contralateral corticospinal tract injury.
- Contralateral paralysis of face, tongue and palate.
- Patients classically present with their uvula directed *towards the unaffected side* plus symptoms of posterior cerebral artery injury.

**Pontine Lesions**

**Inferior Pontine Syndrome**
- Two distinct syndromes secondary to vascular compromise:
  1. *Medial*: Due to injury of *basilar artery*, affecting the corticospinal tract, medial leminiscus and abducens nerve (VI).
  2. *Lateral*: Due to injury of the *anterior inferior cerebellar artery*, causing an ipsilateral facial nerve lesion, and ipsilateral sensorineural hearing loss.

**Medial Longitudinal Fasciculus Syndrome (MLF)**
- Also known as *internuclear opthalmoplegia*.
- Pathognomonic sign of *multiple sclerosis*.
- Injures the nerve fibers between the abducens and oculomotor nerve.
- Patients have a palsy of the *medial rectus muscle* along with *nystagmus*.

**Pontine Hemorrhage**
- Due to an injury of *basilar or cerebellar arteries*.
- Clinical picture: *Unilateral facial and contralateral body paralysis*.
- *Pinpoint pupils are observed if bleeding is severe. This is a common case in USMLE, so remember that pontine hemorrhage causes pinpoint pupils.*

**Medullary Lesions**

**Medial Medullary Syndrome**
- Due to injury of the *anterior spinal artery*. Affected areas include:

**Wallenburg Syndrome (Lateral)**
- Due to an injury of the *posterior inferior cerebellar artery*. Affected areas include:
  1. *Nuclei of cranial nerves IX, X and XI*: Causing dysphagia, dysarthria, dysphonia and loss of the gag and cough reflexes.
  3. *Trigeminothalamic tract*: Causing ipsilateral loss of pain and temperature sensations from the face.
  4. *Lateral spinothalamic tract*: Causing contralateral loss of pain and temperature sensations from the body.
  5. *Vestibular nuclei*: Causing vertigo and nystagmus.

**Tracts and Injuries**

**Dorsal Column**
- Composition: *Gracile fibers from lower limbs and cuneate fibers from upper limbs*.
- Function: Transmits *fine touch and proprioception* from the limbs.
- Course: Fibers ascend in the dorsal column and decussate in the medulla forming the *medial leminiscus*, and end in *Brodmann areas 1, 2 and 3*.
- Injury:
  1. Below decussation: Loss of fine touch and proprioception from the same side of the body.
  2. Above decussation: Loss of fine touch and proprioception from the contralateral side of the body.
Lateral Spinothalamic Tract
- Function: Transmits pain and temperature sensations from the body.
- Receptors: Fast A and slow C fibers.
- Course: Fibers run in the Lissauer tract then decussate in the anterior white commissure at the same level they enter the cord. Fibers ascend in the lateral funiculus and end in Brodmann’s area 1, 2, and 3.
- Injury: Contralateral loss of pain and temperature sensations.

Anterior Spinothalamic Tract
- Function: Transmits deep touch and pressure sensations from the body.
- Injury: Contralateral loss of deep touch and pressure sensations.

Lateral Corticospinal Tract
- Function: Transmits voluntary motor signals.
- Course: Fibers arise from the cerebral cortex and decussate in the medulla.
- Injury: Spastic paresis.
- Note: This tract is characterized by delayed myelination. Myelination is not completed until 2 years of age.

Hypothalamospinal Tract
- Course: Runs from the hypothalamus to the intermediolateral column of the spinal cord.
- Injury: Ipsilateral Horner’s syndrome.
- Spinocerebellar tract: Transmits proprioception from the muscles and joints.
- Ventral trigeminothalamic tract: Transmits pain and temperature from the face.
- Dorsal trigeminothalamic tract: Transmits touch and pressure from the face.

Spinal Cord Lesions (Refer to Fig. 1.47)

Introduction
- Upper motor neuron lesions (UMNL) cause hypertonia and hyperreflexia.
- Lower motor neuron lesions (LMNL) cause hypotonia, hyporeflexia and fasciculations.
- Spinal cord injury above C3 may cause quadriplegia.
- Systemic steroids given in the first 10 hours after spinal cord injury help minimize damage.
- Spinal cord tumors include astrocytomas, meningiomas, and metastatic cancers.

Multiple Sclerosis (MS)
- Introduction: Demyelinating disease affecting the brain and spinal cord. It is most common in females 20–40 years of age.
- Clinical picture: Suspect MS in a young woman presenting with nonspecific limb weakness and visual deficits due to optic neuritis or internuclear ophthalmoplegia.
- Diagnosis:
  1. MRI of brain which shows periventricular white matter plaques. Refer to Fig. 1.48.
  2. CSF: High IgG level.
- Treatment: Systemic corticosteroids.
- Prophylaxis: Beta-interferon.

Poliomyelitis
- Cause: Polio virus, transmitted feco-orally and replicates in the oropharynx.
- Mechanism: LMNL, due to injury of the anterior grey horn.
- Clinical picture: Hypotonia, hyporeflexia, muscle wasting and fasciculation.
- Diagnosis:
  1. Isolation of polio virus from oropharynx or stools.
  2. CSF shows lymphocytosis and elevated protein count.
Amyotrophic Lateral Sclerosis (ALS)
- **Mechanism**: Also known as Lou Gehrig disease. Due to combined UMNL and LMNL. Affects the anterior grey horn and the corticospinal tracts.
- **Clinical picture**: Asymmetrical limb weakness and combination of signs of UMNL (Hypertonia, hyperreflexia, Babinski sign) and LMNL (Hypotonia, hyporeflexia, fasciculation).

Tabes Dorsalis
- **Mechanism**: Dorsal column damage due to untreated syphilis.
- **Clinical picture**: Loss of proprioception and vibration sensations along with electric like pains in the upper and lower extremities.
- **Clinical picture**: Ataxia and positive Romberg sign (Inability of the patient to maintain an upright posture with his eyes closed without swaying or falling over).
- **Note**: Tabetic crisis patients present with abdominal pain and bladder dysfunction.

Brown Sequard Syndrome
- **Mechanism**: Hemisection of the spinal cord.
- **Clinical picture**: 1. Ipsilateral: Flaccid paralysis and Horner’s syndrome.
   2. Contralateral: Loss of pain and temperature sensations.

Anterior Spinal Artery Occlusion
- **Introduction**: Common in Abdominal aortic aneurysm surgeries.
- **Clinical picture**: 1. Flaccid paralysis and loss of pain and temperature bilaterally below the lesion.
   2. Bilateral Horner’s syndrome.

Subacute Combined Degeneration (SCD)
- **Mechanism**: Affects the dorsal and lateral columns, secondary to vitamin B12 deficiency.
- **Clinical picture**: Ataxia, loss of proprioception and loss of vibration sense in a stocking/glove distribution.
- **Note**: Presents in the USMLE as a patient with lower extremity neurological manifestations along with high Mean corpuscular volume (MCV) and Mean corpuscular hemoglobin (MCH) (Suggesting B12 def.)

Syringomyelia
- **Mechanism**: Central cavitation of the cord which injures the anterior grey horns, and the anterior white commissure.
- **Clinical picture**: Bilateral hand and arms weakness, along with loss of pain and temperature sensation in both hands.

Guillain Barre Syndrome
- **Mechanism**: Ascending LMNL that affects facial muscles in 50% of cases. Most common pathogen associated with this syndrome is Campylobacter jejuni.
- **Clinical picture**: Recent flu like illness, followed by lower limb weakness, progressing proximally.
- **Diagnosis**: CSF: Abnormally high protein count with normal cell count.
- **Treatment**: Plasmapharesis.

Cranial Nerves
1. **Olfactory nerve**
   - Originates from the olfactory bulb and ascends through the cribriform plate of the ethmoid bone. Terminates in the olfactory cortex of the uncus (area 34).
- Lesion: Ipsilateral anosmia.
- Lesion in the uncus: Olfactory hallucinations.

**II: Optic nerve**

- Embryologically derived from the diencephalon, and is made of the axons of ganglion cells.
- Pupillary light reflex begins with light stimulating the retina \(\rightarrow\) Optic nerve \(\rightarrow\) Pretectum \(\rightarrow\) Edinger-Westphal nucleus \(\rightarrow\) Ciliary ganglion \(\rightarrow\) Pupils. Refer to Figs. 1.49 and 1.50.
- Pupil *constricts with light and dilates in dark*. This process is mediated by the ciliospinal center of Budge.
- *Argyl Robertson pupil*: Pupil that accommodates to near vision but cannot react to light. Common in patients with syphilis.
- *Papilledema*: Occurs with high intracranial pressure and patients present with blind spots and a normal visual acuity. Refer to Fig. 1.51.
- Uncal herniation causes bilateral dilated fixed pupils.

**III: Oculomotor nerve**

- Motor nerve to eye muscles.
- Supplies all the oculomotor muscles except:
  1. *Superior oblique* muscle: Innervated by cranial nerve IV. (SO4)

- Refer to Fig. 1.52 for actions of the oculomotor muscles.

**IV: Trochlear nerve**

- Action: Innervates the *superior oblique* muscle.
- Injury: Weak downward gaze and vertical diplopia.

**V: Trigeminal nerve**

- Motor: Supplies the *muscules of mastication*.
- Sensory: Supplies *face, mouth, and supratentorial dura*.
- Trigeminal nerve has three divisions:
  1. *Ophthalmic (V1)*: Passes through *superior orbital fissure*.
  2. *Maxillary (V2)*: Passes through *foramen rotandum*.
  3. *Mandibular (V3)*: Passes through *foramen ovale*.
- Injury: Hemianesthesia of the face along with weak mastication. Patient’s jaw will deviate towards the paralyzed side due to unopposed action of lateral pterygoid muscle on the healthy side.
- *Trigeminal neuralgia (Tic douloureux)*: Sharp stabbing pain along the distribution of trigeminal nerve. Treatment: Carbamazepine.

**VI: Abducens nerve**

- Action: Innervates the *lateral rectus* muscle.
- Injury: *Convergent strabismus* and *horizontal diplopia*.

---

**FIG. 1.49 Visual pathway injuries**
**VII: Facial nerve**

- **Motor:** Innervates *muscles of facial expression*.
- **Taste:** *Anterior two thirds of the tongue*.
- Relays in the superior olivary nucleus; hence also supplies the *lacrimal* and *submandibular salivary glands*.

**Clinical picture of injury:**

1. Facial droop and loss of the nasolabial fold on the affected side.
2. Inability to *show teeth, blow cheeks, raise eyebrows* or *close eyes tightly*.

- Division of facial nerve to upper face receive bilateral corticobulbar fibers, while the division to the
lower face receive only contralateral corticobulbar fibers, so:

1. **UMNL**: Weakness of the contralateral lower face (Forehead spared).
2. **LMNL** (Bell’s palsy): Weakness of the ipsilateral upper and lower face (Forehead affected).

**VIII: Vestibulocochlear nerve**

- **Action**: Vestibular portion regulates balance and the cochlear controls hearing.
- **Pathways**:
  1. Hair cells in the inner ear relay signals to the vestibular ganglion and nuclei.
  2. Bipolar cells of cochlea relay signals to the superior olivary nucleus, medial geniculate body (MGB), and finally to the auditory cortex (Areas 41, 42) in the temporo-lateral sulcus.

- **Injury to the vestibular branch**: Vertigo and nystagmus.
- **Injury to the cochlear branch**: Tinnitus and sensorineural hearing loss.
- **Horizontal nystagmus may be either**:
  1. Vestibular: Fast phase is in the same direction.
  2. Post-rotatory: Fast phase is in the opposite direction.
  3. Caloric: Eyes deviate toward the warm water and away from cold water in the ear canal.

**Deafness**

- **Conductive hearing loss**: Caused by obstruction in the auditory canals, e.g., Cholesteatoma in middle ear or atresia of the auditory canal.
- **Sensorineural hearing loss**: Caused by injury to the auditory neurological pathway, e.g., Congenital rubella infection during the 8th week of pregnancy.
- **Weber test**: Place a tuning fork on the forehead. Vibration is louder in the ear with conductive hearing loss, and is diminished in the one with sensorineural hearing loss.
- **Rinne test**: Moving a tuning fork from the mastoid process to in front of the external auditory meatus. The sound is louder on the mastoid in conductive cases, and is louder in front of the ear in normal and sensorineural hearing loss cases.
- **Acoustic neuroma**: Schwann cell tumor arising from the vestibulocochlear nerve at the cerebellopontine angle. May compress cranial nerves V and VII. The tumor is benign and patients present with worsening hearing loss and tinnitus. Diagnosed by MRI and treated surgically.

**IX: Glossopharyngeal nerve**

- **Functions**:
  1. Sensory: Taste and sensory to the posterior one third of the tongue.
  2. Innervates the parotid glands.
  3. Carries input from the carotid sinus (baroreceptor) and the carotid body (chemoreceptor).

- **Injury**:
  1. Loss of taste and sensation from posterior one third of the tongue.
  2. Loss of gag reflex.
  3. Carotid hypersensitivity causing syncope.

- **Glossopharyngeal neuralgia** is a condition similar to trigeminal neuralgia.

**X: Vagus nerve**

- **The main parasympathetic supply to the human body**.
- **Injury**: Paralysis of the soft palate, pharynx and larynx. Could be fatal.
- **Clinical picture**: Dysphagia, hoarseness of voice and loss of cough and gag reflexes. The uvula deviates towards the paralyzed side.

**XI: Accessory nerve**

- **Innervates the sternocleidomastoid and trapezius muscles**.
- **Injury**:
  1. Shoulder drop: Due to a paralyzed trapezius.
  2. Neck looking toward the side of the lesion: Due to the unopposed action of the contralateral sternocleidomastoid.

**XII: Hypoglossal nerve**

- **Innervates all the tongue muscles except the palatoglossus, which is innervated by vagus nerve**.
- **Injury**: Tongue deviates toward the paralyzed side due to unopposed action of the contralateral genioglossus muscle.

**Seizures**

- **Types**:
  1. Seizures can present in different forms, e.g., Grand mal, Absence, Myoclonic, status epilepticus or febrile convulsions.
  2. Seizures are either partial affecting a localized part of the body, or generalized affecting the whole body at the same time.
3. Seizures could also be simple or complex. The only and main difference is that complex seizures, unlike simple ones, are associated with altered or loss of consciousness.

- **Clinical picture:**
  1. **Grand mal seizures:** Starts with generalized increased muscle tone (Tonic phase), followed by generalized convulsions (Clonic phase) during which loss of control over bowel and bladder, and tongue biting might occur. The last stage is postictal phase, during which the patient is lethargic and confused.
  2. **Absence seizures:** Patient presents with episodes of staring spells, during which he/she continuously performs repeated movement, e.g., smacking lips, mumbling. EEG: 3-Hz spike and wave pattern on EEG.
  3. **Temporal lobe seizures:** Preceded by olfactory hallucinations due to uncus stimulation.
  4. **Benign Rolandic epilepsy:** Manifests as muscle twitching and is common in school age children.

  Seizures are followed by postictal state (confusion), and sometimes transient paralysis (Todd’s paralysis).

- **Diagnosis:** EEG. MRI of the brain is also needed to rule out organic causes.
- **Most common cause of seizures in children:** Infection (Febrile seizures).
- **Most common cause of seizures in adults:** Head trauma.
- **Most common cause of seizures in elderly:** Cerebrovascular accident.

- **Treatment:**
  1. Grand mal seizures: Phenytoin (Side effects: Megaloblastic anemia, Gingival hyperplasia), or carbamazepine (Side effects: Bone marrow depression and hepatotoxicity).
  2. Absence seizures: Ethosuximide (Side effect: Steven’s Johnson syndrome) or valproic acid.
  4. Febrile seizures: Phenobarbitone (Side effect: Morbilliform rash).
  5. Status epilepticus: Diazepam first, then Fosphenytoin.

- **Diagnosis:** Edrophonium test (Tensilon test) and EMG are diagnostic.
- **Treatment:** Cholinesterase inhibitors, e.g. pyridostigmine, neostigmine.
- **Note:** Eaton Lambert syndrome is a paraneoplastic syndrome that occurs due to antibodies against calcium channels. It stands as the mirror image of myasthenia gravis as patients have similar symptoms, but both the symptoms and the EMG – unlike M.Gravis- get better by exertion.

**Muscular Disorders**

**Myasthenia Gravis**

- **Mechanism:** Antibodies against acetylcholine or its receptors in the muscles, linked to HLA-DR3. Some cases are associated with a thymus tumor.
- **Clinical picture:** Muscle weakness and diplopia, worse later in the day.

- **Introduction:** Lower motor neuron lesion (LMNL).
- **Clinical picture:**
  1. Generalized symmetrical hypotonia, hyporeflexia, hypotonia...
  2. Tongue fasciculations.
- **Note:** Polio also causes LMNL, but unlike Werdnig-Hoffmann, polio is asymmetrical and there is no sensory loss.

**Disc Prolapse**

- **Cause:** Herniation of the nucleus pulposus due to trauma or degeneration of annulus fibrosus.
- **Clinical picture:**
  1. Radicular back pain shooting down the affected extremity, e.g., Neck pain radiating down one arm, or low back pain radiating down one leg.
  2. Posterior prolapse of the disc causes spinal stenosis or cauda equina syndrome. The latter is an emergency that presents with tingling and numbness below level of lesion, saddle hypoesthesia and bowel/bladder incontinence.

- **On exam:** Positive straight leg raising test. The test is done with the patient laying in supine position; raise each leg separately from the table; test is positive if the patient develops radicular pain (explained above) upon leg raising. (Remember, radicular pain, not lower back pain or pain in the back of the thigh).
- **Diagnosis:** MRI of the spine.
- **Treatment:**
  1. NSAIDs and physical therapy: Best next step.
  2. Surgery, e.g., Discectomy or laminectomy: Last resort unless there are signs of severe compression, e.g., weakness and muscle atrophy.

**Carpal Tunnel Syndrome**

- **Mechanism:** Median nerve compression under the flexor retinaculum.
Causes: Pregnancy, RA or occupational, e.g., Computer work, drilling.
Clinical picture: Hand weakness and numbness, more at night, exacerbated by flexion of the wrist and alleviated by dangling the hand in a dependant position.

On exam:
1. Atrophy of thenar muscles.
2. Tinel sign: Tapping of peroneus longus tendon reproduce symptoms.
3. Phalen test: Dorsal sides of both wrists are approximated to achieve at least a 90° wrist flexion; this reproduces the symptoms.

Diagnosis: Clinically, however, confirmation is via nerve conduction studies.

Treatment: Wrist splints. Surgery is the last resort.

Migraine
Clinical picture: Unilateral throbbing headache associated with photosensitivity and nausea, more common in females, and usually preceded with an aura of light flashes.
Physiology: Serotonin levels are elevated during the aura, and they drop as headache worsens.

Prophylaxis (Chronic cases): Beta blockers, e.g., Propranolol or Methysergide; however the latter carries the risk of causing retroperitoneal fibrosis.

Treatment (Acute): Sumatriptan (5HT-1D agonist) or Ergotamine.

Note: Cluster headache occurs in clusters, each lasting few days at a time. Patients have headache behind a red inflammed eye, lacrimation and rhinorrhea. Treatment: 100% O₂.

Nerve Injuries

Injury of Upper Trunk of Brachial Plexus
Aka Erb’s palsy or waiter’s tip deformity.
Patient arm is adducted, extended, pronated, and medially rotated.

Injury of Lower Trunk of Brachial Plexus
A.k.a. Klumpke paralysis.
Patient presents with loss of motor power and sensation over the medial three and half fingers of the injured hand.

Radial Nerve Injury
Common in midshaft humerus fractures.
Motor: Patient presents with inability to extend his wrist and fingers, hence wrist drop ensues.

Sensory: Loss of sensation over the dorsum of the hand.

Ulnar Nerve Injury
Commonly due to compression at the elbow or wrist.
Motor: Paralysis of interossei and medial 2 lumbricals, causing claw hand deformity.
Sensory: Loss of sensation along the medial third of the hand.

Note: Palmar interossei adduct fingers PAD, while dorsal ones abduct fingers DAB.

Median Nerve Injury
Common in wrist injury, as it lies deep to flexor retinaculum.
Motor: Paralysis of opponens pollicis and flexor digitorum superficialis causing wasting of thenar eminence, and pointing index; which does not flex when making a fist. This deformity is known as Ape hand.
Sensory: Loss of sensation over the lateral two thirds of the palm.

Note: Flexor digitorum superficialis controls the PIP joints, while flexor digitorum profundus controls the DIP joints.

Axillary Nerve Injury
Commonly injured in fractures of the surgical neck of the humerus and anterior displacement of humeral head.

Two muscles suffer paralysis:
1. Deltoid: Leading to adduction of the arm.
2. Teres minor: Leading to medial rotation of the arm.

Common Peroneal Nerve Injury
Common in upper fibular fractures.

Clinical picture:
1. Decreased sensation over lateral leg and foot.
2. Impaired dorsiflexion and eversion of the foot.

Keywords for Nerve Injuries
Loss of knee reflex: Femoral nerve injury.
Waddling gait: Superior gluteal nerve injury.
Loss of plantar flexion of the foot: Tibial nerve injury (L4-S3).
Loss of dorsiflexion (Foot drop): Common peroneal nerve injury (L4-S2).
Ophthalmology

- **Macular degeneration**: Most common cause of blindness in the elderly. Patient presents with gradual painless loss of vision. Treatment: Laser photocoagulation.
- **Central retinal artery occlusion (CRA)**: Patients present with sudden unilateral painless blindness. Retinal exam: Cherry rod fovea. Treatment: Thrombolytics.
- **Central retinal vein occlusion (CRV)**: Presents in the same way as CRA occlusion. Retinal exam: Retinal hemorrhage and exudates. Treatment: Laser photocoagulation.
- **Ischemic optic neuropathy**: Occurs due to involvement of posterior ciliary artery. Common in cases of giant cell arteritis.
- **Hollen Horst plaques**: Retinal plaques that occur mostly due to embolization.
- **Chemical burns**: Emergency, alkaline is more dangerous than acidic. Treatment: Irrigation with water or saline is the first thing to do.
- **Superficial corneal foreign bodies**: Removed by irrigation or by a sterile cotton swab in the office after applying topical anesthetic eye drops. Intraocular foreign body is a contraindication to MRI and to any superficial manipulation of the eye.
- **Open angle glaucoma**: Patient presents with gradual loss of peripheral vision with an end result of complete blindness.
- **Closed angle glaucoma**: Ophthalmological emergency. Patient presents with sudden severe eye pain, halos around light, nausea and vomiting. Urgent treatment: Topical Pilocarpine, Topical Timolol and systemic Acetazolamide.
- **Treatment of glaucoma**: Achieved by 2 mechanisms as described below:
  1. Decrease aqueous humor synthesis.
     - Diuretics: Mainly carbonic anhydrase inhibitors, e.g., Acetazolamide.
     - Beta-blockers, e.g., Timolol.
  2. Increase aqueous humor excretion.
     - Cholinergic agonists: Stimulate contraction of ciliary muscle and increased outflow of aqueous humor through trabecular meshwork, e.g., Pilocarpine.
     - Alpha-agonists, e.g., Epinephrine.
     - Prostaglandins, e.g., Latanoprost.

E.N.T.

- **Otitis externa**: Usually caused by *Pseudomonas aeruginosa*, and patient presents with painful ear and tenderness on movement of the ear pinna. Treatment: *Antibiotic ear drops*.
- **Inner ear infections**: e.g., *Viral labyrinthitis, Vestibular neuritis*. Patients present with vertigo, nausea, vomiting and horizontal nystagmus. Treatment: Meclizine. *Vertical nystagmus indicate a central process, e.g., Vertebrobasilar CVA*.
- **Sinusitis**: Usually caused by *S. Pneumoniae*, and patient presents with *facial pressure and postnasal drip*. On exam: Oropharyngeal cobblestoning and opacification of sinuses on *transillumination*. Treatment: *Amoxicillin*.
- **Nasal meatuses**: Nasolacrimal duct opens into inferior meatus, Sphenoid sinus opens into sphenethmoidal recess, Posterior ethmoid sinus opens into the superior meatus, where all other sinuses open into the middle meatus.
- **Meniere’s disease**: Due to endolymphatic hydrops. Patient presents with recurrent episodes of ear fullness, deafness and vertigo. Treatment: *Diuretics*.

**Important Notes and Keywords**

- **Negri bodies** in the Purkinje cells of the cerebellum is pathognomonic of *rabies*.
- **Hirano rods and neurofibrillary tangles** are pathognomonic of *Alzheimer’s disease*.
- **Degeneration of the basal nucleus of Meynert** is pathognomonic of *Alzheimer’s disease*.
- **Lewy bodies and absence of melanin** from substantia nigra is pathognomonic of *Parkinson’s disease*.
- **Brain stem is the origin of cranial nerves III to XII**.
  1. Midbrain: III–IV.
  2. Pons: V–VIII.
  3. Medulla: IX–XII.
- **Reflexes**:
  2. Triceps reflex: Mediated by C7 and C8.
  4. Ankle reflex: Mediated by S1.
  5. Babinski reflex: Dorsiflexion of big toe and fanning of the toes on stimulation of lateral sole of the foot. It is a sign of an upper motor neuron lesion.
- **Causes of bilateral facial nerve paralysis**: Bilateral Bell’s palsy, e.g., Lyme disease, Sarcoidosis and Guillian Barre syndrome.
- **Spongiform encephalopathy (Mad cow disease)**: Caused by Crutzfeld Jacob (CJ) virus, and patient presents with altered mental status, seizures and myoclonus. Remember the myoclonus very well.
**Respiratory System**

**Important Definitions**
- **TV**: Amount of air that enters the lung on normal inspiration; it is equal to 500 cc.
- **IRV**: Amount of air that enters the lung on forced inspiration.
- **ERV**: Amount of air left in the lung after normal expiration.
- **RV**: Amount of air left in the lung after forced expiration.
  - Note: Residual volume cannot be measured by spirometry and the only way to measure it is by doing complete pulmonary function tests (PFTs).
- **FRC**: Reduced in any disease with low lung volume, e.g., Lung collapse or fibrosis.
- **FRC**: Increased in any disease with large lung volume, e.g., Emphysema.
- Refer to Fig. 1.53 for important equations and definitions.

**Pulmonary Function Tests (PFTs)**
- **Key**: The secret number here is 80%; anything below 80% is abnormal.
- **Obstructive lung diseases**, e.g., COPD: Low FVC and very low FEV1 result in a FEV1/FVC ratio of less than 80%; however TLC is above 80%.
- **Restrictive lung diseases**, e.g., Interstitial lung disease: Low FVC and equally low FEV1, so the ratio is more than 80%; however TLC is below 80%.
- **Mixed (Obstructive and Restrictive)**: FEV1/FVC <80% and TLC <80%.

**Dead Space**
- **Anatomical dead space**: Around 150 mL and is measured by the Fowler method.
- **Physiological dead space**: Measured by Bohr method.

**Respiratory Muscles**
- **Passive inspiration**: Diaphragm.
- ** Forced inspiration**: External intercostals and accessory muscles.
- **Passive expiration**: Passive.
- **Forced expiration**: Internal intercostals and abdominal muscles.

**Compliance**
- **Definition**: Lung distensibility, which is inversly proportional to lung elasticity.
- **Note**: At functional residual capacity level, the force of lung collapse and chest wall expansion are equal in power and opposite in direction.

**Bronchio-Alveolar-Pulmonary System**
- Maximum resistance to airflow occurs at the level of medium sized bronchi.
- There is a fourth power inverse proportion between radius of airway and airflow resistance.
- Surfactant a.k.a. Diplamitoyl-phosphatidylcholine is formed by type II pneumocytes, and is completely formed by the 35th week of gestation. It lines the alveoli to keep them open. This is achieved by

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**Fig. 1.53** Lung volumes and capacities. Total lung capacity (TLC) = IRV + TV + ERV + RV
decreasing surface tension and increasing compliance of the alveoli.

- Large alveoli are stable. It is the small sized ones that easily collapse, especially in absence of surfactant.
- During the respiratory cycle, alveolar pressure and intrapleural pressure measured by a balloon catheter in esophagus change as shown in Fig. 1.54.
- Ventilation and perfusion are highest in the lung bases and least in the apices.
- Ventilation/Perfusion ratio (V/Q): At apex = 1–3, at base = 0.6–0.8.
- If V/Q ratio is equal to zero, that indicates complete airway obstruction, while extremely elevated V/Q ratios indicate circulation obstruction resulting in perfusion defect.

Breathing and Gases

- **Respiratory centers:** Medullary reticular formation contains the major respiratory centers as follows:
  1. Dorsal group: Controls *inspiration*.
  2. Ventral group: Controls *expiration*.
- **Gases:**
  1. Diffusion limited: *Oxygen* and Carbon monoxide (CO).
  2. Perfusion limited: *Carbon dioxide (CO₂)*, NO₂ and Oxygen.
- **Chemoreceptors:**
  1. Central: In medulla, and is stimulated by high CO₂ and high H.
  2. Peripheral: In carotid and aortic bodies. Stimulated by low oxygen, high CO₂ and high H. So when they ask you in the USMLE about how breathing is stimulated in a patient with low oxygen but normal CO₂, the answer is obviously peripheral receptors.
- **Notes:**
  1. Hypoxia causes vasodilatation everywhere in the body except the lungs, where it causes vasoconstriction.
  2. CO₂ is transported in the blood mainly in the form of *bicarbonate* and to a lesser extent bound to hemoglobin.
  3. Pulmonary venous congestion leads to rapid shallow breathing due to stimulation of J receptors.
  4. Hering Bruer reflex: Inhibition of inspiration due to stretch of lung tissue.

Asthma

- **Mechanism:** Inflammatory process of the airways characterized by *reversible bronchospasm*, and increased airway secretions.
- **Clinical picture:** Shortness of breath, wheezing and chronic cough.
- **Diagnosis:** PFTs and *Methacholine challenge test*.
- **Treatment:**
  1. *Inhaled steroids* is the mainstay of treatment: Steroids suppress the hyperreactivity of airways to various stimuli. Side effects: Oral thrush, which is prevented by *washing the mouth after inhalation*.
  2. Exercise induced asthma: *Albuterol* before exercise.
  3. Allergy induced asthma: *Mast cell stabilizer* inhaler, e.g., Nedocromil.
  4. Others:
     - *Beta2 agonist bronchodilators*: Short acting, e.g., Albuterol, or long acting, e.g., Salmeterol.
     - *Anticholinergic inhalers*, e.g., Ipratropium: They cause bronchodilation and suppression of the respiratory airways’ secretions.
     - *Leukotriene inhibitors*, e.g., Montelukast: Last resort in severe asthma.
- **Notes:**
  1. Atopic (Extrinsic allergic) asthma is mediated by antigen antibody complexes on mast cells, and the release of interleukins and O₂ radicals by eosinophils and T lymphocytes.
  2. Sputum of asthmatic patients shows *Charcot Laden crystals*; a breakdown product of eosinophils.
Chronic Obstructive Pulmonary Disease (COPD)

- **Mechanism**: combination of chronic bronchitis and emphysema, leading to expiratory airway obstruction.
- **Chronic bronchitis**: Expectorant cough for at least 3 successive months/year, for at least 2 successive years.
- **Emphysema**: Dilatation of the airspaces distal to terminal bronchioles, mostly centroacinar (Pancinar only in alpha-1 anti-trypsin deficiency).

- **Clinical picture**:
  1. **Blue bloaters**: Patients with predominant bronchitis have cough as their main symptom, plus cyanosis and edema.
  2. **Pink puffer**: Patients with predominant emphysema have dyspnea as their main symptom, plus continuous puffing with expiration.

- **Diagnosis**:
  1. **PFTs**: Show obstructive picture (FEV1/FVC <80).
  2. **Chest X-ray**: Hyperinflated lungs and flattened diaphragm. Refer to Fig. 1.55.

- **Complications**: Multiple, the most significant is Cor-pulmonale, which is right ventricular failure. Refer to CHF for more details.

- **Treatment**: Oxygen is the mainstay of treatment of COPD, and is the only factor that reduces morbidity and mortality. Practically, treatment is the same as asthma.

- **Notes**:
  1. In emphysema, there is low alpha-1 globulin levels.
  2. Patients with alpha-1 antitrypsin deficiency also have recurrent hepatitis. So keep your eyes open in the USMLE for this patient who was born with emphysema and is presenting with elevated transaminases.

Respiratory Failure

- **Definition**: Decline in the respiratory function leading to PO2 <60, and PCO2 >50.

- **Types and causes**:
  1. **Type I**: Hypoxic normocapnic (Low O2, normal CO2): Caused by emphysema, pneumonia and pulmonary edema.
  2. **Type II**: Hypoxic Hypercapnic (Low O2, high CO2): Caused by asthma and COPD.

- **Clinical picture**:
  1. Hypoxia: Cyanosis and tachycardia.

- **Treatment**:
  1. Type I: O2 with high concentrations.
  2. Type II: O2 with low concentrations to maintain the respiratory center’s stimulation. *This is one case where high oxygen flow can be fatal.*

Pneumothorax

- **Types**: Air in the pleural sac, which could be:
  1. **Closed**, e.g., due to ruptured blebs or bullae.
  2. **Open**: Air enters and leaves the pleura without trapping.
  3. **Tension pneumothorax**: Air enters and only partially leaves the pleural sac due to check valve mechanism. Refer to Fig. 1.56.

- **Causes**:
  1. **Primary**: Suspect in tall, thin, middle aged smoker.
  2. **Secondary**: To COPD or cystic fibrosis.

- **Clinical picture**:
  1. **Sudden** respiratory distress.
  2. Chest pain on inspiration due to severe pleurisy.
3. Hemodynamic instability in severe cases due to compression on the heart.

- **On exam:**
  1. **Hyperresonance on chest percussion** on affected side.
  2. Limited air entry on auscultation of affected lung.

- **Diagnosis:** CXR shows hyperinflation and shift of mediastinum to the opposite side.

- **Treatment:** Chest tube insertion; however, if not immediately available and patient is unstable, insert a wide bore needle into the 2nd intercostal space in the mid-clavicular line to allow the trapped air out, till the chest tube is inserted.

- **Pleurodesis** (Sealing of both pleural layers together) is considered in:
  1. First pneumothorax episode in secondary cases.
  2. Second episode in primary cases.

### Lung Cancer

- **Introduction:**
  1. Second most common malignancy in men after prostate cancer, and the third in women after breast and colon cancers; however, it is the number 1 cause of death from cancer in both genders.
  2. Most common cause of pleural effusion.
  3. Smoking increases the lung cancer risk by 10 times more than normal.

- **Types:** Refer to Table 1.12.

- **Clinical picture:** Cough, hemoptysis, weight loss and pleural effusion or sometimes completely asymptomatic.

- **Diagnosis:** Biopsy; peripheral ones by CT guided biopsy, and central ones by bronchoscopic guided biopsy or mediastinoscopy.

- **What else to order:** Bone scan, CT of abdomen and pelvis, and CT of the head to rule out metastases.

- **Treatment:** Surgery (only if the tumor has not metastasized yet), radiation and chemotherapy for all types, except for small cell cancer, where surgery is not an option.

- **Remember:** Central tumors are (SS) Squamous and Small cell. The rest are peripheral.

- **Notes:**

#### Table 1.12 Types of lung cancer.

<table>
<thead>
<tr>
<th>Type</th>
<th>Location</th>
<th>Para-neoplasia</th>
<th>Miscellaneous</th>
</tr>
</thead>
</table>
| Adenocarcinoma   | Peripheral | None                                              | • Most common lung cancer
|                  |          |                                                    | • Early metastases
| Squamous cell carcinoma | Central    | Hypercalcemia: due to release of PTH related peptide | • 2nd most common lung cancer
|                  |          |                                                    | • Causes lung cavitations
| Small cell carcinoma | Central    | • ACTH: Cushing syndrome                           | • Squamous cells are eosinophilic with hyperchromatic nuclei
|                  |          | • ADH: Syndrome of inappropriate ADH (SIADH)       | • Eaton Lambert is just like Myasthenia Gravis, except:
|                  |          | • Muscle weakness: Eaton Lambert, due to antibodies against calcium channels antibodies | 1. Activity makes symptoms better
|                  |          | • Sensory neuropathy: Due to anti-neuronal antibodies (ANNA-1) | 2. Activity makes EMG waves stronger
|                  |          |                                                    | • Small cells are basophilic and lymphocyte sized
| Large cell carcinoma | Peripheral | Gynecomastia                                        |                                                                              |
1. Any type of lung cancer infiltrating the sympathetic chain will cause Horner’s syndrome, and is called Pancoast tumor. Horner’s syndrome presentation:
   - *Ptosis*: Due to paralysis of superior tarsal muscle.
   - *Miosis*: Due to paralysis of dilator pupillae muscle.
   - *Anhydrosis*.

2. Bronchopulmonary segment is formed histologically of a bronchus with its supplying artery and vein, plus the lung segment that they all supply.

3. Mesothelioma is a pleural based malignancy that occurs due to exposure to asbestos for long duration, at least 10 years.

4. Bronchial adenoma is a benign tumor arising from bronchial mucosa. Patient presents with recurrent hemoptysis and carcinoid syndrome (Diarrhea, Flushing, Bronchospasm, right heart valve lesions mainly the tricuspid valve, high urinary 5-HIAA).

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**Pneumonia**

- *Definition*: Infection and consolidation of the pulmonary tissue.
- *Cause*: Community acquired, unless the patient has been in a hospital or a nursing home for more than 72 h before symptoms start; that’s when it is called nosocomial pneumonia. Refer to Fig. 1.57.
- *Types*: Lobar pneumonia is the most common form and is caused by *Streptococcus pneumoniae*; however pneumonia could be interstitial or bronchopneumonia.
- *Phases*:
  1. Congestion.
  2. Red hepatization (2–4 days): Mediated by neutrophils.
  3. Grey hepatization (4–8 days): Characterized by high fibrin content.
  4. Resolution: After 8–10 days from the initial phase.
- *Clinical picture*: Cough and expectoration, fever and shortness of breath.
- *On exam*: The area with pneumonia is dull to percussion, has high Tactile Vocal Fremitus (TVF), Rales and crackles, bronchial sounds and egophony (if the patient says “e”, you hear it as “a” on auscultation).
- *Diagnosis*: Chest X-ray and sputum culture.
- *Treatment*: Any pathogen can cause pneumonia, but be sure to remember that community acquired pneumonia is best treated by Quinolones, e.g., Levofloxacin or a combination of Macrolide, e.g., Azithromycin, and 3rd generation cephalosporin.
- *Notes*:
  1. *Atypical pneumonia*:
     - If the chest X-ray looks worse than how the patient clinically presents, think of atypical pneumonia, especially if the patient also has diarrhea or change in mental status; most common causes are:
       1. *Legionella*: Diagnosed by Direct immuno-fluorescence and culture on charcoal agar. Typical sources are shower heads and air conditioners.
       2. *Mycoplasma*: Diagnosed by high mycoplasma IgM titers.
   - Treatment of atypical pneumonia: Macrolides, e.g., Erythromycin.
  2. *Aspiration pneumonia*: Caused by anaerobes and is more common in the right lung, due to the large right main bronchus that is more in line with the trachea. Suspect aspiration in patients with gastrostomy feeding tubes, alcoholics and after coma or seizure.
  3. *Key facts*:
     - *Staphylococcus aureus*: Causes lung cavitation and hemoptysis. Also the most common
cause of pneumonia following an influenza infection. Methicillin Resistant S. aureus (MRSA) is treated with Vancomycin.

- Klebsiella: Causes apical (Friedlander) pneumonia and red current jelly sputum.
- H. Influenza is one common cause of pneumonia in patients with COPD.

**Bronchiectasis**

- **Mechanism**: Combination of airway obstruction and infection, leading to abnormal persistent dilatation of the bronchi.
- **Most common sites**: Bases of the lungs.
- **Clinical picture**: Cough and expectoration, more on stooping forwards. Also hemoptysis due to mucosal ulceration.
- **On exam**:
  1. Lung bases: Dull to percussion with high TVF.
  2. Lung apices: Resonant to percussion with low TVF: due to compensatory emphysema.
- **Diagnosis**: CXR or CT chest shows honeycomb appearance.
- **Treatment**: Postural drainage and antibiotics.

**Pulmonary Embolism (CPE)**

- **Source**: Most common source is DVT in the lower extremities, which could be explained by Virchow’s triad: Flow stasis, endothelial damage and hypercoagulable state.
- **Clinical picture**: Sudden dyspnea, hyperventilation and pleuritic chest pain in a patient with normal CXR. Presents in the USMLE as a hospitalized or immobile patient who suddenly develops unexplained respiratory distress few days after surgery.
- **Diagnosis**:
  2. Practically, we use V/Q scan (test of choice) which will show ventilation/perfusion mismatch.
  3. If the CXR is not clear, V/Q will not be accurate, so a CT chest is done.
  4. Patients with PE have normal chest X ray.
  5. Right ventricular strain on EKG.
- **Treatment**: Heparin is the first step, followed by warfarin for 3–6 months (Target INR = 2–3).
- Fat pulmonary embolism: Occurs after long bone fractures; patients have dyspnea and skin petechiae. Treatment is mainly supportive.

**Pleural Diseases**

**Pleurisy**

- **Causes**: Any nearby infection or irritation, e.g., Pneumonia, Pneumothorax.
- **Clinical picture**: Stitching chest pain increased with deep inspiration and cough.
- **On exam**: Pleural rub.
- **Treatment**: Treat the cause + NSAIDs.

**Pleural Effusion**

- **Causes**: Transudative, e.g., CHF, Exudative, e.g., Pneumonia, Chylous, e.g., Thoracic duct obstruction, or hemorrhagic, e.g., Malignancy.
- **Clinical picture**: Dyspnea and pleuritic chest pain (Increased with inspiration).
- **On exam**: Decreased everything, i.e., Decreased chest movement on inspiration, Decreased Tactile Vocal Fremitus (TVF), Dullness on percussion and Decreased air entry on auscultation.
- **Diagnosis**: Chest X-ray shows leveling of fluid filling the costophrenic angle. Large effusion pushes the mediastium towards the opposite lung. Refer to Fig. 1.58.
- **Treatment**:
  1. Thoracocentesis is diagnostic and therapeutic. Fluid is sent for analysis to diagnose its nature, e.g., Exudate, transudate, etc....
  2. If fluid reaccumulated after thoracocentesis, chest tube should be inserted.
  3. If fluid reaccumulated after removal of chest tube, pleurodesis should be done (Sealing of the pleural layers).

**FIG. 1.58 Left pleural effusion**
• Notes:
1. Malignant effusions are bloody and they re-accumulate rapidly and pleurodesis is indicated.
2. Empyema is accumulation of pus in the pleural cavity. Treatment: Antibiotics and intercostal tube drainage. If fails: Open drainage and removal of the pleura (Decortication).
3. Lung collapse and lung fibrosis are 2 other diseases with “Decreased everything” on exam, but the mediastinal shift here is towards the opacified lung, not towards the opposite side.

Interstitial Lung Disease (ILD)
• Mechanism: Infiltration of the lung tissue with inflammatory cells leading to restrictive lung disease.
• Causes: Silicosis, asbestosis, Sarcoidosis, drugs (e.g., Amiodarone).
• Clinical picture (5C): Cough, Cyanosis, Clubbing, Crackles and Core-pulmonale.
• CXR: Diffuse reticulonodular infiltrate. Refer to Fig. 1.59.
• Diagnosis: open lung biopsy.
• Treatment: Steroids.
• Notes on some ILDs:

Silicosis and Asbestosis
• Silica: Exposure occurs in glass and sand industry. Clinical picture: Upper lung zones injury and hilar egg shell calcifications.

Sarcoidosis
• Mechanism: Non-caseating granuloma, more common in African Americans. Remember that granuloma is a type IV hypersensitivity reaction.
• Clinical picture:
  1. Uveitis, lacrimal and parotid glands swelling.
  2. CVS: Cardiomyopathy.
  3. CNS: Bilateral facial nerve palsy.
  5. Metabolic:
     • Hypercalcemia: Due to secretion of activated vitamin D by macrophages.
     • Diabetes insipidus: Due to posterior pituitary dysfunction.
• Diagnosis:
  1. High serum angiotensin converting enzyme level (ACE).
  2. Transbronchial biopsy showing non-caseating granuloma is diagnostic. Microscopy shows Schumann and Asteroid bodies.
• Treatment: Self resolving; however severe and non-resolving cases are treated with systemic steroids.
**Notes:****
1. In sarcoidosis, there is *low albumin* and *high gamma globulin* levels.
2. Mucocutaneous forms of sarcoidosis are treated with *chloroquine*.

**Tuberculosis (TB)****
- **Causes:** Mycobacterium Tuberculosis (Acid fast bacillus) is the most common cause; however, in immunocompromised patients Atypical Mycobacteria are involved, e.g., M. Avium, M. Marinum, M. Kansasi.
- **Primary complex:** Ghon’s focus in the upper lung lobe.
- **Pathology:** Mycobacterium Tuberculosis live inside macrophages, after inhibiting the phagosome-lysosome fusion process.
- **Clinical picture:**
  1. 2 nights, 2 losses: Night fever, night sweats, loss of weight and loss of appetite. Mediated by interleukins.
  2. Cough and expectoration.
  3. Hemothysis: Due to erosion of a blood vessel, or oozing from friable granulation tissue.
- **Diagnosis:**
  1. Isolation of the organism on a culture is the diagnostic test of choice. Sample obtained from the sputum or gastric aspirate.
  2. CXR: Apical infiltrate or cavitation.
  3. Tuberculin test: Purified Protein Derivative (PPD) is injected intradermally in the forearm, and the induration (*not erythema*) is measured in 48–72 h. *Note: PPD test becomes positive 3–10 weeks after infection, and not immediately afterwards.*
- **PPD interpretation:**
  1. Induration less than 10 mm in immunocompetent person: Normal.
  2. Induration more than 10 mm in immunocompetent person: Next step is to obtain a CXR:
    - Normal CXR (Latent TB): INH therapy for 9 months.
  3. Induration less than 5 mm in immunocompromised patient: Normal.
  4. Induration more than 5 mm in immunocompromised patient: Next step is to obtain a CXR:
    - Normal CXR (Latent TB): INH therapy for 12 months.
- **Treatment:** 6 months treatment course: 2 months of INH, Rifampin, Pyrazinamide and *Ethambutol (or Streptomycin)*, followed by 4 months course of INH and Rifampin.
- **Side effects of therapy:**
  1. INH: Hepatotoxicity and peripheral neuritis (*Vitamin B6 during therapy is necessary*).
  2. Rifampin: Orange discoloration of body fluids and hepatotoxicity.
  4. Ethambutol: Optic neuritis.

**Sleep Apnea****
- **Definition:** Cessation of breathing during sleep.
- **Types and Causes:**
  1. Central: Respiratory center depression, e.g., Alcohol, BDZ.
  2. Obstructive: Narrow airway, e.g., Large tongue, large palate, big neck.
  3. Pickwickian syndrome (*Obesity hypoventilation syndrome*): Obstructive sleep apnea + Obesity + CO₂ retention.
- **Clinical picture:**
  1. Loud snoring during sleep.
  2. Episodes of apnea during sleep followed by waking up gasping for air.
  3. Daytime sleepiness and fatigue.
- **Diagnosis:** Sleep study (Polysomnography) showing at least 10 apnea episodes/hour, each episode lasting at least 10 seconds.
- **Complications:** Pulmonary hypertension (>20), Cor pulmonale and sudden death.
- **Treatment:**
  1. Continuous Positive Airway Pressure (CPAP) during sleep, and weight loss.
  2. Avoidance of alcohol and BDZ before bedtime.
  3. For resistant cases: Uvulo-Palato-Pharyngo-Plasty (UPPP).

**Solitary Lung Nodule****
- **Definition:** Any nodule that is *less than 5 cm* in diameter, discovered accidentally on a CXR or CT without any related symptoms.
- **Characteristics:**
  1. Benign: Central, round, regular border, uniform calcification.
• Management:
  2. Low risk patient (Young, Non smoker, No family history): Repeat CXR every 3 months for 2 years:
     - If any change in characteristics mentioned above: Biopsy.
     - If stable: Follow up on symptoms.

Cough
• Introduction: Cough is a protective reflex in cases of infection and in post-operative patients.
• Most common cause of cough: Smoking.
• Causes of chronic cough: Chronic sinusitis, GERD and Asthma.
• Antitussives: Decrease cough by 2 mechanisms:
  1. Peripheral: Anesthetize peripheral receptors. Best is Benzonatate.
  2. Central: Increase threshold of cough center. Best is Dextromethorphan.
• Note: One of the complications of lack of cough, deep breaths and using incentive spirometry in post-operative patients is atelectasis. Suspect atelectasis in a patient developing fever 1–2 days after surgery.

Drug-Induced Pulmonary Diseases
• Interstitial lung diseases: Amiodarone, Nitrofurantoin.
• Cough: ACE inhibitors (Treatment: Switch to ARB).
• Bronchospasm: Aspirin and non-selective beta blockers.
• Pulmonary eosinophilia: Gold, penicillamine.

Infectious Diseases

Human Immunodeficiency Virus (HIV)
• Introduction:
  1. Enveloped DS RNA virus with multiple functional enzymes including reverse transcriptase, protease, and integrase.
  2. The outer shell is formed of capsid protein, gp41 and gp120 capsid proteins, and p24 (Early marker).
  3. Reverse transcriptase (RNA dependant DNA polymerase) converts the virus’s RNA to DNA.
• HIV genome: Has Long Terminal Repeat sequences (LTRs) which include:
  1. Sticky ends: Recognized by integrase.
  3. gag (Group antigens): Code for viral antigenic proteins.
  4. pol (Protease, integrase and reverse transcriptase): Protease is the agent that makes HIV contagious.
  5. tat (Transactivator): Activates transcription.
  6. env (Envelope proteins).
• Transmission: Infection is mainly through blood or sexual intercourse; more in females and those who engage in anal intercourse.
• Pathology: HIV targets the following cells:
  1. T lymphocytes: Mainly CD4. If CD4 count drops below 200, the patient requires treatment, even if he does not have any obvious infection.
  2. B lymphocytes: Can trigger other immunological disease.
  3. Monocytes and macrophages: Act as reservoir for the virus. Can also transport it to the CNS, causing aseptic meningitis and neuropathy.
• Clinical picture:
  1. Initial viremia followed by a latent period of 5–10 years.
  2. AIDS related complex (ARC): Weight loss, fever, and night sweats.
• Diagnosis: Positive Enzyme-Linked Immunosorbent Assay (ELISA) test is the first step. If positive, confirm diagnosis by doing Western Blot test.
• Follow up: Best done through the viral RNA load, and CD4 count. They are used for prognostic purposes, early detection of progression of HIV to AIDS, and to assess response to treatment.
• Complications:
  1. Kaposi sarcoma (Purple skin nodules): By Human Herpes Virus-8 (HHV-8). Kaposi sarcoma occurs due to vascular proliferation and hemosiderin deposition.
  2. Oral hairy leukoplakia: By Epstein-Barr virus (EBV). Can be seen on the lateral borders of the tongue.
  3. Chorioretinitis: By Cytomegalovirus (CMV).
  7. Seizures: By Toxoplasma Gondii, which causes diffuse intracranial calcifications, and contrast enhancing mass. Treatment: Sulfadiazine +
Pyrimethamine. Drug of choice to treat toxoplasmosis during pregnancy is Spiramycin.

8. Leukemia: Human T-cell Leukemia Virus-1 (HTLV-1) causes hairy cell leukemia, while HTLV-2 causes T cell leukemia.

9. Pneumonia:
   - Pneumocystis Jiroveci (Formerly P. Carinii “PCP”). Suspect when CD4 count is less than 200. Diagnosis: Bronchoalveolar lavage or lung biopsy. Culture: Does not grow in vitro, but stains with methenamine silver. Treatment: SMX/TMP and/or pentamidine.

Treatment of HIV:
1. Reverse transcriptase inhibitors:
   - Zidovudine (AZT): Inhibits HIV replication. Side effects: Severe headache. Note: Given to pregnant HIV patients to decrease risk of fetal transmission.
   - Didanosine (ddi), Zalcitabine and Lamivudine: All cause pancreatitis and peripheral neuropathy.

2. HIV protease inhibitors, e.g., Indinavir and Ritonavir. Side effects:
   - Elevated liver transaminases.
   - Indinavir causes nephrolithiasis.

Note:
1. Prophylaxis against HIV after a contaminated needle stick injury is a 1 month course of LIZ (Lamivudine, Indinavir, Zidovudine). The main factor deciding the probability of transmission is the depth of the injury.
2. Risk of materno-fetal transmission of HIV is significantly reduced by treating the mother during pregnancy with zidovudine.

Rabies
- Introduction: Rhabdovirus which replicates locally in a wound, and may travel up neuronal axons into the CNS to cause encephalitis.
- Source: Multiple; most famous are dogs, cats, bats and raccoons.
- Pathology: Brain tissue shows virions, a.k.a. Negri bodies.
- Clinical picture: Fever, headache and hydrophobia due to pharyngeal muscles spasm. This may lead to foaming of the mouth, a classic symptom of rabies.
- Treatment: Immunoglobulins and active immunization, using five injections of a killed virus vaccine.
- Note: Washing the wound with soap and water dissolves the lipid envelope of the virus, which leads to prolongation of its incubation period.

Clostridium Tetani
- Introduction: Spore forming, Gram positive anaerobic bacillus with terminal spores (C. Tetani has Terminal spores).
- Mechanism: Tetanospasmin toxin cause tetany by inhibiting the release of GABA from cerebellum, and glycine from Renshaw cells of spinal cord.
- Clinical picture:
  1. Muscle spasms and lockjaw.
  2. Risus sardonicus: Fixed smile due to muscle spasm. (Sign of advanced disease).
- Prevention: Vaccination, and tetanus toxoid is given every 10 years.
- After exposure, e.g., Patient injured his foot by stepping on a rusty nail.
  1. If last toxoid dose was within the last 5 years: No toxoid needed.
  2. If last toxoid dose was more than 5 years ago: Give a new dose of toxoid.
  3. If patient has never been immunized: Give tetanus toxoid and immunoglobulin.
- Treatment of tetanus:
  1. Airway protection, and clean wound.

Clostridium Difficile
- Introduction: Spore forming, Gram positive anaerobic bacillus.
- Mechanism: Exotoxins. Toxin A causes diarrhea. Toxin B is cytotoxic.
- Clinical picture: Pseudo-membranous colitis. Usually follows the use of broad spectrum antibiotics, e.g., Ampicillin, Clindamycin. Patient presents with severe watery malodorous diarrhea and abdominal pain.
- Diagnosis: Detecting C. Diff. toxins in the stools.
- Treatment: Oral metronidazole or Vancomycin. They have to be given orally as they act locally inside the intestine.
Listeria Monocytogenes
- **Introduction**: Non-spore forming, Gram positive bacillus, with unique features:
  1. Facultative intracellular organism.
  2. The only Gram positive organism capable of releasing endotoxins.
  3. End over end motility, a.k.a. tumbling.
- **Clinical picture**: Meningitis and sepsis. Third most common cause of meningitis in neonates (After Strept. Agalactiae, and *E. coli*). It also causes meningitis in immunocompromised patients, e.g., HIV.
- **Treatment**: Ampicillin + Sulbactam or SMX/TMP.

Salmonella
- **Introduction**: A motile H$_2$S releasing bacterium, with Vi antigen.
- **Source**: Food or water contaminated with animal feces. A famous source is undercooked eggs. *S. typhi* is carried only by humans in the gall bladder and not carried by animals.
- **S. typhi**: A facultative intracellular organism, causing typhoid (Enteric) fever, where patient presents with:
  1. Step-ladder fever.
  2. Rosy spots on the abdomen.
  3. RLQ abdominal pain: Often confused with appendicitis.
  4. Treatment: Ciprofloxacin or Ceftriaxone.
- **S. cholera-suis**: Causes bacteremia which targets lungs, liver or even the brain.
- **S. enteritidis**: Causes mucous or watery diarrhea. Treatment: Self resolving. Antibiotics will prolong bacterial shedding.

Rickettsia
- **Introduction**: Gram negative, intracellular organism with ATP/ADP translocator.
- **Characteristics**: Same antigens as Proteus mirabilis (OX-2, OX-19, OX-K), which can be distinguished and diagnosed by Weil-Felix test.
- **Clinical picture**:
  1. Rocky Mountain spotted fever: Caused by *Rickettsia rickettsii*, transmitted by ticks (*Dermacentor*). Clinical picture: Fever, and petechial rash that starts in the palms and soles and creeps towards the trunk.
  2. Epidemic typhus: Caused by *Rickettsia prowazekii*, transmitted by *ticks*. Clinical picture: Fever, and rash that involves the whole body except palms and soles.
  4. Q fever: Caused by *Coxiella burnetti*, transmitted through contact with animals and animal products. Clinical picture: Fever and pneumonia, due to inhalation of endospores. It is the only rickettsia that doesn’t cause rash.
  5. Bartonella henselae: Causes Cat Scratch disease. Clinical picture: Cat scratch, followed by fever, rash and swollen tender postural lymphadenopa-thy. Complication: Bacillary angiomatosis, which is proliferation of blood vessels, common in AIDS patients.
- **Diagnosis**: Complement Fixation Test (CFT).
- **Treatment**: Doxycycline plus chloramphenicol. Drug of choice for cat scratch disease is azithromycin.

Bacillus Cereus
- **Introduction**: Spore forming, Gram positive bacillus.
- **Mechanism**: Heat stable or labile toxin in undercooked rice.
- **Clinical picture**: Diarrhea, mostly after ingestion of undercooked rice.
- **Treatment**: Self resolving without treatment.

Cryptococcus Neoformans
- **Introduction**: Polysaccharide encapsulated yeast.
- **Transmission**: Pigeon droppings.
- **Clinical picture**: Meningitis in immunocompromised patients, e.g., AIDS.
- **Diagnosis**:
  1. India ink staining of CSF shows a halo around the yeast cells.
  2. Culture: Grows on Sabouraud’s agar.
- **Treatment**: Combination of Amphotericin B and flucytosine.
- **Notes**:
  2. Flucytosine: Causes bone marrow depression and GI upset.
Coccidiodes Immitis

- **Introduction:** Thick walled spherules, causing Coccidioidomycosis (San Joaquin valley fever).
- **Location:** Common in the southwestern United States (Desert areas).
- **Clinical picture:** Atypical pneumonia and erythema nodosum (Tender red nodules on tibia).
- **Diagnosis:** Positive complement fixation test (CFT).
- **Treatment:** Fluconazole or itraconazole. Amphotericin B is used in severe cases.
- **Note:** So, when you see a patient in the USMLE who has been to a desert area in the southwestern US recently, and now has pneumonia and bumps on his legs, you know what to think!

Entamoeba Histolytica

- **Introduction:** A parasite that moves by means of pseudopodia, and it exists in 2 forms:
  1. **Mature cyst:** Infective form.
  2. **Trophozite:** Pathogenic form.
- **Clinical picture:** Severe watery diarrhea, with blood and mucus.
- **Complication:** Liver abscesses; mainly involving the right lobe.
- **Diagnosis:** Stool culture shows trophozites with intracytoplasmic RBCs.
- **Treatment:** Metronidazole.
- **Note:** Homosexual men are frequent carriers.

Giardia Lamblia

- **Introduction:** A parasite that also exists in 2 forms:
  1. **Mature cyst:** Infective form.
  2. **Trophozite:** Pathogenic form. It is pear shaped, with 2 nuclei and 4 pairs of flagella.
- **Clinical picture:** Watery malodorous diarrhea, and abdominal distention and bloating. So, when you see a patient in the USMLE who just traveled outside the US recently, and now has abdominal pain, and watery, non-bloody diarrhea, you know what to think!
- **Diagnosis:** Stool analysis shows cysts and/or trophozites.
- **Treatment:** Metronidazole.
- **Note:** Well water and day care centers are notorious sources of Giardia lamblia.

Plasmodium

- **Introduction:** Parasite causing malaria, transmitted by the female anopheles.
- **Clinical picture and causative organism:**
  1. **Tertian:** Attacks of fever and sweats every 48 hours: *Plasmodium vivax* and *Plasmodium ovale*.
  2. **Quartan:** Attacks of fever and sweats every 72 hours: *Plasmodium malariae*.
  3. **Malignant malaria** with variable attack periods: *Plasmodium falciparum*.
- **Prophylaxis:** Chloroquine. If chloroquine resistant, give Mefloquine.
- **Treatment:**
  1. *P. vivax, P. ovale and P. malariae*: Chloroquine for blood forms, and primaquine for tissue forms.
  2. *P. falciparum*: Chloroquine. If chloroquine resistant, give quinine, mefloquine or artemether.
- **Notes:**
  1. *Plasmodium vivax* and *P. ovale* reproduce in the liver to form hypnozites. These stages can cause multiple relapses (Relapsing malaria).
  2. African-Americans resist infection by *P. vivax*, because they do not have Duffy A and Duffy B antigens on their RBCs.
  3. Sickle cell patients are resistant to infection by *P. falciparum*, due to Hbs.

Miscellaneous

- **Sporothrix schenckii:** Cigar shaped budding yeast. **Transmission:** Contact with rose thorns (a.k.a. Rose gardener’s disease). **Clinical picture:** Subcutaneous nodules and ulcers. **Treatment:** Potassium iodide (KI) or itraconazole for cutaneous forms, and Amphotericin B for extracutaneous forms.
- **Aspergillus:** Inhalation causes hypersensitivity reactions type I and III, which leads to bronchospasm. May form aspergilloma in lungs. Also releases aflatoxins which have been linked to liver cancer. Shows branching hyphae under microscope (Candida shows pseudo-hyphae). **Note:** Aspergillus is the nightmare of any bone marrow transplant unit.
- **Chromoblastomycosis:** Causes cauliflower-like masses with copper colored sclerotic bodies and Broad Based Budding (BBB) on microscopy. **Treatment:** Itraconazole.
- **Histoplasmosis and blastomycosis:** Transmitted through birds’ feces and may cause pneumonia.
- **Actinomycosis:** Causes formation of yellow sulfur granules. **Treatment:** Penicillin
• *Shigella*: A pathogen transmitted by contaminated hands and water. Releases *Verotoxin*, which causes *bloody diarrhea; rich in WBC count.*


• *Trypanosoma cruzi*: Transmitted by *Reduviid (Kissing) bug*, and causes skin chagoma (Nodule or papule), a.k.a. *Romana sign*. Late stages might develop *Chagas disease* (Toxic megacolon, cardiomyopathy and achalasia). Treatment: *Nifurtimox*.

**Miscellaneous**

• *Normal labs in the elderly*: Low PO2, Low FEV1, Low Hb, Low GFR and elevated alkaline phosphatase. They also high level of *vitamin A* due to decreased liver clearance.

• *Tumor markers*:
  1. *Carcinoembryonic Antigen (CEA)*: Colorectal cancer.
  4. *Alpha Fetoprotein (AFP)*: Hepatocellular cancer and teratoma.
  5. *Prostatic Specific Antigen (PSA)*: Prostate cancer.

• *Metastases*:
  1. Most common tumor to send metastases: *Breast cancer*.
  2. Most common organ to receive metastases: *Adrenal medulla*.

**Table 1.13 Vitamins and minerals.**

<table>
<thead>
<tr>
<th>Vitamin</th>
<th>Properties</th>
<th>Deficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamin A</td>
<td>• Fat soluble</td>
<td>• Night blindness. <em>Bitot spots</em>. Dry skin and hair.</td>
</tr>
<tr>
<td></td>
<td>• Retinoic acid is used in cases of acne.</td>
<td>• Toxicity: Increased intracranial pressure and joint pains</td>
</tr>
<tr>
<td></td>
<td>• Isotretinoin is a teratogenic form</td>
<td></td>
</tr>
<tr>
<td>Vitamin D</td>
<td>• Fat soluble</td>
<td>• Fatigue, muscle and bone weakness, and fractures</td>
</tr>
<tr>
<td></td>
<td>• D2 is consumed in milk</td>
<td>• Toxicity: hypercalcemia manifested by altered mental status, polyuria and constipation. Common in hyperparathyroidism and sarcoidosis</td>
</tr>
<tr>
<td></td>
<td>• D3 is formed under the skin by UV stimulation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Active form is 1,25 dihydroxycholecalciferol</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• It increases calcium and phosphate absorption from intestine</td>
<td></td>
</tr>
<tr>
<td>Vitamin E</td>
<td>• Fat soluble</td>
<td>• Fragile RBCs and higher risk of hemolysis</td>
</tr>
<tr>
<td></td>
<td>• Antioxidant function: protects RBCs from hemolysis</td>
<td></td>
</tr>
<tr>
<td>Vitamin K</td>
<td>• Fat soluble</td>
<td>• Causes:</td>
</tr>
<tr>
<td></td>
<td>• Synthesized by intestinal flora</td>
<td>1. Vitamin K antagonists, e.g., warfarin</td>
</tr>
<tr>
<td></td>
<td>• It forms gamma-carboxy-glutamate, upon which some clotting factors depend for activation; namely factors II, VII, IX and X, and proteins C and S</td>
<td>2. Destruction of intestinal flora by long term use of antibiotics.</td>
</tr>
<tr>
<td>Vitamin B1 (Thiamine)</td>
<td>• Water soluble</td>
<td>• Coagulopathy with high bleeding tendency</td>
</tr>
<tr>
<td></td>
<td>• Thiamine pyrophosphate is a co-factor for 2 reactions:</td>
<td>• Patients have <em>high PT and APTT</em>.</td>
</tr>
<tr>
<td></td>
<td>1. Oxidative decarboxylation of keto acids</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. Transketolase of HMP shunt</td>
<td></td>
</tr>
<tr>
<td>Vitamin B2 (Riboflavin)</td>
<td>• Water soluble</td>
<td>• 2 important deficiency syndromes:</td>
</tr>
<tr>
<td></td>
<td>• It is a co-factor in oxidation and reduction reactions forming FAD and FMN</td>
<td>1. <em>Beri Beri</em>: Polyneuropathy and CHF.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. <em>Wernicke-Korsakoff syndrome</em>: Triad of encephalopathy, nystagmus and ataxia. Korsakoff is manifested by <em>anterograde amnesia</em> and <em>confabulations</em>.</td>
</tr>
</tbody>
</table>

• Angular stomatitis

• Cheilitis

• Corneal vascularization
<table>
<thead>
<tr>
<th>Vitamin</th>
<th>Properties</th>
<th>Deficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>B3 (Niacin)</td>
<td>• Water soluble</td>
<td>• Pellagra triad:&lt;br&gt;1. Diarrhea&lt;br&gt;2. Dermatitis&lt;br&gt;3. Dementia&lt;br&gt;• Dermatitis of pellagra is mainly on the face and neck arranged in a <em>necklace like</em> distribution.</td>
</tr>
<tr>
<td></td>
<td>• It is a co-factor in oxidation and reduction reactions forming NAD and NADP</td>
<td></td>
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<tr>
<td></td>
<td>• It inhibits lipolysis, so used in type II hyperlipidemia to increase HDL and decrease LDL and VLDL</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Side effects: <em>Facial flushing and pruritis</em></td>
<td></td>
</tr>
<tr>
<td>B5 (Pantothenic acid)</td>
<td>• Water soluble&lt;br&gt;• It is the provider of co-A</td>
<td>• Rash and diarrhea&lt;br&gt;• Peripheral neuropathy&lt;br&gt;• Hyper-excitability and seizures&lt;br&gt;• Causes:&lt;br&gt;1. INH&lt;br&gt;2. OCPs</td>
</tr>
<tr>
<td>B6 (Pyridoxine)</td>
<td>• Water soluble&lt;br&gt;• Forms pyridoxal phosphate, which is essential for transamination and decarboxylation reactions</td>
<td>• Peripheral neuropathy&lt;br&gt;• Hyper-excitability and seizures&lt;br&gt;• Causes:&lt;br&gt;1. INH&lt;br&gt;2. OCPs</td>
</tr>
<tr>
<td>B12 (Cobalamin)</td>
<td>Water soluble&lt;br&gt;• Stores in the liver last for at least 5 years&lt;br&gt;• Absorbed in the ileum, and presence of intrinsic factor is essential for absorption&lt;br&gt;• Co-factor for homocysteine and methylmalonyl co-A reactions</td>
<td>• Macrocytic hyperchromic anemia&lt;br&gt;• Subacute combined degeneration SCD&lt;br&gt;• Causes:&lt;br&gt;1. Vegetarians&lt;br&gt;2. Malabsorption&lt;br&gt;3. Infestation e.g.: <em>Diphyllobothrium latum</em>&lt;br&gt;4. Lack of intrinsic factor = Pernicious anemia&lt;br&gt;5. Lack of ileum</td>
</tr>
<tr>
<td>C (Ascorbic acid)</td>
<td>• Water soluble&lt;br&gt;• It is needed for 2 important processes:&lt;br&gt;1. Intestinal iron absorption by keeping it in the ferrous state&lt;br&gt;2. Collagen synthesis by hydroxylation of proline and lysine</td>
<td>• Caused by decreased intake, most pronounced in people not eating vegetables&lt;br&gt;• Vegetarians → Vit. B12 def.&lt;br&gt;• Meat eaters → Vit. C def.&lt;br&gt;• Scurvy, manifested by:&lt;br&gt;1. Gingival hypertrophy&lt;br&gt;2. Easy bruising and bleeding&lt;br&gt;3. Poor healing</td>
</tr>
<tr>
<td>Folic acid</td>
<td>• Pteridine + Glutamic acid + PABA → Folic acid&lt;br&gt;• Dihydrofolate reductase converts folic acid to FH4. This reaction is inhibited by methotrexate&lt;br&gt;• FH4 reacts with homocysteine to form methionine. This reaction is regulated by B12&lt;br&gt;• Folic acid is essential for DNA and RNA synthesis</td>
<td>• The <em>most common</em> vitamin deficiency in the U.S.&lt;br&gt;• Macrocytic hyperchromic anemia&lt;br&gt;• Neural tube defects if supplementation is not adequate during pregnancy</td>
</tr>
<tr>
<td>Biotin</td>
<td>• Co-factor for many carboxylation reactions: Pyruvate → Oxaloacetate&lt;br&gt;• It is a cofactor for fatty acid synthesis reactions: Acetyl co-A → Malonyl co-A</td>
<td>• Rash and diarrhea&lt;br&gt;• Caused by ingestion of raw eggs, as the egg white contains <em>Avidin</em> which binds biotin; inhibiting its absorption</td>
</tr>
<tr>
<td>Fluorine</td>
<td>• Main source is drinking water</td>
<td>• Deficiency: Dental caries&lt;br&gt;• Toxicity: Chalky white patches on teeth and osteosclerosis</td>
</tr>
<tr>
<td>Zinc</td>
<td>• Normal dietary intake is 6–16 mg/day, only 20% of which is absorbed</td>
<td>• Deficiency: Hair loss, paronychia, rash&lt;br&gt;• Toxicity: Neurological manifestations</td>
</tr>
<tr>
<td>Selenium</td>
<td>• Serves as an anti-oxidant</td>
<td>• Deficiency: Cardiomyopathy&lt;br&gt;• Toxicity: Hair loss, nail dystrophy</td>
</tr>
<tr>
<td>Copper</td>
<td>• A heavy metal</td>
<td>• Deficiency: <em>Menkes’ syndrome</em>; patients have <em>kinky sparse hair</em>.&lt;br&gt;• Toxicity: Hemolysis</td>
</tr>
</tbody>
</table>
3. Most common source of liver metastases: Colon cancer.
4. Most common sources of metastases to brain: Breast, lungs and prostate cancers.
5. Most common sources of metastases to bone: Breast, prostate, thyroid and kidney cancers.

- Preventive medicine and screening:
  1. Mammogram: Annually starting age 40.
  2. Pap smear: Annually after the onset of sexual activity till 3 successive normal smears are obtained, then it is done once every 3 years.
  4. Colonoscopy: Every 10 years starting age 50.
  5. PSA: Annually starting age 50.

- Vitamins and minerals: Refer to Table 1.13.
Chapter 2
Dermatology

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Skin Lesions

- **Macule**: A circumscribed area of discolored skin, no elevations or vesicles.
- **Papule (<0.5 cm) or nodule (>0.5 cm)**: A circumscribed area of a skin elevation.
- **Plaque**: A disc-shaped, elevated lesion greater than 2 cm in diameter.
- **Vesicle**: A fluid-filled lesion, less than 0.5 cm in diameter.
- **Bulla**: A fluid-filled lesion, more than 0.5 cm in diameter.
- **Wheat**: A rapidly-formed skin elevation caused by edema of the dermis. Pathognomonic of urticaria.
- **Comedone**: A plug in the sebaceous gland orifice. Seen in acne vulgaris.
- **Burrow**: A grayish, irregular, linear elevation of the horny layer of the skin. Pathognomonic of scabies.
- **Ulcer**: Loss of skin layers including the dermis, healing with a scar.
• **Abrasion or excoriation**: Superficial loss of skin layers, *not involving the dermis; no scar involved.*
• **Scar**: Connective tissue that replaces lost tissue anywhere in the body.

---

**Fungal Infections**

**Tinea Capitis (refer to Fig. 2.1)**

- **Introduction**: Ringworm of the scalp.
- **Organisms**: Dermatophyte, *Microsporum* or *Tricophyton*.
- **Clinical picture**: Lesions are *itchy*, well circumcribed, and are usually multiple on the scalp. They are oval in shape, of variable sizes, and contain hair stumps.
- **Prognosis**: Lesions heal *without scar* formation.
- **Treatment**: Oral antifungal, such as terbinafine, itraconazole or griseofulvin for 4–6 weeks.
- **Notes**:
  1. **Kerion**: A subtype of tinea capitis infections. Clinical picture: Red, warm, tender swelling with pustular discharge, often confused with an abscess. Treatment: No incision and drainage is needed, antifungals usually suffice.
  2. **Favus**: A subtype of tinea capitis infections. Clinical picture: *Saucer-shaped*, crusty lesions in the scalp, known as *scatula*. Scatula is yellow in color with reddish margins. Unlike other tinea infections, this one heals *with a scar* and could cause alopecia.

**Tinea Corporis (refer to Fig. 2.2)**

- **Introduction**: Ringworm of the trunk.
- **Organisms**: All dermatophytes can cause this disease.

**Tinea Pedis (refer to Fig. 2.3)**

- **Introduction**: Athlete’s foot.
- **Area involved**: Mostly in the interdigital spaces, but can occur anywhere in the foot.
- **Clinical picture**: *Itchy* erythematous macerated lesions.
- **Treatment**: Local antifungals. Oral antifungals are reserved for severe cases.

---

Fig. 2.1 Tinea capitis

Fig. 2.2 Tinea corporis

Fig. 2.3 Tinea pedis
**Tinea Unguium (Onychomycosis)**

- **Clinical picture**: Affects the nails, causing them to be white and brittle.
- **Treatment**: Oral terbinafine; 6 weeks for fingernails, and 12 weeks for toenails, plus local antifungals in severe cases.

**Tinea (Pityriasis) Versicolor (refer to Fig. 2.4)**

- **Organisms**: Malassezia furfur; a subtype of Pityrosporum orbiculare.
- **Area involved**: The trunk, usually the upper chest, neck and back.
- **Clinical picture**: Small, well-defined, scaling macules, of various colors. Some lesions are hypo-pigmented due to the azelaic acid produced by the fungus, which inhibits the melanocytes.
- **Diagnosis**: Examination of the lesions under Wood’s light shows yellow color. KOH skin scraping shows the hyphae and yeast in spaghetti and meatballs appearance.
- **Treatment**: Local with imidazole cream. Oral ketoconazole is reserved for severe cases.

**Candida Albicans**

- **Introduction**: Candida albicans exists in two forms:
  1. Yeast: As flora.
- **Predisposing factors**: Obesity, hyperhidrosis and DM.
- **Diagnosis**: Presence of the pathognomonic hyphae and pseudo-hyphae under microscope. Refer to Fig. 2.5.
- **Treatment**: Mainly local, with nystatins or imidazole. Oral ketoconazole is reserved for severe and resistant cases.
- **Notes**:
  1. **Cutaneous candidiasis**: Common in skin folds, e.g.: diaper rash. Lesions are red and moist with festooned edges, and are surrounded by papules known as Satellite lesions. Refer to Fig. 2.6.
  2. **Oral candidiasis (Thrush)**: Common in patients using inhaled steroids. Lesions are multiple white plaques involving the tongue and esophagus. Refer to Fig. 2.7. Prevention: Washing the mouth after using steroid inhalers.
  3. **Genital candidiasis**: The most common genital infection in females. Clinical picture: Whitish, milky vaginal discharge and curd-like patches. Genital candidiasis are treated by a single dose of oral fluconazole.
Most fungal infections could be easily treated with a topical antifungal, e.g.: imidazole cream or ointment; except for two infections that require systemic therapy: *Tinea capitis* and *Tinea unguium*. Griseofulvin attacks only dermatophytes, and causes GI upset. Ketoconazole and terbinafine are hepatotoxic.

### Viral Infections

#### Warts (refer to Fig. 2.8)
- **Introduction**: A common benign tumor from the epidermal layer of the skin.
- **Organism**: Human papilloma virus (*HPV*).
- **Clinical picture**: Starts as a papule and can occur at any part of the body. Commonly a cauliflower-like lesion; however it can occur in any shape or form.
- **Treatment**: Cauterization, either cryo, electrical or chemical using podophyllin resin in alcohol. *Topical imiquimod* is an alternative treatment.

#### Molluscum Contagiosum (refer to Fig. 2.9)
- **Organism**: Pox virus.
- **Area involved**: Mainly face and neck, but can also occur in the genital area.
- **Clinical picture**: Lesions are pearly white, umbilicated papules.
- **Diagnosis**: Identifying the inclusion molluscum bodies upon staining the contents of the lesion with Wright or Geimsa stains.
- **Treatment**: Lesions often regress spontaneously. Cauterization, either cryo, electrical or chemical using ether is reserved for non-resolving lesions.

#### Herpes Simplex (refer to Fig. 2.10)
- **Introduction**: Very common infection, mainly in children, age 2–5 years.
- **Organism**: Herpes simplex virus (*HSV*):
  1. *HSV* type I targets the eyes and mouth.
  2. *HSV* type II targets the genitals.
Clinical picture: Multiple crops of very painful and tender vesicles on an erythematous base. During the course of the disease, which usually lasts around one week, the vesicles rupture and lesions crust.

Treatment: Systemic Acyclovir for 5 days.

Herpes Zoster (refer to Fig. 2.11)

- Introduction: Also known as shingles. Occurs due to reactivation of a dormant varicella zoster infection, mostly in dorsal roots.
- Risk factors: Immunocompromised state with a positive history of chicken pox.
- Clinical picture:
  1. Chicken pox: Caused by varicella zoster. Lesions are arranged in crops of various lesions in different stages of development, all at the same time, i.e.: macules, papules, pustules, vesicles, crusted lesions.
  2. Shingles (Herpes zoster): The key for diagnosis here is the distribution of lesions, which follow dermatomes. The disease starts with severe burning pain and hyperesthesia, taking a dermatomal distribution, which is then followed by vesicular lesions in a similar distribution and not crossing the midline.

- Complications: The course of the disease is as long as 3–4 weeks, and is commonly followed by post-herpetic neuralgia.
- Treatment: Systemic Acyclovir for 10 days. Famciclovir and valacyclovir are other options.

- Notes:
  1. Vesicular lesions of chicken pox have a dewdrop on a rose petal appearance.
  2. Herpetic lesions in the cornea are irregular, dendritic and could be seen by slit lamp examination after application of fluorescin dye.
  3. Diagnosis of Herpes viruses: Tzanck smear, which shows multinucleated giant cells, and intranuclear inclusion bodies.
  4. Treatment of herpes with acyclovir does not cure the rash; it only shortens duration of the rash and decreases the risk of post-herpetic neuralgia.
  5. Acyclovir is not helpful if started after 24–48 hours from the onset of the rash.

Bacterial Infections

Impetigo

- Introduction: A contagious superficial pyogenic infection.
- Organisms: Staphylococcus aureus or Streptococci.
**Clinical picture:** Red macule, which progresses into a pustule. The pustule ruptures leaving a honey-colored crust, which heals without scar formation.

**Treatment:** Oral antibiotics, mainly penicillinase-resistant penicillins.

**Notes:**
1. Staphylococci release *exfoliatin* which can cause a bullous form of impetigo.
2. If impetigo becomes deep enough to cause ulceration, it is called *ecthyma*.

---

**Erythrasma**

**Clinical picture:** Red, scaly lesions found in skin folds, often confused with tinea.

**Diagnosis:** Examination of the lesions under Wood’s light shows red fluorescence. *Erythro* = Red.

**Treatment:** Oral tetracycline.

---

**Erysipelas**

- **Area involved:** Face and lower limbs.
- **Organism:** *Group A streptococci*.
- **Clinical picture:** A superficial, well-demarcated, red, warm cellulitis.
- **Treatment:** Oral antibiotics, mainly *penicillin or cephalosporins*. In case of penicillin allergy, treat with *erythromycin*.

---

**Erysipeloid**

- **Organism:** *Erysipelothrix rhusiopathiae*.
- **Risk factor:** The patient is usually a butcher or a fisherman who uses sharp objects contaminated with animal flesh.
- **Clinical picture:** Lesion is a small tender purplish area on the finger, where the injury with the sharp object has occurred.
- **Treatment:** Penicillin.

---

**Folliculitis**

- **Introduction:** Inflammation of the superficial part of the hair follicle.
- **Organisms:** *Staphylococcus aureus*, but *Pseudomonas aeruginosa* could also be blamed in some cases, e.g.: Hot tub folliculitis.
- **Predisposing factors:** Obesity, hyperhidrosis, DM.
- **Clinical picture:** Small, pustular lesions surrounding the hair follicles.
- **Treatment:** Oral antibiotics, mainly penicillinase-resistant penicillins. *Hot tub folliculitis is self resolving.*

---

**Furunculosis**

- **Introduction:** Inflammation of the deep part of the hair follicle.
- **Area involved:** Neck and buttocks.
- **Clinical picture:** Lesions are deep boils with pustular discharge.
- **Treatment:** Oral antibiotics and hot compresses. Incision and drainage is reserved for large, complicated lesions.
- **Note:** A collection of furuncles is known as a *carbuncle*.

---

**Hidradenitis Suppurativa**

- **Introduction:** Local inflammation of the *apocrine glands* in the axilla and groin.
- **Organism:** *Staphylococcus aureus*.
- **Clinical picture:** Reddish, painful nodules in the axilla or groin.
- **Treatment:** Oral antibiotics, *tetracycline* is best. Surgical drainage and debridement is also needed.

---

**Paronychia (refer to Fig. 2.12)**

- **Introduction:** Inflammation of the periungual tissue.

---

**Fig. 2.12 Paronychia**
Predisposing factors: A hangnail or ingrown toenail.

Clinical picture: The paronychial fold is erythematous, swollen and tender.

Treatment: Hot compresses and penicillinase-resistant penicillin.

Lupus Vulgaris

Introduction: The most common form of cutaneous TB lesions.

Area involved: Face and neck.

Clinical picture: Lesions are nodular plaques. Pressing the lupus vulgaris lesion with a glass slide reveals a characteristic brownish apple jelly color. This type of test is known as diascopy.

Treatment: TB treatment.

Parasitic Infections

Scabies

Organism: Sarcoptes scabiei.

Area involved: Interdigital spaces; however, can occur anywhere.

Clinical picture: Lesions start as burrows which are extremely itchy, especially at night. This leads to inflammation and even pustules in some severe cases.

Diagnosis: Visualizing burrows and mites on an oil mount under microscopy.

Treatment: Topical permethrine or lindane, and boiling clothes and bed sheets.

Notes:
1. Scabies incognito is one form of scabies that flares up with steroids.
2. Children with scabies do not necessarily have burrows.

Pediculosis (Lice)

Pediculosis capitis: Infects the scalp and looks just like dandruff, except that the eggs cannot be easily pulled off the hairs. Treatment: Topical permethrin.

Pediculosis corporis: Infects the body. Treatment: Topical lindane.

Pediculosis pubis (a.k.a. Phthirius pubis): Infects the pubic area and inner thighs. The most common form of transmission is sexual contact. Treatment: Topical lindane. A common scenario on the USMLE would be finding Phthirus pubis in the eyelashes of a child upon examination, and the correct course of action is to assume sexual abuse until proven otherwise.

Note: Lindane is contraindicated in pregnancy and in children as it might cause CNS toxicity. The alternative treatment in both cases is permethrine.

Acne Vulgaris

Introduction: Inflammation of the pilosebaceous glands; common in adolescents.

Area involved: Face, chest and back.

Clinical picture: Comedones which might progress to papules or even pustules.

Pathology: The exact etiology of acne is not clear; however some theories suggest a link to hormonal imbalance, mainly increased androgens. Others link acne to infection with Propionibacterium acne.

Treatment:
1. Treatment of comedones: Topical retinoids.
2. Treatment of papules or pustules: Topical benzoyl peroxide plus topical antibiotics, mainly clindamycin or erythromycin.
3. In severe cases, intralesional steroid injection or oral antibiotics, such as tetracycline or erythromycin may be added.

Acne Rosacea

Introduction: An inflammatory skin disease that is common in the middle part of the face and is common in the middle age group.

Clinical picture: Erythema, telangiectasia and papules.

Complications: Nose hypertrophy a.k.a. rhinophyma.

Treatment: Oral tetracyclines and topical metronidazole.

Allergic Skin Diseases

Eczema

Introduction: Allergic type IV hypersensitivity reaction of the skin to any factor:
1. Extrinsic forms, i.e.: contact dermatitis, secondary to allergens or irritants like poison ivy, and the eczema ensues at least 4 or 5 days after contact, never immediately afterwards.
2. Intrinsic forms of eczema are multiple and complicated, the most famous being atopic dermatitis, seborrheic dermatitis and pityriasis alba.
General clinical picture: Lesions are always itchy and could form scales as they turn chronic.

Patch test: Eczema is evaluated by testing different substances on the skin in diluted concentrations and noting their effect.

Treatment: Topical corticosteroids, plus H1 blockers.

Atopic dermatitis: refer to Fig. 2.13.

1. A genetic dermatitis, and patients usually have other forms of allergy, such as asthma and allergic rhinitis.
2. Lesions are erythematous and oozing, mainly on ante-cubital and popliteal fossae in children of 2 months up to 6 years of age.
3. These lesions may form papules and develop lichenification.

Seborrheic dermatitis: refer to Fig. 2.14.

1. Occurs mainly, as the name suggests, in areas with sebaceous glands, e.g.: Scalp and eyebrows.
2. Lesions are yellowish, greasy and scaly.
3. Make sure to ask about risk factors for HIV in any young patient with these lesions.
4. Cradle cap is seborrheic dermatitis that affects the scalp of newborns and can be treated with shampoos containing selenium or zinc.

Pityriasis alba: A form of eczema that occurs mainly in children and is notorious, as the name suggests, for the white patches on the face, often confused with vitiligo.

Urticaria

Clinical picture: A wheal-shaped, cutaneous antigen-antibody reaction, mainly in the dermis. The wheals are pale, elevated, rounded and surrounded by erythematous zone and are intensely pruritic. Refer to Fig. 2.15.

Causes: Factors to blame for urticaria are endless; any contact with or ingestion of a substance can lead susceptible patients to develop urticaria.

Treatment: H1 blockers and avoidance of the cause, if known.

Note: Angioedema is a fatal form of urticaria that involves the subcutaneous tissue. Patients become diffusely swollen very quickly, and death may result from laryngeal edema, so look for stridor. Treatment: Epinephrine (life saving), steroids, H1 and H2 blockers. In recurrent angioedema of unclear
cause, consider hereditary angioedema by checking for Cl esterase inhibitor deficiency.

**Erythema Multiforme**

- **Introduction:** A skin reaction to infections or drugs.
- **Clinical picture:**
  1. **The minor form:** Characterized by target-shaped lesions known as or iris-lesions, which are skin lesions that look like a bull’s eye. Just like eczema, lesions start 4 or 5 days after the infection or ingestion of the drug. Refer to Fig. 2.16.
  2. **The major form (Stevens’s-Johnson syndrome):** Characterized by diffuse bullae, mainly around the mouth and eyes. In severe cases, renal failure and fatal pneumonitis may occur.

  - **Skin biopsy:** Necrotic keratinocytes and extensive lymphocytosis.
  - **Treatment:** Systemic corticosteroids, and avoidance of the cause if known.

**Erythema Nodosum (refer to Fig. 2.17)**

- **Pathogenesis:** Inflammation of the dermis and subcutaneous fat.
- **Causes:** Sarcoideal, inflammatory bowel diseases, tuberculosis, streptococcal infections, malignancy and drugs, e.g. OCP. Of all these causes, streptococcal infection is the most common underlying cause.
- **Clinical picture:** Red, tender nodules that occur in the pretibial region.
- **Treatment:** Treat the cause plus NSAIDS.
- **Note:** Erythema nodosum in a case of sarcoidosis is a good prognostic sign.
Toxic Epidermal Necrolysis

- **Introduction**: One of the most severe drug reactions.
- **Clinical picture**: Epidermis peels off in sheets, leaving painful erythematous lesions. This occurs even with gently touching the skin; a.k.a. Nikolsky’s sign.
- **Treatment**: Hospitalize the patient, stop the offending medication and start systemic corticosteroids.
- **Note**: Toxic epidermal necrolysis is often confused in the clinical wards with staphylococcal scalded skin syndrome. They share similar symptoms, signs and Nikolsky’s sign. The latter, however, occurs mainly in newborns and is treated with penicillinase resistant penicillin.

Medication-Induced Skin Diseases

- **Tetracycline**: Photosensitivity, pruritis and dermatitis.
- **Warfarin**: Skin necrosis through depleting protein C stores. This usually develops after about a week from starting the warfarin.
- **NSAIDs**: Toxic epidermal necrolysis, urticaria or Steven’s Johnson syndrome.
- **OCPs**: Erythema nodosum and erythema multiforme.

Scaly Papular Diseases

Psoriasis (refer to Fig. 2.18)

- **Introduction**: A chronic skin disease which is only cosmetically disturbing and slightly itchy.
- It is genetically determined, namely HLA-B13 linked.
- **Pathology**: There are two important phenomena involved:
  1. Parakeratosis: Excessive proliferation of stratum basale and spinosum.
  2. Acanthosis: Retention of nuclei of superficial skin layers.
- **Area involved**: Extensor surfaces, mainly the knees and elbows.
- **Clinical picture**:
  1. Papular lesions, covered with the pathognomonic silvery scales.
  2. Nail pitting, and lifting of nail plate a.k.a Onycholysis.
  3. Asymmetrical arthritis that affects the distal interphalangeal joints (DIP); it shows on X-ray as a pencil in a cup.
  4. Koebner’s phenomenon: Development of lesions at sites of trauma or abrasion.
  5. Auspitz sign: Removal of scales reveals underlying pin-point bleeding.
- **Treatment**:
  1. Most lesions: Topical corticosteroids or topical vitamin D analogues.
  3. Resistant cases: Ultraviolet light or oral methotrexate.

Pityriasis Rosea (refer to Fig. 2.19)

- **Introduction**: An inflammatory, self-limited disease.
- **Clinical picture**:
  1. Starts with the pathognomonic herald patch, which is an oval, red patch on the trunk.
  2. Few days later, generalized patchy skin lesions follow, sparing the extremities. Lesions are well known for their Christmas tree distribution as they line themselves parallel to the ribs.
- **Prognosis**: The disease resolves spontaneously within 1–2 months.
- **Treatment**: Symptomatic.

Lichen Planus (refer to Fig. 2.20)

- **Introduction**: Papular, pruritic skin disease; more common in females.
- **Area involved**: Inner thighs and wrists.
**Clinical picture:** Lesions are polygonal papules with a purplish color, sometimes covered with white lines known as Wickham’s striae.

**Treatment:** Topical corticosteroids and H1 blockers.

---

**Actinic (Senile) Keratosis (refer to Fig. 2.21)**

- **Introduction:** A pre-malignant skin lesion.
- **Clinical picture:** Patient is usually elderly presenting with discrete, scaly papular lesions only on sun exposed areas.
- **Prevention:** Sun screen before sun exposure.
- **Treatment:** Cryo-cauterization or 5-fluorouracil.
- **Note:** All actinic keratosis lesions should be biopsied, due to the potential of their transformation to squamous cell carcinoma.

---

**Malignant Skin Diseases**

**Basal Cell Carcinoma (BCC) (refer to Table 2.1 and Fig. 2.22)**

**Squamous Cell Carcinoma (SCC) (refer to Table 2.1 and Fig. 2.23)**

**Melanoma (refer to Fig. 2.24)**

- **Introduction:** Common in fair skinned individuals, due to sun exposure.
- **Pathology:** Lesions arise from the melanocytes of the stratum basale.
- **Risk factors:** Dysplastic nevi.

---

**Table 2.1 Basal and squamous cell carcinomas of the skin.**

<table>
<thead>
<tr>
<th></th>
<th>BCC</th>
<th>SCC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Layer</td>
<td>Epidermal basal cells</td>
<td>Epidermal keratinizing layer</td>
</tr>
<tr>
<td>Cause</td>
<td>Exposure to UV light</td>
<td>Transformation of premalignant lesions, e.g.: actinic keratosis, scars.</td>
</tr>
<tr>
<td>Macroscopic</td>
<td>Pearly translucent papule</td>
<td>Exophytic nodule with raised everted edges</td>
</tr>
<tr>
<td>Microscopic</td>
<td>Palisade pattern</td>
<td>Cell nest pattern, deep down to the dermis</td>
</tr>
<tr>
<td>Metastases</td>
<td>Locally malignant</td>
<td>Distant metastases</td>
</tr>
<tr>
<td>Treatment</td>
<td>Surgical excision</td>
<td>Surgical excision</td>
</tr>
</tbody>
</table>
**Metastases:** Distant metastases via blood, especially to the brain.

**Clinical picture:** Lesions are brownish in color, and are characterized by one or more of the following:

1. A: Asymmetrical.
2. B: Irregular Border.
3. C: Color changes.
4. D: Diameter of more than 6 mm.

- **Microscopically:** Lesions show melanocytes with malignant characteristics.
- **Prognosis:** The most important prognostic factor is the depth of the lesions.
- **Treatment:** Surgical excision, and chemotherapy with interleukin-1.
- **Note:** Melanoma of the Scalp, Neck, Arm and Back – SNAB – carry worse prognosis.

**Miscellaneous**

**Vitiligo**

- **Introduction:** Depigmentation disease of unknown etiology.
- **Clinical picture:** Lesions are white and macular and occur anywhere in the body. Vitiligo is not pruritic, which helps you differentiate it from other depigmenting skin diseases, e.g., Pityriasis alba.
- **Treatment:** Cosmetic, topical steroids and ultraviolet A light.
- **Note:** Vitiligo could be part of a polyglanular deficiency, so screen for other autoimmune diseases.

**Pemphigus Vulgaris (refer to Fig. 2.25)**

- **Introduction:** Autoimmune disease due to an anti-epithelial antibody destroying the desmosomes.
- **Pathology:** Desmosomes normally pull the epidermal cells together, so when they are destroyed, bullae develop. This phenomenon is called Acantholysis.
- **Clinical picture:** Bullous skin lesions.
- **Treatment:** Systemic corticosteroids.
Note: Blistering of the skin could happen sometimes in healthy individuals after minor trauma; this is known as **Epidermolysis Bullosa**.

**Acanthosis Nigricans**

- **Clinical picture**: Hyperpigmented skin lesions that occur in skin folds, e.g.: axilla.
- **Note**: These lesions are indicative of:
  1. GI malignancy: Mainly gastric.
  2. Endocrine disorders: Mainly insulin resistant DM.

**Lipoma**

- **Introduction**: A benign tumor of the adipose tissue.
- **Clinical picture**: Patient presents with soft lobulated tumor.
- **On exam**: Two pathognomonic signs:
  1. **Dimpling of the skin** on displacing the tumor.
  2. **Slippery edge** on palpation: This is because the tumor is surrounded by two capsules.
- **Complications**:
  1. Intraluminal: Airway obstruction, intussusceptions.
  2. Others: Cosmetic, malignant transformation (rare).
- **Treatment**: Enucleation.

**Keloid**

- **Introduction**: Hypertrophied scar tissue, more common in African-Americans.
- **Clinical picture**: Patient presents with skin growth at the site of a scar from previous trauma or surgery.
- **Treatment**:
  1. Active (erythematous and pruritic): Topical steroids.
  2. Inactive (non-erythematous and non-pruritic): Excision.

**Fibrosarcoma**

- **Introduction**: A malignant tumor that arises from the muscles and tendons.
- **Clinical picture**: Well defined, un-capsulated smooth firm muscular swelling.

**Diagnosis**: Muscle biopsy.

**Next best step**: Chest X-ray to look for metastases.

**Treatment**:

1. Non-metastatic: Wide local excision of tumor, or amputation of the whole limb if bone is involved.

**Desmoid Tumor**

- **Introduction**: A fibrosarcoma of the rectus sheath of the abdomen, a.k.a. Paget disease of rectus sheath.
- **Clinical picture**: A tumor in the abdominal wall, below the level of the umbilicus that protrudes more with contraction of abdominal muscles.
- **Metastases**: Local infiltration only.
- **Treatment**: Wide local excision.

**Dermoid Cyst**

- **Introduction**: A cutaneous cyst that forms due to excessive epithelial growth.
- **Pathology**: Lined by squamous epithelium, filled with sebaceous material, and covered by a fibrous capsule.
- **Clinical picture**: Cystic, mobile, painless swelling, usually at the site of a previous needle prick or injury.
- **Complication**: Intracranial extension.
- **Treatment**: Excision after an X-ray to rule out intracranial extension.

**Sebaceous Cyst**

- **Introduction**: A retention cyst, due to obstructed sebaceous gland’s duct.
- **Clinical picture**: Well defined cystic swelling, usually on the face, which opens up into the surface via a punctum.
- **Complications**: Infection or malignant transformation.
- **Treatment**: Elliptical excision, which must include the punctum.
Human Chorionic Gonadotrophin (HCG)

- **Definition**: A glycoprotein secreted by syncytiotrophoblast.
- **Production**: It starts at implantation (7 days after fertilization) and its levels double every 2 days till it peaks at around 10 weeks gestational age (1,000,000 Units). After the peak, level decreases as the pregnancy progresses to full term.
- **Detection**: By urine analysis (Standard pregnancy test), or by measuring the beta subunit of HCG in serum (More sensitive and specific).

**Uses of HCG**:

1. Diagnosis of pregnancy: Appears in the urine 8 days after fertilization.
2. Diagnosis and follow up of some ovarian and trophoblastic tumors.
3. Evaluation of threatened abortion: If levels are doubling every 2 days, pregnancy is still intact. If no doubling, suspect missed abortion. Explained in detail later.

**Functions of HCG**:

1. Maintains corpus luteum until placental function is well established. (10 weeks).
2. Stimulates fetal testicular function in utero if the fetus is male.

- **Note:** Progesterone production during pregnancy:
  1. During the first 7 weeks: Corpus luteum.
  2. From 7 to 10 weeks: Corpus luteum and Placenta.
  3. 10 weeks onwards: Placenta.

**Human Placental Lactogen (HPL)**

- **Definition:** A polypeptide, which is very close in composition to prolactin.
- **Production:** It starts rising immediately after the missed period, and levels rise up to 7 Ug/ml by 36 weeks gestational age.
- **Uses of HPL:** Good indicator of the functioning placental mass, so it is useful in some cases of high risk pregnancy, e.g., HTN or postmaturity; however, it is of little value in cases of large placenta, e.g., Diabetes mellitus or Erythroblastosis fetalis.
- **Functions of HPL:**
  1. Similar to growth hormone and prolactin: Stimulates growth of breasts.
  2. Inhibits glucose and protein metabolism by mother, sparing them for the fetus.

**Feto-Placental Unit**

- **Composition:** The co-operation of:
  1. Fetus: Through 16 Hydroxy-dehydroepiandrosterone-sulphate (DHEAS)
  2. Maternal placenta: Through her DHEAS
- **End result:** Estrogens, and it is a considered a good test of fetal well-being.
- **Normally:** (Estrone): E2 (Estradiol): E3 (Estriol) = 1:2:3. In pregnancy, the ratio of E1:E2:E3 is 1:2:30.

**Gametogenesis**

- Refer to Figs. 3.1, 3.2 and 3.3
- **Spermiogenesis:** The process by which spermatids are converted to mature sperm.
- **The sperm’s parts:**
  1. **Head:** Covered by an acrosomal cap and contains the genetic material.
  2. **Middle segment:** Composed of mitochondria.
  3. **Tail:** For movement.
• Note: The acrosomal cap is derived from the *golgi apparatus*, and the tail is derived from the *centriole*.

**Fertilization**

• **Definition**: The union of male and female gametes to form the zygote.
• **Timing**: The first 24 h after ovulation.
• **Location**: Most common site is the lateral 1/3 of the Fallopian tube, namely the *ampulla*.
• **Steps**:
  1. Physiologically, after the sperm pierces the zona pellucida, zonal block occurs to prevent further penetrations and, similarly, when the sperm penetrates the vitelline membrane, vitelline block occurs. *Failure of the block systems results in multiple pregnancy.*
  2. Once the sperm comes into contact with the *zona pellucida* of the secondary oocyte, the sperm pronucleus forms and the mitochondria degenerates.
  3. This triggers oogenesis as mentioned earlier, and the female pronucleus is formed.
  4. Both pronuclei fuse to form the zygote.

**Implantation**

• The zygote (*Post fertilization day 2*) undergoes mitosis repeatedly to form the *blastula*, then a *morula* (*32 cell stage*, *post fertilization day 3*).
• The morula secretes fluid creating an internal cavity separating into two masses of cells. This structure is called the *blastocyst* (*day 5*). The inner cell mass is the *embryoblast*, and the outer is *trophoblast*.
• The zona pellucida then degenerates to allow the blastocyst to implant in the *posterior superior wall of the uterus* by post fertilization day 6 or 7.
• Afterwards, the trophoblast undergoes a differentiation process into syncytiotrophoblast and cytotrophoblast and forms villi.
• The invasion of the trophoblast into the endometrium is limited by the *fibrinoid (Nitabuch) layer*. Absence of this layer leads to pathological adherence of placenta.

**Amniotic Fluid**

• **Formation**: From fetal and maternal contributions:
  1. Fetal: *Urine* starting during the *10th week*.
• **Maximum volume**: 1000 ml and is normally reached by the *36th week* of gestation.
• **Composition**:
  1. Mainly water with some glucose and proteins.
  2. Sodium and bilirubin content of the fluid *decrease* throughout pregnancy.
  3. Creatinine and phospholipids content of the fluid *increase* throughout pregnancy.
• **Oligohydramnios**: Fluid <400 ml. Causes: Premature rupture of membranes (*most common cause*), renal agenesis (Potter syndrome), or posterior urethral folds.
• **Polyhydramnios**: Fluid >2000 ml. Causes: Esophageal atresia, anencephaly or maternal DM.
• **Amniotic band syndrome**: Bands in the amnion form in this syndrome. The fetus suffers *craniofacial anomalies, adhesions and amputations*.

**Placenta**

• **Composition**:
  1. Maternal: *Decidua basalis*.
  2. Fetal: *Chorion frondosum* or tertiary villi.
• **Surfaces**: The maternal surface has a *cobblestone appearance* and contains approximately 20 cotyledons, while the fetal surface is *smooth and membranous*. 

**Umbilical Cord**

• **Composition**: Is around 50 cm long and has important components:
  1. Right and left umbilical arteries.
  2. Left umbilical vein: Carries oxygenated blood to the fetus.
  3. Connective tissue, *e.g.*, Wharton jelly, allantoic duct, and amniotic epithelium.
• **Note**: The presence of a single umbilical artery in the cord (5%) is common in *pregnant patients with DM*, and is associated with *fetal cardiovascular anomalies and Edward’s syndrome*.
• **Abnormalities of the cord after delivery**
  1. Patent urachal fistula: Presents with *urine* from the umbilicus.
  2. Vitelline fistula: Presents with *meconium discharge* from the umbilicus.
  3. Omphalocele: A *grey sack* surrounding the umbilicus.
- **Parts:**
  1. In early pregnancy, the placenta is formed of:
     - Syncytiotrophoblast.
     - Cytotrophoblast.
     - Connective tissue.
     - Endothelium of fetal blood vessels.
  2. In late pregnancy, the placenta is formed only of the syncytiotrophoblast and endothelium of fetal blood vessels.

- **Pathological forms of placenta:**
  1. **Placenta Succentriata:** Accessory lobe, which may be retained and cause post-partum hemorrhage.
  2. **Placenta Circumvallata:** Chorionic plate is smaller than decidual plate, which may lead to abortion. The placenta will have a white decidual ring on its margin.
  3. **Placenta membranacea:** A large membranous placenta due to persistence of the chorion leave. May be associated with vasa previa, leading to antepartum hemorrhage.
  4. **Small placenta:** as in Pre-eclampsia, or large placenta: as in DM or Syphilis.
  5. **Pathological adherence (due to absent Nitabuch layer):**
     - Placenta accreta: Implants deep down into muscle layer of uterus.
     - Placenta increta: Placenta penetrates through muscle layer.
     - Placenta percreta: Placenta completely perforates the uterus.
  6. **Abnormal cord attachments:** Central, marginal or velamentous (in membranes). The latter is associated with Placenta membranacea, and if the traversing vessels pass below the presenting part (vasa previa), antepartum hemorrhage of fetal origin could ensue and is a medical emergency.

- **Notes:**
  1. *The placenta lacks MHC antigens, so it does not elicit an immune response from the mother, preventing immunologic rejection.*
  2. Dizygotic twins have 2 placentae, 2 chorions and 2 amnions.

3. Monozygotic twins (in most cases) share a placenta, chorion, but have 2 amnions.

### Blood

- Refer to Table 3.1 for the differentiating points between fetal and maternal blood.

### Amniocentesis

- **Definition:** Tapping of the amniotic fluid for diagnostic or therapeutic purposes.
- **Early amniocentesis (16–18 weeks):**
  1. For diagnosis of chromosomal abnormalities.
  2. For diagnosis of neural tube defects by measuring Alpha-fetoprotein (AFP) in the amniotic fluid or the maternal serum, also known as (MSAFP):
     - High AFP (>2.5 mom): Anencephaly or Spina bifida
     - Low AFP (<0.4 mom):
       1. Down syndrome (Trisomy 21) *(Low AFP, Low estriol, High B-HCG)*
       2. Edward syndrome (Trisomy 18) *(Low AFP, Low estriol, Low B-HCG)*
- **Late amniocentesis (3rd trimester):**
  1. For estimation of fetal lung maturity. Indicators of lung maturity include:
     - Lecithin/Sphingomyelin ratio > 2:1.
     - Phosphatidylglycerol content of 1% (last substance to appear in fluid).
     - Fluid creatinine level of 2 mg/dL or more.
     - Absence of bilirubin in the amniotic fluid.
  2. For amniography: A dye injection in the fluid for placental localization.
- **Therapeutic amniocentesis:** For polyhydramnios or inducing abortion.
- **Complications of amniocentesis:** Injury to internal organs or blood vessels, or premature rupture of membranes (PROM).

#### Table 3.1 Fetal and maternal blood.

<table>
<thead>
<tr>
<th>Type of Blood</th>
<th>Alkali Denaturation Test</th>
<th>Kleihauer Betke Test</th>
<th>Nucleated RBC’s</th>
<th>Hemoglobin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fetal</td>
<td>Pink</td>
<td>Red</td>
<td>Positive</td>
<td>HBF</td>
</tr>
<tr>
<td>Maternal</td>
<td>Brown</td>
<td>Ghost cells</td>
<td>Negative</td>
<td>HbA</td>
</tr>
</tbody>
</table>
Diagnosis of Pregnancy

**Symptoms**
1. Amenorrhea, morning sickness, breast enlargement, and appetite changes, e.g., *Longing*.
2. Quickening: Fetal movements could be felt starting at the 16th week in multiparous, and the 18th week in nulliparous women.

**Signs**
1. Breast enlargement and increased areolar pigmentation.
2. Jaquemier sign: Vulva is soft and hyperpigmented.
3. Chadwick sign: Vagina is soft, warm and hyperpigmented.
4. Goodell sign: Cervix is enlarged, soft and hyperpigmented.
5. Palmer sign: Early uterine contractions, which disappear throughout pregnancy.
6. Hegar sign: Soft lower uterine segment (you can approximate one hand in the anterior fornix to another on the abdomen behind the uterus).
7. Fetal heart sounds, uterine souffle, and palpation of fetal body parts: In second and 3rd trimester.

**Diagnosis**: B-HCG and ultrasound of the uterus.

Maternal Changes During Pregnancy

**Genital Tract**
- **Cervix, vagina and vulva**: Jaquemier, Chadwick and Goodell signs.
- **Uterus**: Weight increases from 50 g to almost 1 kg and it becomes ovoid in shape.
  1. At 12 weeks gestation: Fundus is at the level of public symphysis.
  2. At 24 weeks gestation: Fundus is at the level of the umbilicus.
  3. At 36 weeks gestation: Fundus is at the xiphoid process.
- The uterus performs fine contractions which can be felt by bimanual examination in early pregnancy (*Palmer sign*). These contractions decrease in frequency as the pregnancy progresses, and re-occur prior to labor (*Braxton Hick contractions*).
- The lower uterine segment becomes soft during pregnancy (*Hegar sign*), and it can be differentiated from the upper segment because it is thin with loose adherence of membranes and is passive (*Upper segment is thick and it can contract*).
- **Ovaries and Fallopian tubes**: Increased size and vascularity; also a pregnancy-induced luteoma may form in the ovaries, secreting androgens leading to maternal virilization.

**Breast Glands**
- **First few weeks**: Increased size and vascularity.
- **2nd month**: Increased pigmentation of primary areola and appearance of Montgomery tubercles.
- **3rd month**: Colostrum can be expressed.
- **6th month**: Increased pigmentation around the primary areola (*secondary areola*).

**Cardiovascular and Pulmonary Systems**
- Plasma volume increases by 50%, while RBCs count increases by 25%; thus, physiological hemo-dilution occurs. (A pregnant patient is anemic if Hb <11 g/dL).
- Increase in WBC count in mild degree is expected in pregnancy.
- Coagulation factors I to X are increased, while factor XII is decreased.
- ESR is increased during pregnancy, due to high levels of fibrinogen.
- Cardiac output is increased by 30%–40% (*Hyperdynamic circulation*).
- Blood pressure decreases during 2nd trimester due to decreased peripheral resistance.
- There is increased liability of formation of varicose veins, due to the vasodilatory effect of progesterone and compression of the gravid uterus.
- Pressure effect of the gravid uterus on the diaphragm throughout pregnancy causes:
  1. Decreased: Total lung capacity (*TLC*), Residual Volume (*RV*) and Expiratory Reserve Volume (*ERV*)
  2. Increased: Tidal Volume (*TV*), and mild respiratory alkalosis (Increased pH)

**Gastrointestinal System**
- **Stomach**: Decreased gastric acid production; however, there is also decreased gastric emptying, so pregnant patients commonly complain of dyspepsia.
- **Morning sickness**: Disappears by the 16th to 18th week.
- **Longing**: Due to vasodilatation of nasal blood vessels.
- **Hemorrhoids**: Due to progesterone effect.
- **Hepatic**: Increase in liver enzymes, and cholestasis leading to itching.
Urinary System
- **Increased**: GFR, renal blood flow, glucosuria, aminoaciduria and loss of water-soluble vitamins in urine.
- **Decreased**: Serum levels of urea and creatinine.

Endocrine System
- **Increased**:
  1. Size – *without proportionate increase in vascularity* – of pituitary gland, hence the risk for Sheehan syndrome. See endocrine section of IM.
  2. Serum prolactin levels.
  3. Thyroid binding globulin, hence an increase in bound thyroid hormones (physiological goiter). *Note: Free thyroxin levels are within normal limits.*
- **Decreased**: FSH and LH levels.

Skin
- Chloasma gravidarum: Butterfly pigmentation of the face, due to placental and adrenal steroids.
- Striae gravidarum on the abdomen and buttocks: Due to rupture of elastic fibers.
- Divarication of recti, especially in obese pregnant.
- Linea nigra in midline, spider angiomata and palmar erythema.

Metabolic Changes
- **Body weight**: Increased by an average of 12.5 kg (25–30 lbs), mainly in the second half of pregnancy.
- Pregnancy hormones have anti-insulin effect, so pregnancy is linked to impaired glucose tolerance and glucosuria.
- **Increased**: Serum cholesterol, fat-soluble vitamins, and immunoglobulins A and M.
- **Decreased**: Water-soluble vitamins.

Antenatal Care
- **Target**: Early diagnosis and treatment of any high risk pregnancy.
- **Inconsistent fundal height (fundus too high)**: Most commonly due to incorrect dating of the pregnancy, multiple gestation, or polyhydramnios.
- **Inconsistent fundal height (fundus too low)**: Most commonly due to incorrect dating of the pregnancy, intrauterine growth retardation, fetal death, or oligohydramnios.
- **Test all pregnant women for rubella**: High levels of IgM against Rubella indicate an active infection. Fixed elevated levels of IgG denote immunity.
- **Vaccination**: Only tetanus is indicated. Live attenuated vaccines (e.g., MMR) are contraindicated. Other vaccines (e.g., Yellow fever, rabies) are given only if there is a strong indication.
- **Dietary daily supplementation during pregnancy**:
  1. Daily caloric requirements are 2200 Kcal/day.
  2. Calcium: 1 gm/day.
  3. Folic acid: 1 mg/day. Folic acid def. anemia puts the fetus at risk of neural tube defects, e.g., Anencephaly, spina bifida.
  4. Iron: 60 mg/day. During pregnancy, the mother needs an extra 800–1000 mg of iron compared to non-pregnant women. It is best to supplement an additional 30–60 mg of Fe daily, as only 10% of oral Fe is absorbed.
- **Urine analysis**: Urine should be checked as a routine test in antenatal care visits to rule out urinary tract infection. It is common for pregnant patients to develop asymptomatic bacteriuria leading to severe complications, so treatment is warranted (even when asymptomatic).

Assessment of Fetal Wellbeing
- **Clinical picture**:
  1. Ten or more fetal movements in a 12-h period (starting 32 weeks onwards).
  2. Progressive weight gain and increase in abdominal girth.
  3. Progressive increase in fundal height.
- **Serology**: Serial measurements of HCG, HPL and Estriol (E3) levels.
- **Other tests**: Described below in detail.

Ultrasound
- To measure the gestational sac diameter (*to exclude Anembryonic pregnancy*), and to measure the crown-rump length.
- To measure body diameters; most importantly the head circumference (used to estimate gestational age), and Biparietal diameter (BPD).
- To assess fetal body growth in order to diagnose Intrauterine Fetal Growth Retardation (IUFGR), which has two types. Refer to Table 3.2.
Cardiotocography (CTG)

- **Introduction**: Performed after 32 weeks gestation to assure maturity of fetus, and assess relation of fetal heart rate to uterine contractions.
- **CTG scoring**: ≥ 8 out of 10 is satisfactory. If <8, it has to be repeated every 2 days.
- **Normal parameters**:
  1. Fetal heart rate is 120–160 bpm, with beat to beat variability.
  2. Accelerations (Best sign of fetal well being): Reflex fetal tachycardia in response to fetal movements.
  3. Decelerations: There are three types: Refer to Fig. 3.4
     - **Type 1 (Early)**: Bradycardia that occurs simultaneously with uterine contractions, due to a vagal nervous reflex.
     - **Type 2 (Late)**: Bradycardia that occurs after a uterine contraction, due to transient cessation of placental blood flow with uterine contraction, leading to transient fetal anaerobic metabolism.
     - **Variable deceleration**: Mechanical, due to cord compression, in which vein compression leads to reflex tachycardia, followed by artery compression leading to hypertension and bradycardia. Amnioinfusion might be needed in some cases to overcome this problem.

### Non Stress Test

- **Reactive**: At least 2 accelerations (of at least 15 bpm) in a 20-min period.
- **Non reactive**: Less than 2 accelerations (of at least 15 bpm) in a 20-min period.

### Intrapartum Assessment of Fetal Wellbeing

- Monitoring of fetal heart rate.
- Meconium staining of amniotic fluid is a poor prognostic sign, but not specific.
- Fetal scalp pH measurement (Normal >7.25): If <7.2 think acidosis.

### Abortion

- **Definition**: The termination of pregnancy before 20 weeks gestation.
- **Causes**:
  1. Fetal (e.g., Chromosomal or placental abnormalities). This is the most common cause of 1st trimester abortions.
  2. Maternal: General (e.g., Infections/hormonal), or structural (e.g., Patulous Os or hypoplastic uterus).
- **Clinical picture**: Amenorrhea, followed by abdominal pain and vaginal bleeding.
- **Notes**:
  1. Most common fetal genetic disease to cause abortion: Trisomy 16.
  2. Most common infection to cause abortion in early pregnancy: Mycoplasma Hominis.
- **Types of abortion**: Discussed below in detail.

### Threatened Abortion

- **Definition**: Slight hemorrhage into the choriodecidual space. Stops spontaneously in most cases.
- **Pelvic exam**: Closed cervix.
- **Next best step**: B-HCG measurement and monitoring (Should double every 2 days. If no doubling, consider missed abortion).
- **Treatment**:
  1. Resuscitation and physical rest.
  2. Tocolytics (Anti-PG and B2 agonists) to relax the uterus: Used in 2nd trimester abortion cases only.
  3. 17-OH Progesterone: Used only if the cause is corpus luteum insufficiency.

### Inevitable Abortion

- **Clinical picture**: The fundal level corresponds to the period of amenorrhea (correct height), but the pelvic exam reveals an open cervix, and products of conception protruding through the os.
Treatment:
1. Resuscitation.
2. Evacuation of the uterine contents:
   - 1st Trimester: Suction or D&C (Dilatation and Curettage).
   - 2nd Trimester: Prostaglandins (PG) (Best Choice) or Oxytocin.

Note: Incomplete abortion presents in the same manner as an inevitable abortion; however, in the latter case, the uterus has already expelled some of its contents, so the fundal height will be less than period of amenorrhea. In complete abortion, the uterus has already expelled all products of conception.

Septic Abortion
Definition: Caused by superimposed infection complicating any type of abortion.
Most common organism: Group B Streptococcus, but also consider anaerobes or Staphylococcus.
Clinical picture:
1. Period of amenorrhea, followed by abdominal pain and vaginal bleeding.
2. Fever and malodorous vaginal discharge.
3. Lower abdominal tenderness.
Diagnosis: Cultures from blood, vagina and endocervix.
Complications:
1. Local: Endo- or myometritis, up to pelvic abscess or peritonitis.
2. General: DIC, hemolysis, renal failure or even septic shock.
Treatment:
1. Resuscitation and broad spectrum antibiotics, e.g., Penicillin (Gram positive) plus aminoglycoside (Gram negative) plus metronidazole or clindamycin (Anaerobes).
2. Evacuate the uterus: Suction or D&C (1st trimester), or using PG or oxytocin (2nd trimester). Complicated cases: Hysterectomy.

Habitual Abortion
Definition: 3 or more successive abortions.
Causes: Multiple; most important are:
1. Patulous internal cervical os:
   - Congenital, or secondary to obstetric trauma or use of DiethylStilbesterol (DES) (DES also causes vaginal clear cell adenocarcinoma).
   - Abortions occur in descending pattern (7 ms in first abortion, 4 ms in second abortion, etc.).
   - Diagnosis: Hysterosalpingography (HSG) shows loss of uterine waist (Funneling). Also, a dilator can be passed through the os without resistance.
   - Treatment: Vaginal cerclage (Done at 12 weeks gestation).
2. Uterine hypoplasia:
   - Abortions occur in ascending pattern (4 ms, 7 ms, etc.).
   - Treatment: Vaginal cerclage.
3. Fixed Retroverted Flexed uterus (RVF): Abortion here occurs around the 14th to 16th week of gestation. Commonly associated with urinary retention.

Missed Abortion
Definition: Retained products of conception which are no longer viable, a.k.a. Fleshy mole or Bloody mole.
Clinical picture:
1. Amenorrhea, followed by minimal dark vaginal bleeding but no abdominal pain (Missed abortion is a painless condition).
2. Nipple discharge.
On exam:
1. Fundal level is lower than the period of amenorrhea.
2. Cervix is closed, and there is a small amount of dark blood.
Complications: Septic abortion, and DIC (Common after 3–4 weeks).
Diagnosis:
1. Elevated B-HCG, but it does not double every 2 days.
2. U/S: Shows non-moving fetus without cardiac activity.
Treatment: Uterine evacuation.

Ectopic Pregnancy
Definition: Any pregnancy that implants outside the uterine cavity.
Most common site: Ampulla of the Fallopian tube.
• **Risk factors:** STDs (*PID is the most common cause*), tubal surgery and some contraceptives (e.g., Progesterone pills and intrauterine devices IUD).

• **Pathology:** During ectopic pregnancy, regardless of the site, the following occurs:

  1. Ovaries: Corpus luteum of pregnancy.
  2. Uterus: Increases in size and the endometrium thickens, showing:
     - Decidual reaction (Without villi)
     - Arias Stella reaction: Adenomatous hyperplasia

• **Complications:** Tubal rupture causing intraperitoneal hemorrhage.

• **Clinical picture:**

  1. Amenorrhea: Due to hormones secreted from corpus luteum. Rarely exceeds 8 weeks in duration.
  2. Severe lower unilateral abdominal pain: If this radiates to shoulders, think of perforation and diaphragmatic irritation by intraperitoneal blood.
  3. Vaginal bleeding: Mild in amount, and also rarely decidual casts.
  4. Pressure symptoms (Dysuria, Dyschezia, Dyspareunia): Suspect pelvic hematocoele.

• **On exam:** Cervical motion tenderness (*Jumping sign*), and tender boggy swelling in Cul-de-sac in cases of pelvic hematocoele.

• **Diagnosis:** Positive pregnancy test and absence of intrauterine pregnancy by U/S.

• **Treatment:**

  1. Resuscitation is the best next step.
  2. If ectopic mass <3.5 cm and stable: Abortifacient medications could be used in these cases. e.g., Methotrexate, Prostaglandins or Mifepristone, a.k.a. RU486 (anti-progesterone).
  3. If ectopic mass >3.5 cm or unstable (e.g., rupture or bleeding):
     - Laparotomy or Laparoscopy: Evacuation of fetal sac and membranes.
     - Salpingectomy (Total or partial): If the Fallopian tube is ruptured.

• **Prognosis:**

  1. 50%–60% of patients will have a normal intrauterine pregnancy.
  2. 30%–40% of patients will become infertile.
  3. 10%–15% of patients will suffer another ectopic pregnancy.

• **Note:** Any female patient of reproductive age who presents with abdominal pain must get a pregnancy test to rule out ectopic pregnancy, even if she insists that she is not pregnant.

### Hydatidiform (Vesicular) Mole

• **Definition:** A trophoblastic disease characterized by benign hyperplasia of trophoblast, along with hydropic degeneration of chorionic villi.

• **Risk factors:** Ages >40 or <15, and vitamin A deficiency.

• **Types:** Refer to Table 3.3

• **Pathology:**

  1. Uterus: Studded with fluid filled vesicles up to 1 cm in diameter.
  2. Ovaries: Theca Lutein cysts (Due to HCG production by trophoblast).

• **Clinical picture:** Amenorrhea, symptoms of pregnancy and uterine bleeding which might contain vesicles.

• **On exam:** Large doughy uterus with absent fetal heart sounds.

• **Complications:**

  1. Chorioadenoma Destruens: Malignant mole that perforates the uterus.
  2. Choriocarcinoma: Malignant transformation. Refer to gynecology.
  3. Thyrotoxicosis: Due to release of human chorionic TSH.
  4. Hyperemesis gravidarum: Due to release of large amounts of HCG.
  5. Early Pre-eclampsia: If Pre-eclampsia occurred during the first half of pregnancy, think of hydatidiform mole.

• **Diagnosis:**

  1. B-HCG will be positive even in the highest dilutions.
  2. U/S of uterus: Snow storm appearance.
  3. Doppler: Absent fetal heart sounds.

• **Treatment:** Suction followed by D&C in 2 weeks (*Cluster of grapes inside uterus*).

#### Table 3.3 Hydatidiform mole.

<table>
<thead>
<tr>
<th></th>
<th>Complete mole</th>
<th>Partial mole</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incidence</td>
<td>More common</td>
<td>Very rare</td>
</tr>
<tr>
<td>Malignant potential</td>
<td>Common (10% chance)</td>
<td>Very unlikely</td>
</tr>
<tr>
<td>Karyotype</td>
<td>XX (All Paternal)</td>
<td>Triploidy</td>
</tr>
<tr>
<td>Contents</td>
<td>Vesicles only</td>
<td>Vesicles + Malformed fetus</td>
</tr>
</tbody>
</table>

Hydatidiform (Vesicular) Mole
Follow up:
1. Monitoring the HCG levels weekly for the first 12 weeks after evacuation (12 weeks is the time HCG needs to fall back to normal values), and then monthly for 12 months, to make sure that level of HCG does not rise.
2. If HCG level does not normalize or starts rising, this suggests Choriocarcinoma.

Note: During the follow up period, pregnancy is contraindicated, as that will raise the HCG level and make the follow up difficult.

Antepartum Hemorrhage

Definition: Bleeding from the genital tract after the time of fetal viability (20 weeks), but before full maturation of the fetus (37 weeks).

Causes:
1. Fetal: Vasa previa.
2. Placental: Placenta previa or Abruptio placenta.
3. Local causes: Uterine rupture, due to injury or at the site of a previous scar.

Vasa Previa

Mechanism: Fetal blood vessels present in front of the presenting part of the fetus.

Causes: Velamentous insertion of placenta, and placenta succenturiata.

Treatment: Immediate delivery by C-section.

Placenta Previa

Definition: A placenta that is situated in the lower uterine segment.

Degrees:
1. 1st degree: Away from the internal cervical os.
2. 2nd and 3rd degree: Encroaching on the internal os.
3. 4th degree: Completely covering the internal os.

Clinical picture: Bright red vaginal bleeding: Usually related to sexual intercourse or pelvic exam. It is painless, recurrent and stops spontaneously.

On exam:
1. Fundal level and uterine external palpation are normal.
2. Pelvic examination is absolutely contraindicated (Fatal bleeding).

Diagnosis: Transabdominal (Not transvaginal) ultrasound.

Treatment:
1. Resuscitation is the best next step.
2. Bed rest and sexual abstinence.
3. U/S follow-up: The unequal rate of growth of the upper and lower uterine segments can cause the placenta to migrate upwards throughout pregnancy.

Indications for immediate termination: Uncontrolled bleeding or fetal distress.

Mode of delivery:
1. 1st and 2nd degrees: Vaginal delivery.
2. 3rd and 4th degrees: C-section.

Abruptio Placenta

Mechanism: Separation of a normally-situated placenta.

Risk factors: Hypertension and cocaine abuse. So when you see a pregnant patient in the USMLE who used cocaine and is now presenting with sudden abdominal pain, you know what to think!

Types and clinical picture
1. Revealed Abruptio placenta:
   - Lower margin of placenta separates and blood tracks its way out through vagina.
   - Patient presents with scanty dark and painful vaginal bleeding (It is bright red and painless in placenta previa).
   - Abdominal examination is normal; however, pelvic exam is contraindicated.

2. Concealed Abruptio placenta:
   - Blood is concealed between placenta and uterus.
   - Patient presents with severe abdominal pain, tenderness and rigidity. (No vaginal bleeding).
   - Abdominal examination reveals board-like abdominal rigidity, and pelvic exam is still contraindicated.

Complications:
1. Fetal death: More common in concealed abruptio placenta.
2. Hemorrhagic shock.
3. Couvelaire uterus: Blood dissects its way through uterus to the peritoneum.
4. DIC and renal failure.
5. Postpartum hemorrhage: Might lead to Sheehan’s syndrome (Hypopituitarism).
• **Diagnosis:** Transabdominal (*Not transvaginal*) ultrasound.
• **Treatment:** Immediate termination by C-section.

---

**Premature Rupture of Membranes (PROM)**

• **Mechanism:** Rupture of membranes before the onset of uterine contractions.
• **Causes:** Infections, trauma or iatrogenic (e.g., Cerclage or amniocentesis).
• **Clinical picture:** Sudden gush of watery fluid from the vagina.
• **On exam:**
  1. Fundal level is less than period of amenorrhea.
  2. Fetal parts are easily palpated on external uterine palpation.
• **Complications:**
  1. Infection, e.g., Chorioamnionitis: *Group B strept.* is the most common organism.
  2. Abortion and preterm labor.
  3. Prolonged oligohydramnios leading to fetal lung hypoplasia (*Potter syndrome*).
• **Diagnosis:**
  1. U/S: Confirms oligohydramnios.
  2. Sample from the fluid in posterior fornix on a *nitrazine paper gives blue color*. This confirms that the fluid is amniotic fluid (*Amnio dye* or *tampon test*).
• **Treatment:**
  1. If >36 weeks: Immediate delivery.
  2. If <36 weeks: Betamethasone for 48 h to accelerate fetal lung maturity, and deliver once lung maturity is proven. Keep a close eye for signs of infection (fever, tachycardia, abdominal pain, vaginal discharge).
• **Note:** PROM is one of the cases associated with accelerated lung maturity; others are pre-eclampsia, intrauterine growth retardation and intrauterine infections.

---

**Pre-Eclampsia**

• **Definition:** Pregnancy related *EPH*, i.e., Edema, Proteinuria and Hypertension.
• **Pathology:** Vasospasm and *subintimal* edema.
• **Cause:** Unknown, but most likely due to prostaglandin imbalance causing endothelial damage.
• **Risk factors:** Primigravida, extremes of age and obese patients.
• **Timing:** A disease of the second half of pregnancy (20–40 weeks). The only conditions in which you suspect this disease in the first half of pregnancy are hydatidiform mole, DM, twin pregnancy and polyhydramnios.
• **Clinical picture and exam findings:** Diffuse body edema and elevated blood pressure more than 140/90 on *more than 2 occasions*.
• **Diagnosis:** Clinical diagnosis, plus elevated urinary protein levels.
• **Complications:**
  1. Eclampsia: *Seizures* associated with a high rate of organ failure and mortality. *Treatment:* Magnesium sulfate IV and immediate stabilization of the mother with subsequent delivery (Mg sulfate is continued for 24 h postpartum). *Signs of magnesium toxicity:* Loss of deep tendon reflexes (*First sign*), and respiratory depression. *Antidote for magnesium:* Calcium gluconate IV.
  2. Placenta: Abruptio placenta.
  3. Cerebral edema or hemorrhage: Headache, blurry vision, nausea and vomiting.
  4. Periportal hepatic necrosis: Jaundice, and elevated bilirubin and transaminases.
  6. Renal failure: Oliguria (<500 cc urine output/day), or anuria (<100 cc).
  7. Congestive heart failure and pulmonary edema: Dyspnea, orthopnea and PND.
  8. HELLP syndrome: Microangiopathic hemolysis (H), Elevated liver enzymes (EL), and Low platelets (LP). It carries a very poor prognosis.
• **Treatment of pre-eclampsia:**
  1. **Mild cases:**
    • Control of blood pressure: Best is alphamethyldopa or hydralazine.
    • Betamethasone for 48 h: To accelerate fetal lung maturity.
    • Once fetal lung maturity is achieved, delivery is induced.
  2. **Severe cases, or any signs of organ damage (See complications):**
    • Immediate termination of pregnancy.
    • Prophylactic magnesium sulfate should be given, and continued until 24 h postpartum.
• **Note:** The one and only definitive cure for pre-eclampsia/eclampsia is *delivery*. 

---

Pre-Eclampsia 111
Gestational Diabetes

- **Introduction**: Pregnancy is a diabetogenic state due to placental release of insulinase, and the hyperglycemic effect of hormones, e.g., HPL, Estrogen, Progesterone, Prolactin.

- **Complications**:
  1. Pre-echlampsia and polyhydramnios.
  2. Macrosomia: Neonate weights more than 4 kg, and is fat, with cushingoid features. This occurs due to the reflex increase in fetal insulin secretion to antagonize the elevated blood glucose levels. Remember that insulin is an anabolic hormone. Macrosomia has the risks of post-term labor, C-section, shoulder dystocia and brachial plexus injury.
  3. Congenital anomalies: Due to low levels of arachidonic acid and myoinositol. A rare, but specific, example is caudal regression syndrome (Hypoplasia of sacrum and legs), and transposition of great arteries (TGA).
  4. Fetal hypoglycemia, hypomagnesaemia, hypokalemia and hypocalcaemia due to functional hypoparathyroidism.
  5. Unexplained intrauterine fetal death: Mostly due to placental insufficiency.
  6. Hyperviscosity syndrome: Due to polycythemia, increasing the risk of renal vein and mesenteric thrombosis.

- **Diagnosis**: Glucose tolerance test is the test of choice to diagnose gestational diabetes (Done at 26–28 weeks). Fasting blood sugar is checked ($N < 105$), then the patient is infused with 100 g of glucose, and blood sugar is checked in 1 h ($N < 190$), 2 h ($N < 165$) and 3 h ($N < 145$). If 2 or more of these numbers are above normal, diagnosis is confirmed.

- **Treatment**: Diet control and insulin therapy. Oral hypoglycemics are contraindicated during pregnancy due to their teratogenic and hypoglycemic effects.

  - **Note**: Gestational diabetes typically resolves spontaneously after labor. However, patients with gestational diabetes have a higher risk of developing diabetes mellitus (DM) later in life compared to the normal population.

  - **Hydrops fetalis**: It is the most severe form. Fetus suffers severe hemolysis and diffuse generalized edema a.k.a. anasarca. Fetal liver fails to synthesize any proteins. Fetus looks like Buddha on ultrasound.

  - **Icterus gravis neonatorum**: It is the most common form. Significant elevation of bilirubin leads to jaundice and kernicterus (Remember? Hemolysis increases indirect bilirubin, which cannot pass in the urine or stools, but can easily cross blood brain barrier).

  - **Diagnosis**: In susceptible patients (Rh –ve mother and Rh + ve father, or history of Rh incompatibility), amniocentesis is done at 28 weeks. The bilirubin level is measured using a spectrophotometer and results are plotted on Liley chart.

  - **Screening**: Coombs test and Rh determination should be done at 28 weeks.

  - **Treatment**:
    1. Rh –ve mother should receive RhoGam at 28 weeks and again during the first 24 h after termination of pregnancy, i.e., Labor, abortion, ectopic, etc…
    2. For established cases with Rh isoimmunization: depends on Liley chart:
      - Low or midzone (Mild hemolysis): Repeat amniocentesis in 2–3 weeks.
      - High zone: Immediate termination of pregnancy.

  - **Note**: Morning sickness is mainly nausea and to a lesser extent vomiting. It occurs mainly during the 1st trimester and resolves spontaneously.

Hyperemesis Gravidarum

- **Mechanism**: Severe vomiting during pregnancy, of unknown mechanism. Could be related to psychological and hormonal factors.

- **Complications**: Dehydration, hepatic necrosis and renal failure.

- **Treatment**: Conservative using anti-emetics and aggressive hydration. Termination is only indicated for severe cases with organ dysfunction.

  - **Note**: Morning sickness is mainly nausea and to a lesser extent vomiting. It occurs mainly during the 1st trimester and resolves spontaneously.

Labor

- **Definition**: The end of pregnancy, concluding in expulsion of the fetus and placenta, any time after fetal viability (20 weeks).

- **Clinical picture**:
  1. Uterine contractions of regular pattern along with hardening of the uterus on palpation.
  2. Dilatation and effacement of the cervix
**Stages of labor:** Refer to Table 3.4

**Bishop score:** Used to assess readiness for labor. Refer to Table 3.5

**Malpresentations:**

1. **Face:** Mentum anterior can be delivered vaginally. Mentum posterior presentation must rotate to mentum anterior or C-section will be needed.
2. **Occiput:** Occipito-anterior can be delivered vaginally. Occipito-posterior presentation must rotate to occipito-anterior or C-section will be needed.
3. **Brow:** The diameter engaged here is the occipito-frontal diameter (11.5 cm), which is too wide for vaginal delivery, unless rotated to face or occiput presentation.
4. **Shoulder:** C-section is needed unless rotation to vertex position takes place.
5. **Breech:** Most common of which is **frank breech** (Flexed hips and extended knees), others include **complete breech** (Hips and knees are all flexed) and **footling**. Most breech presentations are delivered using C-section.

**Notes:**

1. Prolonged first stage of labor (More than 20 hours in nulliparous and 14 hours in multiparous) is best managed using meperidine (Demerol).
2. Epidural anesthesia: Prolongs 2nd stage of labor and increases need for oxytocin.
3. Paracervical anesthesia: Carries the risk of fetal bradycardia.
4. Intrauterine fetal distress during prolonged labor can be assessed by Doppler examination of the fetal renal artery, as well as fetal heart rate monitoring.

**Postpartum Hemorrhage**

- **Definition:** Hemorrhage (>500 cc) from the genital tract after labor. The most common cause is uterine atony, followed by retained placenta.
- **Uterine atony:** Uterus is lax and enlarged.
- **Treatment:**
  1. Resuscitation is the first step.
  2. Bimanual massage of the uterus is effective in most cases.
  3. For resistant cases, oxytocin or prostaglandin F2 could be used.
  4. Last resort (for non-resolving cases): Hysterectomy.

**Retained placenta:** Treated by manual removal of placental parts from the uterus and curettage.

**Amniotic Fluid Embolism**

- **Mechanism:** Amniotic fluid enters the maternal circulation during labor.
- **Clinical picture:** Sudden respiratory distress. Just like pulmonary embolism; suspect it when you see a patient in the USMLE who just gave birth few hours ago, now suddenly starting hyperventilating, dropping her oxygen saturation and becoming hemodynamically unstable.
- **Diagnosis:** Clinical diagnosis, confirmed in the postmortem period by presence of amniotic cells and meconium in the lungs and right side of the heart.
- **Treatment:** Supportive.

**Puerperal Sepsis**

- **Definition:** It is infection of the female genital tract after labor.
- **Most common organism:** Group B hemolytic streptococci.
- **Clinical picture:**
  1. Fever and leukocytosis.
  2. Lower abdominal pain and tenderness.
  3. Malodorous vaginal discharge. If you see any patient in the USMLE who gave birth very recently, now having fever and lower abdominal pain, you know what to think! *If puerperal sepsis is ruled out, think pelvic thrombophlebitis.*
• **Diagnosis**: Culture of discharge, blood and endocervix.
• **Treatment**:
  1. Broad spectrum antibiotics: Penicillin + Aminoglycosides + Metronidazole.
  2. Evacuation of the uterus.

**Miscellaneous Notes**

**Thromboembolism**
• **Introduction**: Pregnancy is a hypercoagulable state, and patients are at high risk for thromboembolic events, e.g., DVT, Pulmonary embolism, etc.
• **Treatment**: Heparin, and continue treatment till 6 weeks postpartum.
• **Note**: Coumadin is contraindicated during pregnancy due to teratogenicity.

**APGAR Score**
• **Introduction**: Used to evaluate the cardiopulmonary and nervous system status of the newborn at 1 and 5 min after delivery.
• **Calculation**: Refer to Table 3.6

**Appendicitis During Pregnancy**
• **Introduction**: Atypical presentation during pregnancy, as appendix is pushed all the way up to the right hypochondrium, so it is often confused with cholecystitis in pregnant patients.
• **Complication**: Higher risk of perforation, peritonitis and abortion.
• **Treatment**: Urgent appendectomy.
• **Note**: Test of choice to diagnose pancreatitis during pregnancy is the amylase/creatinine ratio (>5–6%)

**Pre- and Post-Maturity**
• **Pre-maturity**: The most common risk factor for prematurity is past history of a similar condition. Fetus is at risk of sub-eependymal hemorrhage and retrolental fibroplasia.
• **Post-maturity**: The most common cause of postmaturity is incorrect calculation of dates. Fetus is at risk of macrosomia and shoulder dystocia. One of the most important complications of shoulder dystocia is injury to the brachial plexus, mainly upper trunk.

**Postpartum Changes**
• **Menstruation and ovulation**: They re-start around 6–9 months after labor for breastfeeding patients. (Only after 6 weeks if not breastfeeding).
• **Lochia**: Discharge from the genital tract after labor; lasts around 3 weeks. It starts as bloody discharge (Lochia rubra), then turns serous (Lochia serosa) and finally white (Lochia alba).

**Caput Succedaneum**
• **Definition**: Localized edema of the scalp, mostly due to venous obstruction.
• **Causes**: Obstructed labor, or use of suction cup during labor.
• **Fate**: Resolves spontaneously.
• **Notes**:
  1. Cephalhematoma is bleeding that takes place underneath the pericranium, where bleeding characteristically takes the distribution of one or more cranial bones (Unlike caput, Cephalhematoma does not cross suture lines and is not diffuse).
  2. Moulding is overriding of fetal skull bones during labor. Complication: Intracranial hemorrhage, mainly from great cerebral vein of Galen.

**Infections During Pregnancy**
• Transmission of hepatitis B from mother to fetus is increased if the mother is positive for the (e) antigen.
• Only 2.5% of neonates born to mothers with positive hepatitis B surface antigen will be infected at birth.
• Gonorrhea during pregnancy is treated using spectinomycin.
• HIV transmission from mother to fetus is decreased by using Zidovudine (AZT).

<table>
<thead>
<tr>
<th>Table 3.6 APGAR scoring system (N=7–10 out of 10).</th>
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</thead>
<tbody>
<tr>
<td>Zero</td>
</tr>
<tr>
<td>Respiration</td>
</tr>
<tr>
<td>Heart rate</td>
</tr>
<tr>
<td>Muscle tone</td>
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<tr>
<td></td>
</tr>
<tr>
<td>Absent</td>
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<td>Skin color</td>
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Chapter 4
Gynecology

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Estrogen

- **Natural:**
  2. Estradiol (E2): Estrogen of reproductive age.

- **Synthetic:** Multiple forms and dosages. Note that Diethylstilbestrol (D.E.S) is no longer used due to its dangerous effects, e.g., Vaginal adenosis and clear cell adenocarcinoma; also incompetent cervix and abortion.

- **Sources:**
  2. Corpus luteum: Source of E2 during second half of menstrual cycle.

  4. Adipose tissue: Peripheral conversion of androgens to estrogen by aromatase enzyme.

  **Actions:** Refer to Table 4.1

Progesterone

- **Source:** Corpus luteum and placenta.

- **Actions:** Refer to Table 4.1.

Androgen

- **Sources:**
  1. Ovaries: Secrete Androstenedione and Testosterone.
3. Peripheral conversion from one androgen to another.

- **Hyperandrogenism in females**: Anovulation, infertility, hirsutism, clitoromegaly, and increased muscle tone.

### Gonadotrophins (Refer to Fig. 4.1)

- **Luteinizing Hormone (LH):**
  1. Stimulates steroidogenesis by Theca cells.
  2. LH surge stimulates prostaglandins and collagenase enzyme; which induces ovulation by rupture of ovarian follicle.

- **Follicle Stimulating Hormone (FSH):**
  1. Stimulates development of follicles.
  2. Stimulates mitosis of Granulosa cells.

### Menstrual Cycle

- **Endometrial and ovarian cycles**: Refer to Fig. 4.2.
- **Cyclic hormonal levels**: Refer to Figs. 4.3, 4.4, 4.5, and 4.6.

### Puberty

- **Introduction**: Physical maturity involving sexual and reproductive development. The process in order of occurrence includes:
  1. **Thelarche**: Breast development.
  2. **Growth spurt**.
  3. **Pubarche**: Pubic hair development.
  4. **Menarche**: Menstruation.

- **Normal age of puberty**: 9–14 years.

### Precocious Puberty

- **Introduction**: Puberty completion before 9 years of age.
- **Types**:
  1. **Isosexual**:
**Pseudo:** Low FSH, LH and high estrogen. Estrogen excess either from the ovary or iatrogenic could be the cause, e.g., McCune Albright syndrome (Triad of polyostotic fibrous dysplasia, café au Lait skin patches and autonomous estrogen secretion by the ovaries).

2. **Heterosexual:**

- **Congenital Adrenal Hyperplasia (CAH):** Due to 21-Alpha Hydroxylase deficiency causing high androgen and low corticosteroid levels. Suspect it in any female who develops
hirsutism before menarche. Diagnosis: High serum levels of 17-OH progesterone.
- External androgen source.
- Androgen secreting ovarian tumor.

**Notes:**
1. High serum Testosterone: Ovarian cause.
2. High serum DHEA: Adrenal cause.

**Menopause**

- **Definition:** Permanent cessation of menstruation due to exhaustion of follicles, usually preceded by a period of ovarian functional decline known as Climacteric.
- **Normal age of menopause:** Median age of onset in the U.S. is 50 years.
- **Symptoms:**
  1. Hot flashes and excessive sweating: Due to hypothalamic instability.
  2. Anxiety and depression.
  3. Bone pains and fractures: Due to osteoporosis.
  5. UTI and urinary incontinence.
- **Diagnosis:** Elevated serum FSH.
- **Treatment:**
  1. Bone: Bisphosphonates, calcium and vitamin D.
  2. Hot Flashes: Clonidine or SSRIs.
  3. Hormonal Replacement Therapy (HRT): Controversial due to its thromboembolic effects, e.g., DVT, CAD, CVA, and increased risk of breast and endometrial cancer.

**Amenorrhea**

- **Introduction:** Few terms you have to be familiar with:
  2. Secondary amenorrhea: Cessation of previously normal menstruation for a period of 6 months or for 3 successive cycles.
  3. False amenorrhea (Cryptomenorrhea): Due to cervical atresia, imperforate hymen or transverse vaginal septum. Cryptomenorrhea is characterized by cyclic pain.
- **Causes:**
  1. Physiological: Pregnancy, lactation or menopause.
  2. Hypothalamic: Hyperprolactinemia, or anorexia nervosa.

3. **Pituitary:**
   - Hypothyroidism
   - Panhypopituitarism, e.g., Postpartum pituitary hemorrhagic infarction a.k.a. Sheehan syndrome.

4. **Ovarian:** Anovulation, ovarian failure, polycystic ovarian syndrome (PCOS), and Testicular feminization syndrome.

5. **Uterine:**
   - Aplasia or hypoplasia.

6. **Others:** Anemia, Debilitating Disease or Endocrine Disturbance.

- **Diagnosis key:**
  1. Most common cause of primary amenorrhea: Ovarian, followed by uterine.
  3. Most common cause of postpartum amenorrhea: Lactation. Other causes to consider are Sheehan syndrome, prolactinoma and Ashermann syndrome.
  4. Elevated FSH and LH indicate ovarian failure.
  5. Low FSH and LH indicate pituitary or hypothalamic cause.
  6. LH: FSH > 3:1 indicates Polycystic Ovarian Syndrome (PCOS).
  7. Refer to Fig. 4.7 for an algorithm to approach amenorrhea.

![Fig. 4.7 Algorithm for approaching a case of amenorrhea](image-url)
**Polycystic Ovarian Syndrome (PCOS)**

- **Introduction**: Also known as Stein-Leventhal syndrome.
- **Mechanism**: High LH levels cause increased androgen and estrogen formation, which in turn leads to feedback inhibition of FSH. This leads to arrest of follicular development in various stages, plus the following:
- **Clinical picture**:
  1. Anovulation and infertility: Patient complains of long periods of amenorrhea interrupted by periods of prolonged bleeding.
  2. Hirsutism and acne.
- **Diagnosis**:
  2. Elevated serum androgen and estrogen levels, with low or no progesterone.
  3. Laparoscopy: Pearly white ovaries with thick smooth capsules.
  4. Ultrasound: Small ovarian sub-cortical cysts giving Necklace appearance.
- **Treatment**:
  1. If the patient desires pregnancy: Induce ovulation by Clomiphene citrate.
  2. If the patient does not desire pregnancy: two things you can do:
     - Progesterone supplementation.
     - For hirsutism: Estrogen plus Anti-androgen, e.g., Cyproterone acetate.
  3. Resistant cases: Bilateral wedge resection of ovaries.

**Induction of Ovulation**

- **Mechanism**: Anti-estrogens, e.g., Clomiphene citrate, Cyclofenil and Tamoxifen, block the negative feedback of estrogen on the pituitary gland. This in turn leads to increase in FSH; stimulating follicular development and ovulation.
- **Side effects**: Tamoxifen can cause DVT, endometrial cancer and hot flashes.

- **Signs of ovulation**: Pregnancy, increased body basal temperature, or an elevation of serum progesterone level.

**Dysfunctional Uterine Bleeding (DUB)**

- **Introduction**: Any uterine bleeding not related to menstruation.
- **Types**:
  1. **Cyclic**:
     - **Functional**: Short cycles due to short follicular phase. Treatment: Progestins.
     - **Corpus luteum insufficiency**: Premature endometrial shedding causing premenstrual spotting. Treatment: Progestins.
  2. **Acyclic**: Threshold bleeding: Occurs at extremes of reproductive life due to fluctuations in estrogen levels. Treatment: Estrogen in the first 10 days of the cycle, followed by a combination of estrogen and progesterone in the following 10 days.
- **Diagnosis key for vaginal and uterine bleeding**:
  2. Newborns: Mostly due to hormonal withdrawal bleeding. This phenomenon is known as neonatal crisis.
  3. Pre-pubertal age: Mostly due to foreign body.
  4. Peri-pubertal age: DUB.
  5. Childbearing age: Mostly due to complication of pregnancy, or a side effect of contraception.
  6. Peri-menopausal:
     - Most common cause: DUB.
     - Most important cause: Endometrial carcinoma.
  7. Post-menopausal:
     - Most common cause: Complication of HRT.
     - Most important cause: Endometrial carcinoma. Any post-menopausal woman with uterine bleeding must get uterine biopsy to rule out endometrial cancer.
- **Treatment**:
  1. Treat the cause.
  2. If no gross, malignant or pre-malignant lesions: Mostly DUB. Treatment: Progestins.
3. Resistant severe cases: Hysterectomy, or hysteroscopic endometrial ablation/resection.

Infertility

- **Introduction:** There are two types of infertility:
  1. Primary: Inability to conceive after 1 year of unprotected sexual intercourse.
  2. Secondary: Inability to conceive for 2 years after a normal fertile life.

- **Causes:**
  1. **Male causes:**
     - Defective spermatogenesis (Normally takes 75 days).
     - Testicular failure: Either primary (*Low testosterone and high FSH*), or secondary (*Low testosterone and low FSH*).
  2. **Female causes:** Ovarian, tubal, uterine or pelvic.
     - Endometriosis causes pelvic adhesions and anovulation by changing prostaglandin levels.
  3. **Coital factors:** Dyspareunia, frequent or inadequate sexual intercourse.
  4. **Immunological factors:**
     - Female: Cervical or serum antibodies against sperms or ova. Diagnosis: Agglutination test and sperm immobilization test. Treatment: Steroids.

- **Diagnosis:**
  1. **Semen analysis:**
     - Normal semen:
       1. Character: Viscid and liquefies within 0.5 h.
       2. Volume: 2–4 mL.
       4. pH: Alkaline; due to phosphate buffer released by prostate.
       5. Sperm count: 20–200 millions/mL.
       6. Motility: At least 60% of sperms are motile.
       7. Morphology: At least 60% of sperms are normal in shape.
     - Sources of seminal fluid:
       1. 60% from seminal vesicles: Releases fructose for sperms nutrition.

  2. 20% from prostate: Releases phosphate buffer to protect sperms from vaginal acidity.
  3. 10% from Testes.
  4. 10% from other glands.

- **Notes:**
  1. The most common cause of infertility in general: **Male factors**.
  2. The most common cause of infertility in females: **Endometriosis**.

- **Treatment:**
  1. Anovulation: Ovulation induction.
  2. Tubal occlusion: Repeated insufflations, or cutting adhesions.
4. Immunological: Sexual abstinence for 6 months plus corticosteroids.
5. In Vitro Fertilization (IVF): Ovulation is induced by giving HCG, and intracytoplasmic sperm injection (ICSI) is done.

**Contraception**

- **Rhythm method:** Intercourse is avoided between days 10 and 18 of a 28 day cycle.
- **Prolonged lactation:** In a lactating woman, prolactin inhibits release of estrogen and decreases its effects on the uterus preventing conception.
- **Coitus interruptus:** Withdrawal of the penis before ejaculation inside the vagina.
- **Spermicides:** e.g., Non-oxynol 9.
  1. **Advantages:** No medical side effects or contraindications to this method. Associated with a decreased risk of PID.
  2. **Disadvantages:** Intercourse must occur within 2 h of application.
- **Condoms:**
  1. **Advantages:** No medical side effects or contraindications, decreases risk of STDs, and it could be used in cases of premature ejaculation.
  2. **Disadvantages:** High failure rates and may decrease sensation. Latex allergy could be a problem for some patients.
- **Diaphragm/Cervical cap:**
  1. **Advantages:** No medical side effects or contraindications.
  2. **Disadvantages:** Does not decrease risk of STDs. Long term use may lead to toxic shock syndrome (TSS). Mechanism of TSS: Release of the exotoxin TSST-1, which stimulates the production of interleukin-1, TNF and endotoxins. Prevention: Patients should not leave the sponge/diaphragm/cervical cap in the vagina for more than 24 h, or during menses. Clinical picture:
    - Shock
    - Rash: Scarlatiniform and diffuse in distribution.
    - Diarrhea and electrolyte imbalance.
    - Fever and elevated liver enzymes.
- **Vaginal sponge:** A sponge containing non-oxynol 9:
  1. **Advantages:** Easy to use.
  2. **Disadvantages:** Toxic shock syndrome (TSS).
- **Intrauterine Device (IUD):**
  1. **Types:** Inert or coated with copper or progestins.
  2. **Mechanism of action:**
    - Aseptic endometritis, leading to phagocytosis of sperms and ova.
    - Histological changes in endometrium; preventing implantation.
    - Copper: Inhibits carbonic anhydrase enzyme (Necessary for implantation).
    - Progesterone: Causes atrophy of endometrium, and thick cervical mucus.
  3. **Advantages:** Reliable, and may be used for long periods.
  4. **Disadvantages:**
    - Spotting: Especially post-insertional.
    - Post-insertion pain and backache: Due to cervical irritation by the threads.
    - Vaginal discharge, infection, expulsion or perforation.
    - Pregnancy: If threads are accessible, remove the IUD. If not, observe for complications. Septic abortion occurs in 50% of cases.
    - Ectopic pregnancy: Especially with progestin coated IUD, because it decreases tubal motility.
  5. **Contraindications:** Uterine malformation or malignancy.
- **Combined oral contraceptive pills (OCPs):**
  1. **Composition:** Estrogen and progesterone, which suppress FSH and LH. Pills taken in the latter part of the cycle contain more progesterone.
  2. **Mechanism:** They cause endometrial atrophy, and thick cervical mucus.
  3. **Use:** Taken from 5th day of cycle for 21 days, then placebo for 7 days.
  4. **Side effects:** Multiple; the most common are:
    - Nausea and vomiting.
    - Salt and water retention: Cyclic weight gain, and hypertension.
    - Acne and hirsutism.
    - Thromboembolic conditions.
    - Cholestasis and rise of liver enzymes.
  5. **Contraindications:** Patients older than 35, smoking, Diabetes mellitus and hypertension.
  6. **Troubleshooting:**
    - Spotting in early part of cycle: Increase estrogen dose.
    - Spotting in late part of cycle: Increase progesterone dose.
    - Breakthrough bleeding (Common in forgetful patients): Stop pills for 5 days then restart, while using backup contraception.
- Missed period: Stop pills and do a pregnancy test in 2 weeks, while using backup contraception.
- Most common cause of OCPs failure: Incorrect use.

- **Progestosterone only pills:**
  1. **Indication:** Age >45 years, DM, hypertension and lactation.
  2. **Advantages:** Minimal side effects, and no estrogen side effects.
  3. **Disadvantages:** Irregular cycles and spotting.

- **Injectable contraception:**
  1. **Example:** Depot medroxyprogesterone acetate (Depo-provera).
  2. **Indications:** Forgetful patients, or the ones with contraindication to estrogen.
  3. **Advantages:** Improves symptoms of endometriosis.
  4. **Disadvantages:** Not immediately reversible, and may cause irregular cycles.

- **Subcutaneous Implants (Norplant):**
  1. Six cylinders of levonorgestrel, implanted in the medial aspect of the arm.
  2. **Advantages:** Slow release of progestin for up to 5 years, and it can be removed if pregnancy is desired.

- **Postcoital contraception:**
  1. Effective only if done within the first 72 h after unprotected intercourse.
  2. **Composition:** High doses of estrogen, especially ethinyl estradiol.
  3. **Abortifacients:** e.g., Anti-progesterone known as Mifepristone RU 486.

- **Sterilization:** Tubal ligation and vasectomy are the most common. Indicated for couples wishing permanent contraception. Complications include post-tubal ligation syndrome; where patients present with congestive dysmenorrhea and menorrhagia. This syndrome occurs due to interruption of the venous return of fallopian tubes, and is treated with hysterectomy.

- **Pearl index:** A measure of contraceptive failure rates, presented as the number of pregnancies in 100 women using a method of contraception for 1 year. Refer to Table 4.2 for Pearl index.

## Dysmenorrhea

- **Introduction:** Pain related to the menstrual cycle.

- **Types:**
  1. **Spasmodic:**
     - **Clinical picture:** Colicky pain in the lower abdomen and radiating to the inner thighs and low back. Begins with the onset of menstruation and decreases afterwards, and is associated with nausea, vomiting and sweating.
     - **Mechanism:** High levels of prostaglandins (PGF2α) which leads to uterine contraction, or due to failure of the uterus to expel sloughed menstrual tissue secondary to obstruction.
     - **Treatment:** NSAIDS (PG inhibitor), or OCPs (Inhibit ovulation).
  2. **Membranous:**
     - **Mechanism:** Endometrial hypersensitivity to progesterone.
     - **Clinical picture:** Severe lower abdominal and back pain. The pain decreases after passage of membranous endometrial casts through the vagina, after which menstruation ensues.
     - **Treatment:** Progesterone dominant pill to suppress ovulation plus NSAIDs.
  3. **Congestive:**
     - **Clinical picture:** Continuous dull achy pain in the lower abdomen and back due to congestion. Begins 3–5 days before menstruation and subsides with flow.
     - **Treatment:** Treat the cause of pelvic congestion plus NSAIDs.
  4. **Ovarian:**
     - **Clinical picture:** Dull aching pain in one or both iliac fossa due to ovarian congestion. Begins a few days before menstruation and subsides with flow.
     - **Treatment:** NSAIDs and glycerine suppositories for congestion.
• **Premenstrual Menstrual Syndrome (PMS):** Headache, mastalgia, bloating, constipation, joint pains, depression, irritability and nervousness. Etiology is unknown but theories suggest a change in endorphin levels, allergy to ovarian hormones, or vitamin B1 and B6 deficiency. Treatment: NSAIDs (*Ibuprofen*).

• **Mittelschmerz pain:** Mid-cycle pain in *one iliac fossa*, due to ovulation.

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**Endometriosis**

- **Introduction:** Presence of *endometrial tissue outside the uterus*.
- **Locations:**
  1. Ovaries: Most common site. Forms *chocolate cysts*.
  2. Myometrium: Either diffuse (*Adenomyosis*), or localized (*Adenomyoma*).
  3. Extra-uterine: Could be anywhere in or outside the pelvis. Nodules could be in a closed organ (*Endometrioma*).
- **Pathology:** Implants are either black active or grey fibrosed lesions.
- **Clinical picture:**
  1. Infertility: *Endometriosis is the most common cause of female infertility*.
  2. Perimenstrual lower abdominal and back pain: Due to spasmodic dysmenorrhea.
  3. Dyspareunia and menometrorrhagia.
  4. *Endometriomas* are asymptomatic in most patients.
- **Diagnosis:** U/S of the pelvis is suggestive, but diagnosis is confirmed only by visualizing the *powder burn implants* and *chocolate cysts* during laparoscopy.
- **Treatment:**
  1. Create a *pseudo-pregnancy* state using progesterone.
  2. Create a *pseudo-menopause* state using combined anti-estrogen and anti-progesterone, e.g., Gestrinone.
  3. High dose *GnRH* analog: To down-regulate gonadotrophin receptors.
  5. *Surgery*: Reserved for resistant complicated cases.
- **Treatment key:** According to degree of symptoms:
  1. Mild (*Implants without fibrosis*): Hormonal or surgery.
  2. Moderate (*Implants and nodules with fibrosis in the absence of tubal obstruction or ovarian encapsulation*): Hormonal or surgery.
  3. Severe (*Implants and nodules with fibrosis plus tubal obstruction or ovarian encapsulation*): Surgery.
  4. Extreme (Severe fibrosis leading to *frozen pelvis*): Hormonal. *Surgery is contraindicated.*

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**Genital Prolapse**

- **Introduction:** It is the downward displacement of one or more genital organs.
- **Predisposing factors:**
  1. Weakness of the pelvic floor muscles, e.g., After obstetric trauma.
  2. Increased intra-abdominal pressure, e.g., Chronic cough or constipation.
- **Types:**
  1. **Vaginal:**
     - Anterior wall: Bladder (Cystocele), or urethra (Urethrocele).
     - Posterior wall: Intestine (Enterocoele), or rectum (Rectocele).
  2. **Uterine:**
     - 1st degree: Cervix is below level of ischial spines but not past the introitus. *Note that the cervix is normally located at the level of the ischial spines*.
     - 2nd degree: Cervix is protruding outside the introitus, but the uterine body is inside the vagina.
     - 3rd degree (*Procidentia*): The entire uterus lies outside the introitus.
- **Clinical picture:**
  1. Sense of heaviness with a dragging sensation in the perineum.
  2. *Backache*: Due to stretching of the uterosacral ligaments.
  3. *Stress incontinence* and incomplete voiding or defecation.
  4. Congestive dysmenorrhea and menorrhagia.
  5. Genital ulcers, infections and vaginal discharge.
- **On exam:** Assess the tone of the levator ani muscle with the patient in the dorsal lithotomy position. If able to approximate fingers behind the prolapsed mass, it is a 3rd degree prolapse.
- **Treatment:**
  1. Treat the underlying cause.
  2. Pelvic floor exercises, and vaginal pessary to support the prolapse.
  3. Surgery: Reserved for complicated cases.
**Retroverted Flexed Uterus (RVF)**

- **Introduction:** Normally, the uterus is in 90° of anteversion and 160° of flexion.
- **Causes:**
  1. Congenital: This is the most common cause of RVF uterus.
  2. Adhesions in Douglas pouch pulling the uterus backwards.
  3. Ovarian cyst pushing the uterus backwards.
- **Degrees:**
  1. 1st degree: Fundus points to sacral promontory, while the cervix faces downwards and forwards.
  2. 2nd degree: Fundus points toward the body of sacrum, while the cervix faces directly forwards.
  3. 3rd degree: Fundus points toward the tip of coccyx, while the cervix faces upwards and forwards.
- **Clinical picture:** Most cases are asymptomatic. Common symptoms include deep dyspareunia, low backache, congestive dysmenorrhea and menorrhagia.
- **Treatment:**
  1. Plication of the round or uterosacral ligaments.
  2. Modified Gilliam operation: Round ligaments are pulled anteriorly from the inguinal ligament and tied to each other in front of the rectus sheath.

**Recto-Vaginal Fistula**

- **Introduction:** Abnormal communication between rectum and vagina.
- **Cause:** Most common cause is surgical or obstetric trauma, e.g., Episiotomy.
- **Clinical picture:** Stool incontinence and vulvovaginitis.
- **On exam:** Wide perineum, bulging rectal mucosa and dimpling on either side of the anus caused by the torn ends of the anal sphincter.
- **Treatment:**
  1. Rectal washouts and low residue diet before and after surgery.
  2. Low fistula: Lawson-Tait operation.
  3. Middle fistula: Flap splitting.
  4. High fistula: Colostomy, repair the fistula then close colostomy after 2 months.

**Vesico-Vaginal Fistula**

- **Introduction:** An abnormal communication between bladder and vagina.
- **Cause:** Most common cause is surgical or obstetric trauma, e.g., Hysterectomy.
- **Clinical picture:** Urinary incontinence, and recurrent UTIs.
- **On exam:** Use a Sims speculum with the patient lying on her side to visualize the fistula.
- **Diagnosis:**
  1. Urine analysis: The first step in any patient with urinary incontinence.
  2. Methylene blue test: Insert three pieces of cotton inside the vagina, and fill the bladder with methylene blue:
    - If the cotton pieces remain dry: No fistula.
    - If the cotton pieces are wet and stained blue: Vesico-vaginal fistula.
    - If the cotton pieces are wet and not stained: Uretero-vaginal fistula.
- **Treatment:**
  1. Treat genital and urinary infections.
  2. Small fistulas are treated with saucerization. Post-operative urethral catheter and antibiotics are necessary.

**Stress Incontinence**

- **Introduction:** Escape of a small amount of urine that occurs concomitantly with any rise in intra-abdominal pressure, e.g., Laughing, coughing.
- **Mechanism:** Hypermobile bladder neck.
- **Diagnosis:** Cystometrogram: Detects a rise in bladder pressure and activity at the same time as increased intra-abdominal pressure.
- **Treatment:** Bladder training and pelvic floor exercises.
- **Notes:**
  1. In stress incontinence: Flow rate, residual volume and bladder compliance are all within normal limits.
  2. In cases of detrusor instability, there is escape of larger amounts of urine, occurring shortly after a rise in intra-abdominal pressure (Not concomitantly). Treatment: Anti-muscarinics, and tricyclic anti-depressants (TCAs).
3. Anatomical hints:
- Urinary internal sphincter is formed from 3 parts: Trigonal ring, Posterior loop and Loop of Heiss.
- Urinary external sphincter is formed of 3 muscles: Sphincter urethrae, Compressor urethrae, and Urethrovaginal muscle.
- The urethra is suspended by the pubourethral ligament; extending from the pubic symphysis to the middle third of the urethra.
- Bladder innervations: Sympathetic (Hypogastric nerve (T10–L2)), parasympathetic (Pelvic nerve (S2, S3, S4)), and somatic (Pudendal nerve).

Genital Infections

- **Introduction:**
  1. As a rule, know that the normal vaginal pH is 3.5–4.5, which is achieved by vaginal flora, namely the lactobacilli.
  2. All the following infections cause vulvovaginitis, i.e., Painful, red and itchy female genitalia.

Chlamydia

- **Introduction:** The most common sexually transmitted disease (STD).
- **Organism:** Chlamydia trachomatis; an obligate intracellular.
- **Clinical picture:**
  2. Chlamydia L1, L2 and L3: Lymphogranuloma venereum: Patient presents with lymphangitis, inguinal lymphadenopathy and proctocolitis.
  3. Chlamydia D and K: Urethritis, cervicitis, PID and/or perihepatitis (Fitz-Hugh-Curtis syndrome). Some cases are asymptomatic.
- **Chlamydia life cycle:**
  1. Elementary body – the infective stage – attaches to epithelial cells and is endocytosed. It converts inside the cell to the reticulate body.
  2. Reticulate body replicates via binary fission, then reorganizes into elementary bodies.
  3. Exocytosis of the elementary bodies which may then re-infect other cells.

- **Diagnosis:**
  1. Cytology shows intracytoplasmic inclusion bodies, a phenomenon that also occurs in viral infections.
  2. **Culture:** For confirmation, and it takes 48–72 h

- **Treatment:**
  2. Treat all sexual partners.
  3. Should also empirically treat N. gonorrhoea.

Gonorrhea

- **Introduction:** Second most common STD.
- **Organism:** Neisseria gonorrhoea; intracellular Gram negative diplococci.
- **Incubation period:** 7 days in males, and 14 days in females.
- **Clinical picture:** Malodorous greenish mucopustular urethral or vaginal discharge. Some cases are asymptomatic.
- **Diagnosis:**
  1. **Microscopy:** Intracellular Gram negative kidney-shaped diplococci.
  2. **Culture:** For confirmation. Media used are Chocolate or Thayer-Martin agars. Culture reveals Gram negative diplococci, with oxidase positive reaction.

- **Treatment:**
  2. Treat all sexual partners.
  3. Should also empirically treat Chlamydia.
- **Complications:**
  2. Disseminated Gonococcemia: Occurs when the organisms invade the vascular system. Clinical picture: 3(itis): Migrating (Fleeting) arthritis, tenosynovitis, and pustular dermatitis. Note: Blood cultures in these cases are negative.

Bacterial Vaginosis (BV)

- **Organism:** Symbiotic infection of anaerobic bacteria, e.g., *Gardnerella, Bacteroides, Peptococcus.*
• **Clinical picture**: Thin white/gray vaginal discharge with *fishy odor*.

• **Diagnosis**:
  1. *Whiff test*: Add potassium hydroxide (KOH) to discharge, which intensifies the *fishy odor*.
  2. *Clue cells* on wet prep: Clue cells are vaginal epithelial cells coated with coccoid bacteria on their surface.
  3. Vaginal pH >4.5.

• **Treatment**: Oral metronidazole.

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**Pelvic Inflammatory Disease (PID)**

• **Introduction**: Ascending genital infection which may include endometritis, salpingitis, hydrosalpinx, and/or tubo-ovarian abscesses.

• **Organism**: Most commonly caused by *Chlamydia trachomatis* D and K and/or *Neisseria gonorrhoea*. Any organism mentioned in this chapter may cause PID.

• **Clinical picture**:
  1. Lower abdominal and *bilateral groin pain*.
  2. Purulent vaginal discharge.

• **On exam**:
  1. Lower abdominal and *bilateral inguinal tenderness*.
  2. Pelvic exam: *Cervical motion tenderness* (*Chandeli*er sign).  

• **Treatment**: Ceftriaxone or cefoxitin plus doxycycline for 2–3 weeks.

• **Indications for hospitalization**: Pregnancy, pelvic abscess or failure of outpatient therapy.

• **Note**: Barrier contraception and OCPs decrease the risk of acquiring PID.

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**Haemophilus Ducreyi**

• **Clinical picture**: *Chancroid*: a painful genital ulcer with an irregular shape, associated with painful lymphadenopathy.

• **Diagnosis**: Gram negative bacilli arranged in a *school of fish* pattern.

• **Treatment**: Ceftriaxone

• **Note**: Chancre and lymphadenopathy in syphilis are *painless*.

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**Candida Albicans**

• **Introduction**: The most common genital infection. Note that Chlamydia is the *most common STD*.

• **Clinical picture**: Vulvovaginitis with *white curd-like* vaginal discharge.

• **Diagnosis**: *Pseudo-Hyphae* on microscopic exam.

• **Treatment**: Local statin cream and/or single oral dose of fluconazole.

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**Trichomonas Vaginalis**

• **Introduction**: A flagellated organism causing a postmenstrual infection.

• **Clinical picture**: Vulvovaginitis with *frothy vaginal discharge*.

• **On exam**: Punctate hemorrhages on vagina and cervix (*Strawberry cervix*).

• **Diagnosis**: Microscopy reveals *motile flagellated trichomonads*.

• **Treatment**: Oral metronidazole.

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**Herpes Simplex Virus (HSV)**

• **Types**:
  1. Type I: Ophthalmic and oral lesions.
  2. Type II: Genital lesions.

• **Clinical picture**: Small painful vesicles, shallow grey ulcers, and tender lymphadenopathy.

• **Diagnosis**: Tzank smear shows multinucleated giant cells, and intranuclear inclusion bodies.

• **Treatment**: Oral acyclovir.

• **Notes**:
  1. Acyclovir is not helpful beyond 24 h from the start of the rash.
  2. Acyclovir *does not cure the disease*; it only shortens duration of the rash and decreases the risk of complications, e.g., Post-herpetic neuralgia.
  3. If a pregnant patient is having genital Herpes at time of labor, *deliver by C-section* because contact with the lesions in the birth canal may cause neonatal herpes *encephalomyelitis*.

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**Human Papillomavirus (HPV)**

• **Clinical picture**: Lesion starts as a flat wart which later on progress into a verruaceous cauliflower-like lesion (*Condyloma acuminiatum*).

• **On exam**: Cobblestoning of the vaginal mucosa.

• **Diagnosis**: Vacuolated cells with perinuclear halos known as *koilocytes*.

• **Prevention**: Quadrivalent human papillomavirus (Types 6, 11, 16, 18) recombinant vaccine (GARDASIL). Currently approved for females between 9 and 26 years of age.

• **Treatment**: Cauterization of the lesions.
Molluscum Contagiosum
- **Organism:** Pox virus.
- **Clinical picture:** Umbilicated pearly white papules.
- **Diagnosis:** Confirmed by identifying the inclusion molluscum bodies upon staining the contents of the lesions with Wright or Geimsa stains.
- **Treatment:** Regress spontaneously. Cauterization is reserved for non-resolving lesions.

Leiomyoma (Fibroids)
- **Introduction:**
  1. A benign tumor arising from the uterine myometrium.
  2. An estrogen-dependent tumor, so more common in child bearing age and rare before puberty or after menopause.
  3. Fibroids may grow quickly during pregnancy and in patients on OCPs, due to high estrogen levels.
- **Race:** Fibroids are more common in African Americans.
- **Pathology:**
  1. Tumor consists mainly of smooth muscles and fibroblasts.
  2. Fibroids vary in size, shape and number; however they share the fact that they compress the surrounding myometrium, creating a false capsule around them. Luckily, this makes fibroids easy to be enucleated.
  3. A fibroid is a firm tumor, however, it gets softer under the following: Pregnancy, degeneration or if it has undergone a sarcomatous change.
- **Types:**
  1. **Corporal fibroids,** i.e., in the uterine corpus: Most common type. Corporal fibroids are mostly interstitial; however they could grow towards the uterine cavity (Submucous fibroid), or towards the abdominal organ (Subserous fibroid). A subserous fibroid may gain attachment to any abdominal organ and gain blood supply from it, hence the name parasitic fibroid.
  2. **Cervical fibroids:** They are fast-growing and cause pressure symptoms.
- **Clinical picture:**
  1. The most common presentation is being asymptomatic.
  2. Prolonged painful heavy periods are one of the hallmarks of fibroids. So when you see an African-American female of child-bearing age in the USMLE with very painful heavy periods that last for days, you know what to think!
  3. Pressure symptoms, mainly in cervical fibroids: Urinary frequency, dysuria, dyschezia and dyspareunia.
  4. Subserous fibroids are usually discovered accidentally.
- **Diagnosis:** Ultrasound of the uterus/pelvis.
- **Complications:**
  1. Degeneration:
    - Most dangerous is red degeneration; a hemorrhagic necrosis secondary to acute infarction. **Clinical picture:** Severe abdominal pain, fever and vomiting. **Treatment:** Rest, analgesics and antipyretics.
    - A uterus containing fibroids receives a huge blood supply due to release of angiogenic factors; however, the fibroid itself is usually pale and susceptible to degeneration as follows:
      1. **Central part:** Hyaline and cystic degeneration.
      2. **Peripheral parts:** Fatty degeneration and calcification.
  2. Sarcomatous change: The incidence is low, approximately 0.5%; however, the co-incidence of endometrial cancer is around 2% (Both are estrogen-dependent tumors). Sarcomatous change is confirmed microscopically by presence of more than 10 mitotic figures per high power field (Normal <5).
  3. Torsion and inflammation: Severe abdominal pain, nausea and vomiting.
- **Treatment:**
  1. Supportive: Indicated in mild cases, pregnant or near-menopause patients.
  2. Surgical: Indicated only in severe cases:
    - **Polypectomy and D&C:** For submucous fibroids.
    - **Myomectomy:** A very bloody operation even after ligating the uterine vessels (At the base of the round ligament) and ovarian vessels (In the infundibulopelvic ligament).
    - **Hysterectomy:** Most common and successful surgery for leiomyoma removal.

Cervical Intraepithelial Neoplasia (CIN)
- **Introduction:** CIN is a pre-malignant condition, in which cervical epithelium is replaced by cells having malignant characteristics without invasion of the basement membrane.
• **Location:** It starts at the *squamo-columnar junction* of cervix, which is also known as the *transformation zone*.

• **Clinical picture:** Mostly *asymptomatic*.

• **Stages:** Determined by tissue biopsy (*not the Pap smear*):
  1. **CIN I:** Only the deepest 1/3 of the epithelium is involved. Probability of malignant transformation is 15%.
  2. **CIN II:** The deepest 2/3 of the epithelium is involved. Probability of malignant transformation is 70%.
  3. **CIN III:** Involves the whole thickness of the epithelium.

• **Diagnosis:** Refer to Fig. 4.8. Microscopic criteria of malignant cells:
  1. Increased nuclear/cytoplasmic ratio.
  2. Pleomorphism.
  3. High number of mitotic figures.
  4. Loss of polarity.
  5. Increased nuclear size and nucleoli.

• **Treatment:**
  1. **CIN I:** Follow up by cytology and colposcopy every 6 months.
  2. **CIN II and III:** Local destructive surgery, e.g., cautery or laser, however, the lesion must be well-demarcated and the endocervix must be free of disease. If the above conditions are not met, then hysterectomy is indicated.

**Cervical Cancer**

• **Introduction:** Mostly *ectocervical*, and is *squamous* cell in origin.

• **Predisposing factors:** HPV infection; strains 16, 18, 33, 45 and 56, early sexual intercourse, multiple sexual partners and *multiparity*.

• **Clinical picture:**
  1. The key symptom is *contact bleeding*, e.g., Cervical bleeding after intercourse.
  2. Pain, discharge and metastatic symptoms.

• **Metastases:**
  1. Direct: Surrounding structures.
  3. Lymphatic: Paracervical, iliac, and para-aortic L.N.

• **Diagnosis:**
  1. If lesion is grossly visible: Excisional biopsy.
  2. If no visible lesion: Cytology (Pap smear), followed by colposcopy and biopsy.

• **Prevention:**
  1. *Annual pap smears starting the onset of sexual intercourse till 3 successive normal smears, then perform the Pap smear every 3 years.*
  2. GARDASIL: Discussed above. Note that even in immunized patients, Pap smear recommendations should still be followed.

• **Treatment:** Surgery, radiation and chemotherapy: Depending on stage.

• **Notes:**
  1. Most common cause of death in cervical cancer patients is *uremia*.
  2. Types of hysterectomy:
    • *Simple hysterectomy:* Remove uterus.
    • *Extended hysterectomy:* Remove uterus, cervix and vaginal cuff.
    • *Radical hysterectomy:* Remove uterus, cervix, 1/2 vagina, parametrium and lymph nodes.
    • *Exentration:* Radical hysterectomy *plus* organ removal.

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**Cytology**

- **Negative**
  - **Follow up**
  - **Negative**
    - **Cone or Ring biopsy**
    - **Positive (Punctate or Mosaic)**
      - **Colposcopic directed biopsy**

- **Positive**
  - **Colposcopy**

Large loop excision of transformation zone LLETZ
Loop electrosurgical excision procedure LEEP

**Fig. 4.8 Pap smear algorithm**
3. Most common complication of radical hysterectomy: Denervation of the urinary bladder, leading to residual urine.
4. Radiotherapy can flare up pelvic infections and adhesions, causing artificial menopause.

Endometrial Cancer

- **Introduction**: The most common malignancy of the female genital tract.
- **Predisposing factors**: Old age, post-menopausal, low parity, obesity, DM and hypertension.
- **Pathology**: Mainly an adenocarcinoma.
- **Clinical picture**: Key symptom is post-menopausal bleeding: So when you see a post-menopausal patient in the USMLE with uterine bleeding, she mostly has endometrial cancer till proven otherwise.
- **Metastases**:
  1. Direct: To surroundings; the most common metastases of endometrial cancer.
  3. Lymphatic: Para-aortic L.N.
- **Diagnosis**: Endometrial biopsy or fractional curettage: The best next step in any post-menopausal patient with uterine bleeding. Examine the specimen for the presence of hormonal receptors. If present, post-operative hormonal treatment should be included.
- **Treatment**: Surgery, radiation, chemotherapy and hormonal therapy.
- **Note**: Most common cause of death in endometrial cancer patients is metastases.

Epithelial Tumors

- **Introduction**: All types have benign and malignant subtypes.
- **Serous tumors**:
  1. Most common epithelial tumor.
  2. Formed of low columnar epithelium.
  4. Note: Psammoma bodies could be seen in (PMS): Papillary carcinoma of thyroid, Meningioma, Serous ovarian cyst.
- **Mucinous tumors**: Formed of tall columnar epithelium. Could rupture into peritoneum causes pseudomyxoma peritonei.
- **Mesonephroid tumors**: Formed of the pathognomonic Hobnail cells; cubical cells with clear cytoplasm and hyperchromatic nuclei, over which exists a collapsed cytoplasmic membrane.
- **Brenner tumor**: Transitional epithelium with the nuclei having a characteristic longitudinal groove (Coffee bean nucleus).

Sex Cord-Stromal Tumors

- **Granulosa- theca cell tumors**:
  2. Theca cell: Spindle-shaped and filled with lipid.
  3. Clinical picture: They are feminizing tumors:
    - Pre-pubertal: Precocious puberty.
    - Childbearing age: Amenorrhea and irregular bleeding.
    - Post-menopausal: Bleeding.
- **Sertoli- Leydig cell tumors**:
  1. Sertoli cell: Columnar cell with cleft nucleus.
  2. Leydig cell: Polyhedral cell with Crystalloids of Reinke in cytoplasm.
  3. Clinical picture: These are virilizing tumors: Hirsutism, clitoromegaly and deepening of voice.

Ovarian Tumors

Functional Cysts

- **Introduction**: Most common cysts during reproductive age; they are benign.
- **Hallmark**: They never exceed 6 cm in diameter.
- **Mechanism**:
  1. They occur due to gonadotrophin stimulation.
  2. High FSH leads to a Follicular cyst.
  3. High LH leads to a Corpus Luteum cyst. Clinical picture: RLQ or LLQ abdominal pain and delayed menses.
- **Treatment**: Observe, as they usually regress spontaneously.

Germ Cell Tumors

- **Introduction**: Occur mainly in children and young adults.
- **Prognosis**: They are highly malignant tumors, except mature teratoma; however, they are very sensitive to radiotherapy and chemotherapy. That leaves germ cell tumors with better prognosis than epithelial tumors.
- **Clinical picture**: Rapidly growing tumors, so they present with abdominal pain.
• *Dysgerminoma:* Causes *precocious puberty.* Microscopy: Round cells with heavy lymphocytic infiltration.

• *Dermoid cyst (Mature cystic teratoma):* A thick-walled cyst containing ectodermal, endodermal and mesodermal structures plus a *Rokitansky protuberance.* Suspect it in the exam in any question describing an ovarian tumor containing hair and teeth.

**Others**

• *Krukenberg tumors:* Bilateral in 50% of cases, they metastasize from stomach cancer and reach the ovary by retrograde lymphatic spread. Microscopy: *Signet ring cells* in fibrous or myxomatous stroma.

• *Ovarian fibroma:* Solitary or as a part of *Meigs syndrome* (Ovarian fibroma (Benign), ascites and right sided pleural effusion).

**Clinical Picture**

• *Most common presentation is being asymptomatic.*

• Non-specific abdominal symptoms, e.g., *Dyspepsia, bloating or pain.*

**Diagnosis**

• *Tumor markers:*
  1. CA-125: Ovarian tumors, *except mucinous cysts.*
  3. Lactate dehydrogenase (LDH): *Dysgerminoma.*
  4. Human chorionic gonadotropin (HCG) and Alpha-fetoprotein (AFP): *Germ cell tumors.*
  5. Estrogen and progesterone: *Functioning tumors.*

• *Transvaginal ultrasound:* Excellent in confirming ovarian tumors. Relies on showing tumors and cysts through their *neovascularization.*

**Diagnosis Key and Notes**

• Most common ovarian tumor in front of uterus: *Dermoid cyst.*

• Most common ovarian tumor behind uterus: *Endometroid cyst.*

• Most common ovarian tumor in children: *Germ cell tumors.*

• Most common ovarian tumor in reproductive age: *Functional cysts.*

• Most common ovarian tumor in menopause: *Epithelial tumors.*

• Benign ovarian swellings: *Unilateral, cystic, mobile and painless.*

• Malignant ovarian swellings: *Bilateral, solid, fixed and painful.*

• Decreased ovulation, e.g., OCPs use, *decreases* risk of ovarian cancer.

• *Peutz-Jeghers syndrome:* A triad of ovarian cancer, familial Adenomatous Polyposis (*FAP*), and circumanal pigmentation.

**Treatment**

• *Surgery:* *Debulking surgeries,* including removal of as much involved tissues as possible. The most important factor determining success in advanced cases is the *residual tumor mass after surgery.*

• *Chemotherapy:*
  1. Epithelial tumors: *Platinum.*

• *Radiotherapy:* Internal or external: Most beneficial in *germ cell tumors.*

• *Follow up:* Tumor markers, and second look laparotomy.

**Notes**

• *BRCA1 and BRCA2 mutations are associated with high risk of ovarian and breast cancer.*

• *OCPs decrease the risk of ovarian cancer.*

**Choriocarcinoma**

• *Introduction:* *Malignant trophoblastic tumor,* usually following a vesicular mole; however, it can follow any form of termination of pregnancy, e.g., Delivery, abortion, ectopic pregnancy.

• *Staging:*
  1. Stage I: Confined to uterus.
  2. Stage II: Extended to pelvic contents.
  3. Stage III: Metastasized to lungs; *Cannon ball metastases.*
  4. Stage IV: Distant extra-pulmonary metastases.

• *Clinical picture:*
  1. Recent history of evacuation of a vesicular mole (or termination of pregnancy), followed by excessive *irregular vaginal bleeding and a pelvic mass.*
  2. CNS metastases could present with headache or dizziness.
  3. Pulmonary metastases present with hemoptysis.

• *Diagnosis:* Extremely elevated levels of *B-HCG.*
Treatment:

1. **Chemotherapy:** The mainstay of therapy. Combinations used are:
   - **Low risk:** Methotrexate + Folinic acid (leukovorin).
   - **High risk:** MAC or EMACO (Etoposide, Methotrexate, Actinomycin D, Cyclophosphamide, Oncovine (Vincristine).
   - **Criteria for being high risk (3F):**
     1. Last pregnancy was more than 4 months ago.
     2. Last pregnancy was full term.
     3. B-HCG is higher than 40,000 IU/L.

2. **Surgery and radiotherapy:** Reserved for resistant cases.
3. **Follow up:** Serial measurement of B-HCG to detect recurrence.

Non-Neoplastic Epithelial Disorders of the Vulva

- **Squamous cell hyperplasia:** Formerly known as hyperplastic dystrophy. Vulva is thickened, with white patches. Clinical picture: Pruritis of the vulva and dyspareunia. Diagnosis: Biopsy. Treatment: Corticosteroid cream.
- **Lichen sclerosis:** Vulva is atrophic, dry, shrunken and pale white in color.
- **Note:** In a case of vulval itching with white lesions, consider Lichen simplex chronicus, which is thickening of the vulva due to chronic itching and scratching.

Paget’s Disease of the Vulva

- **Introduction:** Intra-epithelial neoplasm, which can be associated with an underlying adenocarcinoma.
- **Clinical picture:** Intense vulval pruritis and tenderness.
- **On exam:** Vulva is velvety red, thickened and covered with white patches.
- **Diagnosis:** Biopsy.
- **Treatment:** Wide local excision with close follow up.

Carcinoma of the Vulva

- **Introduction:** A squamous cell carcinoma. Usually starts as Vulval Intra-epithelial Neoplasia (VIN), which could be detected by the tumor marker S-100 antigen.
- **Clinical Picture:** Painless vulval swelling, bleeding or discharge.
- **Diagnosis:** Biopsy.
- **Treatment:** Radical vulvectomy and bilateral lymph node dissection.
# Chapter 5
Surgery

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Gastrointestinal System

Pharyngeal (Zenker) Diverticulum

- **Mechanism**: Spasm of cricopharyngeus muscle leads to herniation of pharyngeal mucosa through Killian’s Dehiscence; a triangle in the posterior pharyngeal wall bound by oblique fibers of inferior pharyngeal constrictor muscles and transverse fibers of cricopharyngeus muscle.
- **Clinical picture**:
  1. Dysphagia.
  2. Regurgitation of non-digested food; especially on lying down.
- **Complications**: Perforation and malignancy.
- **Diagnosis**: Barium swallow is the test of choice (Esophagogastroduodenoscopy “EDG” might cause perforation).
- **Treatment**:
  1. Small diverticulum: Repeated dilatation.
  2. Large diverticulum: Diverticulopexy or diverticulectomy.

Congenital Esophageal Atresia

- **Introduction**: Usually associated with tracheoesophageal fistula.
- **Types**: Multiple; the most common is an esophagus with a blind upper pouch, and a lower pouch connected to the trachea.
- **Clinical picture**:
  1. Continuous regurgitation of saliva and food from the first day of life.
  2. Meconium pneumonia, chemical pneumonitis and bilious sputum: Due to regurgitation of gastric contents into the airways.
- **Diagnosis**: Test of choice is failure to pass a feeding tube from nose to stomach (Normal = 10 cm).
- **Treatment**: Urgent surgery involving closing the tracheo-esophageal fistula and connecting the pouches of the esophagus. If the pouches are too far apart, a jejunum or colon segment could be used for anastomosis.

Hiatus Hernia

- **Definition**: Herniation of abdominal contents into the thorax.
- **Anatomy**: Normally, the cardia of the stomach is maintained in place by the phreno-esophageal ligament, and it maintains its competence through the acetylcholine release and through the pressure difference between esophagus (8–25 mmHg) and stomach (8 mmHg).
- **Types**:
  1. Sliding (85%): Sliding of the cardia and the stomach into the posterior mediastinum.
  2. Para-esophageal (15%): Herniation of greater curvature of stomach to mediastinum.
- **Causes**: Congenital or acquired, e.g., Obesity, pregnancy, esophagitis.
Clinical picture: Symptoms of Gastro-esophageal Reflux Disease (GERD).
Diagnosis: Barium meal or Esophagogastroduodenoscopy (EGD).
Treatment:
1. Sliding hiatus hernia: Causes GERD which is treated medically by proton pump inhibitors or H2 blockers (Refer to IM). In young patients with severe disease resistant to medical treatment, fundoplication is recommended.
2. Paraesophageal hiatus hernia: Gastropexy.

Notes:
1. Bockdalek hernia: Hiatal hernia through fora-

men of Bockdalek; behind the lateral arcuate

ligament. This is caused by patent pleuro-

peritoneal canal.
2. Morgagnian hernia: Hiatal hernia through fora-

men of Morgagni; located between costal and

erternal origins of diaphragm.
3. Saint’s triad = Hiatus hernia + Diverticular
disease + Chronic cholecystitis.

Post-Corrosive Esophageal Stricture

Causes: Drain liquid, oven cleaner.
Clinical picture and complications:
1. Severe pain and neurogenic shock.
2. Edema of airways and esophagus followed by dysphagia and risk of perforation.

Treatment:
1. First thing to do: Dilution by ingestion of any liquid, e.g., water.
2. Antibiotics and steroids: To decrease edema and fibrosis.
3. Barium swallow in 2 months: Depending on the degree of stricture, the choice is made between dilatation vs Esophagectomy and anastomosis.

Esophageal Cancer

Causes: Smoking, alcohol, Barrett’s esophagus, Plummer Vinson syndrome.
Types: Squamous cell carcinoma (90%), while adenocarcinoma is common only in the lower third of esophagus; mostly as a complication of Barrett’s esophagus.
Clinical picture:
2. Regurgitation of meals and loss of weight.

Diagnosis: Test of choice is EGD and biopsy. Barium swallow shows Rat tail appearance.
Treatment:
1. If small with no metastases: Surgery: Pharyngolaryngectomy (Upper 1/3), or Esophagectomy (Middle 1/3) or Esophagogastrectomy (Lower 1/3), plus chemotherapy and radiation.
2. If large or with metastases: Chemotherapy (5-Flourouracil and Cisplatinum) and radiation. No surgery is needed unless it is palliative, e.g., Esophago-gastric bypass.

Congenital Hypertrophic Pyloric Stenosis (CHPS)

Mechanism: Congenital anomaly leading to hypertrophy of pyloric muscles and dilatation of the stomach.
Clinical picture:
1. Vomiting: Never at birth (2–6 weeks after birth) and Never bilious.
2. Constipation and failure to thrive.

On exam: Olive-like mass in the epigastrium.
Labs: Hypokalemic alkalosis and hyponatremia.
Diagnosis: Gastrograffin meal.
Treatment: Pyloromyotomy.
Note: Duodenal atresia is the most common congenital cause of congenital intestinal atresia. Vomiting is since birth and is bilious (Mirror image of CHPS). Diagnosis: Double bubble sign on abdominal X-ray. Refer to Fig. 5.1. Treatment: Duodenojejunostomy.

Stomach Cancer

Pathology: Multiple types; the most common is adenocarcinoma.
Location: Most common is at the pylorus.
Metastases: Multiple; the most striking is the left supraclavicular lymph node (Virchow lymph node).
Clinical picture:
1. Dyspepsia: Especially to meat products.
2. Dysphagia, nausea, vomiting and hematemesis.
3. Fatigue and weight loss.
Diagnosis: Esophagogastroduodenoscopy (EGD) and biopsy.
Treatment:
1. Upper 2/3 of stomach: Total radical gastrectomy (Stomach, spleen, pancreas and omenta + Roux en-Y gastrojejunostomy).
2. **Lower 1/3:** Lower radical gastrectomy (Lower 2/3 of stomach, spleen, pancreas and omentum + Roux en-Y gastrojejunostomy).

### Splenic Rupture
- **Causes:** Closed or open injuries.
- **Clinical picture:**
  1. Pain and rigidity and in the left hypochondrium.
  2. **Cullen sign:** Bluish discoloration around the umbilicus (Remember Pancreatitis?).
  3. **Kehr sign:** Radiating pain in left shoulder due to phrenic nerve irritation.
- **Diagnosis:** Ultrasound of the left hypochondrium, or CT of abdomen.
- **Treatment:** Splenorrhaphy or partial splenectomy. In severe cases, total splenectomy should be done with immunization against *H.influenza B*, *Meningococci* and *Strept. Pneumoniae*.
- **Note:** If you see any patient in the USMLE who just had a motor vehicle accident and complaining of abdominal pain, first thing to do is resuscitation, followed by CT or US of the abdomen to rule out splenic rupture.

### Gall Stones
- **Types:** Mostly *cholesterol* stones, but could also be pigment or mixed stones.
- **Risk factors:** Female, Fertile, Fat, and in her Forties
- **Clinical picture:** Asymptomatic vs. Dyspepsia and biliary colic in the right hypochondrium radiating to right shoulder and right scapula. Symptoms are commonly associated with ingestion of *fatty food*.
- **On exam:** Pushing on the tip of the right 9th costal cartilage during inspiration elicits severe pain, gasping and guarding rigidity (*Murphy’s sign*).
- **Complications:**
  1. Obstruction of biliary ducts.
  2. Cholangitis: Presents with Charcot’s triad of fever, pain and jaundice.
  3. Passage of the stone through a fistula into the small intestine causing obstruction or gallstone ileus. Diagnosis: Abdominal X-ray which shows *air in the biliary tree* and a stone in the right lower quadrant.
  4. Mirrizi syndrome: Stone impaction in the Hartmann’s pouch causing fistula formation between the pouch and the *common hepatic duct*.
- **Diagnosis:**
  1. Ultrasound of liver and gall bladder is the test of choice. If that showed dilatation of intrahepatic ducts, next best step is Endoscopic Retrograde Cholangio-pancreatography (*ERCP*).
  2. Obstructive (*Cholestatic*) jaundice: Stones in CBD cause significant elevation of *alkaline phosphatase* and *direct bilirubin* with only slight elevation of transaminases.
- **Treatment:**
  1. Gall stones are not treated by cholecystectomy unless they are symptomatic, or associated with cholecystitis. So, if you see a patient with accidental discovery of gall stones and no symptoms, no treatment is needed.
  2. Cholangitis: Treated with antibiotics, e.g., Cefazolin and Metronidazole.
- **Note:** Most gall stones – unlike kidney stones – are radiolucent, so X-rays are not very helpful in most cases.

### Cholecystitis
- **Mechanism:** Mostly due to biliary obstruction, e.g., stone, causing stasis of bile and infection ensues.
- **Organisms:** Mostly *Gram negative* organisms, e.g., *E. coli*, Klebsiella. *Clostridium perfringes* can cause *emphysematous cholecystitis* in diabetic patients.

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**Fig. 5.1 Double bubble sign of intestinal atresia**

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• **Clinical picture:** Similar to cholangitis, i.e., Fever, pain in right hypochondrium and jaundice.

• **On exam:** Positive Murphy’s sign.

• **Diagnosis:** Ultrasound of the gall bladder; typically shows thickening of gall bladder wall with pericystic fluid collection. If the patient is clinically presenting with cholecystitis but the US did not show any changes, the next step is HIDA scan which proves cholecystitis by failure to visualize the gall bladder as contrast moves through the biliary system.

• **Treatment:** Cholecystectomy and systemic antibiotics. If the patient is severely symptomatic but is not a candidate for surgery, cholecystostomy is done.

• **Note:** Chronic cholecystitis present in the same fashion like acute cases but with more insidious onset and prolonged course. Treated medically except in two situations where it requires cholecystectomy:
  1. Chronic calculous cholecystitis.
  2. Chronic acalculous cholecystitis that failed medical treatment.

• **Note:** One of the rare yet scary complications of chronic cholecystitis is carcinoma of the gall bladder. It is a squamous cell carcinoma. Treatment: Cholecystectomy and wedge liver resection. Inoperable cases are treated with radiotherapy. Remember Courvoisier’s sign: A palpable gall bladder in any patient with obstructive jaundice is suggestive of malignancy.

**Random Biliary Notes**

• **Biliary atresia:** Occurs due to failed canalization of biliary tree. Patient presents with hepatomegaly and obstructive jaundice since birth, and bilirubin – unlike neonatal hepatitis – keeps rising. Extrahepatic types are treated with hepaticojejunostomy. Intrahepatic types are treated with liver transplantation.

• **Choledochal cyst:** A congenital cystic dilatation of the biliary tree, which may be extrahepatic or intrahepatic, as in Caroli’s disease. Treatment: Excision and roux-en-Y anastomosis. Caroli disease is treated with liver transplantation.

• **Cholangiocarcinoma:** Cancer of the biliary tree, with biggest risk factors being infection with *Clonorchis Sinensis* (Liver fluke) and choledochal cyst disease.

**Intestinal Obstruction**

• **Mechanism:** Obstruction from inside the lumen (e.g., Stools or mass), in the wall of the lumen (e.g., Mass), or due to compression on the lumen from outside (e.g., Mass or adhesions).

• **Pathophysiology:**
  1. Intestine below obstruction level: Immobile and collapsed.
  2. Intestine above obstruction level: Distended and filled with stools, gas and fluid.

• **Clinical picture:**
  1. Abdominal pain.
  2. Nausea and vomiting: Early if obstruction is high, late if obstruction is low.
  3. Constipation: Early if obstruction is low, late if the obstruction is high.

• **On exam:**
  1. Abdominal distention and hyper-resonance or tympanic to percussion.
  2. Hypoactive or absent bowel movements on and auscultation.
  3. Auscultation: Tinkling sounds.

• **Complications:**
  1. **Strangulation:** It is interruption of the vascular supply of a segment of intestine leading to interstitial and intraluminal bleeding, gangrene and fatal sepsis.
  2. **Intestinal perforation:** Pathognomonic sign on an abdominal X-ray taken in an upright position is subdiaphragmatic air. Refer to Fig. 5.2.

![Fig. 5.2 X-ray showing air under diaphragm](image URL)
Diagnosis: Abdominal X-ray in supine and upright positions: Air fluid levels. Refer to Fig. 5.3.

Treatment:
1. Resuscitation: IV fluids and electrolytes correction is the next best step.
2. Conservative: Nasogastric tube, NPO and await spontaneous resolution.
3. Surgery: If conservative measures failed. Exploratory laparotomy is done, where site and cause of obstruction is identified and repaired.

Note:
1. Most common cause of intestinal obstruction is adhesions.

Volvulus
- Mechanism:
  1. Volvulus neonatorum: Rotation of the midgut loop clockwise instead of counter-clockwise.
  2. Volvulus in adults: Hiatus hernia or abdominal adhesions.
- Clinical picture: Abdominal pain, constipation and bilious vomiting.
- Diagnosis: Abnormal location of the cecum on an upper GI series and Bird beak appearance on barium enema.
- Treatment:
  1. Best next step: Rectal tube insertion to deflate the colon.
  2. Surgical untwisting and fixation of the intestine to abdominal wall.

Intussusception
- Mechanism: Invagination of an intestinal loop into another. Commonly seen in the ileocecal area.
- Clinical picture: Abdominal pain and red current jelly stools.
- On exam: An abdominal sausage-like mass may be appreciated on palpation.
- Diagnosis: Abdominal X-ray shows air fluid levels, while barium enema shows the unique Claw sign.
- Treatment: Reduction by enema. Surgery and manual reduction if enema fails.

Mesenteric Ischemia
- Causes: Arrhythmia, e.g., A. Fib., or atherosclerosis.
- Clinical picture:
  1. Abdominal pain only on eating (Intestinal angina).
  2. Ischemic colitis: Severe abdominal pain and bleeding per rectum.
- On exam: The hallmark is abdominal pain out of proportion to exam. Meaning the exam is inconclusive, with no major finding to explain patient’s pain.
- Diagnosis:
  2. CT abdomen: Shows the pathognomonic thumb-printing sign, due to edema and bleeding in the bowel wall.

Fig. 5.3 X-ray showing air fluid levels of intestinal obstruction
**Treatment:**

1. **Best next step:** Fluid resuscitation.
2. Urgent surgery: Exploratory laparotomy, excision of the ischemic segment and end to end anastomosis.

**Note:** Now when you see a patient in the USMLE who is old and has a history of arrhythmia or severe vascular disease in the heart, brain or legs, and now presenting with abdominal pain, you know what to think!

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**Acute Appendicitis**

**Location:** The appendix is usually situated retro-cecally. However, pre- and post-ileal positions are the most dangerous due to the close proximity to the ileocolic vein; hence the potential for portal sepsis and thrombosis.

**Age:** Common in middle age, and it is unusual to see appendicitis in extremes of age due to scanty lymphoid tissue inside the appendix.

**Risk factors:** Low fiber and high protein diet, and cecal obstruction, e.g., mass.

**Causes:** Lymphoid hyperplasia is the most common cause followed by fecolith obstruction.

**Organisms:** E. coli is the most common organism.

**Clinical picture:**

1. Pain: Epigastric or paraumbilical that later migrates towards the right lower quadrant.
2. Fever, nausea, vomiting and constipation.

**On exam:**

1. Rigidity, tenderness and rebound tenderness at McBurney’s point, located 2/3 of the way along a line between the umbilicus and the right anterior superior iliac spine.
2. Crossed tenderness and crossed rebound tenderness: Palpation of the LLQ causes tenderness (Rovsing sign) and rebound tenderness (Blumberg sign) at the RLQ. This occurs due to displacement of the intestine towards the RLQ.
3. Psoas sign: Pain in RLQ is increased by right thigh extension.
4. Obturator sign: Pain in RLQ is increased by flexion and internal rotation of the right hip.

**Diagnosis:**

1. **CT of the abdomen (Test of choice):** Thickened wall of appendix with distention of the lumen, and absence of compressibility of the appendix.
2. CBC: Leukocytosis.

**Treatment:** Appendectomy. The only contraindication for appendectomy is the presence of a mass or abscess as discussed below.

**Complications:**

1. **Appendicular mass:** Forms around the 3rd day after the onset of appendicitis. Formed of edematous cecum and intestinal loops and omentum. Treatment: Keep patient NPO, insert NG tube and start antibiotics and hot compresses, and then plan appendectomy in 3 months. Fate: Resolution or progresses to appendicular abscess.
2. **Appendicular abscess:** Forms around the 5th day after the onset of appendicitis. Patient presents with high fever, edema and throbbing pain of RLQ. Treatment: Incision and drainage, then plan appendectomy in 6 months.

**Notes:**

1. Pelvic and postileal appendix: Presents with diarrhea and urinary frequency and urgency.
2. Subhepatic appendix: Presents just like cholecystitis, and it is a common presentation of appendicitis during pregnancy, and is associated with 30%–50% risk of abortion.
3. Appendicitis in elderly should raise the suspicion of a mass in the cecum.

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**Meckel’s Diverticulum**

**Introduction:** It is a remnant of vitello-intestinal (Omphalo-mesenteric) duct.

**Rule of 2s:** Present in 2% of population, 2 feet proximal to ileo-cecal valve, 2 inches long and contains 2 types of epithelium; namely gastric and pancreatic.

**Clinical picture:** Bright red bleeding per rectum, mostly in children.

**Diagnosis:** Technetium (Tm99) scan; uptake shows a hot spot.

**Complications:** Bleeding, diverticulitis, intussusception or perforation.

**Treatment:** Excision.

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**Hirschsprung’s Disease (Congenital Megacolon)**

**Mechanism:** A congenital disease that occurs due to presence of aganglionic segment in the colon; lacking Meissner and Auerbach nerve plexuses. This leads to a spastic colonic segment, proximal
to which is a transitional zone and a dilated segment.

- **Clinical picture:**
  1. **Constipation since birth:** Newborn passes stools only once or twice a week, but it is huge in amount and extremely malodorous.
  2. Growth retardation.

- **On exam:** Digital rectal exam reveals a spastic segment, and on withdrawal, a gush of malodorous stool follows.

- **Diagnosis:**
  1. **Test of choice:** Anorectal biopsy, which shows absent ganglia and hypertrophied nerve trunks.
  2. Barium enema without preparation: Colon has to be full with stools to visualize the segments described above.

- **Treatment:** Excision of the aganglionic segment and end to end anastomosis of the remaining ends. Complication: Impotence in males, due to injury of pelvic autonomic nerves.

- **Note:**
  1. Secondary megacolon is a dilated sigmoid colon and rectum all the way down the anal canal without any spastic segment. It is mostly due to constipation. Biopsy is normal and treatment entails laxative and regulation of bowel movements.
  2. Secondary megacolon can also be caused by *Trypanosoma cruzi* (Chagas disease).

### Hemorrhoids

- **Mechanism:** Varicosities of hemorrhoidal venousplexuses. Formed of a small artery surrounded by multiple varicosed dilated veins.

- **Types:**
  1. Internal (*More common*): Located in the lower end of the rectum and covered by mucosa.
  2. External: Located in the lower end of the anal canal and covered by skin.

- **Causes:** Chronic straining, or obstruction of superior rectal veins.

- **Location:** Most common at 3, 7 and 11 o’clock positions

- **Degrees:**
  1. 1st degree: Only mucosal protrusion with no hemorrhoidal prolapse.
  2. 2nd degree: Hemorrhoidal prolapse occurs with defecation and reduce spontaneously.
  3. 3rd degree: Hemorrhoidal prolapse occurs with defecation, but does not reduce spontaneously. Usually the patient has to push it back in.
  4. 4th degree: Hemorrhoidal prolapse that cannot be reduced.

- **Clinical picture:**
  1. Painless bright red bleeding per rectum, mostly at the end of defecation. Patient complains “Small amount of bright red blood in the toilet paper”.
  2. Pruritis and mucus discharge.

- **Diagnosis:** Hemorrhoids can be diagnosed by direct visualization through exam of perineum, proctoscopy or colonoscopy.

- **Complication:** Thrombosis. Suspect in any patient with hemorrhoids who presents with severe sudden perineal pain.

- **Treatment:**
  1. 1st and 2nd degrees: Laxatives, decongestant suppositories and minor procedure if necessary, e.g., Cryosurgery, ligation or injection. Injection causes thrombosis and fibrosis of the hemorrhoids.
  2. 3rd and 4th degrees: Hemorrhoidectomy.

### Anal Fissure

- **Introduction:** A longitudinal ulcer in the lower posterior wall of the anal canal, mostly due to chronic constipation, trauma or ulcerative colitis.

- **Clinical picture:**
  1. Perineal pain during and after defecation.
  2. Bleeding per rectum: Bright red in streaks on stools.
  3. Anal mucus discharge.

- **Diagnosis:** On proctoscope or colonoscopy, hypertrophied anal papilla is seen proximal to the fissure and a skin tag (a.k.a. sentinel piles) distally.

- **Complications:**
  1. Infection: Leads to abscess and fistula formation.
  2. Chronicity: Fissure edges become fibrosed giving it a Button-hole appearance.

- **Treatment:**
  1. Acute: Laxatives and anal dilatation.
  2. Chronic: Same as acute plus fissurectomy and sphincterotomy.
Anal Fistula
- **Mechanism**: Infection or trauma causing the formation of a fistula that opens externally into the skin and internally into the anal canal.
- **Types**: Multiple; the most common being the *low trans-sphincteric anal fistula*, which crosses through internal and external anal sphincters to open internally at the level of anal valves.
- **Clinical picture**: Anal discharge and pruritis, mainly from the fistula.
- **Diagnosis**: Fistulogram.
- **Treatment**: Treat the cause and excise the fistula.
- **Notes**:
  1. Fistulas related to the anterior half of the anal canal have *straight tracks*, while those related to the posterior half have *curved tracks and open into the midline* of the anal canal only.
  2. If you see a patient in USMLE in his 20s or 30s with RLQ abdominal pain, diarrhea, and having a peri-anal fistula, it is Crohn’s disease. Refer to IM section.

Ischiorectal Abscess
- **Introduction**: Infection in this fossa is common due to its poor blood supply.
- **Clinical picture**: Throbbing pain towards one of the lateral walls of the anal canal.
- **On exam**: Tender brawny swelling.
- **Treatment**: I & D via cruciate incision.
- **Note**: In the USMLE, a patient with a treated ischiorectal abscess who now has pain on the opposite side of the anal canal likely has another ischiorectal abscess, as these infections crossover easily between both fossae.

Imperforate Anus
- **Mechanism**: Failure of canalization. It could be high, intermediate or low.
- **Clinical picture**: Failure to pass meconium *since birth*.
- **On exam**: A dimple at the anal area which *bulges upon crying*.
- **Diagnosis**: Invertogram: *Plain films* in lateral view, upside down and with flexed hips after the anus is labeled with a radiopaque marker. The location of gas bubbles helps to define the level of the atresia.
- **Treatment**:
  1. High: Posterior sagittal anorectoplasty.
  2. Low: Cut-back operation or incision and dilatation.

Pilonidal Sinus
- **Mechanism**: Hair penetration into subcutaneous tissue leads to formation of a sinus, most commonly seen over the *coccyx*.
- **Clinical picture**:
  1. Pain in the buttock area upon sitting.
  2. Discharge from a sinus in the lower back.
- **Diagnosis**: Probing of sinus or fistulogram shows a sinus in the midline of the lower back opening inside into the sacrum.
- **Treatment**: Elliptical excision of the sinus.
- **Note**: This disease usually presents in hairy patients sitting for extended periods of time, e.g., Truck drivers, hence it is also known as *Jeep drivers’ disease*.

Carcinoid Tumor
- **Introduction**: An argentaffinoma that arises from nerve plexuses in *Kulchitsky cells*, most common in the appendix.
- **Pathophysiology**: Tumor produces prostaglandin, histamine and serotonin which are then destroyed in the liver. *Liver is the main site of metastases*.
- **Clinical picture**: Flushing, Diarrhea, Bronchospasm and right-sided heart valve lesions (*Tricuspid regurgitation and pulmonary stenosis*).
- **Diagnosis**: Elevated *5-Hydroxyindolacetic acid (5-HIAA) levels in the urine*.
- **Treatment**: Appendectomy or hemicolectomy depending on extent of the tumor.

Hernia
- **Predisposing factors**: Chronic straining increasing intra-abdominal pressure e.g., Heavy lifting, cough.
- **Clinical picture**:
  1. Swelling that gives *expansile impulse on cough*.
  2. Swelling that is *reducible by lying down*.
- **Complications**:
  1. *Strangulation*: A hernia emergency which occurs due to interruption of the blood supply to the herniated intestinal loop. Patient presents with a once reducible hernia that now is red, warm, tender, tense, irreducible and does not give impulse on cough.
  2. *Incarceration*: Trapping of the herniated intestine inside the hernial sac, and is a common cause of strangulation. On exam: Failure to reduce the herniated intestine. Treatment: Muscle
relaxants, placement in Trendelenberg position and urgent surgical intervention.
3. Infection or obstruction.

- **Treatment**: Surgical repair. This usually involves reduction of the herniated intestinal segment and covering the defect with a mesh.

- **Inguinal hernia**: Two types:
  1. **Indirect (Oblique)**: Descends into the scrotum, lateral to inferior epigastric artery. On exam: Positive internal ring test.
  2. **Direct**: Passes through triangle of Hasselbach, medial to the inferior epigastric artery.

- **Femoral hernia**: Common in females, where intestine passes down the femoral ring and canal. Swelling is distal and lateral to pubic tubercle, and it could be reduced downwards and medially. Strangulation is common mainly due to proximity to lacunar ligament and to a lesser extent due to the narrow neck of hernial sac.

- **Umbilical hernia**:
  1. Congenital (Omphalocele): Due to failure of the midgut to return into the abdomen. Treatment: Excision of the sac.
  2. Adults: Due to defect in the linea alba or divarication of recti.

- **Incisional hernia**: Hernia at the site of an incision, mostly due to dehiscence of wound layers. The first sign of abdominal wound dehiscence is serosanguinous discharge from the wound.

**Random GI Notes**

- **Rectal cancer**: Cancer in the upper 2/3 of rectum is treated with anterior resection, whereas that of the lower 1/3 is treated with abdominoperineal resection.

- **Cancer of anal canal**: Upper 1/2 of anal canal gets adenocarcinoma, while lower 1/2 gets squamous cell carcinoma. Treatment: Abdominoperineal resection.

- **Villous adenoma (Carpet tumor)**: Precancerous adenoma that presents with watery diarrhea and hypokalemia. Treatment: Excision and repeat colonoscopy in a few months.

- **Tubular adenoma**: Not precancerous unless it is bigger than 1 cm in diameter or it has a villous component. Treatment: Excision and repeat colonoscopy in a few months.

- **Duodenal hematoma**: Common after direct injury to epigastrium, e.g., By the steering wheel in a car accident. Diagnosis: Coiled spring appearance on X-ray.

- **Earliest substrate to be depleted postoperatively is the glycogen.**

- The artificial fluid that is closest in composition to small intestinal secretions is lactated ringer, and it has a pH <7. Normal saline combined with D5 as an IV fluid can cause dilutional acidosis.

**Urinary System**

**Bladder and Urethra Trauma**

- **Anatomical key**:
  1. **Superior surface of bladder**: Urine leaks inside the peritoneum.
  2. **Anterior surface of bladder or urethra above urogenital diaphragm**: Urine leaks into the retropubic space of Retzius, which is an extraperitoneal space.
  3. **Urethra below the urogenital diaphragm**: Common in straddle injury, and urine accumulates in the superficial perineal space, which is bound by Colle’s fascia and external spermatic fascia.
  4. **Penile urethra**: Urine leaks extraperitoneally underneath the fascia of Buck.


- **Urinary bladder rupture**:
  1. Clinical picture: Strong persistent desire to urinate, but when this is done only a few drops of bloody urine are voided.
  2. On exam: Prostate is not dislocated.
  3. Diagnosis: Ascending cystography: Tear drop sign.
  4. Treatment: Surgical closure of bladder. Note: Intrapерitoneal rupture will show on abdominal X-ray as ground glass appearance.

- **Membranous urethra rupture**: Patient presents with same symptoms as rupture of the bladder above but the prostate here is dislocated and floating inside the pelvis. Treatment: Suprapubic cystostomy followed by surgical urethral closure.

- **Penile urethra rupture**: Common in straddle injury, e.g., Jumping over a fence or a horse. Clinical picture: Penile and scrotal swelling, and blood at the external urethral meatus. Treatment is similar to that of membranous urethra rupture.

**Benign Prostatic Hypertrophy (BPH)**

- **Mechanism**: Disease of the elderly involving adenomatous hyperplasia in the periurethral zone of the prostate.
Pathology: Hyperplastic acini and corpora amylacea.
Clinical picture: Nocturia, urinary frequency, hesitancy, and terminal dribbling.
Complications: Urinary retention and hematuria.
On exam: Rectal exam reveals smooth painless uniformly enlarged prostate.
Diagnosis: Clinical diagnosis, but can be confirmed using the following:
- Transrectal ultrasound and prostate biopsy confirms diagnosis.
- IVP: Smooth elevation at the base of urinary bladder.
- Prostate specific antigen (PSA): Slightly elevated, but will not exceed 10 ng/ml.

Treatment:
- Dihydrotestosterone (DHT) antagonists, e.g., Finasteride, a 5-alpha reductase inhibitor, prevents conversion of testosterone to DHT.
- Surgery, i.e., Transurethral resection of prostate (TURP) is reserved for severe resistant cases with complications.

Prostate Cancer
- Introduction: The most common cancer in males.
- Location: Posterior lobes of prostate, which are rarely involved in BPH.
- Most common metastases: Spine, mostly osteoblastic lesions.
- Clinical picture: Similar to BPH + Back pain and weight loss.

Diagnosis:
- Transrectal ultrasound and prostate biopsy is diagnostic.
- IVP: Irregular elevation at the base of the urinary bladder.
- PSA: Elevated – more than 10.

Prevention: Screen by annual rectal exam and PSA starting age 50.

Treatment:
- Hormonal: Through blocking androgens:
  - Peripherally: With cyproterone or flutamide.
  - Centrally: With continuous LHRH stimulation (Secretion is normally pulsatile rather than continuous).
- Surgery: Radical prostatectomy.
- Chemotherapy: Using taxanes. Only done for cancers resistant to hormonal therapy.

Renal Cell Carcinoma (Hypernephroma)
- Origin: Nephrons; most commonly proximal convoluted tubule (PCT).
- Pathology: Golden yellow tumor, cells are clear and vacuolated. Refer to Fig. 5.4.
- Metastases: Multiple; the most notorious being:
  - Cannon ball metastases to lungs.
  - Extension to left renal vein causing left sided varicocele.
- Clinical picture: Painless hematuria and elevated erythropoietin causing Polycythemia. Refer to IM for clinical picture.

Fig. 5.4 Renal cell carcinoma
• **Diagnosis**: Test of choice is Kidney biopsy. IVP shows Irregular spider leg deformity.
• **Treatment**: Nephrectomy and interleukin therapy.

**Wilm’s Tumor (Nephroblastoma)**
- **Origin**: Embryonic nephrogenic cells.
- **Mechanism**: Deletion of WT-1 gene on chromosome 11.
- **Clinical picture**: Mostly in children as an abdominal mass.
- **Treatment**: A rapidly growing malignant tumor, corrected surgically.
- **Association**: Diseases associated with wilm’s tumor can be remembered by GRAWL: Genitourinary anomalies, Mental Retardation, Aniridia and Wilm’s tumor.

**Cancer of the Urinary Bladder**
- **Risk factors**: Dyes and smoking.
- **Location**: Most common in the base of the bladder.
- **Type**: Most common is transitional cell cancer.
- **Clinical picture**: Non-specific, e.g., Hematuria, necroturia (passage of tiny pieces of tumor tissue in the urine) and weight loss.
- **Diagnosis**: Cystoscopy and biopsy.
- **Treatment**: 1. Radical cystectomy and urinary diversion. 2. Chemotherapy: Cisplatinum, Methotrexate and Vinblastine.

**Horseshoe Kidney**
- **Mechanism**: Fusion of the kidneys at the lower poles during ascent.
- **Location**: Posterior to inferior mesenteric artery.
- **Diagnosis**: IVP shows a “flower vase” appearance.
- **Treatment**: Conservative.

**Varicocele**
- **Mechanism**: Dilatation of pampiniform and cremasteric venous plexuses.
- **Causes**: High venous pressure mostly due to compression, e.g., Pelvic colon compressing left testicular vein, Superior mesenteric vessels compressing left renal vein.

**Testes**

**Undescended Testes (Cryptorchidism)**
- **Embryology reminder**: Testes develop from the testicular ridge (L2 level) and start descent due to differential body growth, high abdominal pressure and the pulling effect of gubernaculum. This descent is completed by the time of birth.
- **Causes**: Hypopituitarism, short spermatic cord or fibrosis.
- **Clinical picture**: Empty and underdeveloped scrotal sac.
- **Complications**: Malignancy (Mainly seminoma) and sterility due to high intra-abdominal temperature which destroys testicular cells.
- **Next best step**: CT scan of abdomen and pelvis or laparoscopy to locate the undescended testicle/s.
- **Treatment**: HCG and orchiopexy if still undesceded by 1 year of age.
- **Notes**:
  1. **Retractile testis**: Sensitive testicle due to strong cremasteric reflex. Any stimulus causes retraction of the testicle up to the superficial subinguinal pouch. Testes can be felt and easily milked down to the floor of the scrotum.
  2. **Ectopic testis**: Testicle that descends outside its normal line of descent due to the pulling effect of one of the gubernaculum’s tails (Lockwood theory). Most common ectopic site is femoral triangle. Treatment: Dissection and scrotal replacement.

**Epispadius**
- **Introduction**: Opening of the urethra into the dorsum of the penis.
- **Mechanism**: Abnormal positioning of the genital tubercle.
- **Association**: Exstrophy of urinary bladder.

**Hypospadius**
- **Introduction**: Opening of the urethra to the undersurface of penis.
- **Mechanism**: Failed fusion of urethral folds.
- **Association**: Bifid scrotum and undescended testes.
- **Clinical picture**: Corpus spongiosum distal to the opening is fibrosed, causing the penis to curve ventrally, a condition known as chordee.
- **Treatment**: Surgical at the age of 2. Circumcision is contraindicated.
Clinical picture: Dragging pain in the scrotum, more common on the left side.

On exam: “Bag of worms” sensation on palpation of scrotal neck, which disappear on scrotal elevation. It also gives a thrill on cough.

Complications:
1. Infertility: Due to thermal effect and chemical effects of glucocorticoids.
2. Thrombosis and hydrocele.

Treatment: Varicosectomy.

Notes:
1. Retroperitoneal diseases, e.g., Tumor, fibrosis, can compress on testicular veins and present as varicocele.
2. In the setting of unexplained left sided varicocele, suspect a renal tumor compressing the left testicular or left renal veins.

Hydrocele

Mechanism: Fluid collection in the processus vaginalis.

Causes: Patent processus vaginalis, varicocele or lymphatic obstruction.

Clinical picture: Painless cystic translucent scrotal swelling, more pronounced on standing up and decreased by scrotal elevation.

On exam: Positive transillumination test.

Complications: Hematocele, pyocele or testicular atrophy.

Treatment: Eversion or plication of tunica vaginalis.

Notes:
1. Congenital hydrocele: Occurs due to patent processus vaginalis, and the mother will complain of the infant’s scrotal swelling getting bigger towards the end of the day.
2. Encysted hydrocele of the cord: Due to non-oblit-eration of a small segment of processus vaginalis. Presents as small cystic translucent swelling on the cord. It is freely mobile, but its mobility is decreased by pulling down on the testicles.

Testicular Torsion

Mechanism: Caused by to the high attachment of tunica vaginalis around the distal end of the cord, a.k.a. Bell Clapper deformity.

Clinical picture: Sudden severe scrotal pain, especially after trauma or straining, e.g., Heavy weight lifting.

On exam: The testicle is situated high and horizontally in the scrotum and extremely tender to touch, plus blue dot sign.

Diagnosis: Clinically; however, venous duplex should also be done.

Complication: Strangulation and ischemic necrosis of testicle.

Treatment: Manual detorsion and orchiopexy within 6 hours of presentation.

Note: Right testicle torsion is usually clockwise, while left is counter-clockwise.

Epididymorchitis

Causes: UTI, STDs and straining, e.g., Heavy weight lifting.

Clinical picture: Fever and unilateral pain in the scrotum.

On exam: Red, warm, tender and swollen testicle and epididymis.

Diagnosis:
1. CBC: Leukocytosis.
2. Urine analysis and intraurethral swab for STDs.

Treatment: Bed rest, scrotal elevation and antibiotics.

Testicular Cancer

Types: Refer to Table 5.1.

Testes 145
Clinical picture:
1. Painless testicular firm swelling.
2. Loss of testicular sensation.

Metastases: Local, blood and lymphatic, mainly para-aortic lymph nodes. Seminoma is famous for sending cannonball metastases to the lungs.

Diagnosis:
1. Gold standard is biopsy, the trick here is that needle biopsy is contraindicated in the testes, so an open biopsy must be done.
3. Teratoma: Elevated serum Alpha-fetoprotein (AFP).

Treatment:
1. Retrograde orchiectomy.
3. Radiation therapy: For seminoma as it is radiosensitive. Teratomas are radioresistant, so retroperitoneal lymph node dissection (RPLND) is done.

Breast

Breast Cancer

Location: Most common in the upper outer quadrant.

Risk factors: Age and positive family history.

Types:
1. Ductal carcinoma: The most common type is the infiltrating adenocarcinoma.
2. Medullary carcinoma: Soft and vascular tumor that occurs at young age, and is characterized by patches of hemorrhage and necrosis under the microscope.
3. Colloid carcinoma: Cystic tumor with honeycomb appearance and signet ring cells.
4. Lobular carcinoma: Arises from the terminal lobular ducts, and is notorious for being bilateral.
5. Paget’s disease: A slow growing tumor characterized by epidermal hyperplasia, multinucleated vacuolated Paget cells and round cell infiltration of the dermis. Paget’s disease might be confused with eczema of the nipple and areola; however, Paget’s disease – unlike eczema – is unilateral, well defined and not itchy.
6. Mastitis carcinomatosis: Aggressive cancer with bad prognosis, common during pregnancy and lactation. It might be confused with lactational mastitis; however, mastitis carcinomatosis – unlike lactational mastitis – affects more than just one quadrant of the breast, is associated with painless lymphadenopathy and does not respond to antibiotics.

Metastases:
1. Direct: To breast tissue and skin.
2. Blood and transperitoneal, e.g., Krukenberg tumor of the ovaries, now believed to occur via retrograde lymphatic permeation.
3. Lymphatic: Subareolar plexus and deep pectoral plexus; both drain to axillary and supravacular lymph nodes. Note that medial quadrants’ lymphatics cross to the opposite breast. Also the lower quadrants can send metastases to umbilicus (Sister Joseph nodule).

Clinical picture:
1. Hard irregular breast mass with ill-defined edge, and lymphadenopathy.
2. Dimpling and puckering: Due to contraction of ligaments of Cooper.
3. Nipple retraction or inversion.
4. Peau d’orange: Edema of the breast skin with pitting at the sites of hair follicles and sweat glands.

Prevention:
1. Annual breast exam by a physician starting the age of 20.
2. Monthly self breast exam by the patient starting the age of 20 (Controversial).
3. Annual mammogram starting the age of 40.

Diagnosis:
1. Gold standard is biopsy.
2. Mammogram: Irregular microcalcifications are suggestive of malignancy. Refer to Fig. 5.5.

Treatment:
1. Surgery:
   - Stages I and II: Radical mastectomy (Breast, pectoral muscles and axillary lymph nodes are removed) or modified radical mastectomy (Breast, pectoralis minor and axillary lymph nodes are removed).
   - Stage III is treated surgically by simple mastectomy (Breast + axillary biopsy) as a palliative surgery to facilitate radiation and minimize complications.
2. Radiation therapy: Used for all patients.
3. **Chemotherapy**: Indicated only if the tumor is bigger than 1 cm and/or if there is lymph node involvement. CMF (Cyclophosphamide, Methotrexate, 5-Florouracil) is a widely used combination.

4. **Hormonal therapy**: Depends on the hormonal receptors found in the tumor:
   - Negative hormone receptors: No treatment. However, 10% of patients with negative estrogen receptors still respond to hormonal treatment.
   - Positive hormone receptors in pre-menopausal patient: Tamoxifen for 5 years. Tamoxifen is an estrogen blocker that increases the risk of DVT, endometrial carcinoma and hot flashes.
   - Positive hormone receptors in post-menopausal patient: Tamoxifen for 5 years followed by aromatase inhibitor therapy for 5 years.
   - Positive her-2-neu receptors: Treat with Trastuzumab (Herceptin).

**Notes**:
1. Most important risk factor in breast cancer in females: Age.
2. Most important prognostic factor in breast cancer: Tumor size and lymph node involvement.
3. Lobular carcinoma in situ is treated with tamoxifen.
4. Ductal carcinoma in situ is treated with simple mastectomy or local resection.
5. Breast cancer in males is treated by modified radical mastectomy and radiation.

**Fibrocystic Disease (Fibroadenosis)**
- **Definition**: Changes in the breast that occur due to evolution and involution
- **Pathology**: A combination of fibrotic and cystic changes.
- **Clinical picture**:
  1. Breast pain and tenderness, more pronounced around menstruation dates.
  2. Breast nodules and nipple discharge, more pronounced around menstruation.
- **On exam**: Nodular breast diffusely on palpation.
- **Diagnosis**: Excisional biopsy is the gold standard.
- **Complication**: Breast cancer.
- **Treatment**: Supportive, except for large lesions, e.g., Cysts or lumps, which can be excised.

**Mastitis**
- **Lactational mastitis**: Common in the first few months of lactation. It is mostly caused by Staphylococcus aureus, affects one quadrant and is treated with penicillinase resistant penicillin.
- **Pubertal mastitis**: Common around the age of puberty. So when you get a case in the USMLE about a male teen whose breasts started getting slightly bigger and showing some redness, just reassure the patient that this is normal.
- **Neonatal mastitis**: Mostly due to estrogen withdrawal, and is associated with nipple discharge a.k.a. Witch's milk.

**Gynecomastia**
- **Definition**: Painful and tender enlargement of the glandular part of the male breast.
- **Causes**: Liver cell failure or drug induced, e.g., Spironolactone, Cimetidine.
• **Treatment**: Treat the cause. If failed, *subcutaneous mastectomy* is done.

• **Note**: When you get a case in the USMLE about a male teen whose breasts started getting slightly bigger; just reassure the patient that this is normal and will resolve.

### Duct Papilloma

- **Clinical picture**: Multiparous female with bloody nipple discharge.
- **Diagnosis**: Mammogram and cytology of the discharge.
- **Treatment**: Microdochectomy, as it is a precancerous lesion.

### Fibroadenoma

- **Clinical picture**: Young nulliparous female with firm smooth mobile breast mass.
- **Complications**: Increase in size, malignancy and myxomatous degeneration.
- **Treatment**: Inoculation. If large in size, simple mastectomy can be done.

### Traumatic Fat Necrosis

- **Mechanism**: Trauma causing the fat to bind with calcium and form a mass.
- **Treatment**: Excision.

### Notes

- **Nipple discharge**: Best next step depends on the scenario as follows:
  1. Discharge + breast mass: Next step is excision of the mass.
  2. Discharge from a single duct: Next step is Microdochectomy.
  3. Discharge from multiple ducts: Next step is Benzidine test (*Detects blood*). If negative, observe the patient. If positive, *ducts excision* is recommended.

- **Duct ectasia**: Breast ductal dilatation along with plasma cell infiltration. Clinical picture: *Worm-like structure* extending away from the nipple under the areola. Treatment: Excision.

- **Galactoceole**: Retention cyst filled with milk. Patient presents with a cyst under the areola which is attached to the nipple *via one point*. Treatment: Excision.

### Hand Infections

- **Organisms**: Mostly *Staphylococcus aureus*, and to lesser extent *streptococcus*.
- **Pulp space infection**: Leads to *loss of pulp resilience* and could end up with *necrosis of the distal phalanx in 2 weeks*. Treatment: Incision and Drainage (I&D).
- **Midpalmar space infection**: Leads to *frog hand deformity*, where patient has dorsal hand edema and *loss of palm concavity*. Treatment: I & D.
- **Thenar space infection**: Leads to *ballooning of the thenar eminence with maintained palm concavity*. Treatment: I & D.
- **Suppurative tonsillitis**: Patient presents with swollen partially flexed tender fingers. Treatment: I & D and treatment of the cause.

### Tongue

#### Ulcers

- **Herpetic**: Painful and vesicular, affects *only one half of the tongue and does not cross the midline*.
- **Syphilitic**: Gummatous ulcer with *punched out edges and yellow leather-like sloughed floor*.
- **T.B.**: Multiple *along the edges of the tongue with undermined edges*.
- **Dental**: Narrow and long, and rubs against a tooth.
- **Dyspeptic**: Superficial, tender and yellow in color. Heals within 7 days
- **Post-pertussis**: *Transverse linear* ulcer on the lower surface of the tongue.

### Cysts

- **Mucous cyst**: Oval bluish cyst that forms on the floor of the mouth due to retention of secretions of submucous salivary glands. Treatment: Excision.
- **Ranula**: Forms due to *extravasation or retention of sublingual salivary glands*. It is also bluish, cystic and in the floor of the mouth. It is different than mucous cyst in being on either side of the frenulum and *never in the midline*, and also being *crossed by the submandibular duct*. Treatment: De-roofing (Marsupialization).

### Tongue Cancer

- **Location**: Occurs most commonly in the *anterior 2/3*.
- **Risk factors**: Smoking, alcohol and leukoplakia.
- **Lymphatic metastases**:
2. **Anterior 2/3:**
   - **Tip:** Submental lymph nodes.
   - **Sides:** Submandibular lymph nodes.
   - **Center:** Submental and submandibular lymph nodes.

- **Diagnosis:** Biopsy.
- **Treatment:**
  1. Anterior 2/3: Radiation needles in the tongue plus surgery.
  2. Posterior 1/3: Radiation only.

### Salivary Glands

**Introduction**

- **Parotid gland:** Salivary gland around the ear that secretes **serous saliva** inside the mouth through Stensen’s duct, which opens at the upper second molar tooth.
- **Sublingual glands:** Located just underneath the tongue, and secrete **mucous saliva**.
- **Submandibular gland:** Located underneath the ramus of the mandible and secretes **mixed saliva** (*Serous and mucous*). The duct opens via Wharton’s duct into the floor of the mouth, just by the frenulum of the tongue.

### Sialolithiasis

- **Clinical picture:** Pain and swelling of the involved gland. Symptoms exacerbated by eating; especially with **sour food or fluids**, e.g., Lemon juice.
- **On exam:** Palpation of the stone in the duct by bimanual palpation.
- **Diagnosis:** X-ray or sialogram.
- **Treatment:** Conservative by sialogogues. Sialadenectomy is reserved for severe cases.

### Sialoadenitis

- **Mechanism:** Infection of the salivary glands by virus or bacteria, esp. *S. aureus*.
- **Clinical picture:** Gland swelling, warmth and tenderness; not related to meals.
- **Treatment:** Best is penicillinase resistant penicillin.

### Ludwig Angina

- **Mechanism:** Microaerophilic streptococcal infection of the **deep** fascia surrounding the **submandibular gland**.

### Clinical picture:
- Fever and **brawny edema** in the submandibular area.
- **Treatment:** Release incision of the skin and deep fascia in the submandibular area, plus systemic antibiotics.

### Salivary Tumors

- **Adenolymphoma:**
  1. Ectopic salivary tissue in the superficial layers of the parotid gland.
  2. Adenolymphoma is cystic, benign, painless and **bilateral** tumor, characterized by **big cystic spaces** filled with clear fluid through which papillae project.
  3. Microscopically shows **palisade pattern**.
  4. Diagnosis: Technetium scan shows increased uptake with **hot spot**.
  5. Treatment: Superficial parotidectomy.

- **Parotid cancer:** Anaplastic adenocarcinoma with facial nerve involvement. So think of this whenever you see a parotid gland tumor with facial nerve palsy at the same time. Treatment: Total parotidectomy and radiation therapy.

- **Pleomorphic adenoma:** Characterized by **incomplete fibrous capsule**. A benign slow growing tumor that does not injure the facial nerve unless it turns malignant. Treatment: Sialadenectomy.

- **Cylindroma:** Characterized by cylinders of cells filled with mucin.

### Head and Neck

#### Cleft Lip

- **Mechanism:** Failure of the **maxillary prominences to fuse with medial nasal prominences**, or failure of the mandibular prominences to fuse with each other.
- **Cause:** Familial or due to injury during the first trimester, e.g., **Rubella**.
- **Clinical picture:** Cleft lip, usually unilateral and mostly on the left.
- **Complications:** Difficulty in feeding.
- **Treatment:** Surgical at age of **10 weeks** by Millard’s operation.

#### Cleft Palate

- **Mechanism:** Failure of fusion of both palatine shelves with either each other, or with the primary palate.
- **Cause:** Same as cleft lip.
- **Complications:** Difficulty in feeding and speech.
**Treatment:** Surgical at the age of 10 to 12 months by Langenbeck’s operation.

**Note:** Pierre Robin syndrome is a cleft palate syndrome in which the patient also has posteriorly displaced mandible (Retrognathia) and tongue.

### Hemangioma

**Capillary hemangioma:** Compressible, non-pulsatile hamartoma, has 3 forms:

1. **Strawberry:** Present at birth and disappears within first year of life.
2. **Salmon patch:** Present at birth and disappears within first year of life.
3. **Portwine stain:** Does not disappear spontaneously. Refer to Fig. 5.6. Requires excision and graft.

**Sturge-Weber syndrome:** Portwine hemangioma, plus leptomeningeal angiomas causing neurological manifestations, e.g., Seizures, CVAs. Skull X-ray in Sturge-Weber syndrome shows tram-track like intracranial calcifications.

**Cavernous hemangioma:** Ill-defined bluish cystic swelling that does not transilluminate. Complication: Hemorrhage. Treatment: No treatment unless bleeding occurs, then excision is warranted.

**Hemangioma**

**Cystic Hygroma**

- **Mechanism:** Cavernous lymphangioma, most common in the lower part of the posterior triangle of the neck.
- **Clinical picture:** Cystic compressible swelling in the neck; present since birth.
- **Treatment:** Excision at 2 years of age.

### Others

- **Frey syndrome:** Excessive sweating induced by eating. Mechanism: Injury of auriculotemporal branch of trigeminal nerve.
- **Crocodile tears syndrome:** Excessive lacrimation induced by eating. Mechanism: Injury of facial nerve during its course inside the parotid gland.

### Venous System

#### Varicose Veins

- **Introduction:** The lower limbs drain through 2 systems of veins; superficial and deep. Both systems are connected via perforators. This network has valves to guarantee passage of the blood only in one direction; from the superficial system into the deep one.
- **Types and causes:**
  1. **Primary:** Prolonged standing and defective valve system.
  2. **Secondary:** DVT, pelvic tumors and pregnancy. All these factors slow the venous return.
- **Clinical picture:**
  1. Dull aching pain towards the end of the day.
  2. Dilated tortuous veins on the surface of the leg, more pronounced upon standing and disappear on leg elevation.
- **Complications:**
  1. Venous ulcer: Due to liposclerosis. Occur mainly in the lower leg, just above the ankle and could get deep enough to cause osteomyelitis of the tibia.
  2. Stasis dermatitis: Due to deposition of hemosiderin.
  3. Talipes equinus deformity: Due to contracture of Achilles tendon. This is induced usually by the patient putting more pressure on his/her frontal part of the foot to avoid pain.
- **Diagnosis:** Duplex ultrasound is the gold standard.
- **Treatment:**
  1. Elastic stockings and treatment of the cause.

![Fig. 5.6 Portwine hemangioma (Nevus flammeus)](image-url)
2. Injection sclerotherapy: Induces *thrombosis* and *fibrosis* of varicosities. Used for *localized varicosities only*.
3. Severe cases with complications: Stripping of the varicose veins or multiple ligation of the incompetent areas.
4. Venous ulcer: *Compression*, antibiotics and subfascial ligation of ankle perforators. Another option is excision and grafting of the ulcerated area.

**Deep Venous Thrombosis (DVT)**

- **Risk factors:**
  1. *Previous DVT is the most important risk factor.*
  2. Recent prolonged immobilization, e.g., Long car ride, long flight, hospitalization, limb fracture.
  3. Medications: *Oral Contraceptive Pills* and Megestrol (Used as appetite stimulant for cancer patients).

- **Pathology:**
  1. Virchow’s triad = Hypercoagulability + Stasis + Endothelial damage.
  2. The blood clot is formed of fibrin and platelets.
  3. Most common site is the lower extremities.
  4. Time frame: Around the 3rd–7th day after start of immobilization.

- **Clinical picture:**
  1. Affected limb is red, warm, tender and swollen.
  2. *Homan’s sign:* Pain in the calf on dorsiflexion of the foot in cases of DVT below the knee.

- **Complications:**
  1. Pulmonary embolism (PE): *DVT in the lower extremities is the most common cause of PE*. So keep that in mind when you see any patient with DVT in the USMLE with sudden respiratory distress. Refer to IM section for more on PE.
  2. Varicose veins, edema and venous ulcer.

- **Differential diagnosis:** Ruptured baker’s cyst or plantaris muscle.

- **Diagnosis:** Gold standard is venography. Practically, we use *Doppler ultrasound*.

- **Prevention:** All hospitalized patients get subcutaneous heparin and/or sequential compression devices on their calves during their hospital stay. It is a standard of care.

- **Treatment:** *Heparin IV drip* initially, and then warfarin is started and continued for 3–6 months maintaining an INR target of 2–3.

- **Notes:**
  1. Inferior Vena Cava filters, e.g., Greenfield filter, are indicated only in 2 conditions:
     - Patients with DVT who have an absolute contraindication to anticoagulation, e.g., GI bleeding.
     - Patients with DVT already on anticoagulation with therapeutic INR, and yet keep suffering recurrent PE.
  2. Thrombophlebitis migrans: *Superficial thrombophlebitis* that lasts for short periods and disappears spontaneously. This is usually a sign of malignancy (Trousseau’s sign), e.g., Pancreatic cancer. So, *intensive screening for malignancy should be the first next step for any patient with thrombophlebitis migrans*.

**Arterial System**

**Atherosclerosis**

- **Pathogenesis:** Thickening of the intima and deposition of subintimal fat forming plaques and calcifications. It occurs mainly in *large arteries*.

- **Clinical picture:** PVD, CAD, CVA.

- **Diagnosis:** Arteriography shows *rat tail* appearance.

- **Treatment:**
  1. Treat the cause.
  3. Surgery: For complications see below.

**Peripheral Vascular Disease (PVD)**

- **Causes:** Atherosclerosis, thrombosis, embolism, smoking.

- **Clinical picture:**
  1. *Acute:* Pain, Pallor, Pulselessness, Paralysis, Parasthesia and Poikilothermia.
  2. *Chronic:*
     - *Atrophic changes:* Thin skin with loss of hair and possible ulcers.
     - *Intermittent claudications:* Muscle cramping on exercise that resolves at rest. This occurs due to accumulation of metabolites due to ischemia, which stimulate the nerve endings.
Rest pain: Due to ischemic neuritis. Patient presents with pain in the affected limb even at rest, and tends to keep that limb uncovered and hanging by the side of the bed while sleeping. This is a sign of impending gangrene.

On exam: Ankle/Brachial pressure index (ABI) (Normal > 1). In cases of ischemia, it is expected to be lower than 1. In cases of rest pain, lower than 0.3.

Location: There are key sites to look for the effects of vascular compromise:
1. Aorto-iliac: Cramping of buttocks and thighs and impotence, a.k.a. Leriche syndrome.
2. Femoro-popliteal: Cramping of the calf muscles.
3. Popliteal: Cramping of the lower leg and foot muscles.

Diagnosis: Arteriography (Digital Subtraction Angiography “DSA”) is the gold standard. Doppler or duplex ultrasound could also be used.

Complication: Gangrene and amputation.

Treatment:
1. Treat the cause, e.g., Stop smoking. Embolic cases should be managed within 6 h by embolectomy and anti-coagulation, or else gangrene is a risk.
2. Medications: Anti-platelets and vasodilators, e.g., aspirin, cilostazole.

Thromboangiitis Obliterans (Buerger’s Disease)

Pathogenesis: An atherosclerotic disease that affects entire neurovascular bundles, but mainly targeting medium and small sized arteries, leaving them with intimal proliferation and a red thrombus.

Cause: Strongly linked to smoking.

Location: Most commonly below the elbow and knee.

Clinical picture: Similar to chronic ischemia. See above.

Diagnosis: Arteriogram which shows patent large vessels and occlusion of medium and small sized ones.

Complication: Gangrene requiring amputation.

Treatment: Stop smoking, and start anti-platelets and vasodilators.

Note: If you see any young or middle aged smoker in the USMLE with severe PVD, it is mostly Buerger’s disease, and he should be advised to quit smoking.

Raynaud’s Disease

Pathogenesis: Episodic arterial vasospasm of the hands, more common in females.

Clinical picture: Sudden pallor and pain in the hands, then they turn blue and back to normal, all within a couple of minutes.

On exam: Radial pulse is within normal limits.

Diagnosis: Clinical, also immersion of the hands in cold water triggers an attack.

Treatment:
1. Avoid cold weather and objects.
2. Calcium channel blockers: Relax vascular smooth muscles.
3. Sympathectomy is the last resort, which is of 2 types:
   - Cervicodorsal sympathectomy: Removal of lower half of stellate ganglion, along with the 2nd and 3rd thoracic ganglia. This is the type used to treat Raynaud’s disease.

Gangrene

Mechanism: Necrosis and putrefaction of tissues.

Causes: Refer to causes of PVD.
Lumbar sympathectomy: Removal of 2nd, 3rd and 4th lumbar ganglia. Done for patients with severe lower limb ischemia, where revascularization surgery is not an option.

Crush Syndrome (Traumatic Rhabdomyolysis)
- **Definition:** Ischemic muscle necrosis due to trauma, e.g., Motor vehicle accident, status epilepticus or severe physical exercise.
- **Pathology:** Ischemia causes necrosis of the muscle and release of large amounts potassium and myoglobin from the muscles.
- **Clinical picture:**
  1. Muscle aches.
  2. Acute renal failure (**ATN**): Due to deposition of myoglobin in the tubules (Rhabdomyolysis).
- **Diagnosis:** Elevated serum CPK (**in thousands**), aldolase and urine myoglobin.
- **Treatment:**
  1. *Aggressive fluid resuscitation is the best next step.*
  2. Alkalization of the urine: Using Bicarbonate drip to help excrete myoglobin without deposition in the tubules.

Thoracic Outlet Syndrome
- **Mechanism:** Cervical rib compressing on 2 main structures; subclavian artery and lower trunk of brachial plexus.
- **Clinical picture:**
  1. Decreased sensations along the ulnar nerve distribution.
  2. *Atrophy of thenar and hypothenar and interossei muscles.*
- **On exam:** Adson test: If the patient turns his chin towards the side of the lesion while taking a deep inspiration, the radial pulses in the affected hand will get weaker.
- **Diagnosis:** X-ray of the neck and chest looking for the compressing object.

<table>
<thead>
<tr>
<th>TABLE 5.2 Fractured base of the skull.</th>
<th>Anterior cranial fossa</th>
<th>Middle cranial fossa</th>
<th>Posterior cranial fossa</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Effect</strong></td>
<td>• Peri-orbital ecchymosis</td>
<td>• Bleeding from the ears</td>
<td>• Bleeding from the mouth</td>
</tr>
<tr>
<td></td>
<td>• Subconjunctival hemorrhage</td>
<td>• CSF otorrhea</td>
<td>• Bruising of the muscles in the back of the neck</td>
</tr>
<tr>
<td></td>
<td>• Epistaxis</td>
<td>• CSF rhinorrhea</td>
<td></td>
</tr>
<tr>
<td><strong>Cranial nerves injured</strong></td>
<td>I and II</td>
<td>VII and VIII</td>
<td>IX, X and XI</td>
</tr>
</tbody>
</table>

Lympathic System

Lymphadenitis
- **Causes:** Infectious or neoplastic.
- **TB lymphadenitis:** Usually affects the upper cervical lymph node group, which become matted and show central caseation surrounded by epithelioid cells under microscopy. Complications: *Cold abscess* and *collar stud abscess*, sinus and tract formation.
- **Syphilitic lymphadenitis:** Starts with *chancre*, where patient has *shotty painless* nodes, which usually involves *epitrochlear and posterior cervical lymph node group.*
- **Filariasis:** Patient has high eosinophilic count.
- **Malignant:** Aspiration reveals blood and necrotic tissue.

Lymphedema
- **Causes:** Congenital, e.g., Lymphedema congenita, or acquired due to malignancy or infection, e.g., Filariasis, Streptococci.
- **Clinical picture:** Edema mostly of the lower extremities, pitting initially then *non-pitting*, a.k.a. Elephantiasis.
- **Diagnosis:** Lymphangiography. *Midnight film is used to diagnose filariasis.*
- **Treatment:** Limb elevation. If resistant, surgery is done to divert lymphatic flow into the deep fascia.

Bones and Fractures

Fracture of the Skull Base
- **Refer to Table 5.2 for locations and effects of injury.**
Rib Fractures

- **Types and clinical picture:**
  1. **Simple:** One or more fractures at the site of maximum curvature. Pain is at the fracture site; gets worse by deep inspiration or cough.
  2. **Flail chest:** Multiple fractures at multiple sites. Chest wall moves paradoxically with breathing, i.e., Moves in with inspiration and out with expiration.

- **Diagnosis:** X-rib in multiple views including oblique films.

- **Treatment:**
  1. If no displacement: Pain control, heals spontaneously.
  2. If displaced: Open reduction and internal fixation.

Spondylosis

- **Mechanism:** Degenerative disorder of the spine and intervertebral discs characterized by osteophytes formation.

- **Treatment:** Conservative; surgery is only needed if there are signs of cord compression. Refer to internal medicine for more details.

Spondylolysis

- **Mechanism:** Stress fracture of the pars interarticularis. Occurs mainly in the lumbar vertebrae, more common in athletes.

- **On exam:** Positive leg hyperextension test on exam.

- **Diagnosis:** X-ray; the fracture is collar-shaped.

- **Note:** Spondylolthesis is a disorder of the pedicles of lumbar vertebrae causing sliding of a vertebral body and lordosis. It is either congenital or secondary to degeneration.

Clavicular Fracture

- **Mechanism:** Occurs at the junction of medial 2/3 and lateral 1/3 of clavicle, mostly due to fall on outstretched hand.

- **Clinical picture:** Step-ladder deformity and tilt of the head towards fractured side due to contraction of sternomastoid muscle.

- **Treatment:** Closed reduction + Sling (Figure of eight sling).

Supracondylar Fracture of Humerus

- **Mechanism:** Fracture of the humerus just above the epicondyles, mostly due to a fall on the tip of a flexed elbow.

- **Clinical picture:** Pain and ecchymosis of the antecubital fossa.

- **X-ray:** Positive fat pad (Sail) sign.

- **Next best step:** Examine radial pulse.

- **Complications:**
  1. Injury to brachial artery: Leads to acute ischemia (Remember all the Ps).
  2. Volkmann contracture: Flexion deformity of the wrist and fingers, mostly due to ischemia causing muscle fibrosis.

- **Treatment:** Reduction + immobilization by cast placement.

Nursemaid Elbow

- **Mechanism:** Pulling on the upper limb causing the radial head to be subluxed off the annular ligament.

- **Clinical picture:** Common in children and the patient presents with flexed and pronated forearm.

- **Treatment:** Manual reduction.

Compartment Syndrome

- **Introduction:** Surgical emergency; common after trauma, fracture or severe infection.

- **Clinical picture:** The affected compartment is red, warm, tender and swollen.

- **On exam:** Severe compartmental pain on passive extension of the digits.

- **Diagnosis:** Elevated pressure inside the compartment by manometry (>30 mmHg).

- **Treatment:** Immediate fasciotomy.

- **Notes:**
  1. Structures in anterior compartment of thigh are femoral artery and nerve.
  2. Structures in anterior compartment of leg are anterior tibial artery and deep peroneal nerve.

Scaphoid Fracture

- **Most common cause:** Fall on an outstretched hand.

- **Clinical picture:** Wrist pain and tender anatomical snuffbox.

- **Complications:** Avascular necrosis of scaphoid bone in proximal fractures.
Diagnosis and management: X-ray does not show the fracture in early stages, so in suspected cases, put a thumb splint and repeats the X-ray in 7–10 days.

Remember: The snuffbox is bounded by 3 pollicis tendons: Extensor pollicis longus, extensor pollicis brevis and abductor pollicis longus (The police guards the box).

Colle’s Fracture
- Mechanism: Posterior displacement of distal radius plus fractured styloid process of the ulna.
- Clinical picture: Pain and palpable fracture in the distal forearm.
- Diagnosis: X-ray shows Dinner fork deformity.
- Treatment: Reduction + immobilization by cast placement.

Dupuytren Contracture
- Mechanism: Fibrosis and contraction of palmar aponeurosis.
- Risk factors: Alcoholism and liver cirrhosis.
- Clinical picture: Painless flexed medial fingers.
- Treatment: Physical therapy, surgery is reserved for severe resistant cases.

Miscellaneous Upper Limb Injuries
- Shoulder dislocation: Mostly anterior dislocation, injuring the axillary nerve and artery. On exam: Externally rotated arm. Treatment: Reduction and sling.
- Lateral epicondylitis (Tennis elbow): Inflammation of common extensor origin.
- Medial epicondylitis (Golfer’s elbow): Inflammation of common flexor origin.
- Boxer’s fracture: Fracture of the head of 5th metacarpal bone.
- Gamekeeper’s fracture: Expect it in a patient coming to the ER after skiing, complaining of thumb pain and tenderness. The pathology is avulsion of medial collateral ligament of thumb.
- Monteggia’s fracture: Dislocation of radial head and diaphyseal ulnar fracture. Expect it in a patient coming to the ER who was in a fight, and used his forearm to stop an attack by a blunt object.

Femoral Neck Fracture
- Risk factors: Elderly women with osteoporosis.
- Clinical picture: Tender, abducted, externally rotated, and shortened leg.
- Complication: Avascular necrosis of femoral head.
- Treatment: Open reduction and internal fixation, unless there is intracapsular fracture, which requires a hemiarthroplasty.

Knee Injuries
- Unhappy triad: The most serious injury after a lateral knee injury, which injures 3 structures (MAM): Medial collateral ligament, Anterior cruciate ligament and Medial meniscus.
- Quadriceps tear: Suspected if you feel a groove above the knee after a knee injury.
- ACL tear: Patient hears a popping sound in his knee, usually during jogging. On exam: Anterior displacement of tibia on femur with the knee flexed 20° (Lachmann’s test).
- Meniscus tear: Patient develops painful swelling on either side of the knee, usually after frequent crouching and standing movement, or after a sudden twist injury to the knee. On exam: Repeated flexion and extension of the knee with internal and external rotation of the ankle reveals palpable and audible clicking sound in the knee joint (McMurray test).
- Note: All knee injuries described above are managed medically with pain control and knee immobilization. Only if condition is not improving, MRI of the knee is obtained (MRI is the test of choice to visualize cruciate ligaments and menisci).

Osgood Schlatter Disease
- Mechanism: Common in soccer players, due to avascular necrosis of tibial tuberosity.
- Clinical picture: Pain and swelling below the knee.
- Note: Tibial fractures typically do not heal well and there is a possibility of malunion due to the relatively poor blood supply.

Slipped Capital Femoral Epiphysis
- Clinical picture: Thigh and knee pain and limping.
On exam: Passive hip flexion is associated with an external rotational movement.

Diagnosis: Medio-posterior displacement of femoral head on frog leg lateral views hip X-ray.

Complication: Avascular necrosis of femoral head.

Treatment: Surgical fixation.

Miscellaneous Lower Limb Injuries

- **Ankle sprain**: Due to injury of the anterior talofibular ligament. No fracture is involved. Treatment: Ice packs and early mobilization.
- **Jones’ fracture**: Occurs with foot inversion, where the 5th metatarsal tuberosity is avulsed.
- **Pott’s fracture**: Occurs with foot eversion, where the medial malleolus is avulsed.
- **Lover fracture**: Occurs in patient falling from a height landing on his heels. Fracture involves the calceneous, neck of femur, and lumbar vertebrae.

Osteomyelitis

- **Mechanism**: Infection of the bone, directly from a nearby septic focus or through seeding from the bloodstream in cases of bacteremia.
- **Pathology**: Bone death (Sequestrum) and new bone formation (Involucrum).
- **Most common organism**: Staphylococcus aureus. Salmonella is common in patients with sickle cell disease, but S. aureus is still the most common organism.
- **Clinical picture**: Red, warm, tender and swollen limb.
- **Diagnosis**:
  1. Gold standard to diagnose osteomyelitis in general: Bone biopsy.
  2. Radiological test of choice for acute cases: MRI.
  3. Radiological test of choice for chronic cases: X-ray; shows periosteal elevation.
  4. Practically: Bone scan – it is very sensitive; however, it is not specific.

**Table 5.3 Bone tumors.**

<table>
<thead>
<tr>
<th>Ewing sarcoma</th>
<th>Osteogenic sarcoma</th>
<th>Giant cell tumor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Diaphysis of long bones</td>
<td>Metaphysis of long bones</td>
</tr>
<tr>
<td>Unique feature</td>
<td>Onion skin appearance on X-ray</td>
<td>Sun ray appearance and Codman triangle on X-ray due to elevation of the periostium</td>
</tr>
<tr>
<td>Notes</td>
<td>Translocation t11;22</td>
<td>Most common malignant bone tumor</td>
</tr>
<tr>
<td>Treatment</td>
<td>Amputation + Radiation therapy</td>
<td>Amputation + Chemotherapy</td>
</tr>
</tbody>
</table>

Bone Tumors

Refer to Table 5.3 for the most common bone tumors.

Emergencies

Burns

- **Types**: Depends on the surface area involved:
  1. Minor: Less than 15% of body surface area.
  2. Major: More than 15% of body surface area.
- **Degrees**: Multiple classifications exist; the most common are:
  1. 1st degree: Erythema, e.g., sunburn Heals in one week without scarring.
  2. 2nd degree: Vesicles, with injury to most of the dermis.
  3. 3rd degree: Injury to the subcutaneous tissue.
  4. 4th degree: Injury to muscles, ligaments and bones.
- **Complications**:  
  1. Shock: Neurogenic, hypovolemic or even septic shock.
  3. GI: Stress ulcer of the duodenum (Curling ulcer).
- **Treatment**: First thing to do is ABC: Airway maintenance by intubation, Breathing support by mechanical ventilation, Circulation maintenance by establishing wide bore IV lines and starting aggressive fluid resuscitation using 6 ratios of plasma.
- **Notes**:  
  1. Plasma ration = Body weight in kg × % of body burned / 2.
2. Rations are given as 3 in the first 12 h, 2 in the second 12 h, and 1 in the last 12 h.
3. Cleaning of the wounds and grafting if needed.

ABCD of Emergency

- **A (Airway):** Immobilize the neck, open airway by jaw thrust and clear the airway of any foreign bodies.
- **B (Breathing):**
  1. If patient is breathing, move to C.
  2. If not breathing, intubate the patient with a cuffed endotracheal tube (Use uncuffed tube for children below 8 years of age).
  3. If not breathing and cannot intubate, do cricothyrotomy.
- **C (Circulation):**
  1. Most sensitive indicator for intravascular volume is the pulse.
  2. Most sensitive indicator for capillary circulation is the rate of capillary refill.
  3. Best place to check for pulse is carotid artery (In infants, brachial artery is the best).
  4. Wide bore IV line has to be established within 90 seconds, and CPR (cardiopulmonary resuscitation) should be immediately started if the patient has no pulse.
  5. Best IV fluid is lactated ringer; however aggressive hydration is contraindicated for patients with myocarditis and hypoplastic left heart syndrome.
- **D (Drugs):** LANE (Lidocaine, Atropine, Narcan, Epinephrine) could be given through endotracheal tube.

Toxicology

**Introduction**

- **First aid:** First measure in any patient with any toxicity is securing an Airway, maintaining Breathing, and establishing Circulation (ABC).
- **Activated charcoal:** Helps decrease or even block absorption of toxins in the stomach, and it works for everything except Lithium, Iron and Cyanide (LIC).

**Lead**

- **Clinical picture:** Patient who just moved to a house with classic old paints and pipe system, now presenting with abdominal pain and anemia.

**Ethylene Glycol (Anti-Freeze)**

- **Clinical picture:** High anion gap metabolic acidosis, and oxalate crystals in urine.
- **Treatment:** Ethanol and hemodialysis.
- **Note:** Methanol (Bootleg) (Moonshine) is converted inside the body into formic acid and formaldehyde, which cause high anion gap metabolic acidosis and blindness, respectively. Treatment: Ethanol.

**Cyanide**

- **Introduction:** Has a bitter almond odor, and makes the blood cherry red in color.
- **Mechanism:** Inhibits cytochrome oxidase and cellular oxygen uptake.
- **Cause:** Cyanide toxicity is common to happen due to prolonged Na nitroprusside infusion.
- **Treatment:** Nitrites and Sodium thiosulfate.

**Organophosphates**

- **Introduction:** Present in insecticides and nerve gas.
- **Mechanism:** Irreversible inhibition of cholinesterase enzyme.
- **Clinical picture:** Cholinergic symptoms, e.g., Salivation, diarrhea, vomiting, miosis.
- **Treatment:** Cholinesterase reactivator, e.g., Pralidoxime.

**Arsenic**

- **Introduction:** Heavy metal with garlic odor that interferes with oxidative phosphorylation.
- **Clinical picture:** Polyneuritis, skin hyperpigmentation, liver and kidney failure.
- **Treatment:** Gastric lavage, Dimercaprol and hemodialysis.

**Opioids**

- **Clinical picture:** Pinpoint pupils, respiratory depression and hypothermia.
- **Antidote:** Naloxone.
- **Remember:** BDZ are reversed by Flumazenil, not Naloxone.
**Carbon Monoxide**

- **Clinical picture:** It is winter time and a family has been spending the entire weekend at home *in front of the fireplace*. Now they *all* presented to the ER with *confusion, headache* and *dizziness*. Another classic example is a patient who tried to commit suicide by locking himself in his garage with his car engine running.
- **Treatment:** *Hyperbaric* or *100% oxygen*, and treat the cause.

**Mercury**

- **Clinical picture:** *Ataxia*, vomiting, diarrhea and renal failure.
- **Treatment:** Dimercaprol or Penicillamine.

**Iron**

- **Clinical picture:** *Hemorrhagic gastroenteritis*.
- **Treatment:** Iron chelators, e.g., *Desferrioxamine*. 
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Pediatrics

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Breast Feeding

Introduction

- **Timing:** Most infants start feeding within the first 6 hours after birth.
- **Most important factor for efficient breast feeding:** Adequate hydration of mother.
- **Type of milk:** Colostrum is the main breast milk during the first 7–10 days after labor, after which it transforms to the established form. Colostrum has a high content of proteins, macrophages, immunoglobulins, epidermal growth factor (for GI epithelization), and small amount of calories compared to established milk.

Advantages of Human Milk

- **Bifidus factor:** A glycoprotein that stimulates the growth of *lactobacillus bifidus* and *lactobacillus acidophilus* in the infant’s intestine. Lactobacilli convert lactose to lactic acid; which kills pathogens and promotes absorption of calcium and iron.
- **Essential fatty acids:** e.g., Linoleic, linolenic and arachidonic acids. They are essential for maturation of the CNS.
- **Iron:** High iron content with high bioavailability, hence, routine iron supplementation is not needed before 6 months of age in breast fed infants.
- **Lactoferrin:** Bacteriostatic to *E. coli*. Mechanism: Iron chelation.

Non-Human Milk

- **Introduction:** Contains more phosphate than human milk, which inhibits iron absorption.
- **Cow and buffalo milk:** Most common commercial milk. Cow milk (though rich in potassium and proteins) causes iron deficiency anemia, allergy, malabsorption, hypocalcemia, and vitamin C deficiency.
- **Goat milk:** The least allergic; however, it is deficient in folic acid.

Forms of Feeding

- **First 6 months:** Breast feeding.
- **6–12 months:** Mixed feeding, i.e., Breast milk and solid food.
- **12 months onwards:** Solid food.

Weight

- **After birth:** Sudden weight drop, followed by weight gain.
- **Day 7 to day 14:** Plateau of infant’s weight.
- **Day 14:** A second drop of weight to baseline.
- **4 months of age:** Normally, weight should be double the birth weight.
Troubleshooting

- **Milk engorgement**: Breast is full, tense and tender. **Prevention**: Early and regular breast feeding. **Treatment**: Evacuation, ice packs and NSAIDs.

- **Nipple abnormalities**: e.g., Retracted or inverted nipple. **Treatment**: Manual expression of the milk using suction pump.

Notes

- **Best schedule of breast feeding is on demand**, i.e., Whenever the infant needs to be fed. Another recommended schedule is:
  1. 0–3 months: 6 feeds/day.
  2. 3–6 months: 5 feeds/day.
  3. 6–12 months: 4 feeds/day.

- HIV is a contraindication for breast feeding.

- Hepatitis B is a contraindication for breast feeding, **unless the guidelines are followed**, i.e., The newborn should receive hepatitis B immunoglobulin and vaccine at birth.

- Premature milk formulas are rich in cystine.

- Iron deficiency is common in infants by 6 months of age once solid food is introduced; accordingly, 15 mg/day of FeSO4 starting the 5th month is necessary. So when you see an infant in the USMLE who is older than 6 months of age and having anemia, you know what to think!

Development

- **Milestones**: Refer to Table 6.1 for developmental milestones.

- **Tanner staging**: Refer to Table 6.2 for Tanner staging.

- **Order of maturation**:
  1. Males: Testes → Penis → Growth spurt → Pubic hair.
  2. Females: Telarche (Breast development) → Growth spurt → Pubarche (Pubic hair development) → Menarche (Menstruation).

Cardiovascular System

Embryology

- **Heart tube**: Two heart tubes form in the mesoderm. Lateral folding fuses the two into the primitive heart tube. The primitive heart tube gives rise to the endocardium, while the mesoderm surrounding the tube gives rise to myocardium and epicardium.

- **The heart tube has 5 dilatations**:
  1. Truncus arteriosus: Gives rise to aorta and pulmonary trunk.
  2. Bulbous cordis: Gives rise to the smooth parts of right and left ventricles (Conus arteriosus) and the aortic vestibule.
  3. Primary ventricle: Gives rise to trabeculated parts of both ventricles.
  4. Primary atrium: Gives rise to trabeculated parts of both atria.
  5. Sinus venosus: Gives rise to smooth part of right atrium, the oblique vein of left atrium and the coronary sinus.

- **Smooth part of left atrium**: Forms by fusion of the pulmonary veins and left atrial wall. Note: The line between the smooth and trabeculated parts of the atria is an important landmark known as the crista terminalis.

- **Aorticopulmonary septum**: Formed from the neural crest and extends to separate the aorta and pulmonary trunk.

- **Atrioventricular (AV) septum**: Formed by fusion of the ventral and dorsal AV cushions. Abnormal septum formation results in a unilateral heart or tricuspid atresia.

- **Interventricular septum**:
  1. Muscular part: Grows caudocranially and stops short of the AV septum, leaving a gap.
  2. Membranous part: Fills the gap and joins the muscular portion, completing the IV septum.

- **Timing**: Heart formation is complete and functioning by the 4th week of gestation.

- **Congenital heart diseases**: Incidence rate is 1%, which increases to 6% among newborns with family history of congenital heart disease.
**Shunts**: All congenital heart defects discussed below are **left to right shunts**, except for three (right to left): TGA, Truncus arteriosus and Tetralogy of Fallot.

**Prostaglandin E1**: Used in cyanotic heart diseases to maintain a Patent Ductus Arteriosus (PDA). If PGE1 is given and the patient develops pulmonary edema, this indicates an anomalous pulmonary venous return (APVR) with obstruction.

**Hyperoxia test**: Administer 100% oxygen and check PO2 on arterial blood gases:
1. PO2 >200: No congenital heart disease.
2. PO2 <150: Congenital heart disease.
3. PO2 <50: TGA, Ebstein anomaly or anomalous pulmonary venous return.

**Persistent Truncus Arteriosus**

- **Mechanism**: If the aorticopulmonary septum does not develop completely, the truncus arteriosus persists with a right-to-left shunt through a large VSD.
- **Clinical picture**: Cyanosis, water hammer pulse and a systolic murmur.

---

**Transposition of Great Arteries (TGA)**

- **Introduction**: The most common cyanotic cardiac anomaly.
- **Mechanism**: Improper twisting of the aorticopulmonary septum, leading to the aorta originating from RV, and pulmonary artery from LV.
- **On exam**: Right ventricular heave and harsh pansystolic murmur.
- **Pathology**: These patients have right ventricular hypertrophy giving the heart an “egg-shaped” silhouette on CXR.
- **Treatment**: Digoxin, diuretics and prostaglandin E1 to keep the ductus arteriosus open until surgical correction is performed.
- **Note**: Without a PDA, these patients die in a couple of months.

---

**Table 6.1 Developmental milestones.**

<table>
<thead>
<tr>
<th>Age</th>
<th>Milestones</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 month</td>
<td>Raising head from prone position, reaction to sounds</td>
</tr>
<tr>
<td>2 months</td>
<td>Raising chest from the floor, smiling</td>
</tr>
<tr>
<td>3 months</td>
<td>Maintaining “head up” position, cooing</td>
</tr>
<tr>
<td>4–5 months</td>
<td>Rolling on the floor, sitting supported</td>
</tr>
<tr>
<td>6–7 months</td>
<td>Sitting unsupported, babbling, recognizing strangers</td>
</tr>
<tr>
<td>8 months</td>
<td>Saying “papa” and “mama” to anybody</td>
</tr>
<tr>
<td>9 months</td>
<td>Creeping, crawling, waves bye-bye</td>
</tr>
<tr>
<td>10–11 months</td>
<td>Saying “mama” only to mom, and “papa” only to dad + One new word</td>
</tr>
<tr>
<td>12 months</td>
<td>Walking unsupported, Throwing objects, 2 new words</td>
</tr>
<tr>
<td>13–14 months</td>
<td>3 new words</td>
</tr>
<tr>
<td>15 months</td>
<td>Creeping upstairs, walking backwards, 4–5 new words</td>
</tr>
<tr>
<td>18 months</td>
<td>Running, copying others’ actions, playing with other children</td>
</tr>
<tr>
<td>21 months</td>
<td>Walking upstairs, squatting, asking for food</td>
</tr>
<tr>
<td>24 months</td>
<td>Walking upstairs and downstairs, parallel play</td>
</tr>
<tr>
<td>30 months</td>
<td>Jumping, holding pen</td>
</tr>
<tr>
<td>3 years</td>
<td>Riding tricycle, knowing full name, group play</td>
</tr>
<tr>
<td>5 years</td>
<td>Performing complex tasks, e.g., Tying shoes</td>
</tr>
</tbody>
</table>

**Table 6.2 Tanner staging.**

<table>
<thead>
<tr>
<th>Stage</th>
<th>Breast</th>
<th>Pubic hair</th>
<th>Male genitalia</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Elevation of nipple</td>
<td>No pubic hair</td>
<td>Small genitalia</td>
</tr>
<tr>
<td>II</td>
<td>Breastbud</td>
<td>Sparse fair colored hair, only at base of genitalia</td>
<td>Enlargement of testes and scrotum</td>
</tr>
<tr>
<td>III</td>
<td>Increased size of breasts and areola</td>
<td>Hair gets darker, curlier and starts spreading</td>
<td>Increase in penile length</td>
</tr>
<tr>
<td>IV</td>
<td>Further elevation of nipple, a.k.a. secondary mound</td>
<td>Hair is similar to adult type in shape, but there is lack of hair on medial side of thighs</td>
<td>Increase in penile breadth, full development of glans and thickening and darkening of scrotal skin</td>
</tr>
<tr>
<td>V</td>
<td>Mature breast</td>
<td>Mature pubic hair</td>
<td>Mature genitalia</td>
</tr>
<tr>
<td>VI</td>
<td>Stage VI: Hair grows up linea alba, a.k.a. Male escutcheon</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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Tetralogy of Fallot

- **Mechanism**: Abnormal migration of neural crest cells, leading to displacement of the infundibular septum.
- **Tetralogy**: Pulmonary stenosis, Right ventricular hypertrophy, Overriding aorta and VSD.
- **Clinical picture**:
  2. Cyanotic (Tet) spells: Attacks of infundibular spasm associated with any exercise or infection.
- **On exam**:
  1. Patient is in squatting position: Increases venous return, hence decreases hypoxia.
  2. Systolic murmur at the left sternal border.
- **CXR**: Boot shaped heart.
- **Treatment**: Surgical correction, e.g., Blalock Taussig.
- **Treatment of tet spells**: Put the patient in squatting (or knee-chest) position and administer IV fluids, beta blockers, morphine to decrease ventilations and phenylephrine to increase SVR. Oxygen is only minimally effective since the problem is decreased pulmonary blood flow.

Ebstein Anomaly

- **Mechanism**: Prolapse of the tricuspid valve into a hypoplastic right ventricle.
- **Pathology**: Patients have patent foramen ovale, resulting in dilated left atrium.
- **Complications**: Supraventricular tachycardia and Wolf Parkinson White syndrome.
- **Treatment**: Digoxin, diuretics and prostaglandin E1.

Ventricular Septal Defect (VSD)

- **Mechanism**: Failed fusion of the right and left bulbar ridges with the AV cushions.
- **Location**: Most commonly in the membranous part of the IV septum.
- **Pathology**: Begins as a left-to-right shunt at birth but the shunt reverses due to pulmonary hypertension. This shunt reversal is known as Eisenmenger syndrome.
- **Clinical picture**: Cyanosis and recurrent chest infections.
- **On exam**: Harsh pansystolic murmur all over the precordium.
- **CXR**: Biventricular enlargement and left atrial dilatation.
- **Treatment**: The defect usually closes spontaneously by age 7; otherwise, surgical correction is required.

Atrial Septal Defect (ASD)

- **Mechanism**: Persistent ostium secundum or less likely an ostium primum defect.
- **Clinical picture**: Most cases are asymptomatic and have a wide fixed and split S2.
- **CXR**: Right atrium and right ventricle dilatation.
- **Treatment**: Most cases do not require treatment. Complicated cases are treated surgically by closing the defect with a pericardial patch.
- **Note**: Holt-Oram syndrome: ASD + Multiple congenital skeletal anomalies.

Patent Ductus Arteriosus (PDA)

- **Pathology**: Ductus arteriosus normally closes 2 weeks after birth. PDA is more common in premature infants and in congenital rubella syndrome, due to high prostaglandin E levels.
- **Clinical picture**:
  1. Hyperdynamic circulation.
  2. Wide pulse pressure, i.e., High systolic and low diastolic pressure.
  3. Machine-like murmur heard best on the pulmonary area (Left 2nd space).
- **Treatment**: Anti-prostaglandin, e.g., Indomethacin.

Hypoplastic Right Heart Syndrome

- **Causes**: Tricuspid atresia, or pulmonary atresia with an intact septum.
- **Pathology**: Most cases also have VSD, ASD or PDA, resulting in left ventricular hypertrophy.
- **Treatment**: Prostaglandin E1 until surgical correction can be performed.

Hypoplastic Left Heart Syndrome

- **Introduction**: Most common congenital heart disease to cause death in the first month of life.
- **Pathology**: Hypoplastic left ventricle, along with mitral and aortic atresia.
- **Association**: PDA and ASD to maintain circulation through a left to right shunt.
- **Treatment**: PGE1 and heart transplant.
Respiratory System

Hyaline Membrane Disease (Respiratory Distress Syndrome)

- **Mechanism**: Deficiency of surfactant secreted by type II pneumocytes.
- **Incidence**: More common among premature and low birth weight infants.
- **Pathology**: Surfactant production is suppressed by asphyxia and increased by thyroxin and cortisol.
- **Clinical picture**: A newborn in respiratory distress and cyanosis due to collapsed alveoli.
- **CXR**: Diffuse ground glass appearance. Refer to Fig. 6.1.
- **Detection**: Amniotic fluid’s Lecithin:Sphingomyelin ratio <1.5.
- **Complication**: Bronchopulmonary hypertrophy and squamous dysplasia.
- **Treatment**:
  1. Steroids (Betamethasone) to mother before premature delivery to accelerate fetal lung maturity.
  2. Mechanical ventilation and artificial surfactant.

Cystic Fibrosis

- **Mechanism**: Mutation of CFTR gene on the long arm of chromosome 7, which controls chloride channels. It is an autosomal recessive disease, due to 3 base deletion of phenylalanine.
- **Clinical picture**:
  1. Recurrent respiratory infections: Mainly *Pseudomonas cepacia* and *Staphylococcus aureus*.
  2. Malabsorption and steatorrhea: Deficiency of vitamins A, D, E and K.
  3. Infertility and meconium ileus: Due to viscid secretions.
  4. Dehydration: Hyponatremia and metabolic alkalosis.
- **On exam**: Clubbing is present in all cases.
- **CXR**: Bleb sign.
- **PFTs**: Mixed obstructive and restrictive pattern.
- **Diagnosis**: Sweat chloride test; level of more than 60 meq is diagnostic.
- **Treatment**: Chest physiotherapy, antibiotics and pancreatic enzymes.

**Alpha-1 Anti-Trypsin Deficiency**

- **Mechanism**: Inherited deficiency leading to congenital panacinar emphysema.
- **Pathology**: Emphysema is dilatation of the airspaces *distal to terminal bronchioles*, and is normally centroacinar, except in this disease where it is panacinar.
- **Clinical picture**:
  2. Recurrent hepatitis. So keep your eyes open in the USMLE for this patient who was born with emphysema and is presenting with elevated transaminases.
- **Diagnosis**:
  1. Low or undetectable alpha-1 anti-trypsin level.
  2. PFTs: Show obstructive picture (*FEV1/FVC* <80).
- **Treatment**: Alpha-1 anti-trypsin replacement.
- **Note**: Patients with emphysema have a tendency to form bullae. The bullae here are mainly basal, while in acquired emphysema or COPD, they are apical.

**Kartagener’s Syndrome (Immotile Cilia Syndrome)**

- **Pathology**: Ciliary dysmotility due to a defective dynein arm.
- **Clinical picture**: SSSS: Recurrent Sinusitis, Sterility, Situs inversus, e.g., Dextrocardia and Bronchiectasis.

Fig. 6.1 CXR showing hyaline membrane disease (Neonatal RDS)
Infectious Diseases

Croup

• **Cause**: Multiple, but most common is parainfluenza-1.

• **Clinical picture**: Croup is laryngo-tracheo-bronchitis, as follows:
  1. Laryngitis: Hoarseness of voice.
  2. Trachitis: Retrosternal pain and brassy, metallic barking cough.
  4. Stridor: It is noisy inspiration due to upper airways narrowing (Note: Asthma and emphysema cause noisy expiration “wheezing” due to lower airways narrowing).

• **Diagnosis**: Neck X-ray: Subglottic narrowing (Steeple sign). Refer to Fig. 6.2.

• **Treatment**:
  1. Supportive treatment till viral infection resolves.
  2. Stridor: Racemic epinephrine nebulizer inhalation.
  3. Oxygen and systemic steroids are reserved for severe cases.

• **Note**: Vascular rings also cause barking cough, but examination of the patient and radiological work up is completely normal.

Epiglottitis

• **Cause**: Multiple, but most common is Haemophilus influenza B. This organism grows only in the presence of NAD and hematin (Factors V and X).

• **Clinical picture**:
  1. Fever.
  2. Hyperextended neck with the patient leaning forwards (Dog sniffing position).
  3. Persistent copious drooling.
  4. Sore throat and hoarseness of voice (Hot potato voice).
  5. Stridor and respiratory distress in severe cases.

• **Diagnosis**:
  1. Lateral view neck X-ray: Edematous epiglottis (Thumbs-up sign). Refer to Fig. 6.3.
  2. Definitive diagnosis is through direct visualization of a swollen cherry red epiglottis; however, examination of the oropharynx in any case suspicious for epiglottitis is contraindicated, unless it is done in the operating room, with easy access to cardio-pulmonary support measures. The concern here is how easy these patients can have laryngospasm and complete airway obstruction by any minimal manipulation of the oropharynx.

• **Treatment**:
  1. First thing to do is secure an airway by intubating the patient. If in emergency situation, and the airway has collapsed, do cricothyrotomy.
  2. Antibiotics: Drug of choice is 3rd generation cephalosporins, e.g., Cefuroxime.

• **Note**: Hot potato voice is also a sign of peri-tonsillar abscess. Clinical picture: Sore throat, odynophagia and hot potato voice, but no hyperextended neck, drooling or stridor.

Bronchiolitis

• **Age**: 4 months–18 months (Rare in patients older than 18 months).

• **Cause**: Multiple, but most common is Respiratory Syncytial Virus (RSV), followed by mycoplasma.

• **Pathology**: Inflammation of the respiratory bronchioles, along with excessive secretions and wall edema, leading to airway narrowing.
Clinical picture: Cough and expectoration.
On exam: Crackles and wheezing on chest auscultation.
CXR: Hyperinflated chest.
Complications: Respiratory failure and apnea.
Treatment:
1. Hospitalization, IV fluids and oxygen.
2. Anti-viral: Best for RSV is Ribavirin, and for mycoplasma is erythromycin.

Whooping Cough (Pertussis)

Cause: Bordetella pertussis.
Mechanism: Toxin activates cAMP (Through ADP ribosylation, by inhibiting Gi protein). This stimulates the release of histamine and insulin, and inhibits phagocytosis.
Clinical picture:
2. Paroxysmal phase (4–8 weeks): Paroxysms of cough followed by a stridor, a.k.a. inspiratory whoop. The pathognomonic feature is vomiting immediately following these paroxysms.
3. Convalescent phase (Months): Mild cough that resolves gradually.
Complication:
1. Bronchopneumonia: It is the most common complication.
2. Bronchiectasis: It is the second most common, however, very specific.

Diagnosis: Unique presentation, plus:
1. Leukocytosis: Namely atypical lymphocytosis.
2. Sputum culture: Bordetella pertussis grows on Bordet Gengou agar.
3. Normal ESR.
Treatment: Erythromycin for 14 days.
Notes:
1. There is no transplacental immunity against pertussis. Immunity against pertussis is only cell mediated, while the transplacental immunity is humoral.
2. There is no post-infectious immunity against pertussis.
3. B. Pertussis and C. Diphtheria are both extracellular organisms releasing exotoxins.

Scarlet Fever (Scarlatina)

Cause: Group A beta-hemolytic streptococcus.
Clinical picture:
1. Scarlet rash: Sandpaper-like punctate erythematous rash. It starts in the neck, axilla and groin. Fate of rash: Desquamation; starts in fingers and toes.
2. Fever: High grade.
3. Swollen erythematous tonsils, covered by pus and exudates.
4. Strawberry tongue: Starts white with red dots, then becomes red with white dots.
5. Flushed cheeks with circum-oral pallor.
**Complications**: Post-strept. glomerulonephritis and rheumatic fever.

**Diagnosis**: Oropharyngeal swab to check for streptococcal antigens.

**Treatment**: Penicillin 40 mg/kg/day for 10–14 days.

**Note**: If patient is allergic to penicillin, the alternative is erythromycin.

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**Botulism**

- **Cause**: Clostridium botulinum; a Gram-positive, spore forming anaerobe.
- **Mechanism**: Toxins prevent acetylcholine release at neuromuscular junction.
- **Source**: Canned foods and honey. A typical case in the USMLE is for an infant whose parents put honey in his milk bottle.

**Clinical picture**:

1. Flaccid paralysis: *Descending marsh from head to toe*, a.k.a. *Floppy baby*.
2. Ds: Dilated pupils, Diplopia, Dysphagia, Dysarthria, Diminished gag reflex.

**Diagnosis**: Detection of toxins in stools (*Best*) or serum.

**Treatment**:

1. First next step is to secure an airway by intubating the patient.
2. Botulinum antitoxin: Even before confirming the diagnosis.

---

**Diphtheria**

- **Cause**: Corynobaeterium diphtheria; a non-spore forming bacillus.
- **Mechanism**: Colonizes in the pharynx releasing exotoxins targeting CVS & CNS.
- **Clinical picture**: Fever, chills, sore throat and barking cough; often confused with croup.
- **On exam**: Grey pseudomembrane on pharynx. Histologically, it is formed of C. Diphtheria, necrotic tissue, WBCs and fibrin.
- **Diagnosis**: Culture on Loeffler or Tellurite media.
- **Complications**: Respiratory failure, myocarditis, bulbar palsy or even LMNL (Combined motor and sensory loss).
- **Treatment**: Treat Diphtheria with *(DAD)*:
  1. Diphtheria antitoxin.
  2. Antibiotics: *Penicillin is the drug of choice*. If PCN allergy exists, erythromycin.
  3. DPT vaccination: As there is no post-infectious immunity.

---

**Notes**:

1. Diphtheria toxins can only be produced in patients with iron deficiency.
2. Exotoxin of Diphtheria works through its (A) portion by inhibiting *Elongation Factor 2 (EF2)* and protein synthesis. This is achieved by ADP ribosylation.
3. Factor 2 (EF2) and protein synthesis. This is achieved by ADP ribosylation.

---

**Lyme Disease**

- **Cause**: *Borrelia Burgdorferi*; a spirochete.
- **Transmission**: *Ixodes tick* (Deer tick).
- **Clinical picture**:
  1. Stage 1: *Erythema Chronicum Migrans* (ECM). Ring-shaped lesion with central clearing. Refer to Fig. 6.4.
  2. Stage 2:
     - Arthralgias and arthritis.
     - CVS injury, e.g., Myocarditis, A-V block.
     - CNS injury, e.g., Meningitis, bilateral Bell’s palsy.
  3. Stage 3: Chronic arthritis and encephalopathy.
- **Prevention**: Vaccination, e.g., Lymerix, Immulyme, before going to infested areas, i.e., Northeast, Midwest and west coast.
- **Diagnosis**: *Clinical*, as antibodies against Borrelia burgdorferi cross react with other organisms.
- **Treatment**:
  1. Less than 8 years of age: *Oral amoxicillin* for 21 days.
  2. Older than 8 years of age: *Oral doxycycline* for 21 days.
  3. If CNS or CVS injury: *Parenteral ceftriaxone or penicillin G* for 21 days.

![Fig. 6.4 Erythema chronicum migrans of Lyme disease](image-url)
Rocky Mountain Spotted Fever
- **Cause**: Rickettsia rickettsii.
- **Geographical distribution**: Southeast, and ohio river valley.
- **Clinical picture**: Fever and petechial (Spotted) rash, starting at wrists and ankles, and spreading proximally.
- **Complications**: Thrombocytopenia, CVS or CNS injury.
- **Treatment**: Tetracycline. Must be started within 5 days from onset of symptoms.

Infectious Mononucleosis
- **Cause**: Epstein Barr virus (EBV), and less likely Cytomegalovirus (CMV).
- **Transmission**: Mostly through saliva, hence the name kissing disease.
- **Clinical picture**: Fever, chills, fatigue, sore throat due to pharyngitis and abdominal pain due to splenomegaly.
- **On exam**:
  1. Petechiae on hard and soft palate.
  2. Multiple enlarged and tender cervical lymphadenopathy.
  3. Splenomegaly: Lower edge is palpated just below the costal margin.
- **CBC**: Atypical lymphocytosis, and anemia due to antibodies against Li antigen of RBCs.
- **Diagnosis**: Monospot test: Positive heterophil antibodies against sheep RBCs.
- **Contraindication**: Penicillin causes rash in these patients.
- **Complication**: Splenic rupture. So when you see a patient in the USMLE with features of mononucleosis who goes to wrestle, and then comes to the ER with excruciating abdominal pain, you know what to think!
- **Treatment**: Self resolving.

Measles
- **Early clinical picture**:
  1. CCC: Cough, coryza and conjunctivitis.
  2. Koplik spots: Red lesions with white center on buccal mucosa.
- **Late clinical picture**: Rash: Maculopapular and confluent, starts behind the ears and descend downwards. It heals with branny desquamation in the same fashion, i.e., From the top downwards.
- **Complications**:
  1. Most common: Pneumonia. Early due to measles, or late due to secondary bacterial infection.
- **Note**: Measles is a predisposing factor for vitamin A deficiency.

Rubella: Known as German measles or 3 days measles. Also starts with cough, coryza and conjunctivitis and the rash has a descending marsh. The differentiating points are:
  1. Koplik spots are pathognomonic for measles, while post-auricular and posterior cervical lymphadenopathy is pathognomonic for rubella.
  2. Rash of measles is confluent, while that of rubella is not.

Mumps
- **Clinical picture**: Swollen salivary glands, mainly the parotids
- **Complications**:
  1. Most common: Pancreatitis.
  3. Orchitis: Might cause testicular atrophy and sterility.
  4. Sensorineural hearing loss.

Roseola Infantum (Exanthem Subitum)
- **Cause**: Human Herpes virus 6.
- **Clinical picture**: High grade fever, followed by rash on the trunk which spreads distally towards the extremities as it fades away.

Erythema Infectiosum (Fifth Disease)
- **Cause**: Parvovirus.
- **Clinical picture**: Slapped cheeks appearance and maculopapular rash that starts in the arms, and spreads proximally to the trunk then to lower extremities.

Chicken Pox
- **Cause**: Varicella zoster virus.
- **Clinical picture**: Crops of lesions in various stages of development at the same time, i.e., Macules, papules, crusted, healing. Rash is vesicular and is characterized by the pathognomonic teardrop-shaped vesicles (a.k.a. Dew drops on a rose petal). Refer to Fig. 6.5.
Complication: Extension to cerebellum. So, when you see a patient with chicken pox in the USMLE who suddenly started developing ataxia and incoordination, you know what to think!

Note: If a patient who just gave birth has a chicken pox for less than 2 days, isolate the neonate and give him varicella zoster immunoglobulin. If more than 2 days, it is too late to intervene.

Syphilis

- **Cause**: Treponema pallidum.
- **Incubation period**: 6 weeks.
- **Congenital syphilis**: Transmits to fetus after the 4th month of gestation:
  1. At birth:
     - Atrophied dried nasal mucosa (Snuffles).
     - Hepatosplenomegaly.
     - Maculopapular rash and severe periostitis.
  2. Childhood form: Characterized by multiple pathognomonic findings:
     - E.N.T.: Saddle nose (Destroyed nasal bridge), Hutchinson teeth (Separated and notched upper central incisors), Mulberry molars (Molars with too many cusps) and raghades (Linear scars around the mouth).
     - Bone: Sabre shins (Inflamed bowed tibiae), Clutton joints (Painless effusion) and destruction of medial proximal tibial metaphysis (Wimberger sign).
  3. Adulthood syphilis:
     1. Primary (6 weeks): Characterized by painless chancre and painless lymphadenopathy. Chancre is a well demarcated ulcer with indurated base, and it resolves spontaneously without scar formation.

2. **Secondary**:
   - Rash: All forms except vesicular, i.e., Macular, papular, pustular, mixed, but never vesicular. Rash is more prominent in palms and soles.
   - Condyloma lata: Wart-like lesions on moist surfaces, e.g., Lips. Highly contagious lesions.
3. **Latent**: 25% of patients have relapse during that period.
4. **Tertiary**:
   - Gummas: Occur in skin (Painless) or bones (Painful).
   - CVS: Injury to vasa vasora of aorta, leading to aortic aneurysm and aortic dissection. Also causes coronary obstruction and aortic regurgitation.
   - Neurosyphilis: Multiple forms ranging from asymptomatic, to meningitis or even infarction. Pathognomonic presentations are:
     a. Tabes dorsalis: As explained in neurology, it targets the dorsal column (Causing ataxia), and dorsal roots (Causing loss of reflexes, pain and temperature sensation).
     b. General paresis of insane: Aphasia, confusion and seizures.
     c. Argyl-Robertson pupil: As explained in neurology, it accommodates to near vision, but never reacts to light.

**Diagnosis**:
1. Dark field microscopy: Corkscrew movement.
2. Serology: Venereal Disease Research Laboratory (VDRL), Rapid Plasma Reagin (RPR), Treponema pallidum immobilization test (TPI) or the most specific test Florescent Treponemal Antibodies (FTA).

**Treatment**: Penicillin is the drug of choice for all patients, as follows:
1. Congenital syphilis: Benzathine penicillin G for 10 days.
2. Primary, secondary and early latent syphilis: Benzathine penicillin G 2.4 million units IM, only once.
3. Late latent syphilis: Benzathine penicillin G 2.4 million units IM weekly for 3 weeks.
4. Neurosyphilis: Procaine penicillin G 2.4 million units IM daily + Probenecid for 14 days.

**Notes**:
1. Patients with penicillin allergy must get desensitization.
2. Jarish Herxheimer’s reaction: Few days after starting treatment, patients develop sudden spike in temperature and worsening symptoms. This occurs
due to release of pyrogenes from killed bacteria. Treatment: Supportive, and continue treatment. Indication of cure from syphilis: fourfold decrease in titers.

Herpangina
- **Cause:** Coxsackie A16 virus.
- **Clinical picture:** Sore throat and painful erythematous ulcers on corners of mouth.
- **Complication:** Spread of lesions to hand and feet (Hand-foot-mouth syndrome).

Immunization
- **Schedule:** Refer to Table 6.3 for the latest immunization guidelines.
- **Side effects of vaccines:**
  1. Pain, redness and swelling around injection site.
  2. Low grade fever.
  3. MMR: Rash, arthralgia, arthritis and mild parotid enlargement.
- **Note:**
  1. Polio vaccine is stored in very low temperature to remain active. Breast feeding is contraindicated 2 hours before and after polio immunization.

<table>
<thead>
<tr>
<th>Vaccine</th>
<th>Schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hepatitis B</td>
<td>• Monovalent hepatitis B vaccine is given in a series of 3 shots: 0, 1 and 6 months of age If mother is hepatitis B positive, the newborn should receive the monovalent vaccine and hepatitis B immunoglobulin within the first 12 hours after birth</td>
</tr>
<tr>
<td>Hepatitis A</td>
<td>• A series of 2 shots: 12 and 18 months of age</td>
</tr>
<tr>
<td>Rotavirus</td>
<td>• A series of 3 shots: 2, 4 and 6 months of age</td>
</tr>
<tr>
<td>Diphtheria, Tetanus and Pertussis (DTaP)</td>
<td>• A series of 5 shots:</td>
</tr>
<tr>
<td></td>
<td>1. First three: 2, 4 and 6 months of age</td>
</tr>
<tr>
<td></td>
<td>2. Fourth shot: 18 months of age (12 months after the third dose)</td>
</tr>
<tr>
<td></td>
<td>3. Fifth shot: 5 years of age</td>
</tr>
<tr>
<td>Hemophilus influenza B (HiB)</td>
<td>• A series of 4 shots:</td>
</tr>
<tr>
<td></td>
<td>1. First three: 2, 4 and 6 months of age</td>
</tr>
<tr>
<td></td>
<td>2. Fourth shot: 12 months of age</td>
</tr>
<tr>
<td>Pneumococcal Inactivated polio</td>
<td>• Similar to HiB</td>
</tr>
<tr>
<td></td>
<td>• A series of 4 shots:</td>
</tr>
<tr>
<td></td>
<td>1. First three: 2, 4 and 6 months of age</td>
</tr>
<tr>
<td></td>
<td>2. Fourth shot: 4 years of age</td>
</tr>
<tr>
<td>Measles, Mumps and Rubella (MMR)</td>
<td>• A series of 2 shots:</td>
</tr>
<tr>
<td></td>
<td>1. First shot: 12–15 months of age</td>
</tr>
<tr>
<td></td>
<td>2. Second shot: 4–6 years of age</td>
</tr>
<tr>
<td>Varicella Human Papilloma Virus (HPV)</td>
<td>• Similar to MMR</td>
</tr>
<tr>
<td></td>
<td>• A series of 3 shots, approved for females only at this time:</td>
</tr>
<tr>
<td></td>
<td>1. First shot: 11 years of age</td>
</tr>
<tr>
<td></td>
<td>2. Second shot: 2 months after first shot</td>
</tr>
<tr>
<td></td>
<td>3. Third shot: 6 months after second shot</td>
</tr>
<tr>
<td>Meningococcal vaccine</td>
<td>• One shot at age 11–12 years</td>
</tr>
</tbody>
</table>

Neurology

Cerebral Palsy
- **Definition:** Central motor deficit that occurs during brain formation.
- **Causes:** Multiple, the most common of which are fetal hypoxia (e.g., Placental insufficiency or obstructed labor), and intrauterine infections.
- **Clinical picture:**
  1. Paralysis: One or more or all limbs. Again, pure motor paralysis, with no sensory deficits.
  3. Hyperreflexia and clonus.
- **Treatment:** Physical, occupational and speech therapy.
**Craniostenosis**

- **Definition:** Premature closure of one or more of the cranial suture lines.
- **Clinical picture:**
  1. Abnormally shaped skull.
  2. Increased intracranial pressure: Headache, blurry vision, nausea and vomiting.
  3. Ophthalmology: Optic atrophy and blindness.
- **Diagnosis:** Palpable ridge over the prematurely closed suture line. Skull X-ray shows Silver beaten appearance.
- **Types:**
  1. Acrocephaly: Due to premature closure of coronal and lambdoid sutures.
  2. Scaphocephaly: Due to premature closure of sagittal suture.
  3. Plagiocephaly: Due to unilateral closure of coronal suture.
- **Treatment:** Craniotomy and opening of the suture.

**Febrile Convulsions**

- **Definition:** Tonic clonic seizures due to sudden rise of body temperature above 38.5°C.
- **Mechanism:** Irritation of brain cells due to hyperthermia.
- **Diagnostic criteria:**
  1. Patient: 6 months–6 years old with normal CNS.
  2. Fever: Rapid rise above 38.5°C.
  3. Convulsions: Tonic clonic, less than 15 min in duration, and is recurrent. After the seizure, the patient regains full consciousness and has no residual neurological deficits. Accordingly, it is very easy to differentiate from epileptic seizures, as the latter are followed by a postictal state (Confusion, neurological deficits, Todd’s paralysis).
- **Treatment:**
  1. Urgent decrease of body temperature.
  2. Phenobarbitone: Drug of choice if patient is still having seizures after controlling body temperature.
- **Notes:**
  1. Febrile convulsions is a familial disease.
  2. EEG is completely normal 2 weeks after the attack.
  3. Of these patients, 2% end up suffering from epileptic seizures later in life.

**Retinoblastoma (Cat Eye)**

- **Incidence:** Most common ocular malignancy in children.
- **Mechanism:** Mutation of the RB gene, due to deletion of long arm of chromosome 13. This activates binding of a dephosphorylated protein to transcription factor E2F, causing G1 arrest.
- **Clinical picture:** White pupil (Leukocoria).
- **Treatment:** Surgical plus chemotherapy and radiation.
- **Notes:**
  1. Cataract is the most common cause of white pupil.
  2. Causes of congenital cataracts are toxoplasmosis, galactosemia and Down syndrome.

**Retinitis Pigmentosa**

- **Mechanism:** Genetic, but could also occur due to abetalipoproteinemia
- **Clinical picture:** Tubular vision and night blindness.
- **Treatment:** Supportive and vitamin A in abetalipoproteinemia.

**Miscellaneous**

- **Buphthalmos (Congenital glaucoma):** Either genetic or secondary to congenital rubella syndrome. The eyes and pupils are usually enlarged with deep anterior chambers and impending damage to the optic nerve.
- **Retrolental fibroplasias:** Oxygen induced retinopathy in premature infants.
- **Coloboma iridis:** Defect in the iris due to failure of closure of choroid fissure.
- **Retinal detachment:** Usually occurs between pigment and neural layers.

**Musculoskeletal System**

**Duchenne Muscular Dystrophy (DMD)**

- **Mechanism:** X-linked disease, as the DMD gene is located on the short arm of X chromosome on location (Xp21).
- **Defect:** Lies in the lack of:
  1. Dystrophin protein: Regulates calcium channels of muscles.
  2. Actin: Anchors the extracellular matrix.
- **Clinical picture:**
  1. Pseudohypertrophy of muscles: Most pronounced in calf muscles, and occurs due to deposition of connective and fibrous tissue.
2. Muscle weakness and hyporeflexia: Proximal more than distal.
3. Gower sign: Patients use their arms to rise from the floor.

- **Diagnosis**: High serum levels of CK-MM, aldolase and LDH. EMG and muscle biopsy are diagnostic.
- **Notes**:  
  1. Duchenne is the most common cause of thoracolumbar scoliosis in children.
  2. Becker muscular dystrophy is similar to DMD, except for the fact that dystrophin is present but small in quantity. The disease in Becker is milder and slower in progression.

**Marfan Syndrome**

- **Mechanism**: Autosomal dominant disease resulting in defective Fibrillin-1.
- **Clinical picture**:
  1. Very tall patient with arm span exceeding height, and elastic joints.
  2. Dilated ascending aorta, aortic regurgitation and mitral valve prolapse.
  3. Thoracic aortic aneurysm due to cystic medial necrosis.
- **Complication**: Aortic dissection. So when you see a patient in the USMLE with features of marfan presenting with tearing chest pain radiating to his back, and big difference of blood pressure between right and left arms, you know what to think!

**Ehler-Danlos Syndrome**

- **Mechanism**: Autosomal dominant disease resulting in defective collagen, mainly types I and III. Underlying disorder is failed hydroxylation of collagen’s lysine.
- **Clinical picture**: Hyperelastic skin and joints.

**Osteogenesis Imperfecta**

- **Mechanism**: Deficiency of type I collagen, due to mutation of COL1A1 gene.
- **Clinical picture**: Fragile bones with multiple fractures and blue sclera due to thin connective tissue.

**Developmental Dysplasia of the Hip (DDH)**

- **Definition**: Congenital dislocation of the hip.

- **On exam**:
  1. **Ortolani test**: Abduction of the hip results in a click of relocation.
  2. **Barlow test**: Abduction of the hip along with pressure leads to poster-superior dislocation.
- **Diagnosis**: Hip X-ray shows false acetabulum.
- **Complication**: Avascular necrosis of femoral head.
- **Treatment**: Heals spontaneously in 4 weeks. If it did not heal, keep the thigh in an abducted flexed position using a harness.

**Achondroplasia**

- **Mechanism**: Mutation of fibroblast growth factor (FGF-3).
- **Clinical picture**: Newborn born as a dwarf with short limbs and normal IQ. Refer to Fig. 6.6.
**Complication**: Neck X-ray is important to rule out odontoid process hypoplasia; a risk factor for subluxation and spinal cord compression.

### Congenital Absence of Muscles

- **Poland syndrome**: Defect in formation of the pectoralis major muscle.
- **Prune belly syndrome**: One or more abdominal muscles are absent; usually associated with hydronephrosis and undescended testes.

### Genetic Disorders

#### Down’s Syndrome (refer to Fig. 6.7)

- **Mechanism**: Trisomy of chromosome 21. Most common underlying mechanism is nondisjunction, and less commonly translocation (t14:21) and mosaicism.
- **Clinical picture**:
  1. Head: Microcephaly with flat occiput and flat nasal bridge.
  2. Eyes: Medial epicanthal folds and speckled iris (Brushfield spots).
  3. Mouth: Small mandible (Micrognathia) and small mouth (Microstomia).
  4. Upper limbs: Short broad hands (Brachydactyly) with a simian crease.
  5. Genital: Cryptorchidism and infertility.
  6. Lower limbs: Gapping between toes (Sandal gap toe).
  7. Impaired phagocytic system: Frequent and recurrent infections.
  8. Congenital anomalies: *The most common in descending order are*:
     - Endocardial cushion defects = VSD + ASD + Common A-V canal.
     - Annular pancreas and duodenal atresia.
- **Ultrasound**: Suspected in the first trimester by presence of nuchal translucency.
- **Antenatal diagnostic criteria for Down syndrome**:
  1. Low alpha-fetoprotein level: MSAFP < 0.4 mom.
  2. Low estrogen (E3) level.
  3. Elevated B-HCG level.
- **Notes**:
  1. Down syndrome is the most common cause of congenital mental retardation.
  2. Down syndrome patients also have high risk of developing acute lymphoblastic leukemia (ALL) and Alzheimer’s dementia at an early age.

#### Edward’s Syndrome

- **Mechanism**: Trisomy of chromosome 18. Most common underlying mechanism is nondisjunction.
- **Clinical picture**: Mental and growth retardation, and multiple congenital anomalies with some unique features:
  1. Hypertonia, prominent occiput, clenched hands and rocker-bottom feet.
  2. Choroid plexus cysts.
- **Antenatal diagnostic criteria for Edward’s syndrome**:
  1. Low alpha-fetoprotein level: MSAFP < 0.4 mom.
  2. Low estrogen (E3) level.
  3. Low B-HCG level.

#### Patau’s Syndrome

- **Mechanism**: Trisomy of chromosome 13. Most common underlying mechanism is nondisjunction.
- **Clinical picture**: Mental and growth retardation, and multiple congenital anomalies with some unique features:
1. **Colobomas**: Erosions in the iris.
2. **Cleft lip** and/or **cleft palate**.
3. **Polydactyly**.

**Turner Syndrome**
- **Mechanism**: Monosomy (45X) or isochromosome of long arm of X chromosome.
- **Barr bodies**: Buccal smear in these patients shows no Barr body.
- **Clinical picture**:
  1. Spontaneous abortion: Usually occurs when the fetus has Turner syndrome, as she develops **hydrops fetalis** or **cystic hygroma**.
  2. Short stature.
  3. Head: Low posterior hair line and low set ears.
  4. Mouth: Straight lower lip and curved upper one (**Shark mouth**).
  6. Chest: Underdeveloped breasts with widely spaced nipples (**Shield chest**).
  8. Congenital anomalies:
     - CVS: **Coarctation of the aorta**.
     - GU: **Fibrosed ovaries** and **horseshoe kidneys**.
     - GI: **Colonic telangiectasia**.
- **Management**: Patients with Turner syndrome should receive screening for all the congenital anomalies and receive hormone replacement therapy.

**Klinefelter Syndrome**
- **Mechanism**: Extra X chromosome causing trisomy (47XXY).
- **Barr body**: Buccal smear in these patients shows at least one Barr body.
- **Clinical picture**:
  1. Tall stature with **eunuchoid** features.
  2. GU: Small penis, scrotum and testicles.
  3. Infertility: Due to an **occluded genital ductal system**.
- **Management**: Patients with Klinefelter syndrome should receive testosterone replacement therapy.

**Fragile X Syndrome**
- **Mechanism**: X-linked recessive disease.
- **Disorder**:
  1. Fragile site on the long arm of the X chromosome.
  2. Fragile site is due to an abnormal number of CGG repeats.
  3. This leads to decreased expression of the **FMRI gene**, which normally produces a protein needed for brain functioning.
- **Clinical picture**:
  1. Head: **Long face, big ears and big jaw**.
  2. GU: **Big testicles**.

**Ornithine Transcarbamoylase Deficiency**
- **Mechanism**: X-linked recessive.
- **Pathology**: This enzyme normally binds **ornithine** to **carbamoyl phosphate** to form **citrulline** inside the mitochondria during the **urea cycle**.
- **Clinical picture**: Vomiting, headache, lethargy and seizures after ingestion of high protein diet, mainly due to hyperammonemona and hypernitrogenemia.
- **Diagnosis**: High orotic acid levels in the urine.
- **Treatment**: Nitrogen excretion using benzoic acid and phenylacetate.

**Alport Syndrome**
- **Mechanism**: X-linked dominant, however in a minority of cases AR or AD.
- **Disorder**: Defects in type IV collagen; a component of basement membranes.
- **Clinical picture**: Painless hematuria, cataract and **sensorineural hearing loss**. So when you see a child in the USMLE who is deaf and having painless hematuria, you know what to think!
- **Complication**: Chronic kidney disease, and End Stage Renal Disease (ESRD).

**Cri-du-Chat Syndrome**
- **Mechanism**: Deletion of the short arm of chromosome 5 (5p-).
- **Clinical picture**:
  1. Mental and growth retardation, and multiple congenital anomalies.
  2. **Moon face and cat-like cry**: Due to laryngeal hypoplasia.

**Wolf-Hirshhorn Syndrome**
- **Mechanism**: Partial deletion of the short arm of chromosome 4 (4p-).
- **Clinical picture**:
1. Prominent forehead and nose, frequently compared to a warrior's helmet.
2. Short philtrum of the upper lip.

**Prader-Willi Syndrome**

- **Mechanism:** Deletion of the long arm of chromosome 15 (15q-).
- **Source:** Deletion here occurs by paternal imprinting due to methylation of cytosine during gametogenesis.
- **Clinical picture:**
  1. Short, obese patient with small hands and feet and almond-shaped eyes.
  2. Hyperphagia and hypogonadism.

**Angelmann Syndrome (Happy Puppet Syndrome)**

- **Mechanism:** Deletion of the long arm of chromosome 15 (15q-).
- **Source:** The differentiating point from Prader-Willi is that the imprinting here is maternal.
- **Clinical picture:** Mental retardation, and continuous laughing and smiling (Like a happy puppet).

**DiGeorge's Syndrome**

- **Mechanism:** Deletion of long arm of chromosome 21 (21q-).
- **Pathology:** This leads to defective development of the 3rd and 4th pharyngeal pouches; accordingly, parathyroid glands and thymus are absent.
- **Clinical picture (George always shows TLC):**
  1. Tetany: Due to hypocalcaemia, caused by lack of parathyroid hormone.
  2. Lack of thymus: Leads to recurrent infections.
  3. Cardiovascular anomalies.
- **Treatment:** Thymus and bone marrow transplantation.

**Von Hippel Lindau Syndrome (VHL)**

- **Mechanism:** Deletion of VHL gene on chromosome 3.
- **Clinical picture:**
  1. Hemangioblastomas everywhere, e.g., Cerebellum, retina.
  2. Malignancy: VHL is normally a tumor suppressor, so these patients are at risk of developing renal cell cancer.

**Phenylketonuria (PKU)**

- **Mechanism:** Autosomal recessive disease.
- **Disorder:** Absence of phenylalanine hydroxylase enzyme which normally converts phenylalanine to tyrosine.
- **Clinical picture:**
  1. Fair skin, hair and eyes: Due to decreased melanin synthesis.
  2. Microcephaly and mental retardation: Due to accumulation of phenyl-pyruvate, -lactate and -acetate.
  3. Hypertonia and seizures: Due to accumulation of serotonin.
  4. Musty odor: Due to accumulation of phenylacetate.

**Diagnosis:**

1. Measuring the activity of phenylalanine hydroxylase enzyme.
2. Elevated serum levels of phenylalanine >20%.
3. Elevated urine levels of phenyl-pyruvate, -lactate and -acetate.

**Treatment:** Dietary restriction of phenylalanine and aspartame (Aspartame releases phenylalanine when digested).

**Note:** Do not confuse PKU with homocystinuria, as the latter also causes congenital fair skin, hair and eyes, and some features of Marfan syndrome plus multiple recurrent thromboembolic phenomena. Homocystinuria is treated by restriction of diet rich in sulphhydril groups.

**Galactosemia**

- **Mechanism:** Autosomal recessive disease.
- **Types and clinical picture:**
  1. **Type I:**
    - Disorder: Absence of galactokinase enzyme, which normally converts galactose to galactose-1-phosphate.
    - Clinical picture: Cataracts and galactosuria.
  2. **Type II:**
    - Disorder: Absence of galactose-1-phosphate uridylyltransferase enzyme, which normally converts galactose-1-phosphate to glucose-1-phosphate.
    - Clinical picture: Cataracts, galactosuria and:
      1. CNS: Microcephaly and mental retardation.
      2. GI: Hepatosplenomegaly and liver cirrhosis.

**Von Hippel Lindau Syndrome (VHL)**

- **Mechanism:** Deletion of VHL gene on chromosome 3.
- **Clinical picture:**
  1. Hemangioblastomas everywhere, e.g., Cerebellum, retina.
  2. Malignancy: VHL is normally a tumor suppressor, so these patients are at risk of developing renal cell cancer.
3. GU: Fanconi’s syndrome = Glucosuria, phosphaturia and aminoaciduria.

- **Treatment:** Restricting galactose in the diet.

**Albinism**

- **Mechanism:** Autosomal recessive, but can also be inherited as AD or XLR.
- **Disorder:** Absence of tyrosinase enzyme, which normally converts tyrosine to melanin.
- **Clinical picture:**
  1. Depigmented skin, hair, iris and retina.
  2. High risk of blindness and skin cancer.

**Apert Syndrome**

- **Mechanism:** Autosomal dominant syndrome.
- **Disorder:** Mutation occurs in the gene of fibroblast growth factor (FGF-2).
- **Clinical picture:** Craniosenosis and fused digits.

**Neurofibromatosis**

- **Mechanism:** Autosomal dominant syndrome.
- **Types and clinical picture:**
  1. *Type I* (Von Recklinghausen’s): Inherited on chromosome 17.
     - Skin: café-au-lait patches. Refer to Fig. 6.8.
     - Lisch nodules: Pigmented iris nodules.
  2. *Type II* (Central neurofibromatosis): Inherited on chromosome 22.
     - Bilateral acoustic neuroma: Acoustic neuroma is a schwannoma with Antoni A and Antoni B bodies.
     - Astrocytoma.

**Tuberous Sclerosis**

- **Mechanism:** Autosomal dominant syndrome.
- **Clinical picture:** Multiple hamartomas plus 4 pathognomonic signs:
  1. Ash leaf spots: Flat, hypopigmented skin lesions.
  2. Shagreen patches: Areas of increased skin thickness.
  3. Subungual fibroma.
  4. Periventricular tubers: Causing mental retardation and seizures.

**Xeroderma Pigmentosum**

- **Mechanism:** Breakage disorder.
- **Pathology:** Ultraviolet light causes failure of the DNA repair mechanism, namely the ultraviolet endonuclease, which in turn leads to accumulation of pyrimidine dimers.
- **Clinical picture:** Multiple skin lesions, and skin cancer.

**Hereditary Non-Polyposis Colon Cancer (HNPCC)**

- **Mechanism:** Mismatch repair secondary to microsatellites. MSH2 gene is blamed in most HNPCC cases.
- **Clinical picture:** HNPCC (Lynch syndrome) is a familial form of colon cancer. Involves the following diagnostic criteria (3,2,1):
1. Occurrence of colon cancer in at least 3 first degree relatives.
2. These cancers occur over a period of at least 2 generations.
3. At least one of these 3 relatives is less than 50 years of age.

**Note:** Women in families with HNPCC are at high risk of endometrial and ovarian cancer as well.

**Leber’s Optic Neuropathy**
- **Mechanism:** Mitochondrial inheritance.
- **Disorder:** Mutation of ND4 gene which is normally responsible for:
  1. Regulation of the conversion of arginine to histidine.
  2. Encoding NADH dehydrogenase, which regulates ATP and electron transport.
- **Clinical picture:** Loss of central vision, and maintaining a peripheral tubular visual field.
- **Complication:** Optic nerve degeneration and blindness.

**Spotlight on Famous Oncogenes**
- **BRCA:** Mutation leads to breast and ovarian cancer.
- **p53:** Mutation of this gene on chromosome 17 leads to cancer.
- **Rb1:** Mutation of this gene leads to retinoblastoma.
- **APC:** Mutation of this gene leads to familial adenomatous polyposis.
- **ras:** This gene is associated with colon cancer.
- **c-myc, t8:14:** This gene is associated with Burkitt’s lymphoma.
- **Bcl-2, t14:18:** This gene is associated with follicular lymphoma.
- **Bcr/abl:** This gene is associated with chronic myeloid leukemia (CML).
- **Philadelphia chromosome (t 9:22):** This translocation is pathognomonic for CML and its presence is associated with a good prognosis.
- **t15:17:** This translocation is pathognomonic for AML, and its presence is associated with a good prognosis.
- **Human Herpes Virus (HHV-8):** Kaposi sarcoma.
- **Human Papilloma Virus (HPV):** Cervical cancer.
- **Epstein Barr virus (EBV):** Burkitt’s lymphoma and nasopharyngeal cancer.
- **Hepatitis viruses B and C:** Hepatocellular cancer.
- **Note:** DNA mutations can be diagnosed using Single Stranded Conformational Polymorphism (SSCP), which shows 2 bands for homozygous mutations, and 4 for heterozygous ones.

**Immunological Diseases**

**Introduction**
- **Fact:** Know the following as a rule:
  1. Failure of cell mediated immunity (CMI): Leads to infection by viruses and intracellular bacteria.
  2. Failure of humoral immunity: Leads to infection by extracellular bacteria.

**Bruton’s Agammaglobulinemia**
- **Mechanism:** X-linked recessive disease, where there are no or low gammaglobulins due to deficiency of the tyrosine kinase needed for maturation of B lymphocytes.
- **Pathology:** Patient does not have tonsils or germinal centers in the lymph nodes.
- **Clinical picture:** Patient is usually 6 months of age or older presenting with recurrent extracellular bacterial infections and absent tonsils.
- **Diagnosis:** Very low IgG level and absence of all other immunoglobulins.

**Selective Ig Deficiency**
- **Mechanism:** Deficiency of one or more Ig, most common is selective IgA deficiency.
- **Clinical picture:** Frequent upper and lower respiratory tract infections, allergies, diarrhea, or could even be asymptomatic.

**Wiskott-Aldrich Syndrome**
- **Mechanism:** X-linked recessive disease.
- **Defect:** Defect in T cells and IgM only.
- **Clinical picture:** Triad:
  1. Thrombocytopenia and bleeding.
  2. Eczema.
  3. Combined T and B cell deficiency causing recurrent infections.
- **Historically:** Thought to be caused by a defective IgM response to capsule polysaccharides, such as pneumococcus.
- **Note:** The gene for the Wiskott-Aldrich syndrome protein (WASP) has now been isolated and it plays a role in many immune functions.
Severe Combined Immunodeficiency (SCID)

- **Mechanism:** Absent T and B lymphocytes due to defective stem cell development.
- **Causes:** Multiple inherited causes:
  1. Deficiency in adenosine deaminase (ADA): *Autosomal recessive.*
  2. MHC class II deficiency.
  3. Defective tyrosine kinase enzyme: *Autosomal recessive.*
  4. Defective IL-2 receptor: *X-linked.*
- **Clinical picture:** Patient is usually less than 6 months of age presenting with recurrent bacterial, viral and fungal infections.
- **Prevention and treatment:** Used to be fatal; however, currently early detection and bone marrow transplantation may be curative.

Chronic Granulomatous Disease (CGD)

- **Mechanism:** X-linked deficiency of NADPH oxidase in neutrophils.
- **Clinical picture:** Recurrent fungal and staphylococcal infections. Suspect it when you see a patient in the USMLE with recurrent oral thrush, diaper rash, abscesses and granulomas.
- **Diagnosis:** Inability of cells to reduce nitroblue tetrazolium dye to formazan.
- **Treatment:** Gamma interferon.

Chediak-Higashi Syndrome

- **Mechanism:** Autosomal recessive disease.
- **Pathology:** Defect in microtubule polymerization which leads to failure of chemotaxis and phagocytosis.
- **Clinical picture:** Recurrent staphylococcal and streptococcal infections.
- **Diagnosis:** Neutropenia and prolonged bleeding time.
- **Association:** Albinism and neurological defects, e.g., ataxia, neuropathy.

Leukocyte Adhesion Deficiency

- **Mechanism:** Defect in the adhesion protein (LFA-1) involved in phagocytosis.
- **Clinical picture:** Recurrent fungal, staphylococcal and streptococcal infections at a young age.

Transient Hypogammaglobulinemia

- **Mechanism:** Decrease in serum IgG after maternal immunity wanes.
- **Age:** Around the age of 6 months.
- **Prognosis:** Spontaneously resolves after 1–2 months to 1–2 years.

Chronic Mucocutaneous Candidiasis

- **Mechanism:** Disorder of T cell response to Candida.
- **Clinical picture:** Recurrent yeast infections of mucous membranes and skin.

Ataxia-Telangiectasia Syndrome

- **Mechanism:** Autosomal recessive disorder.
- **Clinical picture:**
  1. Combined T and B cell deficiency: Recurrent infections.
  2. Cerebellar ataxia and oculo-cutaneous telangiectasia.
- **Complication:** Stomach cancer and non-Hodgkin’s lymphoma.

C1 Estrase Inhibitor Deficiency

- **Mechanism:** Autosomal dominant disease causing hereditary angioedema.
- **Diagnosis:** Low levels of C4 and C1 estrase inhibitor.

C5–C9 Deficiency

- Complement deficiency associated with increased risk of infection with meningococcal and gonococcal infections.

Neonatology

**Normal Full Term Features**

- **Blood pressure:** SBP in 70s–80s, DBP in 40s–60s.
- **Pulse:** 100s–150s.
- **Respiratory rate:** 30s–40s.
- **Posture:** Partial generalized flexion.
- **Skin:** Covered with whitish material known as Vernix caseosa.
- **Color:** Purple mottling and Mongolian spots, which disappear by 2 years of age.
GI: First stools are black, then turn greenish for 3 or 4 days (Transitional stools), after which they become golden yellow in color.

GU:
1. First urine output occurs 24–48 h after birth, and is pink in color due to high urate content.
2. Breast enlargement and nipple secretions (Witch's milk).
3. Labial hypertrophy and bloody vaginal discharge: Due to estrogen withdrawal.

Hematology: Hemoglobin of newborn at birth is 17–18 g/dL, a.k.a. physiological polycythemia of newborn, with mild reticulocytosis.

Weight: 10–90% percentile is appropriate for gestational age. Below 5% is small for age, and above 95% is large for age.

Reflexes:
1. Moro's reflex: Extension and abduction of limbs followed by exactly the opposite, i.e., Flexion and adduction. This reflex disappears by the 3rd month of age. Persistent Moro’s reflex indicates mental injury, e.g., Cerebral palsy or retardation.
2. Grasp reflex: Also present at birth and disappears by the 3rd month of age.

Care of newborn: APGAR scoring, vitamin K injection and applying erythromycin eye drops prophylactically against Chlamydia's inclusion conjunctivitis. Note: Inclusion conjunctivitis usually occurs 4–5 days after birth, while chemical conjunctivitis occurs only in the first 24 h after birth.

Neonatal Sepsis

Introduction: Most common cause of fever in neonates is dehydration, so always make sure to assess for dry mucus membranes and sunken fontanelles in any neonate with fever.

Most common organisms: Group B streptococci, followed by E. coli.

Clinical picture: Lethargy, weak cry, fever or hypothermia and poor feeding.

Diagnosis: CXR, CBC, blood cultures, urine analysis and culture, sputum culture and lumbar puncture.

Treatment: Empirical treatment immediately after cultures are obtained. Best combination used is Ampgent (Ampicillin + Gentamycin). If there is any suspicion for meningitis, a 3rd generation cephalosporin (e.g., Ceftriaxone) must be added.

Congenital Infections and Drug Induced Disorders

Congenital rubella syndrome:
2. Eye: Glaucoma, cataract and Salt and pepper retinopathy.
3. CVS: Patent ductus arteriosus (PDA) and myocardial necrosis.
4. Bone: Longitudinal radiolucent areas in metaphysis of long bones.

Congenital toxoplasmosis syndrome:
1. CNS: Hydrocephalus and scattered intracranial calcifications.
2. Eye: Chorioretinitis.

Congenital cytomegalovirus syndrome:
1. CNS: Hydrocephalus and periventricular intracranial calcifications.
2. Eye: Chorioretinitis.

Congenital herpes simplex syndrome: Skin, Eye, Mouth (SEM syndrome), presenting with vesicular skin lesions and chorioretinitis. Most infections occur during passage of fetus through an infected birth canal. Prevention: Delivery by C-section before rupture of membranes.

Congenital varicella zoster syndrome: Limb hypoplasia and multiple scarring.

Fetal alcohol syndrome:
1. Microcephaly.
2. Midfacial hypoplasia.
3. Short palpebral fissures.
4. Long philtrum of the lip.

Fetal hydantoin syndrome:
1. Cleft lip and/or palate, and mental retardation.
2. Cupid bow: Curved upper lip that looks like the bow of Cupid.
3. Nail and digits hypoplasia.
4. Goiter and hypothyroidism.
5. Thalidomide: Limb defects (Phocomelia).
Hemorrhagic Disease of the Newborn

- **Definition:** It is a physiological self-limited hemorrhage that normally occurs after birth.
- **Onset:** 2–5 days after delivery; never in the first day.
- **Mechanism:** Depletion of vitamin K and vitamin K-dependent clotting factors previously supplied intrauterine through the maternal blood.
- **Clinical picture:**
  1. Prolonged bleeding episodes.
  2. Prolonged PT and PTT.
- **Prevention:** All newborns receive vitamin K injection immediately after delivery.
- **Treatment:** Vitamin K, Fresh frozen plasma (FFP) and blood transfusion.

Physiological Anemia of Infancy

- **Definition:** It is a physiological drop in hemoglobin after delivery. The drop starts at the end of the 1st week and plateaus by the 8th week to a level of 9–11 g/dL.
- **Mechanism:** Short life span of hemoglobin F and rapid increase in body size and plasma volume.
- **Anemia of prematurity:** Premature infants experience a more severe Hb drop, mainly due to short life span of RBCs caused by vitamin E deficiency.

Neonatal Necrotizing Enterocolitis

- **Pathology:** Infection of the intestine leading to necrosis.
- **Most common location:** Distal ileum and proximal colon.
- **Most common organisms:** Clostridium perfringens and *E. coli*.
- **Clinical picture:** Abdominal distention and blood in the stools.
- **Diagnosis:** Abdominal X-ray, which shows gas accumulation in submucosa of intestinal wall (*Pneumatosis intestinalis*). Air under diaphragm on an upright film indicates intestinal perforation.
- **Treatment:**
  1. Hydration and antibiotics: Best is *antipseudomonas penicillin, e.g., Cefazidime, Cefepime, plus aminoglycoside.*
  2. Surgery: Intestinal resection is reserved for cases with perforation or failure to respond to medical management.

Neonatal Jaundice

- **Definition:** Yellow discoloration of skin and sclera of neonate, due to serum bilirubin elevation beyond 7 mg (Normal = 0.1–0.8 mg).
- **Physiological jaundice:**
  1. Most common form of neonatal jaundice.
  2. Timing: Starts in the 2nd or 3rd day (Never the first), and lasts for a week before resolving spontaneously.
  3. Bilirubin: Does not exceed 12 mg, and is mainly indirect (Unconjugated)
- **Hemolytic disease of the newborn:**
  1. Occurs mainly due to Rh incompatibility in the previous pregnancy, which has led to development of Rh antibodies, or due to ABO incompatibility.
  2. Clinical picture: Jaundice on first day of life, hydrops fetalis or icterus gravis neonatorum. Discussed in gynecology.
- **Treatment of neonatal jaundice:**
  1. **Phototherapy:**
     - Indicated if cord bilirubin is more than 2.5 mg, or if serum bilirubin is more than 10 mg. Diarrhea is a common side effect.
     - Exposure to blue light of 470 nm wavelength, which leads to formation of a soluble form of indirect bilirubin that can be excreted in the urine. (Remember, Indirect or unconjugated bilirubin is not allowed to pass in the urine, however, it can cross the blood brain barrier.)
     - Neonates during phototherapy must wear dark sun glasses to protect their retina, and a metal cover to protect their genitalia.
  2. **Exchange transfusion:**
     - Indicated if cord bilirubin is more than 5 mg, or if serum bilirubin is more than 20 mg. It is done using type O Rh-ve blood, and amount given is double the neonate’s plasma volume.
     - Complications of exchange transfusion: Neonatal vascular thrombosis or vasospasm, hypocalcemia and hypoglycemia.
- **Notes:**
  1. **Breast milk jaundice:** Indirect hyperbilirubinemia that usually occurs by the 2nd week after delivery. Mechanism: Inhibition of neonatal conjugation enzyme (Glucuronyl transferase) by 3-alpha-20-beta-pregnandiol in the breast milk. Treatment: Hold breast feeding for 48 h, then
resumes. Condition resolves spontaneously by 10 weeks of age.

- **Key:**
  3. Jaundice persistent beyond 1 month of age: Congenital jaundice, biliary atresia or breast milk jaundice.

Kernicterus

- **Definition:** Brain injury due to deposition of indirect bilirubin. Main deposition is in the basal ganglia and brain stem’s mitochondria.
- **Clinical picture:**
  1. Stage 1: Brain edema causing lethargy, hypotonia and poor feeding.
  2. Stage 2 and 3: Rigidity, convulsions and oculogyric crisis (Conjugate deviation of eyes).
  3. Stage 4: Cerebral palsy and extra-pyramidal manifestations.
- **Prevention and treatment:** Urgent lowering of bilirubin level. Discussed earlier.

Miscellaneous

- **Allergic rhinitis:** Could be seasonal or perennial. Clinical picture: Paroxysmal rhinorrhea and nasal stuffiness, dark halos around the eyes (Allergic shiners) and a horizontal crease on the nose (Allergic salute). Treatment: Antihistamines and nasal steroids.
- **Angioedema:** Usually induced by introduction of a foreign substance into the body, e.g., Medication, bee sting. Hereditary angioedema due to deficiency of C1 esterase inhibitor. Clinical picture: Swelling of eye lids, lips and tongue. Main concern: Airway protection. Treatment: Epinephrine (Life saving), steroids and antihistamines (H1 and H2 blockers).
- **Allergic triad (AAA):** Allergic rhinitis + Atopic dermatitis + Asthma.
- **Testicular feminization syndrome:** Mechanism: Mutation of androgen receptors, through deletion of the DNA binding protein of the receptors, so testosterone is produced but it cannot act. Clinical picture: External female appearance and has a vagina, but no ovaries or uterus. Workup reveals undescended testes and 46 XY chromosomes.
  - **Male phenotypic genital anomalies:** Mechanisms: 5 alpha-reductase or 17 beta-hydroxysteroid dehydrogenase deficiency. Clinical picture: Underdeveloped male genitalia. Diagnosis: High serum testosterone and androstenedione levels respectively, due to lack of conversion to the active forms.
  - **Most common cause of stridor in pediatrics:** Foreign body aspiration, and mostly located in the right main bronchus (Wider and more in line with trachea). Most common foreign body: Nuts. Next best step: Rigid bronchoscopy.
  - **Most common cause of stridor in someone who uses their voice excessively, e.g., Opera singer:** Laryngeal papilloma.
- **Infantile microcystic disease:** Autosomal recessive disease characterized by cystic dilatation of PCT. Clinical picture: Edema and proteinuria. Antenatal diagnosis: Elevated alpha fetoprotein level.
  - **Most common cause of hydronephrosis in children:** Ureteropelvic junction stricture. Treatment: Pyeloplasty.
  - **Most common cause of chronic kidney disease in children:** Obstructive uropathy.
  - **Most common cause of hemorrhagic cystitis in children:** Adenovirus infection.
  - **Most common cause of diarrhea in children:** Viral gastroenteritis.
  - **Most common cause of constipation in children:** Voluntary (Functional).
  - **Most common intestinal tumor in children:** Juvenile colonic polyps.
  - **Most common cause of intracranial hemorrhage in children:** A-V malformations.
  - **Most common cause of asphyxia in children:** Choking on food.
  - **Most common cause of epistaxis in children:** Voluntary nose picking.
  - **Placental insufficiency syndrome:** Affects the fetal weight during the second half of pregnancy. Newborn has big hands, big feet, big head and small liver.
  - **Meconium aspiration syndrome:** Asphyxia during labor stimulates fetal breathing, which might lead to aspiration of meconium and respiratory distress for few days after delivery. Complication: Pneumothorax.
  - **Beckwith-Wiedemann syndrome:** A chromosomal deletion syndrome, resulting in a macrosomic neonate with visceromegaly, polycthemia and hypoglycemia.
  - **Sudden infant death syndrome (SIDS):** Unexplained death during sleep, most common between
2 and 4 months of age. Prevention: Infant should always lie on their back.

- **Icthyosis**: X-linked disease. Mechanism: Defective keratinization of the skin. Location: Neck and trunk, sparing the extremities. Clinical picture: Dry scaly skin, frequently compared to fish scales. Pathology: Thick stratum corneum layer. Treatment: Topical emollients.

- **Toxic epidermal necrolysis**: A subtype of erythema multiforme, and is characterized by target-like lesions and Nikolsky sign (Easy detachment of mucus membranes and skin lesions upon pressure).

- **Scalded skin syndrome**: Skin infection by Staphylococci, and is characterized by beefy red skin lesions and Nikolsky sign. Treatment: Penicillinase-resistant penicillin.

- **Erythema toxicum neonatorum**: Occurs in full term neonates, and disappears by 5 days of age. Clinical picture: Evanescent vesicle, papules and pustules. Diagnosis: Gram stain of the fluid in lesions reveals excessive eosinophils.

- **Cradle cap**: Seborrheic dermatitis of the scalp in newborns. Resolves spontaneously.

- **Pustular melanosis**: Heal with hyperpigmented lesions.

- **Sebaceous nevus**: Yellowish, hair-free lesion on the scalp.

- **Thyroid diseases**: In males and females of the pediatric population occur with the ratio of 1:1. Congenital hyperthyroidism could occur due to transplacental transfer of TSI or LATS, and it is self resolving in few months without treatment.

- **Polydactyly**: Common among African Americans. In Caucasians, it is usually associated with cardiovascular anomalies.

- **Teeth decay**: Bottled sweetened milk causes decay in the upper central incisors and back teeth.

- **Job Buckley disease**: Recurrent staph. infections, rash and elevated IgE.

- **Feil syndrome**: Abnormal fusion of neck vertebrae leading to short neck and high scapula, a.k.a. Sprengel deformity.

- **Visual acuity**: At birth it is 20/400, by the age of 5 it is 20/20. Snellen chart can be used to assess visual acuity by the age of 4 years.

- **Circumcision**: Decreases the risk of penile cancer, only if done at a young age.

- **Infant walkers**: Proven to delay the development of walking skills.

- **All congenital infections (Discussed earlier)**: Risk factor for autism.

- **Safety measures during car rides**:
  1. Infants must ride in a rear-facing seat until they are at least 1 year old and at least 20 lbs in weight.
  2. 20 lbs–40 lbs: Front-facing seat with a harness.
  3. > 40 lbs: Belt positioning booster seat until the child is 80 lbs and 4’9” tall, after which the car seat with seat belt can be safely used.
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Psychiatry

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Introduction

Axes of Mental Disorders
- **I**: Clinical disorder, e.g., Depression.
- **II**: Personality disorder or mental retardation.
- **III**: Medical disease, e.g., Hypothyroidism.
- **IV**: Environmental factors.
- **V**: Global Assessment of Function (GAF).

Targets of Doctor-Patient Interview
- **Rapport**: Includes the following techniques:
  1. **Support**, e.g., “That must have been a horrible experience for you.”
  2. **Empathy**, e.g., “Oh dear, you must be worried about the complications!”
  3. **Validation**, e.g., “I can understand why you felt the way you did. If I were in your place, I would have felt the same way too.”
- **Information**: Obtain information from the patient using the following techniques:
  1. **Silence**: You will get multiple cases in the USMLE about the fact that you should never interrupt your patient while he or she is talking. If the patient is very talkative, try to aim for closed ended questions, but never interrupt the patient.
  2. **Open-ended questions**, e.g., “What brought you in today?”
  3. **Closed-ended questions**, e.g., “Do you have a cough?”
  4. **Reflection**, e.g., “Okay, so you said you fell and hit your head?”
  5. **Facilitation**, e.g., “What happened after you fell and hit your head?”
  6. **Recapitulation**, e.g., “Now that I have heard the entire story, let me summarize my understanding of what happened.”
- **Memory**: 3 types of memory you need to test for:
  1. **Immediate**: Lasts for 5 min, and is controlled by mammillary bodies.
  2. **Recent**: Lasts for 12 h, and is controlled by Hippocampus.
  3. **Remote**: Old concrete information, e.g., Name, place of birth.

Important Definitions
- **Psychosis**: Loss of relation with the real world. Characterized by hallucinations.
- **Neurosis**: Mixture of anxiety, worry and irritability.
- **Mood**: Emotion that the patient feels from within, e.g., Depressed, happy.
- **Affect**: Emotion that the patient shows from outside, e.g., Looks depressed.
- **Concentration**: Tested by asking the patient to start with the number 100 and to count backwards by sevens, i.e., 100, 93, 86, etc....
- **Attention**: Tested by observing the patient during the interview for how easily he/she gets distracted by surrounding stimuli.
- **Cognitive ability**: Tested by asking “How many states are in the US?” or “How much is 5 multiplied by 5?”
- **Spatial ability**: Tested by asking the patient to draw a clock.
- **Abstract reasoning ability**: Ability to understand metaphors, e.g., Proverbs.
- **Perseveration**: Patient thinks or talks about the same word or idea over and over again.
- **Flight of ideas**: Patient thinks or talks about different, unrelated words or ideas at a fast pace.
- **Delusion**: False perception of an idea, e.g., “I think the FBI are watching me” or “I think that my co-workers are trying to set me up.”
- **Illusion**: Also false perception of an actual object, e.g., A patient would look at a wire on the floor, and tell you “Careful, that snake is too close to your foot.”
- **Hallucination**: Seeing, hearing, smelling, or feeling something that does not exist, e.g., A patient looks at the floor (where there is nothing) and tells you “Careful, there are spiders all over the floor” or “Jesus was talking to me yesterday and told me to try that drug, nobody could hear him, only I did.”
- **Idea of reference**: e.g., “I watched that movie on the TV last night, and it was talking about my life, it was full of details of my life, they were telling my story.”

Tests
Intelligence Quotient (IQ): IQ = Mental age/Chronological age \times 100. Culture plays a major role in affecting IQ. Scoring:

2. Borderline: 70–90.
3. Mental retardation: Below 70.

Personality tests: Multiple, including the Minnesota multiphasic personality inventory (566 true or false questions), Rorschach inkblot, sentence completion and Thematic Apperception Test (TAT).

Neuropsychological tests: Multiple, including Halsted battery (To localize brain lesions) and Nebraska test (To determine brain hemispheric dominance).

Others:

1. Dexamethasone suppression test: Positive in cases of depression.
2. Serotonin: Low levels in cases of depression, alcoholism and aggression.
3. Dopamine: Low level in Parkinson’s disease and high level in schizophrenia and chorea.
4. Na lactate intravenously or CO₂ inhalation: Induce panic attacks.
5. Lie detection test: Done using Na amobarbital (Truth serum).
6. Electroencephalogram (EEG): Normal in dementia and abnormal in delirium. Evoked EEG is used to detect cortical response to stimuli.

Age

Child Development

- Infant (0–15 months):
  1. Sticks to the mother at all times. If separated from mother at this age, separation anxiety, anaclitic depression and failure to thrive may ensue.
  2. Stranger anxiety: Most pronounced during the first year of life.

- Toddler (15 months–2.5 years): Show 2 important phenomena:
  1. Rapprochement: Separates from mother voluntarily, but returns to her intermittently for reassurance.
  2. Object permanence.

- Pre-schooler (2.5–6 years): Show multiple important phenomena:
  1. Control over bowel function: By age 4. Encopresis (Loss of control over bowels) could be due to multiple reasons, most common of which is voluntary retention with overflow.
  2. Control over bladder function: By age 5. Enuresis (Loss of control over bladder) is best treated using a buzzer or Imipramine. Functional enuresis is more frequent among males, and occurs just before awakening in the morning.
  3. Band-aid phase: During these few years, the child is so overwhelmed by any minor illness or injury, so surgery is not preferred during these years.
  4. They have no understanding of the meaning of death.

- Schooler (6–11 years): By that age, the child can:
  1. Understand the meaning of death.
  2. Be taken to surgery and hospitalized if needed, without serious consequences.

- Adolescents: By age 11 in females and 13–14 in males:

- Stages of development: Also been classified as shown in Table 7.1, as follows:
  1. Freud: According to the organ through which pleasure is achieved.
  3. Erikson: According to achievement of certain goals (Psychosocial)

Aging

- Average life expectancy for Americans at this time is 75 years, with more predominance to Caucasians compared to African Americans, and to females compared to males (7 years difference).
- By the year 2020, around 15% of the people living in the US will be in the elderly age group (>65 years).
- Depression is very common among the elderly population, and is commonly misdiagnosed as dementia, hence called pseudo-dementia. So when you see any elderly patient in the USMLE with what looks like dementia, make sure to look first for any symptoms indicating depression.

**Table 7.1 Stages of human development.**

<table>
<thead>
<tr>
<th>Stage</th>
<th>Freud</th>
<th>Piaget</th>
<th>Erikson</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infant</td>
<td>Oral</td>
<td>Sensorimotor</td>
<td>Trust</td>
</tr>
<tr>
<td>Toddler</td>
<td>Anal</td>
<td>Sensorimotor</td>
<td>Shame and Doubt</td>
</tr>
<tr>
<td>Preschooler</td>
<td>Phallic</td>
<td>Pre-operational</td>
<td>Intent and Guilt</td>
</tr>
<tr>
<td>Schooler</td>
<td>Latent</td>
<td>Concrete</td>
<td>Industry and Inferiority</td>
</tr>
<tr>
<td>Adolescent</td>
<td>Genital</td>
<td>Abstract</td>
<td>Personality, Intimacy and Generosity</td>
</tr>
</tbody>
</table>
Elderly have low brain weight, increase in the size of ventricles and sulci, along with decreased cerebral blood flow; however, their IQ does not change.

Development Disorders

Attention Deficient Hyperactivity Disorder (ADHD)

- **Clinical picture:** As the name implies, the child cannot pay any attention, and is hyperactive. Classic presentation is for a child who scores poorly in school, cannot follow instructions, is easily distracted and always interrupts his teacher and classmates.
- **Treatment:** Amphetamine or Methylphenidate. Side effects of these medications include insomnia, tics, night terror and choreiform movements.
- **Notes:**
  1. Incidence of mental retardation in patients with ADHD is 10–20%.
  2. There is a genetic component in ADHD which is strongly associated with OCD and Tourette’s syndrome.

Conduct Disorder

- **Clinical picture:** A child who acts like a “thug”. A classic presentation is for a child who physically assaults other kids, destroys property, lies and steals from others.
- **Treatment:** Psychotherapy and family therapy.
- **Notes:**
  1. If this disorder persists beyond 18 years of age, it is known as Anti-social personality disorder.
  2. Conduct disorder is frequently associated with a history of abuse by addicts parents.

Oppositional Defiant Disorder

- **Clinical picture:** A child who is also acting like a “thug” only towards authority figures. A classic presentation is for a child who gets along with his classmates very well, but when it gets to his teachers or parents, he is impolite. Also carries a history of abuse.
- **Treatment:** Psychotherapy and family therapy.

Autistic Disorder

- **Clinical picture:**
  1. A child who refuses to talk or move, and is highly nervous and anxious, especially when anybody tries to help or touch him.
  2. Characteristic features include repetitive and destructive behavior, e.g., Continuous spinning, repetitive head smashing against the wall.

Asperger disorder: Looks just like autistic disorder, with the exception that patients communicate and move normally.

Selective mutism: A disorder that is common in females, misdiagnosed as shyness. The child is essentially normal, but only in certain situations (e.g., In front of strangers she would not talk).

Rett Disorder

- **Clinical picture:** After a period of normal development, the child starts to lose already acquired skills.
- **Note:** Almost always occurs in females. Another form of the disease that presents similarly in males is called Childhood disintegrative disorder.

Tourette’s Disorder

- **Mechanism:** Dysfunction in the regulation of dopamine in caudate nucleus.
- **Clinical picture:** More common in males, where the child has multiple motor tics and at least one vocal tic. It could be transient (<1 year) or chronic (>1 year).
- **Treatment:** Haloperidol. Note that treatment is lifelong.
- **Note:** There is a strong genetic link between Tourette’s, ADHD and OCD syndromes.

Separation Anxiety Disorder

- **Introduction:** Fear of loss of attachment figures.
- **Clinical picture:** Typical presentation is for a child who refuses to leave home right after the family moved to a new house.
- **Prognosis:** These patients usually develop agoraphobia later in life.
- **Treatment:** Supportive by gradual acclimatization to the new situation.

Abuse

Child Physical Abuse

- **Clinical picture:** Shaken baby syndrome, which is characterized by retinal hemorrhage and detachment and spiral bone fractures.
- **Treatment:** Hospitalize the patient and contact social services.
**Child Sexual Abuse**

- **Introduction**: Most common age involved is 9–12.
- **Clinical picture**: Suspect in any child with recurrent UTIs, or with *phthirius pubis* in eye lashes.
- **Note**: The abuser is usually a very close family relative or friend.
- **Treatment**: Contact social services.

**Others**

- **Elderly abuse**: The abuser is mostly the spouse or caregiver. Treatment: Contact social services.
- **Partner abuse**: Whether physical or sexual, starts with tension building up, followed by battery and ending up with apology. Female risk of being physically or sexually abused during their life is around 25%. Treatment: Do not contact social services; only advise the patient that abuse is illegal and that she has the right to seek help by contacting social services.
- **Statutory rape**: Any sexual intercourse younger than 18 years of age falls under this category, regardless whether it was consensual or not.

**Drug and Alcohol Abuse**

- **Introduction**: Abuse is an abnormal use of a substance that leads to some sort of impairment. *Dependence, on the other hand, is an abuse combined with tolerance and withdrawal symptoms.*
- **Types and features**: Refer to Table 7.2.

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**Table 7.2 Most commonly abused drugs and their effects.**

<table>
<thead>
<tr>
<th>Transmitter</th>
<th>Clinical picture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cocaine</td>
<td>Dopamine</td>
</tr>
<tr>
<td></td>
<td><em>Mechanism: Vasoconstriction</em></td>
</tr>
<tr>
<td></td>
<td><em>Tactile hallucinations, i.e., Sensation of bugs crawling under your skin</em></td>
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<tr>
<td></td>
<td><em>Chest pain: Due to coronary vasospasm</em></td>
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<tr>
<td></td>
<td><em>Perforated nasal septum</em></td>
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<tr>
<td></td>
<td><em>Sympathetic hyperactivity: Hypertension, tachycardia and dilated pupils</em></td>
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<tr>
<td></td>
<td><em>Withdrawal: Crash syndrome (Depression, fatigue and somnolence), followed by dysphoria</em></td>
</tr>
<tr>
<td></td>
<td><em>Cocaine metabolite: Benzoylecgonine</em></td>
</tr>
<tr>
<td></td>
<td><em>Note: Cocaine is the only anesthetic that causes vasoconstriction</em></td>
</tr>
<tr>
<td>Opioids</td>
<td>Dopamine</td>
</tr>
<tr>
<td></td>
<td><em>Analgesia: Due to increase in the pain threshold</em></td>
</tr>
<tr>
<td></td>
<td><em>Euphoria: Due to stimulation of the ventral tegmentum</em></td>
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<tr>
<td></td>
<td><em>Pin point pupils: Due to stimulation of the Edinger-Westphal oculomotor nucleus</em></td>
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<tr>
<td></td>
<td><em>Emesis: Due to stimulation of chemoreceptor trigger zone</em></td>
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<tr>
<td></td>
<td><em>Fluid retention: Due to stimulation of ADH secretion</em></td>
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<tr>
<td></td>
<td><em>Others: Anti-tussive, increase intracranial pressure and histamine release, and also causes constipation</em></td>
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<tr>
<td></td>
<td><em>Indications: Pain, diarrhea and cough</em></td>
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<td></td>
<td><em>Elimination: In urine and bile in the form of morphine-6-glucuronide</em></td>
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<tr>
<td></td>
<td><em>Tolerance: Common to all effects except constipation and pupillary constriction</em></td>
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<tr>
<td></td>
<td><em>Reversal: Naloxone.</em></td>
</tr>
<tr>
<td></td>
<td><em>Withdrawal (Cold turkey):</em></td>
</tr>
<tr>
<td></td>
<td>1. First stage: Lacrimation, rhinorrhea and muscle aches</td>
</tr>
<tr>
<td></td>
<td>2. Second stage: Excessive sweating</td>
</tr>
<tr>
<td></td>
<td>3. Third stage: Excessive micturition and defecation, vomiting and diarrhea</td>
</tr>
<tr>
<td></td>
<td><em>Treatment of withdrawal: Methadone and clonidine.</em></td>
</tr>
<tr>
<td>Alcohol</td>
<td>GABA</td>
</tr>
<tr>
<td></td>
<td><em>Euphoria initially, followed by depression.</em></td>
</tr>
<tr>
<td></td>
<td><em>Wernicke’s encephalopathy: Encephalopathy, nystagmus and ataxia. Due to Thiamine (B1) deficiency affecting mamillary bodies.</em></td>
</tr>
<tr>
<td></td>
<td><em>Korsakoff syndrome: Amnesia (Antero- and retro-grade) and confabulations. Due to Thiamine (B1) deficiency affecting the Hippocampus</em></td>
</tr>
<tr>
<td></td>
<td><em>Withdrawal: Delirium tremens (DTs) in 2–5 days, where patient has delirium, tremors and possibly seizures. Treatment: BDZ is the first step (Best is Clordiazepoxide) plus folic acid, thiamine (B1), and pyridoxine (B6)</em></td>
</tr>
<tr>
<td></td>
<td><em>Alcohol intoxication level: 0.08–0.15%</em></td>
</tr>
<tr>
<td></td>
<td><em>If patient has blood alcohol level &gt;0.10% and shows no symptoms of intoxication, suspect tolerance</em></td>
</tr>
<tr>
<td></td>
<td><em>Blood alcohol level &gt;0.4% is fatal</em></td>
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<tr>
<td></td>
<td><em>Chronic alcoholism causes impotence, decreased sperm count and testosterone level</em></td>
</tr>
</tbody>
</table>
Sleep

Sleep Waves and Stages

- Patient awake, relaxed and eyes closed: Alpha waves.
- Patient awake, concentrating and eyes open: Beta waves.

- **Stage 1 of sleep:** Theta waves.
- **Stage 2 of sleep:** Sleep spindles and K complexes. 45% of our sleeping time is spent in stage 2.
- **Stages 3 and 4 of sleep:** Delta (Slow) waves. Sleep walking and nocturnal enuresis occur during these 2 stages.

- **Rapid Eye Movement (REM) sleep:**
  1. Alpha, Beta and Theta waves combined giving a saw-tooth appearance.
  2. Dreams, nightmares, sympathetic stimulation, erection and complete skeletal muscles relaxation occur during this stage.
  3. REM rebound to compensate for missed REM on the previous sleep cycle is common.

4. After you fall asleep, the cycle goes as 90 min of normal sleep alternating with 10 min of REM sleep, and the cycle keeps repeating itself.

5. REM sleep is regulated by acetylcholine, and is suppressed by MAOI.

Regulation of Sleep

- **Serotonin and melatonin:** Induce sleep.
- **Dopamine and norepinephrine:** Inhibit sleep. That is the reason anti-psychotics improve sleep.

Sleep Disorders

- **Narcolepsy:** Uncontrollable attacks of falling asleep. Some key symptoms in these patients are:
  2. Hallucinations: Either before falling asleep (Hypnagogic), or upon waking up (Hypnopompic).

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**TABLE 7.2 (Continued)**

<table>
<thead>
<tr>
<th>Transmitter</th>
<th>Clinical picture</th>
</tr>
</thead>
</table>
| LSD (Lysergic acid diethylamide) Serotonin | - Mechanism: An agonist of serotonin 5-HT1 and 5-HT2 receptors  
- Dream-like state, e.g., Pt thinks he is flying  
- Visual hallucinations  
- Bad trips: Panic attacks  
- Flashbacks: Patient experiences the symptoms he develops in the absence of the drug  
- Reversal: Haloperidol |
| Marijuana (Cannabis) Serotonin | - Depersonalization  
- Loss of time perception  
- Conjunctival redness  
- Increased appetite (The munchies)  
- Used clinically to treat chemotheraphy-induced emesis. |
| PCP (Angeldust) Serotonin | - Blocks NMDA receptors, which leads to inhibited uptake of Norepinephrine, serotonin and dopamine.  
- Hyperthermia, hypersalivation, aggression and violent behavior  
- Treatment: Phentolamine, diazepam, haloperidol and acidification of urine |
| Methylxanthines (Caffeine) Dopamine | - Mechanism: Inhibit phosphodiestrase, which in turn leads to elevated cAMP and cGMP levels. This leads to positive inotropic and chronotropic effects  
- Insomnia, alertness and diuresis  
- Side effects: Increases gastric HCL production  
- Precautions: It can cross placenta and is found in breast milk  
- Withdrawal: Headache, sleepiness and lethargy |
| Amphetamine Dopamine | - Mechanism: It decreases the appetite and increases alertness  
- Indications: ADHD and narcolepsy  
- Side effects: Psychosis, insomnia and GI upset  
- Reversal: Chlorpromazine |
| Nicotine Dopamine | - Mechanism: Inhibits the ganglia after an initial phase of stimulation  
- Side effects:  
  1. Low dose: Euphoria and increased alertness  
  2. High dose: Depression of the respiratory center  
- Withdrawal: Irritability, headache and craving  
- Metabolite of nicotine: Cotinine |
• **Sleep terror**: This disorder occurs during *delta wave sleep* (Not the REM like all other dreams and nightmares). Patient is screaming in bed with what looks like a bad nightmare: however, it is very hard to get him/her to wake up. After waking up, the patient has no recollection of the incident. It is an indicator of possible temporal lobe epilepsy later in life.

• **Klein Levin syndrome**: Episodes of *hypersomnia and hyperphagia*, each lasting 1–2 weeks.

• **Sleep changes during depression**:
  1. Normal sleep onset.
  2. Frequent awakenings during the night and in the early morning (*Terminal insomnia*).
  3. REM sleep: Short latency, and high frequency, which tends to decrease throughout the night.

### Delirium

#### Introduction

- **Definition**: Delirium is a cyclic disorder, where patient fluctuates in and out of *consciousness*, more commonly towards the night time; a.k.a. *sundowning phenomenon*.

- **Population**: Very common to see delirium in elderly patients admitted to the hospital, specifically to the ICU (*ICU psychosis*), where almost one third of the patients would suffer some degree of delirium.

#### Clinical Picture

- Altered level of consciousness.
- Disorientation: *First to time*, then place and finally to person.
- Visual hallucinations.
- EEG changes.

#### Treatment

- **Treat the cause**: Delirium in the elderly is caused by *DIM; Drugs, Infections or Metabolic derangement*.
- **Drug of choice**: Haloperidol.

### Schizophrenia

#### Introduction

- **Introduction**: Cycle of symptoms that lasts at least 6 months at a time, more common in the winter months, and in young adults (20–40 years).
- **Mechanism**: Unknown, but the fact that it is more prevalent in the cold months suggest a possible link to viral infection.

- **Personality**: Most patients already have *borderline personality*; characterized by splitting, mood swings and suicidal attempts.

- **Risk**: 50% in monozygotic twins.

- **Forms**: Paranoid, disorganized or *catatonic (Waxy flexibility)*.

- **Duration**:

  1. Less than 1 month: *Brief psychotic disorder*.
  2. One–6 months: *Schizophreniform disorder*.
  3. More than 6 months: *Schizophrenia*.

#### Pathology

- **Transmitters**: Decreased GABA neurons in hippocampus.

- **Hormones**: Low serum levels of FSH and LH.

- **Positron Emission Tomography (PET) scan**: Shows decreased glucose uptake by frontal lobes, and hyperactive dopamine loaded basal ganglia.

- **EEG**: Decreased alpha and increased Theta and Delta waves with epileptiform activity.

#### Clinical Picture

- **Prodrome**: Patient is calm, and only shows some change in interests, e.g., Sudden interest in politics, religion or languages.

- **Psychosis**: Characterized by the following:

  1. Hallucinations: Mainly auditory (*Delirious patients have visual ones*).
  2. Thought blocking: Moves his lips frequently without vocalizing.
  4. Loose association: Changing subjects quickly while talking.
  5. Tangentiality: When you ask the patient a question, he would start the answer in a good organized way, and then slide away from the subject into something else.
  6. Echolalia: Increased alertness and response to sounds, often compared to *parrots*.

- **Residual phase**: Social withdrawal.

#### Types of Symptoms

- **Positive**: As above, and they respond to typical antipsychotics (*Block D2 receptors in the mesolimbic system*).

- **Negative**: Patient does not have typical presentation as discussed above. He is rather blunt and withdrawn at all times. Patients in this category do not
respond to typical anti-psychotics; however, they respond only to atypical anti-psychotics, e.g., Clozapine and risperidone (Both block 5HT-2 receptors).

Notes

- **Schizophrenia of childhood**: More common and presents at an earlier age in males compared to females.
- **Schizoaffective disorder**: Schizophrenia plus a mood disorder, e.g., Depression.
- **Orbitofrontal syndrome (Pseudo-psychopathic)**: Disinhibited behavior, emotional lability, euphoria and jocular effect.
- **Side effects of neuroleptics (Anti-psychotics)**:
  1. Akathesia: Subjective feeling of restlessness.
     Treatment: Propranolol.
  2. Tardive dyskinesia: Abnormal movements and posturing.
     Prevention: Benztropine.
     Treatment: Discontinue the drug and switch to another neuroleptic.
  3. Neuroleptic malignant syndrome: Rigidity and hyperthermia due to severe actin-myosin coupling resulting in excessive ATP production.
     Treatment: Dantrolene.
  4. Anti-cholinergic effects, e.g., urinary retention, constipation, xerostomia.
  5. Drug specific side effects:
     - Clozapine: Agranulocytosis.
     - Chlorpromazine: Bluish grey skin discoloration.
     - Thoridazine: Orthostatic hypotension and retinal pigmentation.

Mood Disorders

Major Depressive Disorder

- **Mechanism**: Depletion of serotonin and norepinephrine.
- **Best screening**: Ask the patient if he or she is depressed.
- **Clinical picture**: At least 5 of the following:
  2. I: Loss of interest, a.k.a. Anhedonia, and “feeling worthless”.
  3. G: Guilt feelings
  4. E: Lack of energy
  5. C: Lack of concentration
  6. A: Change in appetite; increased or decreased
  7. P: Psychomotor retardation and agitation
  8. S: Suicidal ideation. It occurs in 60–70% of patients; however, only 15% actually do it. Women are more likely to have suicidal ideas and plans than men; however, men are more likely to be successful in committing suicide than women.
- **Concordance rate**: 70% in monozygotic twins, 20% in dizygotic twins.
- **Treatment**: SSRI (First line) or TCAs.
- **Notes**:
  1. Most anti-depressants take 3–6 weeks to be fully effective, so do not make any changes in dosing of medication before 6 weeks from starting the medication.
  2. After initiation of therapy, it is very important to follow up frequently on the patient, as antidepressants might give the patient enough energy to commit suicide early in the course of their treatment.
  3. Electroconvulsive therapy (ECT) is only indicated for severe depression that is resistant to treatment. **Side effects of ECT**: Retrograde amnesia that resolves gradually over 6 months. **Contra-indication to ECT**: High intracranial pressure, e.g., Tumor, bleeding, hydrocephalus.
  4. Patients with suicidal ideation must be admitted (Voluntarily or involuntarily) to a psychiatric ward. Involuntary admission must be certified by 2 physicians. Risk factors for suicide: Depression, male gender, lack of spouse, alcoholism and most importantly a previous suicidal attempt.
  5. Patients with homicidal ideation must be admitted (Voluntarily or involuntarily) to a psychiatric ward. Also the police and the potential victim should be contacted (Tarasoff decision).
  6. Dysthymia: Patient with depressed mood for at least 2 years (Just feels down), but does not have enough depression criteria to diagnose with major depressive disorder.
  7. Double depression: Major depression episode followed by dysthymia. Treatment: MAOI.
  8. Atypical depression: Depression with severe anxiety. Treatment: MAOI.
  9. Cyclothymia: Patient with hypomanic mood for at least 2 years, but does not look manic as described below.
  10. Postpartum blues is a depressed mood that occurs during the first week after labor; however, postpartum depression is a major depressive disorder that does not start till at least 1 month after labor (10% of women suffer from that).

Bipolar Disorder

- **Duration of symptoms**: At least 3 months.
- **Types**:
  1. I: Depression alternating with mania.
  2. II: Depression alternating with hypomania.
• **Clinical picture:** During manic episodes, the patient feels overjoyed, goes out on shopping sprees, has flight of ideas and a strong feeling of grandiosity, e.g., “I won’t talk to a clerk about my application, people like me talk to CEOs directly.”

• **Risk:** 75% in monozygotic twins.

• **Treatment:** Mood stabilizers; discussed later. TCAs and SSRIs are contraindicated in bipolar disorder as they increase the likelihood of suicide.

• **Note:** Theories suggest a link with X chromosome.

### Personality and Pain Disorders

#### Personality Disorders

• **Paranoid:** Multiple delusions and suspicions, e.g., “I think everybody is trying to set me up at work because I am smart.”

• **Borderline:** Swinging mood, stormy relationships and splitting, e.g., “When I was at the hospital, all nurses on the 7th floor were horrible, but the rest were really good.”

• **Passive aggressive:** Procrastination is the key finding. They show enthusiasm to whatever you suggest, but then passively resist doing it and they end up being aggressive when confronted, e.g., You suggest HIV testing to a patient; he shows enthusiasm that he should have it done, but he comes back one month later without having the test done, and when you ask him, he just gets angry and flustered and tell you “Well, I called the lab and they just did not answer the phone.”

• **Histrionic:** Seductive provocative personality. If you see a patient who is dressed and acting like a porn star, you know what to think!

• **Narcissistic:** Grandiosity; they believe they are better than everybody else. Do not confuse this with the grandiosity of mania, as the latter is a short term episodic disorder, but narcissism is a life long personality disorder.

• **Avoidant:** Avoids getting involved in any activity or relationship for fear of rejection.

• **Dependant:** Frequently depends on someone else for decisions and actions.

### Pain (Somatoform) Disorders

• **Somatization (Briquet’s syndrome):** Patient presents with at least 4 pain symptoms, 2 GI related, 1 sexual and 1 neurological complaints. (And yes, in the exam, you have to count.)

• **Body dysmorphic disorder:** The patient fixates on one normal part of her body with complete belief that it looks wrong, e.g., A model comes to your clinic every week complaining about how big her nose is.

• **Conversion disorder:** Subjective, functional disturbance induced by exposure to a certain emotional event, e.g., A patient who lost her vision for one hour once she found out she failed an exam. These patients don’t seem concerned about the functional disturbance; this is known as *La belle indifference.*

• **Hypochondriasis:** The patient exaggerates mild symptoms, insists there is something wrong and demands a work up. He spends his time seeing different doctors, a.k.a. doctor shopping, e.g., A patient who has seen 15 doctors in the last 6 months for his headaches. He is convinced he has a brain tumor when the brain imaging and clinical scenario are consistent with typical tension headaches.

• **Pain disorder:** A patient who has unexplainable pain, e.g., A patient who complains her arm hurts, but all the work up is normal. Similarly, if a patient complains of an unexplainable symptom (not pain), it is called “Undifferentiated somatoform disorder”, e.g., A patient who complains of shortness of breath, but all the work up is normal.

• **Factitious disorder (Munchausen’s syndrome):** Patient fakes different symptoms, just for the sake of getting attention. These patients are willing to take medications or undergo surgeries if you asked them to, e.g., A mother is taking her kid from one clinic to another, and keeps telling the doctor about million complaints that the kid has; however, all the work up comes back normal, this is known as *Munchausen’s by proxy.*

• **Malingering:** Patient fakes different symptoms, just for the sake of getting a certain benefit, e.g., Time off, financial compensation. These patients are not willing to take medications or undergo surgeries if you asked them to.

• **Gain:** When patients complains of pain, they gain 2 things:
  1. **Primary:** They express their emotional problems, but in the form of an illness.
  2. **Secondary:** Getting attention and tender loving care (TLC).

• **Treatment:** Best treatment for all above disorders is psycho- and group therapy.

### Defense Psychology

#### Defense Mechanisms

• **Displacement:** Displacing a certain emotion from one unacceptable situation to a more acceptable
one, e.g., A lawyer who just had an argument with his domineering wife goes to his office and is rude to his female secretary all day.

- **Acting out**: Irresponsible action induced by a certain emotion, usually done by teenagers, e.g., A 16 year old who just had an argument with her mom goes to her room and destroys the TV set with a baseball bat.

- **Altruism**: Doing good things to avoid certain negative or guilt feelings, e.g., A mafia hit man who just murdered someone last week went to the bank today and gave $1000 to charity.

- **Identification**: Subjectively inheriting a certain behavior, e.g., A person who was mistreated by his parents as a kid insists on mistreating his own kids in the same way.

- **Fixation**: The permanence of a childish attitude, e.g., An adult man watching cartoons every day.

- **Projection**: The projection of certain unacceptable feelings into others, e.g., A person who is angry with his co-worker accuses his co-worker of being angry with him.

- **Rationalization**: Attempting to rethink a certain event to make it seem less serious, e.g., After failing an exam for licensure in Canada, the engineering student says “Well, that’s okay, I never really liked Canada that much anyway.”

- **Reaction formation**: Attempting to hide certain unacceptable feelings by doing or saying something very acceptable, e.g., A worker is very angry with his boss for messing up his schedule, but when he sees him, he says “Hey boss, I like your tie.”

- **Sublimation**: Expressing an unacceptable emotion in an acceptable situation, e.g., A student who is furious after failing his exam goes to practice some boxing.

- **Suppression**: Deliberately not thinking of unacceptable emotions, e.g., A doctor who has phobia from female genitalia puts his feelings aside to examine a female patient who came complaining of vaginal discharge.

- **Repression**: Completely forgetting an unacceptable emotion, e.g., A student who is extremely stressed about the USMLE experiences a period of unconcern and doesn’t even recall he’s scheduled to take the test.

- **Regression**: Adopting a child’s attitude to escape a certain unacceptable emotion, e.g., A 55 year old patient hospitalized for a heart attack wants his mom to stay with him in the room, then he wets the bed during sleep.

- **Intellectualization**: An unconscious avoidance of an unacceptable emotion by using logic or focusing on the minutiae of the situation, e.g., A surgeon explains to his co-workers in details about how he was diagnosed the other day with terminal lung cancer, yet he is talking normally about it without any emotion, trying to use his case for a routine medical discussion.

- **Isolation of affect**: Failure to express emotions, e.g., The same surgeon as above explains to his co-workers about how his dad died of the same cancer and the details of the days before his death and how much that experience broke his heart, yet not showing any affect that fits this dramatic story.

### Dissociation

- **Definition**: Group of disorders that occur as a defense mechanism against fear or severe underlying anxiety.

- **Dissociative amnesia**: Patient cannot recall painful events, e.g., A man who does not remember anything about a motor vehicle accident that killed his wife and kids.

- **Dissociative fugue**: Patient cannot recall change in identity and location, e.g., A woman once lived in the UK, then came to Michigan and has been working here for 5 years. She comes to see you in the clinic and she knows she is in Michigan, but has no recollection of having lived in the UK or moved from anywhere to anywhere.

- **Dissociative identity**: A patient who has more than one personality, but none of them is aware of the other, e.g., A conservative librarian received a note in the mail to attend a court trial for stripping in public and attempting prostitution. She shows up to court with the belief that there is a misunderstanding, but they show her pictures showing her naked in the street (which she has no recollection of).

- **Depersonalization**: Patient believes he lives outside of his own body and can watch himself.

- **Treatment**: For all above conditions is hypnosis and psychotherapy.

### Eating Disorders

#### Introduction

- **Common among females, adolescents, and persons under stress.**

- **At least 30% of the American population falls in the obese range, and 20% in the overweight one.**

### Anorexia Nervosa

- **Weight loss**: Loss of at least 15% of body weight.

- **Eating behavior**: Starvation.

- **Personality**: Perfection seeking person, with good scores in school and fear of getting fat.
• **Sexual**: Amenorrhea and absence of any interest in sex.
• **Metabolic**: Metabolic acidosis, hyperlipidemia and osteoporosis.
• **CBC**: Anemia and leucopenia.
• **Skin**: Lanugo (Downy hair).
• **GI**: Melanosis coli (Pigmentation of colonic wall), due to overuse of laxatives.

**Bulimia Nervosa**

• **Weight loss**: Normal body weight or even overweight.
• **Eating behavior**: Binges of eating followed by induced vomiting.
• **GI**: Esophageal varices, parotid gland swelling and eroded enamel of anterior teeth.
• **Signs of induced gagging**: Scars and marks on the dorsum of hands.

**Treatment**

• **Anorexia nervosa**: Amitryptiline, Cyproheptadine or SSRIs, plus behavioral and family psychotherapy.
• **Bulimia nervosa**: SSRIs, plus behavioral and family psychotherapy.

**Sex**

**Gender Identity and Role**

• **Gender identity**: When the person can identify his/her gender, i.e., Male vs female. Usually occurs around age 3.
• **Gender role**: How the person acts, i.e., Like a male vs female.

**Sex Cycle**

• **Excitement**: Characterized by erection in males, and tenting of uterus in females.
• **Plateau**: Enlarged inner part and contraction of outer part of the vagina.
• **Orgasm**: Characterized by ejaculation in males and uterine contraction in females. Contraction of anal sphincter also occurs during this stage.
• **Resolution**: Muscle relaxation.

**Sexual Disorders**

• **Sexual disorders**: Multiple; the most common are:
  1. Males: *Secondary impotence*, i.e., Secondary to stress or anxiety.
  2. Females: *Failure to orgasm.*
• **Medically related sexual disorders**: Multiple; the most common are:
  1. Coronary artery disease (CAD): Patients have decreased libido due to fear of suffering another heart attack. If the patient can climb 2 flights of stairs or accommodate a heart rate of 130 bpm without a problem, he can have sex.
  2. DM: Impotence and retrograde ejaculation.
• **Medication or drug-related sexual disorders**:
  1. Increased sexuality: Anti-depressants, anti-psychotics, marijuana, cocaine, amphetamine and small amounts of alcohol.
  2. Decreased sexuality: Excessive amounts or long duration of alcohol use.
• **Premature ejaculation**: Common sexual problem. Treatment: SSRI.
• **Hyposexual sexual desire**: Decreased sexual desire of one partner towards another.
• **Sexual arousal disorder**: Absence of sexual arousal during intercourse.
• **Sexual aversion**: Normal person who is just not so much into sex. Again, the patient is not homosexual or having any psychological problems.
• **Transvestic fetishism**: A man who gets pleasure from wearing women’s clothing or vice versa.
• **Frotteurism**: e.g., A man attempting to touch and rub into women in the elevator or the bus without their consent.
• **Voyeurism**: A person enjoying watching other people having sex.
• **Sadism**: A person enjoying giving physical pain to his partner during sex.
• **Masochism**: A person enjoying receiving physical pain during sex.
• **Vaginismus**: Painful contraction of the outer part of the vagina preventing sexual intercourse.

### Important Disorders

**Obsessive Compulsive Disorder (OCD)**

• **Definition**: Disorder in which patients have recurrent thoughts and repetitive behaviors that interfere with the patient’s life. They have strong insight (Know they have a problem) and ego dystonia (Patient views his behavior as inconsistent with the way he sees his own personality).
• **Mechanism**: Obsessions with a certain idea, followed by compulsions to do something.
• **The most common form**: Obsessions with contamination, e.g., Frequent hand washing.
- **Treatment**: SSRI are the drugs of choice. Clomipramine (TCA with serotonin activity) is another option.
- **Note**: Ego dystonia of OCD is absent during childhood.

### Panic Attacks
- **Mechanism**: Possibly genetic disease; more common in females.
- **Common medical association**: Mitral valve prolapse.
- **Clinical picture**: At least 2 attacks a week:
  1. Hyperventilation and tachycardia.
  2. Chest pain, diaphoresis, tremors and sense of impending death.
  3. Anxiety and fear of having attacks (*Anticipatory anxiety*), especially when present in an open place (*Agoraphobia*).

- **Treatment**:
  1. Acute attacks: Benzodiazepine, e.g., Alprazolam.
  2. Maintenance: SSRI.

### Phobia
- **Definition**: Irrational fear (*Fear without a cause*) of something or a situation.
- **Examples**:

- **Treatment**: Behavioral and cognitive therapy.

### Post-Traumatic Stress Disorder (PTSD)
- **Definition**: Stress disorder that follows a life threatening event, e.g., War, motor vehicle accident, rape, assault.
- **Clinical picture**: Anxiety, nightmares, flashbacks and social withdrawal.
- **Duration of symptoms**:
  1. Longer than 1 month: PTSD.
  2. Shorter than 1 month: Acute stress disorder.
- **Note**: If same symptoms develop after a non-life threatening event, e.g., A breakup, divorce, death of a pet, it is called Adjustment disorder not PTSD.

- **Treatment**: Behavioral and group therapy is the treatment of choice. SSRI are also used.

### Generalized Anxiety Disorder
- **Definition**: Excessive worry and anxiety about almost everything, which has been lasting for more than 6 months.
- **Clinical picture**: Anxiety, nervousness, irritability and muscle tension.
- **Treatment**: Drug of choice is Buspirone. Benzodiazepines (BDZ) can also be used.

### Medically-Induced Psychological Disorders
- **Cancer of tail of the pancreas**: Depression.
- **Cushing syndrome**: Depression.
- **Wilson’s disease**: Anger and aggression.
- **Temporal lobe epilepsy**: OCD and paranoia.
- **Ulcerative colitis and migraine headaches**: OCD.
- **Hyperparathyroidism**: Psychosis.
- **Asthma**: Dependency.
- **Chronic kidney disease and dialysis**: Depression and suicidal ideation.

### Behavioral and Cognitive Therapy (Refer to Table 7.3)

#### Extinction
- **Definition**: Gradual decrease of a negative behavior after positive reinforcement is removed.
- **Example**: A kid used to get attention from his family every time his brother took his toys, by claiming that his leg hurt. They rushed him to the doctor many times, and found everything was normal. For the last week, his family stopped paying that much attention, and eventually he stopped claiming that his leg hurts.

#### Reinforcement
- **Positive reinforcement**: Giving a reward to change behavior, e.g., “If you do something good, I will give you a cookie.”
- **Negative reinforcement**: Giving a punishment to change behavior, e.g., “If you do something bad, I will take away your cookie.”
- **Note**: Reinforcement is the most rapid and effective way to adjust a behavior.
### Psychopharmacology

#### Introduction

**Facts:** Know these two facts well: A patient’s mood is regulated by norepinephrine and serotonin, and mania is the reciprocal of depression.

**Medications:** TCA, SSRI, MAOI and mood stabilizers.

#### Tricyclic Antidepressants (TCA)

**Introduction:** TCAs take 3–4 weeks to achieve a therapeutic effect.

**Mechanism:** Block the reuptake of norepinephrine.

**Indications:**
1. Major depressive disorder.
2. Imipramine: TCA of choice to treat enuresis.
3. Clomipramine: TCA of choice to treat Obsessive compulsive disorder (OCD). Note that the drug of choice in general to treat OCD is SSRI.

**Side effects:**
1. Anti-cholinergic effects: Urinary retention, constipation, xerostomia.
2. Toxicity (Low therapeutic index): Hypotension, prolonged Q-T interval.

**Note:** Amoxapine and maprotiline are second generation TCAs.

#### Selective Serotonin Reuptake Inhibitors (SSRI)

**Mechanism:**
1. Inhibit presynaptic serotonin reuptake.

2. Inhibit cytochrome P450 system, hence increasing free levels of other drugs.

**Indications:** Major depressive disorder, OCD, anorexia and bulimia nervosa, premature ejaculation and panic attacks.

**Side effects:**
1. Delayed ejaculation, hence used to treat premature ejaculation.
2. Insomnia, tremors and weight loss.

**Examples:** Fluoxetine, Paroxetine, Sertraline.

#### Monoamine Oxidase Inhibitors (MAOI)

**Indications:** Atypical and resistant depression.

**Complications:**
1. Tyramine hypertensive crisis: If given with a tyramine containing substance (Red wine or cheese). Treatment: Phentolamine plus nifedipine.
2. Serotonin syndrome: If given with SSRI. Clinical picture: Muscle rigidity, hyperreflexia and clonus. Treatment: Serotonin antagonist e.g., Cyproheptadine.

**Examples:** Phenelzine, tranylcypromine.

#### Mood Stabilizers

**Mechanism:** Lithium acts via the phosphatidylinositol system.

**Indication:** Bipolar disorder.

**Lithium side effects:**
1. Teratogenicity: Ebstein anomaly.
2. Hypothyroidism.
4. Toxicity: Vomiting, diarrhea, tremors and nystagmus. Note: Therapeutic level of lithium: 0.6–1.2 meq/L.

Carbamazepine side effects: SIADH and Stevens-Johnson syndrome.
• Examples: Lithium, carbamazepine.

Ethics

Living Will
• Definition: Legal document describing what kind of medical measures should and should not be used.
• Rule of thumb: Simply do what the patient wants, even if it does not make perfect sense to you. If there is a DNR already signed by the patient, do not ask the family or anybody: just do what the will says.
• Example: If you see a patient in the USMLE whose will indicate a DNR (Do Not Resuscitate), but the only way to save him is Endotracheal (ET) intubation, do not intubate.
• Your responsibilities are:
  1. Make sure the patient understands the advantages and disadvantages of his decision, e.g., “If you do not get intubated, you are going to die.”
  2. Do everything else you can to save the patient without breaking the DNR limitations, e.g., If it indicates that he does not want intubation, but now he cannot breathe, try to use a mask or a Bi-level positive airway pressure machine (BiPAP).

Durable Power of Attorney
• Introduction: A patient can choose someone to be the decision maker on his behalf if he becomes incompetent. Again, this is a legal document done by a lawyer.
• Example: You see a patient in the USMLE who cannot breath and likely needs intubation, but does not have any living will or DNR, and can’t make decisions for himself. If a family member shows up and presents papers that he has durable power of attorney, and asks you not to intubate the patient and to just let him go, then you do what he says.
• Your responsibilities are:
  1. Make sure that the decision maker actually does have durable power of attorney documentation.

Surrogate Decision
• Introduction: The idea here is to ask the people who know the patient best what they think he would have wanted (Not what the family wants).
• Rule of thumb: What if you get a patient in the USMLE who cannot breath and needs intubation. He is comatosed, does not have a living will, DNR order or given power of attorney to anyone. Your responsibility is to ask his close family if the patient would have agreed to intubation if he was competent to make his own decision.
• To sum up:
  1. First one to ask for a decision: The patient.
  2. If patient is incompetent: Person with durable power of attorney.
  3. If no power of attorney: Surrogates.
  4. If no surrogates: Treat the patient fully with no limitations.

Euthanasia
• Passive: Simply to leave the patient to die and not interfere. The only thing you provide is comfort measures so that the patient would not suffer much. It is legal.
• Active: Speeding up the patient’s death, e.g., Using medications, etc... This is illegal and is considered a crime.

Children
• Rule of thumb: You must get consent before treating or even touching any patient. Any child below 18 yours of age is a minor who has to be consented for by his parents or legal guardians (See exceptions below).
• In emergency situations: Treat the child fully without limitations even if the parents decide otherwise, e.g., A man and his 12 years old son come to the ER after a motor vehicle accident. You find that the kid has intra-abdominal hemorrhage and has to be taken to surgery immediately. The father states that he does not want you to take the kid for surgery even though you explained that he might die if he doesn’t go. What you should do: Take the kid to surgery.
• **In non-emergency situations**: If the parents refuse to consent to treating their child, what you should do is to **get a court order to treat the child**.

• **Exceptions**: You **do not** need parental consent in the following situations:

1. Emergency situations: Explained above.
2. Absence of parents and legal guardian: If a child is brought to the ER by his school teacher because of abdominal pain, but you could not contact his parents and he does not have a legal guardian. Do you take consent from the teacher? Answer: **No**, only parents or legal guardian consent; if none is available, you treat the patient without consent.
3. Treatment of sexually transmitted diseases (STD).
5. Care during pregnancy.
6. Treatment of alcohol or drug dependence.
7. **Emancipated minors**: Any minor (<18) who has one or more of the following factors: Self supporting and living on his own, married, has children or in the military.

**Pregnant**

• **Introduction**: A pregnant woman has the right to decide for the fetus in her uterus.

• **Example**: A pregnant woman is brought to the ER after a motor vehicle accident, and she is having intra-abdominal hemorrhage, but she tells you that she does not want you to do anything. You explain to her that she will die if you do not act, and she does not change her mind. Then you explain that if you take her to surgery and deliver her baby, he might have a chance of living, and she still refuses. What you should do?: *Do what she says.*

**Criminal Law**

• **Mental insanity**: Defined as having a mental or severe psychological abnormality, plus one of the following statutory criteria:

  1. **M’Naghten**: Most reliable criterion. Evaluates if the patient understands his actions; what is right and what is wrong at the time of the crime.
  2. **American law institute model penal code**: Reliable. Evaluates whether the patient understands the wrongfulness of his actions at the time of the crime and lacks the capacity to control his actions.
  3. **Durham**: Not reliable. Evaluates if the crime was strictly induced by the mental or psychological abnormality, i.e., No accusation if mentally ill.

• **Mens rea elements**: Evaluates whether or not the crime was based on intent.

• **Irresistible impulse rule**: Defendant unable to refrain from the crime, e.g., Due to a fit of rage.

**Miscellaneous Ethics Issues**

• **Malpractice**: 4 Ds: Dereliction of duty causing direct damage to the patient. It is not a crime; however, it is a civil wrong punishable **financially** (*No jail)*.

• **Tarasoff decision**: When a patient threatens he has intentions to harm a certain person, you have to admit the patient involuntarily to the psychiatry ward and contact the authorities and social services, and most importantly the potential victim.

• **Sexual relationships**: Never have a sexual relationship with your patients. What if they give you a patient in the USMLE that sees you regularly, and they ask you what you are going to do if you really like her and want to have a relationship with her? Answer: **Terminate your medical services to her, and ask her to start seeing another doctor.**

• **STDs**: They must be reported to the state health department, which in turn reports them to the Center of Disease and Control (CDC).

• **Confidentiality**: Diagnosis of any patient should not be disclosed to anybody other than the patient himself.

• If the family of a patient asks you to hide a diagnosis from him/her, what should you do?

  1. Inform them that the patient has the right to know his diagnosis.
  2. Inform them that if the patient asks you directly about the diagnosis, you are obligated by the law to disclose the diagnosis.
  3. **Beneficence**: If you believe that the patient will be harmed by knowing his diagnosis at that time, you can withhold that information. However, if the patient asks you directly about his diagnosis, you **must tell him**.
  4. **Nonmaleficence (Do no harm)**: This should be your target at all times.

• **HIV**:

  1. If you have a patient diagnosed with HIV, you (or the Health Department) must inform his wife and/or sexual partners if he/she does not voluntarily do it.
  2. If you have a colleague physician who was diagnosed with HIV, it is okay for him to practice medicine; however, your responsibility is to make sure he/she is taking all the precautions necessary to protect his patients.
• Alcohol: If you smell alcohol on the breath of your colleague physician, talk to him. If he does not acknowledge your advice, report him to chief of staff and to state boards.

Health Insurance
• Private: Multiple companies and they cover most of the costs depending on the tier, e.g., Blue cross/Blue shield pays for hospitalization (Blue cross) and diagnostic tests and physician fees (Blue shield).
• Federal:
  1. Medicare: Covers the elderly (>65 years of age), and is decided by federal government.
  2. Medicaid: Covers the poor (Aid for the poor), and is decided by each state.
• Note: Patients with end-stage renal disease (ESRD) on dialysis are covered by medicare.

Miscellaneous
Freud’s Theories of the Mind
• Id: “I want.” Unconscious drives that begin at birth.
• Superego: “You cannot have it.” The moral compass or conscience that develops by 6 years of age.
• Ego: “Let’s find a way.” Balances the id and superego, and it develops at birth.
• Unconscious: Primary thinking, which involves primitive desires with no use of logic or planning.
• Conscious: Secondary thinking, which involves the use of logic and planning, e.g., Ego.

Kubler Ross Stages of Dying
1. Denial: e.g., A patient jumps off the bed right after an MI to do push ups.
2. Anger: e.g., “It isn’t fair, I didn’t deserve this.”
3. Bargaining and undoing: e.g., “If I make it through this, I’ll never smoke again.”
4. Depression: Discussed earlier.
5. Acceptance: Patient accepts reality and shows signs of readiness to face it.

Grief Reactions
• Refer to Table 7.4.

Important Disorders
• Kleptomania (Stealing crazy): e.g., A rich person walks into a restaurant and cannot resist stealing the silverware.

Table 7.4 Grief reactions.

<table>
<thead>
<tr>
<th></th>
<th>Normal grief reaction</th>
<th>Abnormal grief reaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sleep Interest</td>
<td>Mild disturbance</td>
<td>Major disturbance</td>
</tr>
<tr>
<td>Sleep Interest</td>
<td>Still enjoys usual habits</td>
<td>Loss of interest</td>
</tr>
<tr>
<td>Guilt</td>
<td>Mild guilt feelings</td>
<td>Major guilt feelings</td>
</tr>
<tr>
<td>Psychosis</td>
<td>Illusions</td>
<td>Hallucinations</td>
</tr>
<tr>
<td>Suicidal</td>
<td>Rare</td>
<td>Common</td>
</tr>
<tr>
<td>Treatment</td>
<td>Social support</td>
<td>SSRI</td>
</tr>
</tbody>
</table>

• Pyromania (Fire crazy): e.g., A person who loves to set things on fire without any purpose.
• Trichotillomania (Hair crazy): e.g., A person who cannot resist pulling on his hair.

Alcoholism and CAGE Questionnaire
• CAGE: Used to screen for alcoholism:
  1. C: Have you ever felt you needed to Cut down on drinking?
  2. A: Have you ever felt Annoyed by anyone criticizing your drinking?
  3. G: Have you ever felt Guilty about your drinking?
  4. E: Have you ever felt you needed an Eye-opener after a night of drinking?
• Treatment of alcoholism:
  1. Disulfiram (Antabuse).
  2. Psychotherapy, e.g., Alcohol Anonymous (AA).
  3. DTs: Refer to abuse above. Neuroleptics are absolutely contraindicated.

Doctor-Patient Relationship
• Transference: Feelings and reactions of the patient towards the doctor.
• Counter-transference: Feelings and reactions of the doctor towards the patient.

Important Theorists
• Abraham Maslow: Personality is equal to a group of motivations.
• Margaret Mahler: Discussed separation and individualization.
• Joh Boulby: Described ethological and psychoanalytical thinking.
• Rene Spitz: Isolated kids are at risk of infections and personality disorders.
• Harry Stack Sullivan: Described interpersonal relations.
Others

- **Koro**: Delusions of retraction of one’s penis into the body.
- **Dhat**: Pathological concern about ejaculation, found in Asian Indian cultures.
- **Nervios**: Attacks of tearfulness, abdominal pain and headache. A term most commonly used by Hispanics.
- **Dormido**: Pathological concern about heart attacks and strokes.
- **Ghost sickness**: Pathological concern about death and the deceased, found in the Navajo culture.
- **Brain fog**: Attacks of neck pain, confusion and headache. Common among students.
- **Nihilism**: The belief that something ceased to exist.
- **Animus**: Masculine part of a female personality.
- **Anima**: Feminine part of a male personality.
- **Universality**: Feeling that everybody else is just like you.
- **Cohesion**: Individuals teaming up to achieve a certain goal.
- **Consensual validation**: Understanding yourself through comparison to others.
- **Idealization**: Perception of yourself as being “Perfect.”
- **Asceticism**: Pleasure obtained by refraining from basic pleasures.
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