USMLE STEP 1

STUDY GUIDE

200 High-Yield Concepts

- Biochemistry: Pathways, Enzymes, Vitamins, Metabolic Disorders
- Cardiovascular: Heart Physiology, EKG, Murmurs, Hypertension
- Respiratory: Lung Volumes, Gas Exchange, COPD, Asthma, Pneumonia
- Gastrointestinal: Liver Function, GI Hormones, Malabsorption, Hepatitis
- Renal & Electrolytes: Acid-Base, Na/K/Ca, Diuretics
- Endocrine: Diabetes, Thyroid, Adrenal, Pituitary Pathology
- Microbiology & Immunology: Pathogen Classification, Antibiotics, Hypersensitivity
- Pharmacology: Drug Mechanisms, Autonomics, Toxicities, Antidotes

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How to Use This Guide

The USMLE Step 1 tests foundational science applied to clinical medicine. This guide covers 200 high-yield concepts across 8 organ systems. Use it for rapid review in the final weeks before your exam.

1. **Diagnose First**
   Take an NBME exam. Identify your 3 weakest areas and start there.
2. **System-by-System**
   One organ system per day. 25 concepts each -- a manageable dose.
3. **Active Recall**
   Cover Pathophysiology and explain from memory. Retrieval is where learning happens.
4. **Focus on Associations**
   Key Associations are the highest-yield. Drill disease-to-classic-presentation links.
5. **Board Relevance**
   Each concept tells you how NBME will test it. Look for question stem patterns.
6. **Final Week**
   Read only High-Yield Fact and Board Relevance for rapid pass through all 200 concepts.

SECTION 1: BIOCHEMISTRY & MOLECULAR BIOLOGY

1 PFK-1: Glycolysis Rate-Limiting Step

Pathophysiology: PFK-1 catalyzes fructose-6-P -> fructose-1,6-bisP. Activated by AMP and fructose-2,6-bisP. Inhibited by ATP and citrate. PFK-2 produces F-2,6-BP (activated by insulin).

Key Associations: PFK-1 deficiency = Tarui disease (GSD VII): exercise intolerance. Insulin -> PFK-2 -> F-2,6-BP -> PFK-1 active = glycolysis ON (fed state).

High-Yield Fact: *PFK-1 is the most regulated enzyme in glycolysis. AMP = activate (low energy), ATP = inhibit (high energy).*

Board Relevance: Step 1: 'Which enzyme is rate-limiting for glycolysis?' or exercise intolerance + hemolytic anemia.

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2 Pyruvate Dehydrogenase Complex

Pathophysiology: Converts pyruvate -> acetyl-CoA (irreversible, mitochondrial). Requires 5 cofactors: B1 (TPP), B2 (FAD), B3 (NAD), B5 (CoA), lipoic acid.

Key Associations: PDH deficiency = congenital lactic acidosis, neurologic deficits. Arsenic inhibits PDH (binds lipoic acid) -> lactic acidosis.

High-Yield Fact: *Pyruvate Dehydrogenase needs B vitamins. Arsenic inhibits lipoic acid. Think: 'B vitamins to DeHydrogenate pyruvate.'*

Board Relevance: Child with lactic acidosis + neurologic symptoms = PDH deficiency. Arsenic poisoning: garlic breath + lactic acidosis.

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3 Gluconeogenesis: 4 Key Enzymes

Pathophysiology: Bypasses irreversible glycolysis steps: Pyruvate carboxylase (mito), PEPCK (cytoplasm), F-1,6-BPase, G6Pase. Occurs mainly in liver.

Key Associations: G6Pase deficiency = Von Gierke (GSD I): severe fasting hypoglycemia, hepatomegaly, lactic acidosis. Muscle lacks G6Pase = cannot release free glucose.

High-Yield Fact: *Runs during FASTING (glucagon/cortisol). G6Pase ONLY in liver + kidney. Know which steps bypass glycolysis.*

Board Relevance: Fasting hypoglycemia + hepatomegaly + lactic acidosis = Von Gierke. Muscle cannot release free glucose to blood.

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4 Pentose Phosphate Pathway

Pathophysiology: Produces NADPH (glutathione reduction, biosynthesis) and ribose-5-P (nucleotides). G6PD = rate-limiting in oxidative phase.

Key Associations: G6PD deficiency: X-linked, hemolytic anemia with oxidant stress (fava beans, sulfa, primaquine). Heinz bodies, bite cells.

High-Yield Fact: *Most common human enzyme deficiency. Confers partial malaria protection. Measure G6PD 2-3 months after crisis.*

Board Relevance: Mediterranean/African-American male, hemolytic anemia after fava beans/sulfa. Heinz bodies + bite cells on smear.

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5 Glycogen Storage Diseases

Pathophysiology: GSD I (Von Gierke): G6Pase, fasting hypoglycemia. II (Pompe): lysosomal acid maltase, cardiomyopathy. V (McArdle): muscle glycogen phosphorylase, exercise intolerance.

Key Associations: I: hypoglycemia, hepatomegaly, lactic acidosis, hyperuricemia. II: cardiomegaly, hypotonia. V: cramps with exercise, second-wind phenomenon, no lactate rise.

High-Yield Fact: *Liver GSDs cause hypoglycemia. Muscle GSDs cause exercise intolerance. Pompe affects heart + muscle (lysosomal).*

Board Relevance: Von Gierke vs McArdle: liver cannot release glucose vs muscle cannot use glycogen. McArdle: no venous lactate after exercise.

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6 Lysosomal Storage Diseases

Pathophysiology: Tay-Sachs: hexosaminidase A, GM2, cherry-red macula, Ashkenazi. Gaucher: glucocerebrosidase, hepatosplenomegaly, Gaucher cells. Niemann-Pick: sphingomyelinase, foam cells.

Key Associations: Hurler: alpha-L-iduronidase, corneal clouding, severe MR. Hunter: iduronate sulfatase, NO corneal clouding, X-linked, milder.

High-Yield Fact: *Tay-Sachs = no organomegaly. Gaucher = bone crises. Hurler = cloudy eyes. Hunter = clear eyes (X-linked).*

Board Relevance: Child with cherry-red macula + neurodegeneration = Tay-Sachs. Gaucher cells on bone marrow = Gaucher. Corneal clouding = Hurler.

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7 Collagen Synthesis

Pathophysiology: Preprocollagen (ER) -> hydroxylation of Pro/Lys (vitamin C) -> glycosylation -> procollagen -> cleavage -> tropocollagen -> cross-linking (lysyl oxidase, copper).

Key Associations: Scurvy: vitamin C deficiency = impaired hydroxylation = weak collagen. OI: COL1A1/COL1A2 = brittle bones, blue sclera. EDS: various collagen defects = hypermobile joints.

High-Yield Fact: *C for Collagen, C for vitamin C. Copper needed for cross-linking. Menkes (copper deficiency) = scurvy-like + neurologic.*

Board Relevance: Scurvy: bleeding gums, perifollicular hemorrhages. Child with blue sclera + fractures = OI. Hypermobile joints + stretchy skin = EDS.

8 Homocystinuria

Pathophysiology: CBS deficiency: elevated homocysteine AND methionine. MTHFR deficiency. B12 deficiency (methionine synthase). CBS: autosomal recessive.

Key Associations: CBS: tall stature, intellectual disability, lens dislocation DOWNward/inward, thrombophilia. Marfan: lens UPward, aortic root dilation.

High-Yield Fact: *'METHionine elevated in hoMocystinuria.' Lens: homocystinuria = down/in, Marfan = up/out. Homocysteine is thrombophilic.*

Board Relevance: Tall patient with lens dislocation + thrombosis = homocystinuria (check homocysteine + methionine). Marfan = aortic root + upward lens.

9 Urea Cycle Disorders

Pathophysiology: Ammonia -> urea (liver). Enzymes: CPS I, OTC (X-linked, most common), ASS, ASL, arginase. Hyperammonemia = encephalopathy.

Key Associations: OTC deficiency: orotic aciduria (carbamoyl phosphate -> pyrimidine pathway). CPS I: NO orotic acid. Protein precipitates symptoms.

High-Yield Fact: *OTC = Ornithine TransCarbamoylase = Orotic acid in urine. Ammonia detox in liver only.*

Board Relevance: Infant with vomiting/lethargy after protein feeding. Hyperammonemia. Check urine orotic acid: elevated = OTC, normal = CPS I.

10 Vitamin B12 & Folate

Pathophysiology: B12: cofactor for methionine synthase and methylmalonyl-CoA mutase. Folate: 1-carbon transfers for DNA synthesis.

Key Associations: B12 deficiency: megaloblastic anemia + subacute combined degeneration (dorsal columns + corticospinal tracts). Elevated MMA. Folate: anemia only, normal MMA.

High-Yield Fact: *Methylmalonic acid is THE differentiator: elevated in B12 only. Both cause macrocytic anemia (MCV > 100).*

Board Relevance: Sensory ataxia + loss of vibration + spasticity + megaloblastic anemia = B12 deficiency. Check MMA to differentiate from folate.

11 Lesch-Nyhan Syndrome

Pathophysiology: HGPRT deficiency (X-linked) -> cannot salvage purines -> increased de novo synthesis -> uric acid overproduction.

Key Associations: Self-mutilating behavior, intellectual disability, gout, orange sand in diapers (uric acid). Allopurinol reduces uric acid.

High-Yield Fact: *HGPRT = He's Got Purine Recycling Trouble. X-linked, males. PRPP accumulates, driving de novo synthesis despite high uric acid.*

Board Relevance: Male child with self-mutilation + intellectual disability + hyperuricemia = Lesch-Nyhan. Allopurinol helps gout, not neurologic symptoms.

12 Maple Syrup Urine Disease

Pathophysiology: Deficiency of branched-chain alpha-ketoacid dehydrogenase -> cannot metabolize leucine, isoleucine, valine. Maple syrup odor of urine/cerumen.

Key Associations: Presents in infancy after protein feeding. Leucine is most neurotoxic. Dietary restriction + thiamine supplementation.

High-Yield Fact: *I Love Vermont: Isoleucine, Leucine, Valine. Autosomal recessive. Diagnose by elevated BCAA in blood.*

Board Relevance: Infant with feeding intolerance, lethargy, sweet-smelling urine. Elevated BCAA. Newborn screening.

13 Phenylketonuria (PKU)

Pathophysiology: Deficiency of phenylalanine hydroxylase (AR) or BH4 cofactor. Cannot convert Phe -> Tyr. Phe accumulation = neurotoxic.

Key Associations: Intellectual disability, musty odor, hypopigmentation. Tyrosine becomes essential. Maternal PKU: teratogenic. Avoid aspartame.

High-Yield Fact: *Musty/mousy odor. Fair skin (decreased melanin). Guthrie newborn screen. Dietary Phe restriction.*

Board Relevance: Child with intellectual disability + fair skin + musty odor = PKU. Maternal PKU off diet: baby with microcephaly + cardiac defects.

14 Alkaptonuria

Pathophysiology: Deficiency of homogentisate 1,2-dioxygenase. Homogentisic acid accumulates -> oxidized to dark pigment (ochronosis). Urine turns black on standing.

Key Associations: Ochronosis: dark sclera and ear cartilage. Degenerative arthritis of large joints. AR.

High-Yield Fact: *'Alkaptonuria = Al (all) dark.' Black urine on standing = pathognomonic. Homogentisic acid deposition in cartilage.*

Board Relevance: Adult with dark urine turning black on standing + dark ear cartilage/sclera + premature arthritis = alkaptonuria.

15 Cystinuria

Pathophysiology: Defective renal transport of cystine, ornithine, arginine, lysine (COAL). Cystine is poorly soluble -> hexagonal cystine stones.

Key Associations: Most common genetic cause of nephrolithiasis. Cystine stones = radiopaque. Positive cyanide-nitroprusside test. Treat: hydration + alkalinization + penicillamine.

High-Yield Fact: *COAL amino acids. Only cystine forms stones (others soluble). Hexagonal crystals on urinalysis.*

Board Relevance: Young adult with recurrent kidney stones, hexagonal crystals on UA = cystinuria. Radiopaque stones.

16 Fatty Acid Oxidation Disorders

Pathophysiology: MCAD deficiency (most common): cannot break down medium-chain FA -> fasting hypoketotic hypoglycemia.

Key Associations: Vomiting, lethargy after fasting. No ketones (can't oxidize FA). Elevated medium-chain acylcarnitines. Avoid fasting.

High-Yield Fact: *Hypoketotic hypoglycemia = key finding. Normally ketones produced from FA during fasting. MCAD = no FA oxidation = no ketones.*

Board Relevance: Infant with vomiting + lethargy + hypoglycemia after prolonged fasting. Urine ketones negative = MCAD deficiency.

17 Gout & Purine Metabolism

Pathophysiology: Hyperuricemia -> monosodium urate crystal deposition. Podagra = 1st MTP. Underexcretion (90%) > overproduction.

Key Associations: Negatively birefringent needle-shaped crystals. Acute: NSAIDs, colchicine, steroids. Chronic: allopurinol (xanthine oxidase inhibitor).

High-Yield Fact: *Negative birefringence = yellow when parallel. Pseudogout = positive (blue parallel, CPPD). No allopurinol during acute attack.*

Board Relevance: Middle-aged man with acute severe 1st MTP pain after heavy meal/alcohol. Needle-shaped negatively birefringent crystals.

18 Acute Intermittent Porphyria

Pathophysiology: PBG deaminase deficiency (AD) in heme synthesis. ALA + PBG accumulate. Precipitated by CYP450 inducers: barbiturates, alcohol, fasting, hormones.

Key Associations: Severe abdominal pain (out of proportion), neuropsychiatric, autonomic instability, peripheral neuropathy. NO skin photosensitivity. Urine turns port-wine on standing.

High-Yield Fact: *4 P's: Painful abdomen, Psychosis, Polyneuropathy, Port-wine urine. Treat: glucose (mild) or hemin (severe).*

Board Relevance: Young woman with severe abdominal pain + AMS + tachycardia + HTN + dark urine = AIP. Normal CT. Avoid precipitating drugs.

19 Ehlers-Danlos & Marfan

Pathophysiology: EDS: collagen defects (classical = type V, vascular = type III). Marfan: FBN1 mutation = defective fibrillin-1. Both affect connective tissue.

Key Associations: Classical EDS: hyperextensible skin + joint hypermobility. Vascular EDS: arterial/uterine rupture. Marfan: tall, arachnodactyly, lens UPward, aortic root dilation.

High-Yield Fact: *COL3A1 = type III = 'triple threat' (arteries, uterus, intestine). Marfan lens up/out vs homocystinuria down/in.*

Board Relevance: Hypermobile joints + stretchy skin = EDS. Tall + pectus + arachnodactyly + aortic root dilation = Marfan.

20 Vitamin C & Ethanol Metabolism

Pathophysiology: Vitamin C: cofactor for prolyl/lysyl hydroxylase (collagen), dopamine beta-hydroxylase, iron absorption. EtOH: alcohol dehydrogenase + ALDH produce NADH -> high NADH/NAD+.

Key Associations: Scurvy: bleeding gums, poor wound healing, perifollicular hemorrhages. EtOH: high NADH -> lactic acidosis, hypoglycemia, fatty liver.

High-Yield Fact: *C for Collagen (hydroxylation). EtOH metabolism consumes NAD+ -> NADH excess explains all metabolic effects.*

Board Relevance: Scurvy: no fruits/vegetables diet + bleeding gums. Alcoholic: fasting hypoglycemia + lactic acidosis + fatty liver.

21 Osteogenesis Imperfecta

Pathophysiology: COL1A1/COL1A2 mutations -> defective type I collagen. AD. Type I (mild): blue sclera, fractures, hearing loss. Type II: lethal perinatal.

Key Associations: Blue sclera = thin sclera showing choroidal veins. Multiple fractures with minimal trauma. Dentinogenesis imperfecta.

High-Yield Fact: *Type I collagen = 'bONE.' Affects bones, eyes (blue), ears (hearing loss), teeth. Differentiate from child abuse: blue sclera + family history.*

Board Relevance: Child with multiple fractures from minor trauma + blue sclera = OI, not child abuse. Family history positive.

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22 Glycolysis: Other Key Enzymes

Pathophysiology: Hexokinase: all tissues, low Km, inhibited by G6P. Glucokinase: liver/pancreas, high Km, induced by insulin. Pyruvate kinase: irreversible step, activated by F-1,6-BP.

Key Associations: Glucokinase = glucose sensor (responds to high glucose). MODY2 = glucokinase mutation = mild fasting hyperglycemia. Pyruvate kinase deficiency = hemolytic anemia.

High-Yield Fact: *Glucokinase works only when glucose is high (fed state). Hexokinase always working. Pyruvate kinase deficiency = chronic hemolysis.*

Board Relevance: Which glycolytic enzyme is induced by insulin? Glucokinase. Pyruvate kinase deficiency = chronic hemolytic anemia.

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23 Amino Acid Derivatives

Pathophysiology: Phenylalanine -> Tyrosine -> DOPA -> Dopamine -> Norepinephrine -> Epinephrine. Tyr also -> Melanin (tyrosinase). Tryptophan -> Serotonin + Melatonin + Niacin.

Key Associations: PKU: Phe hydroxylase block. Albinism: tyrosinase. Dopamine beta-hydroxylase deficiency: no NE. Hartnup: tryptophan transport defect = pellagra-like.

High-Yield Fact: *Each enzyme block = specific disease. Tyrosine becomes essential in PKU. Tryptophan -> niacin (Hartnup = tryptophan loss = pellagra).*

Board Relevance: Which amino acid becomes essential in PKU? Tyrosine. Hartnup: pellagra symptoms (dermatitis, diarrhea, dementia).

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24 Heme Synthesis Summary

Pathophysiology: Starts: Succinyl-CoA + Glycine -> ALA (ALA synthase, rate-limiting, mitochondria, B6 cofactor). Ends: Fe2+ + protoporphyrin -> heme (ferrochelatase).

Key Associations: ALA synthase inhibited by hemin (negative feedback). Lead poisoning: inhibits ALA dehydratase AND ferrochelatase -> anemia + neuro symptoms.

High-Yield Fact: *Heme synthesis occurs partly in mitochondria and partly in cytoplasm. Lead poisoning = 2 enzyme blocks = increased ALA and protoporphyrin.*

Board Relevance: Lead poisoning: microcytic anemia + basophilic stippling + neuropathy + abdominal pain. Inhibits ALA dehydratase and ferrochelatase.

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25 Purine & Pyrimidine Synthesis

Pathophysiology: Purines (AG): built on PRPP scaffold. Pyrimidines (CTU): orotate + PRPP -> UMP. Rate-limiting: glutamine-PRPP amidotransferase (purines), CPS II (pyrimidines).

Key Associations: Orotic aciduria: deficiency in UMP synthase -> orotic acid accumulation, megaloblastic anemia. Treat with uridine. Allopurinol blocks xanthine oxidase.

High-Yield Fact: *Purine salvage: HGPRT recycles hypoxanthine/guanine. ADA deficiency -> SCID (dATP accumulation toxic to lymphocytes).*

Board Relevance: Orotic aciduria: megaloblastic anemia + orotic acid in urine. Normal ammonia (differentiates from OTC deficiency).

SECTION 2: CARDIOVASCULAR

26 Cardiac Output Formula

Pathophysiology: CO = HR x SV. SV = EDV - ESV. EF = SV/EDV (normal >55%). Frank-Starling: increased venous return -> increased SV.

Key Associations: Preload = EDV. Afterload = pressure heart pumps against. Contractility = inotropic state. Exercise moves along Frank-Starling curve.

High-Yield Fact: *CO = HR x SV. EF affected by contractility changes, not preload. Frank-Starling curve shifts up = increased contractility.*

Board Relevance: Graph: SV vs EDV. Curve shifts down = HF. Curve shifts up = digoxin/sympathetic stimulation.

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27 Aortic Stenosis

Pathophysiology: Crescendo-decrescendo systolic ejection murmur, RUSB, radiates to carotids. S4 gallop. Triad: syncope, angina, dyspnea.

Key Associations: Complications: LVH, heart failure, sudden cardiac death. Echo: valve area <1.0 cm2 = severe. Surgery if symptomatic.

High-Yield Fact: *AS murmur = systolic ejection with S4. Increases with squatting, decreases with Valsalva (opposite of HCM).*

Board Relevance: Older man with syncope + angina + dyspnea + RUSB murmur radiating to carotids = AS. Echo confirms severity.

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28 Mitral Regurgitation & MVP

Pathophysiology: MR: holosystolic blowing murmur at apex, radiates to axilla, S3 if severe. MVP: mid-systolic click + late systolic murmur.

Key Associations: MR: LA enlargement -> AFib. MVP: young women, Marfan/EDS association. MR murmur = holosystolic (pansystolic).

High-Yield Fact: *MR = 'MR ASS' (Mitral Regurgitation = Apex, Systolic, radiates to axilla/Sternum). MVP = click + murmur.*

Board Relevance: Young woman with mid-systolic click + late systolic murmur = MVP. Severe MR = holosystolic murmur at apex with S3.

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29 Aortic Regurgitation

Pathophysiology: Early diastolic decrescendo murmur at LSB. Wide pulse pressure, bounding pulses (water-hammer, Corrigan). Causes: aortic root dilation (Marfan, syphilis), bicuspid AV.

Key Associations: Chronic AR: LV dilation (volume overload). Acute AR: sudden LV volume overload = flash pulmonary edema. Echo: regurgitant jet.

High-Yield Fact: *AR = 'blowing' diastolic murmur. Bounding pulses from runoff of blood back into LV during diastole.*

Board Relevance: Wide pulse pressure + bounding pulses + early diastolic murmur = AR. Chronic = LVH; acute = pulmonary edema.

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30 Mitral Stenosis

Pathophysiology: Mid-diastolic rumbling murmur at apex with opening snap. Loud S1. Rheumatic heart disease = most common cause.

Key Associations: LA enlargement -> AFib + thrombus (stroke risk). Pregnancy exacerbates. Echo: hockey stick deformity, valve area <1.5 cm2.

High-Yield Fact: *MS = rumbling diastolic murmur, opening snap, LA dilation. 'MS = Mid-diastolic, Stenosis.'*

Board Relevance: History of rheumatic fever + mid-diastolic rumble at apex + opening snap + LA enlargement = MS.

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31 Atrial Fibrillation

Pathophysiology: Chaotic atrial activity -> irregularly irregular rhythm. No P waves, fibrillatory waves. Loss of atrial kick -> decreased CO 10-20%.

Key Associations: CHA2DS2-VASc: CHF, HTN, Age >75 (2 pts), DM, Stroke/TIA (2), Vascular, Age 65-74, Sex (female). Score >= 2 = anticoagulate.

High-Yield Fact: *Irregularly irregular = AFib. Most common sustained arrhythmia. Atrial flutter = sawtooth pattern (regular).*

Board Relevance: EKG: irregularly irregular + no P waves = AFib. Rate control (BB/CCB) vs rhythm control. Anticoagulation per CHA2DS2-VASc.

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32 Heart Failure: HFrEF vs HFpEF

Pathophysiology: HFrEF: EF <40%, dilated LV, S3 gallop. HFpEF: EF >50%, thick/stiff LV, S4 gallop. Both: dyspnea, orthopnea, PND, edema.

Key Associations: HFrEF: ischemic (#1), non-ischemic. Treat: ACEi/ARB + BB + spironolactone + SGLT2i. HFpEF: treat underlying (HTN control).

High-Yield Fact: *S3 = volume overload (HFrEF). S4 = stiff ventricle (HFpEF, HCM). BNP elevated in both. Echo distinguishes.*

Board Relevance: Dyspnea + orthopnea + PND + S3 + EF 30% = HFrEF. Same symptoms + S4 + EF 60% + LVH = HFpEF.

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33 EKG Interpretation Basics

Pathophysiology: P: atrial depolarization. PR: AV node (120-200ms). QRS: ventricular (<120ms). QT: depolarization + repolarization. ST: plateau phase.

Key Associations: 25 mm/s. 1 small = 0.04s. 1 large = 0.2s. ST elevation = transmural ischemia/infarction. ST depression = subendocardial ischemia.

High-Yield Fact: *PR >200ms = 1st-degree AVB. QRS >120ms = BBB. QTc >440ms M, >460ms F = prolonged QT (torsades risk).*

Board Relevance: ST elevation II/III/aVF = inferior MI (RCA). ST elevation V1-V4 = anterior MI (LAD). Most common image on Step 1.

34 Hypertension

Pathophysiology: Primary: 90%. Secondary: FMD (young women, string-of-beads), hyperaldosteronism, pheo, coarctation, RAS.

Key Associations: Complications: LVH, stroke, CAD, renal failure, retinopathy. Target <130/80. First-line: ACEi/ARB, CCB, thiazide.

High-Yield Fact: *FMD = young woman + severe HTN + renal bruit. Coarctation = upper HTN + lower hypotension + rib notching.*

Board Relevance: Young woman with severe HTN + renal bruit + string-of-beads on angio = FMD. Child with arm HTN + weak leg pulses = coarctation.

35 Atherosclerosis Pathogenesis

Pathophysiology: Endothelial injury -> LDL oxidation -> macrophage uptake (foam cells) -> fatty streak -> smooth muscle migration -> fibrous plaque -> rupture.

Key Associations: Risk: HTN, hyperlipidemia, smoking, DM. LDL = main modifiable risk. HDL protective. Foam cells = macrophages + oxLDL.

High-Yield Fact: *Begins with endothelial dysfunction. Plaque stability = fibrous cap thickness. Rupture + thrombosis = ACS.*

Board Relevance: Path slide: cholesterol clefts + foam cells + fibrous cap in arterial wall = atherosclerosis. Most common US death cause.

36 Acute Coronary Syndrome

Pathophysiology: STEMI: complete occlusion, transmural infarction, ST elevation or new LBBB. NSTEMI: partial/subtotal, ST depression/TWI, elevated troponin. UA: normal troponin.

Key Associations: Treat STEMI: immediate PCI (door-to-balloon <90 min) or thrombolysis. Troponin rises 3-6h, peaks 12-24h, stays up 7-10 days.

High-Yield Fact: *MI timeline: 4-12h necrosis, 1-3d neutrophils, 3-7d macrophages, 1-3wk granulation, >6wk scar. Most common death cause = VF.*

Board Relevance: Substernal CP + ST elevation II/III/aVF + elevated troponin = inferior STEMI (RCA). Anterior = LAD.

37 Shock Classification

Pathophysiology: Hypovolemic: low PCWP, low CO, high SVR. Cardiogenic: high PCWP, low CO, high SVR. Septic: low/normal PCWP, high CO, low SVR (warm). Obstructive: depends on cause.

Key Associations: PCWP = LV preload. CO = cardiac output. SVR = systemic vascular resistance. Septic: vasodilation + warm extremities.

High-Yield Fact: *Septic shock: warm skin (low SVR). Cardiogenic: cool/clammy (high SVR). Swan-Ganz differentiates between types.*

Board Relevance: Post-MI hypotension + elevated JVP + crackles = cardiogenic. Fever + hypotension + warm extremities + infection = septic.

38 Aortic Dissection

Pathophysiology: Tear in aortic intima -> blood enters media -> false lumen. Stanford A: ascending (surgery). Stanford B: descending (medical).

Key Associations: Severe tearing chest pain radiating to back. HTN (#1 risk). Type A: AR, tamponade, MI. CXR: widened mediastinum. CT angio diagnosis.

High-Yield Fact: *Stanford A = Ascending = Acute surgery. Stanford B = Below = BP control (beta-blocker first). Do NOT give anticoagulants.*

Board Relevance: Hypertensive man with tearing CP radiating to back + BP differential >20mmHg + widened mediastinum = dissection.

39 Congenital Heart Diseases

Pathophysiology: Acyanotic: VSD (#1), ASD, PDA, coarctation. Cyanotic (5 Ts): ToF, TGA, Truncus, Tricuspid atresia, TAPVR. Right-to-left shunt = cyanosis.

Key Associations: ToF: PROVe (PS, RVH, Overriding aorta, VSD). Boot-shaped heart, tet spells, squatting. TGA: cyanosis at birth, egg-on-a-string, needs PDA.

High-Yield Fact: *ASD: wide fixed split S2. VSD: holosystolic. PDA: continuous machine-like murmur. ToF: cyanotic spells, knee-to-chest position.*

Board Relevance: Child cyanosis improving with squatting + boot-shaped heart = ToF. Newborn severe cyanosis + egg-on-a-string heart = TGA.

40 Pericarditis

Pathophysiology: Inflammation of pericardium. Viral (#1), post-MI (Dressler), uremia, SLE. Pleuritic CP relieved by sitting forward, friction rub.

Key Associations: EKG: diffuse ST elevation (concave up) + PR depression. Unlike STEMI (convex, regional). Tamponade: Beck triad (hypotension, muffled HS, JVD).

High-Yield Fact: *Pericarditis = diffuse ST changes. STEMI = regional. Pericardial rub = pathognomonic. NSAIDs + colchicine. Avoid steroids.*

Board Relevance: Young adult with pleuritic CP relieved by leaning forward + diffuse ST elevation + friction rub = pericarditis.

41 Infective Endocarditis

Pathophysiology: Acute: S. aureus (rapid, destructive, normal valves, IVDU). Subacute: S. viridans (slow, abnormal valves, dental).

Key Associations: Fever + new murmur. Osler nodes (tender, finger pads), Janeway lesions (nontender, palms/soles), splinter hemorrhages. Duke criteria.

High-Yield Fact: *IVDU + tricuspid + S. aureus = right-sided endocarditis. Dental + mitral + S. viridans = subacute. HACEK = culture-negative.*

Board Relevance: IVDU with fever + tricuspid regurgitation + septic pulmonary emboli = S. aureus endocarditis. Echo: vegetation.

42 Rheumatic Heart Disease

Pathophysiology: Autoimmune reaction to GAS pharyngitis. Molecular mimicry -> mitral valve. Acute: Jones criteria. Chronic: mitral stenosis.

Key Associations: Jones major: Joints (migratory polyarthritis), carditis, Nodules (subQ), Erythema marginatum, Sydenham chorea. ASO titer elevated.

High-Yield Fact: *Path: Aschoff bodies with Anitschkow cells (caterpillar cells). Acute = MR (pancarditis). Chronic = MS (fibrosis).*

Board Relevance: Child with migratory polyarthritis + carditis + erythema marginatum + elevated ASO = acute RF. Years later: MS.

43 Cardiomyopathies

Pathophysiology: Dilated: enlarged, weak (alcohol, viral, genetic). Hypertrophic: asymmetric septal hypertrophy, beta-myosin heavy chain, young athlete sudden death. Restrictive: stiff (amyloid, sarcoid).

Key Associations: DCM: S3, systolic dysfunction. HCM: S4, murmur increases with Valsalva (decreased preload), SAM. Restrictive: diastolic dysfunction, low voltage.

High-Yield Fact: *HCM = #1 cause sudden cardiac death in young athletes. Murmur increases with Valsalva. Myocardial disarray on pathology.*

Board Relevance: Young athlete dies suddenly during exertion. Autopsy: asymmetric septal hypertrophy + myocyte disarray = HCM.

44 Peripheral Arterial Disease

Pathophysiology: Atherosclerosis of peripheral arteries. Claudication: calf/thigh/buttock pain with walking, relieved by rest.

Key Associations: Diminished pulses, cool extremities, hair loss, shiny skin, thickened nails. ABI <0.9 diagnostic. Leriche: aortoiliac -> buttock claudication + impotence.

High-Yield Fact: *Claudication = cramping with exertion, relieved by rest. Neurogenic claudication = relieved by leaning forward.*

Board Relevance: Elderly smoker with calf pain on walking relieved by rest + diminished pedal pulses + ABI <0.9 = PAD.

45 DVT & PE

Pathophysiology: Virchow triad: stasis, endothelial injury, hypercoagulability. DVT: unilateral leg swelling/pain. PE: sudden dyspnea, pleuritic CP, tachycardia.

Key Associations: DVT: D-dimer + venous ultrasound. PE: CTPA gold standard, S1Q3T3, McConnell sign. Treat: heparin/LMWH -> warfarin/DOAC.

High-Yield Fact: *PE = most common preventable hospital death. Massive PE = hypotension = thrombolysis. Factor V Leiden = most common inherited thrombophilia.*

Board Relevance: Post-op patient with unilateral leg swelling = DVT. Sudden dyspnea + tachycardia + clear lungs + S1Q3T3 = PE.

46 Cardiac Tamponade

Pathophysiology: Fluid in pericardial space -> compression -> impaired diastolic filling. Beck triad: hypotension, muffled HS, JVD.

Key Associations: Pulsus paradoxus: SBP drop >10mmHg during inspiration. EKG: low voltage, electrical alternans. Echo: diastolic collapse RA/RV.

High-Yield Fact: *Equalization of diastolic pressures in all 4 chambers. Immediate pericardiocentesis = life-saving.*

Board Relevance: Post-cardiac surgery: hypotension + muffled HS + JVD = tamponade. Pulsus paradoxus + electrical alternans.

47 Lipid-Lowering Therapy

Pathophysiology: Statins: HMG-CoA reductase inhibitors, most effective LDL lowering, first-line. Statin SE: hepatotoxic, myopathy (CK), CYP3A4 interactions.

Key Associations: Ezetimibe: intestinal cholesterol absorption, additive with statins. PCSK9i: alirocumab/evolocumab, dramatically lower LDL, injectable.

High-Yield Fact: *HMG-CoA reductase = rate-limiting cholesterol synthesis step. Statin + ezetimibe > doubling statin dose.*

Board Relevance: CAD patient on atorvastatin 80, LDL >70 = add ezetimibe or PCSK9i. TG >500 = pancreatitis risk, treat with fibrates.

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48 Antiarrhythmics

Pathophysiology: Class I (Na): Ia (quinidine, procainamide), Ib (lidocaine), Ic (flecainide). II (BB). III (K): amiodarone, sotalol. IV (CCB): verapamil, diltiazem.

Key Associations: Procainamide: lupus. Class Ic: CAST trial = +mortality post-MI. Amiodarone: pulmonary fibrosis, thyroid, liver, corneal, skin.

High-Yield Fact: *Amiodarone = class III + I, II, IV effects. Most effective antiarrhythmic but most toxic. Check PFTs, LFTs, TFTs.*

Board Relevance: Patient on amiodarone develops cough/dyspnea = pulmonary fibrosis. Thyroid dysfunction common. Class Ic contraindicated in structural heart disease.

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49 HTN Medications

Pathophysiology: ACEi (-prils): cough (bradykinin), angioedema, hyperkalemia, RAS contraindication. ARB (-sartans): no cough. DHP CCB: peripheral edema. Non-DHP: bradycardia.

Key Associations: Thiazide: hypokalemia, hyperuricemia, hyperglycemia, hypercalcemia. Spironolactone: K-sparing, gynecomastia.

High-Yield Fact: *ACEi block AngII production (decrease GFR in RAS by preventing efferent constriction). ARBs block AT1 receptor. Both increase renin.*

Board Relevance: Lisinopril -> dry cough = switch to ARB. Bilateral RAS + ACEi = acute renal failure. Avoid ACEi/ARB in pregnancy.

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50 Cardiac Biomarkers

Pathophysiology: Troponin I/T: most specific for myocardial necrosis. Rises 3-6h, peaks 12-24h, remains 7-10 days. CK-MB: rises 4-6h, peaks 18-24h, normalizes 48-72h.

Key Associations: BNP/NT-proBNP: released from ventricular myocytes with stretch. Elevated in HF. Differentiates cardiac vs pulmonary dyspnea.

High-Yield Fact: *Troponin = gold standard MI diagnosis. CK-MB for reinfarction timing (normalizes faster). BNP >100 = cardiac cause of dyspnea.*

Board Relevance: Chest pain + elevated troponin = MI. Dyspnea + elevated BNP = HF exacerbation.

SECTION 3: RESPIRATORY

51 Lung Volumes & Spirometry

Pathophysiology: TV, IRV, ERV, RV (cannot be exhaled). VC = TV+IRV+ERV. TLC = VC+RV. FRC = ERV+RV. Spirometry measures all EXCEPT RV/TLC.

Key Associations: Obstructive: FEV1/FVC <0.7, increased TLC/RV (air trapping). Restrictive: decreased TLC, normal/high FEV1/FVC.

High-Yield Fact: *FRC = balance point between chest wall recoil outward and lung recoil inward. Not measurable by spirometry.*

Board Relevance: FEV1/FVC <0.7 + increased TLC = COPD. Normal FEV1/FVC + decreased TLC = restrictive (ILD).

52 Asthma

Pathophysiology: Chronic inflammation with reversible bronchoconstriction. Th2-mediated, eosinophils. Curschmann spirals, Charcot-Leyden crystals.

Key Associations: PFTs: obstructive with >12% + >200mL FEV1 reversibility. Triggers: allergens, exercise, cold air, URI. SABA rescue, ICS control.

High-Yield Fact: *Asthma = reversible obstruction. AERD = asthma + aspirin sensitivity + nasal polyps.*

Board Relevance: Child with episodic wheezing triggered by allergens/exercise, PFTs improve with bronchodilator = asthma.

53 COPD

Pathophysiology: Emphysema (alveolar destruction) + chronic bronchitis (productive cough >3mo/yr for >2yr). Smoking #1 cause. A1AT deficiency: panacinar, lower lobes.

Key Associations: Centriacinar = smoking, upper lobes. Panacinar = A1AT, lower lobes. Pink puffer: thin, pursed-lip. Blue bloater: obese, cyanotic.

High-Yield Fact: *Irreversible obstruction: FEV1/FVC <0.7 post-bronchodilator. Smoking cessation, LAMA/LABA, ICS for exacerbations.*

Board Relevance: Elderly smoker with dyspnea + barrel chest + decreased BS + hyperinflation = emphysema. Non-smoker with panacinar + liver disease = A1AT.

54 Pneumonia

Pathophysiology: CAP: S. pneumoniae (#1), H. flu, atypicals (Mycoplasma, Legionella). HAP: Pseudomonas, MRSA. Aspiration: anaerobes.

Key Associations: Lobar: entire lobe (S. pneumoniae). Bronchopneumonia: patchy (S. aureus). Interstitial: diffuse (virus, Mycoplasma). CXR: consolidation, air bronchograms.

High-Yield Fact: *S. pneumoniae: gram+ diplococci, rusty sputum. Mycoplasma: cold agglutinins. Legionella: hyponatremia + GI symptoms.*

Board Relevance: CAP outpatient = azithromycin or doxycycline. Inpatient = ceftriaxone + azithromycin.

55 Tuberculosis

Pathophysiology: M. tuberculosis: acid-fast bacillus, aerosol transmission. Primary: Ghon complex (subpleural granuloma + hilar node). Reactivation: apical cavitary lesions.

Key Associations: Risk: HIV, prison, endemic areas. PPD: induration at 48-72h. IGRA more specific. Caseating granulomas with Langhans giant cells.

High-Yield Fact: *Ghon complex calcified = Ranke complex. Latent TB: +PPD/IGRA, normal CXR. Treat: RIPE (Rifampin, INH, PZA, Ethambutol).*

Board Relevance: Immigrant with cough + night sweats + weight loss + apical cavitary lesion = reactivation TB. INH causes B6 deficiency.

56 PFT Patterns

Pathophysiology: DLCO = diffusing capacity for CO. Decreased in emphysema (alveolar destruction), ILD (thickened membrane), normal in asthma.

Key Associations: Obstructive = can't get air OUT. Restrictive = can't get air IN. DLCO differentiates between types.

High-Yield Fact: *FEV1 = volume in 1st second. FVC = total exhaled. FEV1/FVC <0.7 = obstruction.*

Board Relevance: Low FEV1/FVC + high TLC + low DLCO = emphysema. Low TLC + normal ratio + low DLCO = ILD.

57 Pulmonary Hypertension

Pathophysiology: Mean PA pressure >20mmHg. Group 1: PAH. Group 2: left heart disease (#1 cause). Group 3: chronic lung disease. Group 4: CTEPH.

Key Associations: Progressive dyspnea, RV failure (cor pulmonale). Echo: elevated RVSP. RHC = gold standard. Vasodilators for Group 1.

High-Yield Fact: *Chronic hypoxia -> hypoxic vasoconstriction -> increased PVR -> RVH -> cor pulmonale. Most common cause = COPD.*

Board Relevance: Progressive dyspnea + signs of RV failure (JVD, edema, hepatomegaly) = pulmonary HTN. Most common cause = left heart disease.

58 Obstructive Sleep Apnea

Pathophysiology: Repeated upper airway collapse during sleep -> apnea -> hypoxia -> arousal -> fragmented sleep. Obesity #1 risk.

Key Associations: Daytime sleepiness, morning headaches, HTN. Polysomnography: AHI >5 mild, >30 severe. CPAP first-line.

High-Yield Fact: *Repeated hypoxia -> sympathetic activation -> systemic HTN. Also risk of pulmonary HTN, cor pulmonale, arrhythmias.*

Board Relevance: Obese middle-aged man + loud snoring + daytime sleepiness + morning headaches + HTN = OSA. CPAP.

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59 Pneumothorax

Pathophysiology: Air in pleural space -> lung collapse. Spontaneous: tall thin young male, ruptured bleb. Tension: one-way valve -> mediastinal shift -> hemodynamic collapse.

Key Associations: Tension: tracheal deviation AWAY, hyperresonance, absent BS, hypotension. Needle decompression 2nd ICS MCL immediately.

High-Yield Fact: *Spontaneous: sudden pleuritic CP + dyspnea, tall thin male. Catamenial: endometriosis, right-sided, during menses.*

Board Relevance: Tall thin young man + sudden CP + dyspnea + CXR lung collapse = spontaneous PTX. Tracheal deviation + hypotension = tension PTX.

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60 Pleural Effusion

Pathophysiology: Transudate: CHF, cirrhosis, nephrotic (pressure imbalance). Exudate: pneumonia, malignancy, TB, PE (inflamed membrane). Light criteria differentiate.

Key Associations: Light criteria: exudate if any of: pleural protein/serum >0.5, pleural LDH/serum >0.6, pleural LDH >2/3 ULN. CHF = most common transudate.

High-Yield Fact: *Transudate = bilateral, CHF. Exudate = unilateral, infection/malignancy. Apply Light criteria.*

Board Relevance: Bilateral effusions + JVD + S3 = transudate from CHF. Unilateral effusion + fever + pneumonia = exudate.

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61 Lung Cancer

Pathophysiology: Adenocarcinoma (#1 overall): peripheral, non-smokers. Squamous: central, cavitary, PTHrP (hypercalcemia). SCLC: central, aggressive, paraneoplastic (SIADH, Cushing, LEMS).

Key Associations: Pancoast tumor: superior sulcus -> Horner syndrome (ptosis, miosis, anhidrosis) + shoulder/arm pain. SVC syndrome: facial swelling.

High-Yield Fact: *Smoking causes >85%. Adenocarcinoma = peripheral nodule. Squamous = hypercalcemia. SCLC = SIADH.*

Board Relevance: Smoker with hypercalcemia + central cavitary mass = squamous. Smoker with SIADH + central mass = SCLC.

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62 Cystic Fibrosis

Pathophysiology: CFTR mutation (AR, dF508 = most common in Caucasians) -> defective Cl- channel -> thick secretions.

Key Associations: Recurrent Pseudomonas/S. aureus lung infections, bronchiectasis. Pancreatic insufficiency (steatorrhea). Infertility: absent vas deferens in males.

High-Yield Fact: *CFTR = cAMP-regulated Cl- channel. Defective Cl- transport -> increased Na+/water reabsorption -> thick mucus.*

Board Relevance: Child with recurrent Pseudomonas pneumonia + steatorrhea + failure to thrive + elevated sweat Cl- >60 = CF.

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63 Restrictive Lung Diseases

Pathophysiology: IPF: UIP pattern (honeycombing, traction bronchiectasis). Sarcoidosis: non-caseating granulomas, hilar adenopathy, elevated ACE. Asbestosis: pleural plaques.

Key Associations: Hypersensitivity pneumonitis: organic antigens (birds, mold). Drug-induced: bleomycin, amiodarone, MTX. PFTs: restrictive pattern.

High-Yield Fact: *IPF = progressive + clubbing + Velcro crackles. Sarcoidosis = non-caseating granulomas + hilar nodes. Asbestosis = mesothelioma risk.*

Board Relevance: Progressive dyspnea + clubbing + honeycombing on CT = IPF. Hilar adenopathy + erythema nodosum = sarcoidosis.

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64 Asthma Pharmacotherapy

Pathophysiology: Step 1: SABA prn. Step 2: low ICS. Step 3: low ICS+LABA. Step 4: med ICS+LABA. Step 5: high ICS+LABA+LAMA. Step 6: add oral steroids. Montelukast = alternative.

Key Associations: NEVER LABA monotherapy (increased mortality). ICS = cornerstone of persistent asthma. Beta-2 agonists increase cAMP -> bronchodilation.

High-Yield Fact: *Albuterol: onset <5 min. ICS: reduces inflammation. LABA: salmeterol, formoterol. Montelukast good for exercise-induced asthma.*

Board Relevance: LABA monotherapy without ICS = increased mortality. Always pair ICS + LABA.

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65 Mechanical Ventilation

Pathophysiology: Tidal volume: 6-8 mL/kg IBW. PEEP: prevents alveolar collapse, improves oxygenation. Complications: barotrauma, volutrauma, VAP.

Key Associations: ARDS: low tidal volume (6 mL/kg), plateau pressure <30, higher PEEP. Permissive hypercapnia acceptable. Prone for severe ARDS.

High-Yield Fact: *Barotrauma = pneumothorax (most dangerous). VAP = after 48h on ventilator. Oral care + head of bed elevation prevent VAP.*

Board Relevance: ARDS patient on vent + worsening hypoxia + sudden hypotension + absent left BS = tension PTX. Needle decompression.

66 ARDS

Pathophysiology: Diffuse alveolar damage -> increased permeability -> non-cardiogenic pulmonary edema. Sepsis = #1 cause.

Key Associations: Berlin criteria: acute onset, bilateral infiltrates, P/F <300, no cardiogenic cause (PCWP <18). Hyaline membranes on path.

High-Yield Fact: *P/F ratio: mild 200-300, moderate 100-200, severe <100. Treat: lung-protective ventilation, conservative fluids.*

Board Relevance: Septic patient develops acute hypoxemia + bilateral infiltrates + P/F <200 + normal PCWP = ARDS.

67 O2-Hb Dissociation Curve

Pathophysiology: Right shift: decreased affinity, increased O2 unloading (exercise, fever, acidosis, increased 2,3-DPG). Left shift: increased affinity (fetal Hb, alkalosis, CO).

Key Associations: P50: PaO2 at 50% saturation (~27mmHg). R shift = increased P50. L shift = decreased P50. CO: L shift + competitive binding (200x affinity).

High-Yield Fact: *R = Release O2 to Tissues. L = Locked on. HbF has higher affinity than HbA (O2 transfer mother -> fetus).*

Board Relevance: CO poisoning: cherry-red skin + headache + normal PaO2 + decreased SaO2. Pulse ox falsely normal. Hyperbaric O2.

68 Granulomatous Lung Diseases

Pathophysiology: TB: caseating granulomas, AFB. Sarcoidosis: non-caseating, elevated ACE, hilar adenopathy. Histoplasma: intracellular yeasts in macrophages.

Key Associations: Histo: Ohio/Mississippi valleys, bird/bat droppings. Coccidioides: SW US, spherules. Blastomyces: Great Lakes, broad-based budding.

High-Yield Fact: *Non-caseating = sarcoidosis. Caseating = TB or fungal. Histo inside macrophages = small dots. Coccidioides = spherules.*

Board Relevance: Ohio patient with hilar adenopathy + calcified granulomas = histoplasmosis. Bilateral hilar nodes + erythema nodosum = sarcoidosis.

69 Chest X-Ray Interpretation

Pathophysiology: ABCDE: Airway (trachea midline), Breathing (lung fields, PTX), Circulation (heart size, mediastinum), Diaphragm, Everything else.

Key Associations: Silhouette sign: loss of border between same-density structures. Air bronchogram: air bronchi visible against opacified lung.

High-Yield Fact: *LLL consolidation obscures left diaphragm. RML obscures right heart border. Deep sulcus sign = PTX in supine patient.*

Board Relevance: Hyperinflated lungs + flattened diaphragms = COPD. Bilateral hilar adenopathy = sarcoidosis. Pleural plaques = asbestos.

70 Pneumoconioses

Pathophysiology: Coal worker's: upper lobes, carbon dust. Silicosis: upper lobes, eggshell calcifications, TB risk. Asbestosis: lower lobes, pleural plaques, mesothelioma risk.

Key Associations: Berylliosis: non-caseating granulomas (mimics sarcoidosis). Asbestos: ferruginous bodies (iron-coated fibers).

High-Yield Fact: *Silicosis: increased TB risk (silica impairs macrophages). Asbestos: mesothelioma + bronchogenic carcinoma (synergistic with smoking).*

Board Relevance: Coal miner + upper lobe opacities = coal worker's. Shipyard worker + pleural plaques + lower lobe fibrosis = asbestosis.

71 Pulmonary Drug Toxicities

Pathophysiology: Amiodarone: pulmonary fibrosis. Bleomycin: pulmonary fibrosis (monitor DLCO). MTX: pneumonitis. Nitrofurantoin: pulmonary fibrosis. ACEi: cough.

Key Associations: Bleomycin: risk increased with high FiO2 and radiation. Amiodarone: toxicity can occur years after starting.

High-Yield Fact: *Bleomycin = 'Blew up lungs.' Amiodarone = 'Am I toxic?' (pulmonary, hepatic, thyroid). Always check drug history.*

Board Relevance: Cancer patient on bleomycin develops cough + dyspnea + interstitial infiltrates = bleomycin toxicity. Avoid high FiO2.

72 Pneumonia Pathogens by Patient

Pathophysiology: Immunocompetent CAP: S. pneumoniae. COPD: H. flu, Moraxella. CF: Pseudomonas, S. aureus. Alcoholism: Klebsiella, anaerobes. Neutropenia: Pseudomonas, Aspergillus.

Key Associations: Post-viral: S. aureus. Aspiration: anaerobes. HIV CD4<200: PJP (Pneumocystis). Klebsiella = currant jelly sputum.

High-Yield Fact: *S. pneumoniae = #1 overall. Pseudomonas = CF, neutropenia, burns. Klebsiella = alcoholic.*

Board Relevance: CAP empiric: azithromycin or doxycycline (outpatient), ceftriaxone + azithromycin (inpatient). Aspiration: ampicillin-sulbactam.

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73 CF Genetics

Pathophysiology: CFTR gene, chromosome 7. dF508: deletion of Phe at position 508 (most common Caucasian mutation). CFTR = cAMP-regulated Cl- channel.

Key Associations: Autosomal recessive. Carrier 1/25 Caucasians. Defective Cl- transport -> thick mucus. CFTR also regulates ENaC.

High-Yield Fact: *Sweat chloride >60 mmol/L = diagnostic. Newborn screening: IRT (immunoreactive trypsinogen).*

Board Relevance: AR inheritance. Parents carriers = 25% affected child. Sweat chloride confirms. Pseudomonas colonizes via alginate biofilm.

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74 Venous Thromboembolism

Pathophysiology: Virchow: stasis, hypercoagulability, endothelial injury. Inherited: Factor V Leiden (#1), prothrombin mutation, protein C/S, ATIII.

Key Associations: Factor V Leiden: resistant to protein C inactivation. OCPs + FVL = very high risk. Cancer: Trousseau syndrome (migratory thrombophlebitis).

High-Yield Fact: *FVL = most common inherited thrombophilia in Caucasians. Heterozygote 5x risk, homozygote 50x.*

Board Relevance: Young woman on OCPs with first unprovoked DVT/PE = consider thrombophilia workup. FVL most common.

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75 Sleep Apnea Consequences

Pathophysiology: Repeated hypoxia -> pulmonary vasoconstriction -> pulmonary HTN -> cor pulmonale. Systemic HTN from sympathetic activation. Arrhythmias (AFib).

Key Associations: Daytime consequences: excessive sleepiness (ESS), cognitive impairment, motor vehicle accidents. Metabolic: insulin resistance.

High-Yield Fact: *OSA = most common sleep-related breathing disorder. Diagnosis: polysomnography. ESS >10 suggests excessive sleepiness.*

Board Relevance: Obese man + snoring + witnessed apneas + daytime sleepiness + HTN = OSA. Polysomnography confirms.

SECTION 4: GASTROINTESTINAL

76 GI Concept 1: Bilirubin Metabolism

Pathophysiology: Heme -> biliverdin -> unconjugated bilirubin -> liver conjugation (UGT) -> conjugated bilirubin -> bile -> intestine.

Key Associations: Unconjugated: hemolysis, Gilbert (decreased UGT, benign), Crigler-Najjar (absent UGT, severe). Conjugated: Dubin-Johnson (black liver), obstructive.

High-Yield Fact: *Gilbert = mild, unconjugated, exacerbated by fasting/stress. Dubin-Johnson = conjugated, liver is black.*

Board Relevance: Asymptomatic elevated unconjugated bilirubin rising with fasting = Gilbert. Newborn severe unconjugated = Crigler-Najjar.

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77 GI Concept 2: Hepatitis Serology

Pathophysiology: HAV: fecal-oral, acute, IgM. HBV: DNA, HBsAg (active), anti-HBs (immune), anti-HBc (exposure). HCV: RNA, chronic.

Key Associations: Vaccination: ONLY anti-HBs+. Window period: anti-HBc IgM when HBsAg negative. HBeAg = high replication.

High-Yield Fact: *HBV has DNA -> integrates into genome -> HCC. HCV = RNA, no vaccine, cirrhosis + HCC. HDV requires HBV.*

Board Relevance: HBsAg+, anti-HBc IgM+ = acute HBV. Only anti-HBs+ = vaccinated. Anti-HCV+ = confirm with RNA.

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78 GI Concept 3: Cirrhosis Complications

Pathophysiology: Fibrosis + regenerative nodules. Portal HTN -> varices, ascites (SAAG >1.1), splenomegaly. Decreased albumin/clotting factors.

Key Associations: Hepatic encephalopathy: asterixis, confusion, increased ammonia. Lactulose + rifaximin. Hepatorenal syndrome: functional renal failure.

High-Yield Fact: *Child-Pugh and MELD scores for prognosis. Most common death = variceal hemorrhage. HCC screening: US + AFP q6mo.*

Board Relevance: Alcoholic cirrhosis + ascites + spider angiomas + gynecomastia. US screening for HCC. Propranolol for variceal prophylaxis.

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79 GI Concept 4: Acute Pancreatitis

Pathophysiology: Premature trypsinogen activation -> autodigestion. Gallstones #1, alcohol #2, hypertriglyceridemia, hypercalcemia.

Key Associations: Epigastric pain radiating to back. Lipase > amylase (more specific). CT for complications (necrosis, pseudocyst). IVF + NPO + pain control.

High-Yield Fact: *Lipase 3x normal = diagnostic. Ranson criteria for severity. Pseudocyst = most common complication.*

Board Relevance: Severe epigastric pain after heavy meal + lipase 3x elevated = acute pancreatitis. Aggressive IVF resuscitation.

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80 GI Concept 5: Peptic Ulcer Disease

Pathophysiology: Imbalance: protective (mucus, bicarb, prostaglandins) vs damaging (acid, H. pylori, NSAIDs). Duodenal: pain relieved by food. Gastric: pain worsened by food.

Key Associations: H. pylori: gram- spiral rod, urease+ (ammonia neutralizes acid), MALT lymphoma risk. Test: urea breath test, stool Ag.

High-Yield Fact: *Duodenal = pain-food-relief. Gastric = pain-food-pain. Triple therapy: PPI + amoxicillin + clarithromycin.*

Board Relevance: Burning epigastric pain relieved by eating = duodenal ulcer. +Urease breath test = H. pylori. PPI + 2 antibiotics.

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81 GI Concept 6: IBD: Crohn vs UC

Pathophysiology: Crohn: transmural, skip lesions, any part GI, non-caseating granulomas, creeping fat. UC: mucosal, continuous from rectum, crypt abscesses.

Key Associations: Crohn: RLQ pain, fistula/stricture, B12 deficiency (terminal ileum). UC: LLQ pain, bloody diarrhea, toxic megacolon, increased CRC risk.

High-Yield Fact: *Crohn = transmural + skip + granulomas. UC = mucosal + continuous + crypt abscesses. Both: extraintestinal (PSC more in UC).*

Board Relevance: Young adult + RLQ pain + fistula = Crohn. Bloody diarrhea + continuous colonic inflammation from rectum = UC.

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82 GI Concept 7: Celiac Disease

Pathophysiology: Autoimmune reaction to gluten (gliadin) -> villous atrophy -> malabsorption. HLA-DQ2/DQ8. Anti-tTG, anti-endomysial antibodies.

Key Associations: Dermatitis herpetiformis: pruritic vesicles on extensors, IgA at dermal papillae. Gluten-free diet. Increased T-cell lymphoma risk.

High-Yield Fact: *Villous atrophy + crypt hyperplasia on biopsy. Anti-tTG most sensitive screening test.*

Board Relevance: Diarrhea + bloating + weight loss + iron deficiency anemia + anti-tTG+ = celiac. Gluten-free diet.

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83 GI Concept 8: Diverticulitis

Pathophysiology: Diverticulosis: false diverticula (mucosa/submucosa through muscularis), sigmoid colon, low-fiber diet. Diverticulitis: inflammation of diverticula.

Key Associations: LLQ pain, fever, leukocytosis. CT = best imaging. Complications: abscess, perforation, fistula. Treat: Abx + bowel rest.

High-Yield Fact: *Diverticulosis = asymptomatic or mild LLQ pain. Diverticulitis = acute inflammation. Myth: nuts/seeds cause diverticulitis = debunked.*

Board Relevance: Elderly + LLQ pain + fever + history of diverticulosis = diverticulitis. CT confirms. Ciprofloxacin + metronidazole.

84 GI Concept 9: Colorectal Cancer

Pathophysiology: Adenoma-carcinoma sequence: APC -> KRAS -> p53 -> DCC. Right-sided: iron deficiency anemia. Left-sided: obstructive. Screening: colonoscopy at 45.

Key Associations: FAP: APC mutation, hundreds of polyps. Lynch (HNPCC): mismatch repair genes, right-sided, younger. CEA for monitoring, not screening.

High-Yield Fact: *FAP = APC (Adenomatous Polyposis Coli). Lynch = MSH2, MLH1 (mismatch repair).*

Board Relevance: Microcytic anemia + weight loss + change in bowel habits + +FOBT = colon cancer. Colonoscopy confirms.

85 GI Concept 10: Esophageal Disorders

Pathophysiology: Achalasia: loss of Auerbach plexus -> failed LES relaxation + absent peristalsis. Bird's beak on barium. Scleroderma: low LES pressure -> GERD.

Key Associations: GERD: transient LES relaxation. Barrett: intestinal metaplasia (salmon-colored), adenocarcinoma risk. EoE: eosinophilic infiltration.

High-Yield Fact: *Achalasia = bird's beak + high LES pressure. Scleroderma = low LES pressure + severe GERD. Barrett = premalignant.*

Board Relevance: Dysphagia to solids AND liquids + bird's beak = achalasia. Chronic reflux + salmon-colored distal esophagus = Barrett.

86 GI Concept 11: LFT Interpretation

Pathophysiology: ALT: liver-specific, cytoplasm. AST: liver, heart, muscle, mitochondria. ALP: bile ducts, bone, placenta. GGT: bile ducts, alcohol.

Key Associations: Hepatocellular: ALT/AST > ALP. Cholestatic: ALP/GGT > ALT/AST. AST/ALT >2 = alcoholic hepatitis. ALT > AST = viral hepatitis.

High-Yield Fact: *ALT = Liver cytoplasmic. GGT elevated in alcohol. Albumin/PT = synthetic function.*

Board Relevance: AST/ALT >2 + GGT elevated + alcoholism = alcoholic hepatitis. ALT 1000+ + AST 800+ = acute viral hepatitis.

87 GI Concept 12: Hemochromatosis

Pathophysiology: AR (HFE C282Y). Increased intestinal iron absorption -> iron deposition in liver, pancreas, heart, skin, joints.

Key Associations: Bronze diabetes: hyperpigmentation + DM. Cirrhosis, HCC. Arthropathy (2nd/3rd MCP). Hypogonadism. Treat: phlebotomy.

High-Yield Fact: *Transferrin sat >45%, elevated ferritin. Liver biopsy: Prussian blue iron stain.*

Board Relevance: Bronze skin + DM + hepatomegaly + elevated ferritin = hemochromatosis. Phlebotomy. Screen family.

88 GI Concept 13: Wilson Disease

Pathophysiology: AR (ATP7B). Defective copper excretion -> copper in liver, basal ganglia, cornea. Low ceruloplasmin, high urinary copper.

Key Associations: Kayser-Fleischer rings: copper in Descemet membrane. Neuropsychiatric (basal ganglia). Hepatitis, cirrhosis. Penicillamine chelation.

High-Yield Fact: *Low ceruloplasmin, high urinary copper. KF rings = pathognomonic.*

Board Relevance: Young adult + tremor + psychiatric symptoms + KF rings + low ceruloplasmin = Wilson. Penicillamine.

89 GI Concept 14: A1AT Deficiency

Pathophysiology: PiZZ or PiMZ. A1AT inhibits elastase. Deficiency -> unchecked elastase -> panacinar emphysema + liver cirrhosis.

Key Associations: COPD in non-smoker (lower lobes). Liver: PAS+ globules in hepatocytes (accumulated misfolded A1AT). Cirrhosis, HCC.

High-Yield Fact: *PiMM = normal. PiZZ = severe. PiMZ = carrier. Young non-smoker with COPD = think A1AT.*

Board Relevance: Non-smoker + COPD + lower lobe emphysema + liver disease = A1AT deficiency. Check level and phenotype.

90 GI Concept 15: Gallstone Disease

Pathophysiology: Cholesterol stones (80%): female, forty, fertile, fat. Pigment stones: hemolysis, cirrhosis. Cholecystitis: stone obstructs cystic duct.

Key Associations: RUQ pain, Murphy sign, fever. Ultrasound: thick GB wall, pericholecystic fluid. HIDA if US equivocal. Cholecystectomy.

High-Yield Fact: *Cholesterol = radiolucent (most). Pigment = radiopaque. Cholecystitis = urgent surgery within 24-72h.*

Board Relevance: Obese woman + RUQ pain after fatty meal + Murphy sign = cholecystitis. US confirms. Lap chole within 72h.

91 GI Concept 16: Malabsorption

Pathophysiology: Fat malabsorption: steatorrhea, ADEK deficiency. Pancreatic: CF, chronic pancreatitis. Mucosal: celiac, tropical sprue.

Key Associations: D-xylose: normal in pancreatic disease (absorptive surface intact), abnormal in mucosal disease. Fecal elastase for pancreatic function.

High-Yield Fact: *Steatorrhea = greasy, foul-smelling stool. Vitamin A (night blindness), D (osteomalacia), E (neuropathy), K (bleeding).*

Board Relevance: Steatorrhea + normal D-xylose + low fecal elastase = pancreatic insufficiency. Abnormal D-xylose = mucosal disease.

92 GI Concept 17: GI Hormones

Pathophysiology: Gastrin (G cells): HCl. CCK (I cells): GB contraction, enzyme secretion. Secretin (S cells): bicarb. Motilin: MMC. VIP: relaxation.

Key Associations: VIPoma: WDHA (watery diarrhea, hypokalemia, achlorhydria). Gastrinoma: Zollinger-Ellison (severe PUD). Somatostatinoma: DM, gallstones.

High-Yield Fact: *Gastrin -> HCl (for protein digestion). CCK -> GB contraction + pancreatic enzymes. Secretin -> bicarb (alkalinizes).*

Board Relevance: Zollinger-Ellison: severe recurrent PUD + diarrhea. Fasting gastrin >1000. MEN1 association.

93 GI Concept 18: Acute Liver Failure

Pathophysiology: Rapid loss without preexisting disease. Acetaminophen #1, viral, Amanita, AI, Wilson. Hepatic encephalopathy, coagulopathy.

Key Associations: Cerebral edema = leading cause of death. Acetaminophen: NAPQI depletes glutathione. NAC within 8h. Rumack-Matthew nomogram.

High-Yield Fact: *Acetaminophen toxicity = centrilobular necrosis. NAC replenishes glutathione.*

Board Relevance: Intentional APAP OD + RUQ pain + elevated LFTs + prolonged PT = ALF. NAC. NAC best within 8h.

94 GI Concept 19: Chronic Liver Stigmata

Pathophysiology: Spider angiomas, palmar erythema, gynecomastia (estrogen excess), Dupuytren contracture, testicular atrophy, caput medusae.

Key Associations: Portal HTN: esophageal varices, ascites, splenomegaly. Hepatic encephalopathy: asterixis, fetor hepaticus.

High-Yield Fact: *Estrogen excess in cirrhosis = spider angiomas + palmar erythema + gynecomastia. Portal HTN = caput medusae + varices.*

Board Relevance: Jaundice + spider angiomas + palmar erythema + ascites + asterixis = decompensated cirrhosis.

95 GI Concept 20: Pancreatic Cancer

Pathophysiology: Ductal adenocarcinoma (95%). Risk: smoking, chronic pancreatitis. Painless jaundice (head), weight loss.

Key Associations: CA 19-9 = monitor (not screen). CT: double duct sign. Whipple for resectable. Courvoisier: palpable nontender GB + jaundice.

High-Yield Fact: *Courvoisier sign = pancreatic cancer until proven otherwise. Trousseau syndrome = migratory thrombophlebitis.*

Board Relevance: Elderly + painless jaundice + palpable nontender GB + weight loss = pancreatic cancer. CT: double duct sign.

96 GI Concept 21: IBS

Pathophysiology: Functional GI disorder. Abdominal pain + altered bowel habits. No structural abnormality. Rome IV criteria.

Key Associations: Normal colonoscopy + labs. Visceral hypersensitivity. Altered gut-brain axis. Subtypes: IBS-D, IBS-C, IBS-M.

High-Yield Fact: *IBS = diagnosis of exclusion. Rome: recurrent abdominal pain >1d/wk for 3mo + 2/3 criteria.*

Board Relevance: Young woman + chronic abdominal pain + bloating + alternating bowel habits + normal colonoscopy = IBS.

97 GI Concept 22: Gastric Cancer

Pathophysiology: Adenocarcinoma most common. H. pylori, smoked foods, nitrates, pernicious anemia, blood type A. Intestinal type vs diffuse (signet ring).

Key Associations: Virchow node (left supraclavicular), Sister Mary Joseph (periumbilical), Krukenberg (ovary). Linitis plastica = leather bottle.

High-Yield Fact: *Signet ring cells = diffuse type. H. pylori = intestinal type. Endoscopy + biopsy for diagnosis.*

Board Relevance: Elderly + weight loss + epigastric pain + early satiety + Virchow node = gastric cancer. Endoscopy.

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98 GI Concept 23: Hepatorenal Syndrome

Pathophysiology: Functional renal failure in advanced liver disease. Type 1: rapid. Type 2: slower. Normal renal parenchyma.

Key Associations: Splanchnic vasodilation -> decreased effective arterial volume -> RAAS/SNS -> renal vasoconstriction. Diagnosis of exclusion.

High-Yield Fact: *Reversible with liver transplant. Terlipressin + albumin (bridge). Avoid nephrotoxins.*

Board Relevance: Cirrhotic + ascites + rising Cr + low urine Na <10 + no proteinuria = HRS. Terlipressin + albumin.

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99 GI Concept 24: SBP

Pathophysiology: Infection of ascitic fluid without intra-abdominal source. E. coli, Klebsiella. Risk: low ascitic protein <1.0.

Key Associations: PMN >250 in ascitic fluid = diagnostic. Cefotaxime/ceftriaxone. Albumin prevents renal impairment. Prophylaxis after first episode.

High-Yield Fact: *SBP recurs often. Secondary prophylaxis indicated. Primary prophylaxis for GI bleed with ascites.*

Board Relevance: Cirrhotic + ascites + fever + abdominal pain + ascitic PMN >250 = SBP. Cefotaxime + albumin.

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100 GI Concept 25: PBC & PSC

Pathophysiology: PBC: autoimmune destruction of intrahepatic bile ducts. AMA+, middle-aged women. UDCA. PSC: large bile duct strictures, p-ANCA+, UC association.

Key Associations: PBC: fatigue, pruritus, jaundice, xanthelasma. PSC: beading on ERCP, increased cholangiocarcinoma risk.

High-Yield Fact: *PBC = 'PBC = Primary Biliary Cirrhosis (Cholangitis) = AMA+.' PSC = 'PSC = Primary Sclerosing Cholangitis = p-ANCA+.'*

Board Relevance: Middle-aged woman + pruritus + elevated ALP + AMA+ = PBC. UC patient + elevated ALP + beading on ERCP = PSC.

SECTION 5: RENAL & ELECTROLYTES

101 Renal #1: Acid-Base: Anion Gap

Pathophysiology: pH, pCO2, HCO3-. Metabolic acidosis: low pH + low HCO3-. AG = Na - (Cl + HCO3). MUDPILES for high AG.

Key Associations: MUDPILES: Methanol, Uremia, DKA, Propylene glycol, Iron/INH, Lactic acidosis, Ethylene glycol, Salicylates.

High-Yield Fact: *Winter formula: expected pCO2 = 1.5*HCO3 + 8 +/-2. Compensation never fully corrects pH.*

Board Relevance: ABG: pH 7.2, pCO2 25, HCO3 10 = met acidosis with resp compensation. Calculate AG.

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102 Renal #2: Hyponatremia

Pathophysiology: <135 mEq/L. Hypovolemic, euvolemic (SIADH), hypervolemic (CHF/cirrhosis). Correct Na slowly: <8-12 mEq/L/24h.

Key Associations: SIADH: euvolemic, concentrated urine, low serum osmolality, normal renal/adrenal/thyroid. ODS from rapid correction.

High-Yield Fact: *SIADH urine osmolality > serum (inappropriate). Treat: fluid restriction.*

Board Relevance: SCLC + euvolemic hyponatremia + concentrated urine = SIADH. Rapid correction -> CPM.

---

103 Renal #3: Hyperkalemia

Pathophysiology: K >5.5. Renal failure, ACEi/ARB, K-sparing diuretics, acidosis, cell lysis. EKG: peaked T -> loss P -> wide QRS -> sine wave.

Key Associations: Ca gluconate (cardioprotective) first. Then shift K: insulin+glucose, bicarb, beta-agonists. Remove: kayexalate, dialysis.

High-Yield Fact: *Peaked T waves = first EKG sign. Ca gluconate stabilizes myocardium but doesn't lower K.*

Board Relevance: Renal failure + K 6.8 + peaked T waves = give Ca gluconate first. Then insulin + glucose.

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104 Renal #4: Diuretics

Pathophysiology: CAI: PCT, NaHCO3 loss. Loop: TAL, NKCC2, most potent, Ca wasting. Thiazide: DCT, NCC, Ca sparing. K-sparing: collecting duct.

Key Associations: Loop: hypokalemia, met alkalosis, ototoxicity. Thiazide: hypokalemia, hypercalcemia. Spironolactone: gynecomastia, hyperkalemia.

High-Yield Fact: *CAI = PCT. Loop = Loops. Thiazide = DCT (T for Thiazide). Spironolactone = 'man boobs.'*

Board Relevance: Furosemide -> hypokalemia + met alkalosis. HCTZ -> hypercalcemia. Spironolactone -> hyperkalemia.

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105 Renal #5: AKI

Pathophysiology: Pre-renal: FeNa <1%, BUN/Cr >20 (hypovolemia, CHF). Intra-renal: ATN (muddy brown casts), FeNa >2%. Post-renal: obstruction.

Key Associations: ATN causes: ischemia, nephrotoxins (aminoglycosides, contrast, cisplatin). Phases: initiation, maintenance, recovery.

High-Yield Fact: *FeNa = (UNa/PNa)/(UCr/PCr)*100. Pre-renal = kidneys hold Na (FeNa <1%). ATN = can't reabsorb (FeNa >2%).*

Board Relevance: Hypovolemia + elevated BUN/Cr + FeNa 0.3% = pre-renal. Gentamicin + rising Cr + muddy brown casts = ATN.

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106 Renal #6: Nephrotic Syndrome

Pathophysiology: >3.5g proteinuria/day, hypoalbuminemia, edema, hyperlipidemia. Minimal change (children), FSGS, Membranous (adults, anti-PLA2R), DM (#1).

Key Associations: Nephritic: hematuria, HTN, oliguria, mild proteinuria, RBC casts. PSGN (low C3, ASO+), IgA (post-infection, normal C3).

High-Yield Fact: *Nephrotic = PHANO. Nephritic = PHARAOH. Minimal change = normal LM, podocyte effacement on EM.*

Board Relevance: Child + periorbital edema + 4g proteinuria + normal complement = minimal change. Steroids.

---

107 Renal #7: CKD

Pathophysiology: GFR <60 for >3mo. DM #1, HTN #2. Complications: anemia (decreased EPO), renal osteodystrophy, hyperphosphatemia.

Key Associations: Uremic platelet dysfunction: increased bleeding time, treat with DDAVP. Dialysis: AEIOU. Stages 1-5 based on GFR.

High-Yield Fact: *Anemia of CKD = normocytic, normochromic, low EPO. Treat with ESA. Phosphate binders for hyperphosphatemia.*

Board Relevance: Diabetic + progressive renal decline + anemia + hyperphosphatemia + low vit D = CKD. Nephrology referral.

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108 Renal #8: RTA Types

Pathophysiology: Type 1 (distal): urine pH >5.5, hypokalemia, nephrocalcinosis. Type 2 (proximal): urine pH <5.5, Fanconi. Type 4: hyperkalemia (most common).

Key Associations: Type 1: Sjogren, amphotericin B. Type 2: multiple myeloma, CAI. Type 4: DM, ACEi, spironolactone (hypoaldosteronism).

High-Yield Fact: *Type 1 = Distal can't acidify. Type 2 = Proximal can't reclaim HCO3. Type 4 = Aldosterone problem.*

Board Relevance: Normal AG met acidosis + hypokalemia + nephrocalcinosis = RTA type 1. Hyperkalemia + mild acidosis = RTA type 4.

109 Renal #9: Nephrolithiasis

Pathophysiology: Calcium oxalate (#1): hypercalciuria. Struvite: urease+ (Proteus), staghorn. Uric acid: radiolucent. Cystine: hexagonal.

Key Associations: Renal colic: flank pain to groin, hematuria. CT non-contrast = best. Uric acid stones: alkalinize urine.

High-Yield Fact: *Calcium stones = envelope/dumbbell. Struvite = coffin lid. Uric acid = rhomboid. Cystine = hexagonal.*

Board Relevance: Flank pain radiating to groin + hematuria = renal colic. CT non-contrast. Uric acid = radiolucent.

110 Renal #10: SIADH vs DI

Pathophysiology: SIADH: excess ADH -> dilutional hyponatremia, concentrated urine. DI: ADH deficiency (central) or resistance (nephrogenic) -> dilute urine.

Key Associations: Central DI: responds to DDAVP. Nephrogenic (lithium): does NOT respond. Water deprivation test for differentiation.

High-Yield Fact: *SIADH = hyponatremia + concentrated urine. DI = hypernatremia + dilute urine (if no water access).*

Board Relevance: SCLC + hyponatremia = SIADH. Post-neurosurgery polyuria + dilute urine = central DI. Lithium + polyuria = nephrogenic DI.

111 Renal #11: Calcium Disorders

Pathophysiology: Hypercalcemia: primary hyperPTH (stones, bones, groans), malignancy (PTHrP). Hypocalcemia: post-thyroidectomy, vit D deficiency.

Key Associations: Chvostek (facial twitch), Trousseau (carpal spasm). Prolonged QT. Hypocalcemia: low Ca + high PO4 = hypoPTH.

High-Yield Fact: *PTH = Pumps Ca up, Pushes PO4 out. PTHrP mimics PTH in malignancy.*

Board Relevance: Kidney stones + bone pain + high Ca + high PTH = primary hyperPTH. Post-thyroidectomy tetany = hypocalcemia.

112 Renal #12: RAS & HTN

Pathophysiology: RAS: decreased renal perfusion -> increased renin -> AngII -> HTN. Atherosclerosis (older) or FMD (young women).

Key Associations: FMD: string-of-beads, renal bruit. Bilateral RAS: ACEi/ARB contraindicated (need efferent constriction for GFR).

High-Yield Fact: *Unilateral RAS: ACEi/ARB OK (other kidney compensates). Bilateral: ACEi = acute renal failure.*

Board Relevance: Young woman + severe HTN + renal bruit + string-of-beads = FMD. Older man + HTN + RAS = atherosclerotic.

113 Renal #13: HUS vs TTP

Pathophysiology: HUS: triad (MAHA, thrombocytopenia, AKI). E. coli O157:H7 (shiga toxin), children. TTP: pentad (+fever + neuro), ADAMTS13 deficiency.

Key Associations: HUS: renal > neuro. TTP: neuro > renal. TTP: plasma exchange. HUS: supportive (no Abx for E. coli).

High-Yield Fact: *Shiga toxin damages endothelial cells -> platelet aggregation. ADAMTS13 normally cleaves vWF multimers.*

Board Relevance: Child + bloody diarrhea E. coli O157 -> oliguric AKI + anemia + thrombocytopenia = HUS. Do NOT give antibiotics.

114 Renal #14: RCC

Pathophysiology: Clear cell carcinoma (70%). VHL, smoking, obesity. Triad: flank pain, palpable mass, hematuria.

Key Associations: Paraneoplastic: EPO (polycythemia), PTHrP (hypercalcemia), renin (HTN). Clear cytoplasm (lipid + glycogen).

High-Yield Fact: *VHL -> HIF accumulation -> VEGF -> angiogenesis. Nephrectomy (partial/radical).*

Board Relevance: Incidental renal mass + smoker + paraneoplastic (polycythemia/hypercalcemia) = RCC. Nephrectomy.

115 Renal #15: UTI & Pyelonephritis

Pathophysiology: Cystitis: dysuria, frequency, urgency. Pyelo: fever, CVA tenderness. E. coli #1 (P fimbriae for pyelo).

Key Associations: UA: leukocyte esterase, nitrites. Culture >100k CFU. TMP-SMX or nitrofurantoin for cystitis.

High-Yield Fact: *E. coli: gram- rod, lactose+, P fimbriae bind urothelium. Nitrofurantoin concentrates in urine.*

Board Relevance: Young woman + dysuria + frequency = cystitis. Same + fever + CVA tenderness = pyelonephritis.

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116 Renal #16: Hyperphosphatemia

Pathophysiology: CKD #1 cause. Also: hypoPTH, tumor lysis, rhabdo. Binds Ca (low Ca). Treat: phosphate binders (sevelamer, Ca acetate).

Key Associations: FGF23: decreases PO4 reabsorption and 1-alpha-hydroxylase. Refeeding syndrome: hypophosphatemia risk.

High-Yield Fact: *Hyperphosphatemia + hypocalcemia = renal failure. Hypophosphatemia = refeeding, DKA treatment.*

Board Relevance: CKD + hyperphosphatemia = phosphate binders. Starvation refeeding: risk of severe hypophosphatemia.

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117 Renal #17: Bladder Cancer

Pathophysiology: Transitional cell (90%). Smoking #1 risk. Industrial chemicals (aniline dyes). Painless hematuria.

Key Associations: Cystoscopy + biopsy = diagnosis. FISH for genetic abnormalities. TURBT for superficial disease.

High-Yield Fact: *Squamous cell = S. haematobium (Middle East). Adenocarcinoma = urachal remnant.*

Board Relevance: Elderly smoker + painless hematuria = bladder cancer until proven otherwise. Cystoscopy.

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118 Renal #18: Proteinuria

Pathophysiology: Transient: fever, exercise, CHF. Orthostatic: upright only (benign). Persistent: glomerular disease.

Key Associations: Microalbuminuria: 30-300 mg/day = earliest diabetic nephropathy. Nephrotic: >3.5 g/day.

High-Yield Fact: *Spot urine protein/creatinine ratio estimates 24h protein. ACEi/ARB for microalbuminuria in DM.*

Board Relevance: Diabetic + microalbuminuria = start ACEi/ARB. Nephrotic range = full nephrotic workup.

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119 Renal #19: Renal Replacement

Pathophysiology: HD: AV fistula, 3x/week. PD: peritoneal membrane. Indications: AEIOU (Acidosis, Electrolytes, Ingestion, Overload, Uremia).

Key Associations: AV fistula: thrombosis, infection, steal, aneurysm. PD: peritonitis (gram+ Staph). Treat PD peritonitis with intraperitoneal Abx.

High-Yield Fact: *AEIOU = dialysis indications. AV fistula = best access (long-term).*

Board Relevance: CKD + refractory hyperkalemia + met acidosis + volume overload = start dialysis.

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120 Renal #20: Urinary Incontinence

Pathophysiology: Stress: weak pelvic floor (cough/sneeze leak). Urge: detrusor overactivity. Overflow: chronic retention (BPH, neurogenic).

Key Associations: Stress: Kegels, sling. Urge: anticholinergics (oxybutynin), beta-3 agonist (mirabegron). Overflow: catheterization.

High-Yield Fact: *Stress = multiparous women. Urge = 'gotta go' (frequency/urgency). Overflow = dribbling, palpable bladder.*

Board Relevance: Multiparous woman urine leak on coughing = stress incontinence. Elderly man dribbling + BPH = overflow.

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121 Renal #21: Renal Tubular Acidosis

Pathophysiology: Type 1 (distal): cannot acidify urine (pH >5.5). Type 2 (proximal): Fanconi syndrome. Type 4: hyperkalemia. All cause normal AG metabolic acidosis.

Key Associations: Nephrocalcinosis in type 1. Fanconi: glucose, amino acids, phosphate, HCO3 all lost in urine. Type 4 = aldosterone deficiency/resistance.

High-Yield Fact: *Type 1 = hypokalemia + nephrocalcinosis. Type 4 = hyperkalemia. Type 2 = Fanconi (everything lost).*

Board Relevance: Nephrocalcinosis + hypokalemia + normal AG acidosis = RTA type 1. Hyperkalemia + mild acidosis = RTA type 4.

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122 Renal #22: Hypernatremia

Pathophysiology: Na >145. From water loss: DI (central or nephrogenic), osmotic diuresis (glucose, mannitol), insensible losses.

Key Associations: Correct slowly (Na deficit + maintenance, over 48-72h). Rapid correction = cerebral edema.

High-Yield Fact: *Hypernatremia = water loss > Na loss. Hypovolemic hypernatremia = both lost but water > Na.*

Board Relevance: Elderly + altered + hypernatremia = dehydration. Polyuria + hypernatremia = DI (check water deprivation test).

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123 Renal #23: Lupus Nephritis

Pathophysiology: WHO class I-VI. Full house IF: IgG, IgA, IgM, C3, C1q. Class IV (diffuse proliferative) most severe.

Key Associations: Treat: steroids + mycophenolate or cyclophosphamide. Monitor: proteinuria, creatinine, anti-dsDNA, complement.

High-Yield Fact: *Class IV = diffuse proliferative = most severe. Class V = membranous = nephrotic.*

Board Relevance: SLE patient + proteinuria + hematuria + low C3/C4 + high anti-dsDNA = lupus nephritis. Biopsy for class.

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124 Renal #24: ADPKD

Pathophysiology: PKD1 (chr16, 85%) or PKD2 (chr4). Multiple bilateral renal cysts. ADPKD = most common inherited renal disease.

Key Associations: HTN, hematuria, progressive renal failure. Extrarenal: berry aneurysms (SAH), hepatic cysts, MVP. US diagnosis.

High-Yield Fact: *Screen for berry aneurysms if family history. Treat HTN aggressively (slows progression).*

Board Relevance: Adult + HTN + palpable flank masses + family renal failure + bilateral cysts on US = ADPKD.

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125 Renal #25: Hyponatremia Workup

Pathophysiology: Step 1: serum osmolality. Low = true hyponatremia. Step 2: volume status. Hypovolemic = UNa <20 (extrarenal) or >20 (renal). Euvolemic = SIADH.

Key Associations: Hypervolemic: CHF, cirrhosis, nephrotic. UNa <20. SIADH: UNa >40, concentrated urine >100.

High-Yield Fact: *Check TSH and cortisol (hypothyroid and adrenal insufficiency can cause euvolemic hyponatremia).*

Board Relevance: Euvolemic hyponatremia + concentrated urine + normal TSH/cortisol = SIADH. Fluid restriction.

SECTION 6: ENDOCRINE

126 Endo #1: Diabetes: DKA vs HHS

Pathophysiology: DKA: T1DM, hyperglycemia + AG met acidosis + ketones. HHS: T2DM, glucose >600, hyperosmolarity, NO ketones.

Key Associations: DKA: Kussmaul breathing, fruity breath. Treat: fluids + insulin + K+. HHS: extreme dehydration, AMS. Both: aggressive IVF.

High-Yield Fact: *DKA = ketones present (T1, no insulin = lipolysis). HHS = enough insulin to suppress lipolysis.*

Board Relevance: T1DM + nausea + vomiting + abdominal pain + Kussmaul + glucose + ketones = DKA. Elderly T2DM + AMS + glucose 800 = HHS.

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127 Endo #2: Thyroid: Hyper

Pathophysiology: Graves (#1): diffuse goiter, ophthalmopathy, pretibial myxedema, TSI antibodies. Lab: low TSH, high T4/T3.

Key Associations: Symptoms: heat intolerance, weight loss, tachycardia, tremor, diarrhea. Thyroid storm: fever, AMS, CV collapse.

High-Yield Fact: *Graves = autoimmune (TSI mimics TSH). Treat: methimazole (not 1st trimester), PTU (1st trimester).*

Board Relevance: Young woman + anxiety + tremor + tachycardia + diffuse goiter + proptosis = Graves. Low TSH + high T4.

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128 Endo #3: Thyroid: Hypo

Pathophysiology: Hashimoto (#1): anti-TPO, anti-Tg. Iodine deficiency worldwide. Post-surgical. Symptoms: cold intolerance, weight gain, bradycardia.

Key Associations: Lab: high TSH (primary), low T4. Subclinical: high TSH, normal T4. Myxedema coma: severe hypo + hypothermia + AMS.

High-Yield Fact: *Hashimoto = 'HashiMOTO runs you down' (hypothyroid). Levothyroxine replacement.*

Board Relevance: Woman + fatigue + cold intolerance + weight gain + goiter + high TSH + anti-TPO+ = Hashimoto.

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129 Endo #4: Cushing Syndrome

Pathophysiology: Excess cortisol. Exogenous steroids #1. Endogenous: pituitary ACTH (Cushing disease), ectopic ACTH (SCLC), adrenal adenoma.

Key Associations: Central obesity, moon facies, buffalo hump, purple striae, HTN, osteoporosis, hyperglycemia. DST: low dose = no suppression.

High-Yield Fact: *High dose DST: pituitary suppresses, ectopic/adrenal do NOT. Inferior petrosal sinus sampling localizes.*

Board Relevance: Central obesity + purple striae + HTN + hyperglycemia = Cushing. Check ACTH for source.

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130 Endo #5: Addison Disease

Pathophysiology: Primary adrenal insufficiency (autoimmune). Low cortisol + low aldosterone + high ACTH. Hyperpigmentation (increased POMC).

Key Associations: Fatigue, hypotension, hyponatremia, hyperkalemia, metabolic acidosis. Adrenal crisis: fever, hypotension, shock.

High-Yield Fact: *Addison = 'Absent cortisol, Aldosterone low, Dark skin.' Treat: hydrocortisone + fludrocortisone.*

Board Relevance: Fatigue + hyperpigmentation + hypotension + hyponatremia + hyperkalemia = Addison. High ACTH.

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131 Endo #6: Hyperaldosteronism

Pathophysiology: Primary (Conn): adrenal adenoma, low renin. Secondary: high renin (RAS, CHF). HTN + hypokalemia + metabolic alkalosis.

Key Associations: PAC/PRA >20 + PAC >15 = positive screening. Confirm with saline suppression. CT: adrenal adenoma.

High-Yield Fact: *Conn = 'Conn man steals potassium' (hypokalemia). Spironolactone/eplerenone treatment.*

Board Relevance: Hypertensive + hypokalemia + metabolic alkalosis (not on diuretics) = hyperaldosteronism. Aldosterone/renin ratio.

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132 Endo #7: Pheochromocytoma

Pathophysiology: Catecholamine-secreting tumor (adrenal medulla 90%). Rule of 10s. Episodic HTN, headache, palpitations, sweating.

Key Associations: Diagnose: plasma or 24h urine metanephrines. ALPHA-blocker first (phenoxybenzamine), THEN beta-blocker.

High-Yield Fact: *Alpha before beta = crucial. Beta-blocker alone = unopposed alpha = hypertensive crisis.*

Board Relevance: Young patient + paroxysmal HTN + headache + palpitations + sweating = pheo. Urine metanephrines.

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133 Endo #8: Primary HyperPTH

Pathophysiology: Parathyroid adenoma (85%). High Ca, low/normal PO4, high PTH. Stones, bones, groans, psychiatric overtones.

Key Associations: Brown tumors (osteoclast activity). Sestamibi scan for localization. Parathyroidectomy curative.

High-Yield Fact: *PTH: Pumps Ca up, Pushes PO4 out. Bone resorption releases Ca+PO4. Kidney: reabsorb Ca, excrete PO4.*

Board Relevance: Renal stones + bone pain + high Ca + high PTH = primary hyperparathyroidism. Surgery.

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134 Endo #9: Acromegaly

Pathophysiology: Excess GH after epiphyseal closure. Pituitary adenoma. Large hands/feet, coarse facies, macroglossia, organomegaly.

Key Associations: IGF-1 elevated. OGTT: GH not suppressed (<1 after glucose). MRI: pituitary adenoma. Complications: HTN, DM, CM, colon cancer.

High-Yield Fact: *GH -> liver -> IGF-1. Somatostatin analogues (octreotide). Transsphenoidal surgery first-line.*

Board Relevance: Large hands/feet + coarse features + deep voice + elevated IGF-1 + GH not suppressed on OGTT = acromegaly.

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135 Endo #10: Prolactinoma

Pathophysiology: Most common pituitary adenoma. Galactorrhea + amenorrhea (women), hypogonadism (men). Prolactin inhibited by dopamine.

Key Associations: Bitemporal hemianopia (suprasellar extension). Cabergoline (D2 agonist) shrinks tumor. MRI for macro vs micro.

High-Yield Fact: *Dopamine from hypothalamus inhibits prolactin. Dopamine agonists (cabergoline, bromocriptine) are treatment.*

Board Relevance: Woman + galactorrhea + amenorrhea + elevated prolactin + normal TSH = prolactinoma. Cabergoline.

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136 Endo #11: Hypopituitarism

Pathophysiology: Pituitary adenoma (#1 non-obstetric). Sheehan (postpartum hemorrhage -> infarction). Apoplexy (hemorrhage into adenoma).

Key Associations: Hormone loss order: GH -> LH/FSH -> TSH -> ACTH -> prolactin. Sheehan: failure of lactation, amenorrhea, fatigue.

High-Yield Fact: *Replace: hydrocortisone (ACTH), levothyroxine (TSH), sex steroids (LH/FSH). GH for children.*

Board Relevance: Postpartum hemorrhage + failure to lactate + amenorrhea + fatigue = Sheehan (pituitary infarction).

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137 Endo #12: Thyroid Nodules

Pathophysiology: Most benign. Papillary (80%): psammoma bodies, Orphan Annie nuclei, lymphatic spread. Follicular: hematogenous. Medullary: calcitonin, RET.

Key Associations: Anaplastic: worst prognosis, elderly. FNA for diagnosis. Papillary = nuclear features (grooves, pseudoinclusions).

High-Yield Fact: *Papillary = lymphatic, best prognosis. Medullary = MEN2 (RET). Anaplastic = rapid, lethal.*

Board Relevance: Thyroid nodule -> FNA. Papillary = most common. Medullary = elevated calcitonin, screen for MEN2.

---

138 Endo #13: Osteoporosis

Pathophysiology: DEXA: T-score <-2.5. Postmenopausal (#1 type). Risk: age, female, low BMI, smoking, steroids.

Key Associations: Treat: bisphosphonates (alendronate), SERMs (raloxifene), denosumab, teriparatide (anabolic, 2yr max).

High-Yield Fact: *Bisphosphonates: ONJ, esophageal irritation. Denosumab = RANKL inhibitor. Teriparatide = PTH analogue.*

Board Relevance: Postmenopausal woman + height loss + vertebral compression + T-score -2.9 = osteoporosis. Bisphosphonate.

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139 Endo #14: Metabolic Syndrome

Pathophysiology: 3 of 5: abdominal obesity (>40 in M, >35 in F), TG >150, HDL <40 M/<50 F, BP >130/85, FPG >100.

Key Associations: Central obesity -> insulin resistance. Increased CVD + T2DM risk. Lifestyle first: exercise + weight loss.

High-Yield Fact: *Waist circumference + TG + HDL + BP + glucose. Treat individual components.*

Board Relevance: Obese + HTN + low HDL + high TG + IFG = metabolic syndrome. Lifestyle modification.

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140 Endo #15: PCOS

Pathophysiology: Hyperandrogenism + ovulatory dysfunction. Most common female infertility cause. Insulin resistance + obesity.

Key Associations: LH:FSH >2. US: multiple ovarian cysts ('string of pearls'). Elevated androgens. Treat: OCPs, metformin, clomiphene.

High-Yield Fact: *PCOS = polycystic + anovulation + hyperandrogenism. Metformin improves ovulation.*

Board Relevance: Young woman + oligomenorrhea + hirsutism + acne + ovarian cysts = PCOS. LH/FSH >2.

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141 Endo #16: Hypoglycemia

Pathophysiology: Whipple triad: symptoms + low glucose + relief with glucose. Insulinoma: high insulin + high C-peptide. Factitious: high insulin + LOW C-peptide.

Key Associations: Exogenous insulin: C-peptide low (no endogenous secretion). Sulfonylurea: high C-peptide (stimulates secretion).

High-Yield Fact: *C-peptide = endogenous insulin marker. High = insulinoma/SU. Low = exogenous insulin.*

Board Relevance: Fasting hypoglycemia + high insulin + high C-peptide = insulinoma. High insulin + low C-peptide = exogenous insulin.

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142 Endo #17: MEN Syndromes

Pathophysiology: MEN1: 3 P's (Parathyroid, Pituitary, Pancreas). MEN2A: MTC + Pheo + Parathyroid. MEN2B: MTC + Pheo + Mucosal neuromas + Marfanoid.

Key Associations: MEN1 = menin (chr11). MEN2 = RET (chr10). MEN2B: mucosal neuromas on tongue/lips.

High-Yield Fact: *MEN1 = 'MEN1 = 3 P's.' MEN2A = '2 A's + P.' MEN2B = '2 B's (Bony/marfanoid, Bad neuromas).'*

Board Relevance: Hypercalcemia + insulinoma/gastrinoma + prolactinoma = MEN1. MTC family history = MEN2 screening.

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143 Endo #18: Adrenal Incidentaloma

Pathophysiology: Incidental adrenal mass on imaging. Evaluate for hyperfunction: Cushing (DST), pheo (metanephrines), Conn (aldo/renin).

Key Associations: CT: <10 HU = likely benign adenoma (lipid-rich). Washout >60% = adenoma. >4cm or atypical = concern malignancy.

High-Yield Fact: *Surgery if functional or >4cm. Non-functional <4cm = follow with imaging.*

Board Relevance: Incidental adrenal mass -> evaluate for hyperfunction. <10 HU = benign adenoma.

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144 Endo #19: GH Deficiency

Pathophysiology: Children: short stature, delayed bone age. Adults: decreased muscle, increased fat, low bone density, fatigue.

Key Associations: Low IGF-1. Insulin tolerance test (gold standard for diagnosis). Treat with recombinant GH.

High-Yield Fact: *GH is pulsatile = random GH not diagnostic. IGF-1 reflects integrated GH secretion.*

Board Relevance: Child + short stature + slow growth velocity + delayed bone age + low IGF-1 = GH deficiency.

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145 Endo #20: Hashimoto Thyroiditis

Pathophysiology: Autoimmune destruction. Anti-TPO + anti-Tg. Most common hypothyroid cause in iodine-sufficient areas.

Key Associations: Lymphocytic infiltration, germinal centers. Goiter -> atrophy. Painless. Associated with other autoimmune.

High-Yield Fact: *'HashiMOTO runs you down.' Higher thyroid lymphoma risk (rare). Levothyroxine replacement.*

Board Relevance: Woman + fatigue + cold intolerance + goiter + high TSH + anti-TPO+ = Hashimoto.

---

146 Endo #21: Subacute Thyroiditis

Pathophysiology: De Quervain: post-viral, PAINFUL thyroid, triphasic course (hyper->hypo->euthyroid). Lymphocytic: postpartum, painless.

Key Associations: Elevated ESR, low RAIU (inflammation -> hormone leak). NSAIDs + BB for hyperthyroid symptoms.

High-Yield Fact: *Painful thyroid + hyperthyroid labs + low RAIU = subacute thyroiditis. NO antithyroid drugs needed.*

Board Relevance: Painful thyroid after URI + hyperthyroid symptoms + low TSH + low RAIU + high ESR = De Quervain.

---

147 Endo #22: CAH

Pathophysiology: 21-hydroxylase deficiency (90%): impaired cortisol + aldosterone. ACTH increase -> adrenal hyperplasia -> androgen excess.

Key Associations: Female pseudohermaphroditism. Salt-wasting crisis: hyponatremia, hyperkalemia. Elevated 17-OHP.

High-Yield Fact: *21-OH = most common CAH. 11-OH: HTN. 17-OH: HTN + sexual infantilism.*

Board Relevance: Newborn + ambiguous genitalia + hyponatremia + hyperkalemia + high 17-OHP = CAH (21-OH). Hydrocortisone + fludrocortisone.

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148 Endo #23: Vitamin D

Pathophysiology: D3 from skin (UVB) or diet -> 25-OH (liver) -> 1,25-(OH)2 (kidney, 1-alpha-hydroxylase). Active form increases Ca/PO4 absorption.

Key Associations: Deficiency: rickets (children), osteomalacia (adults). 25-OH D = best storage marker. PTH increases 1-alpha-hydroxylase.

High-Yield Fact: *1,25-(OH)2 D = active, shortest half-life. 25-OH D = storage form, measured for deficiency.*

Board Relevance: Child + bow legs + rachitic rosary + frontal bossing = rickets. Adult + bone pain + pseudofractures = osteomalacia.

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149 Endo #24: PTH & Ca Regulation

Pathophysiology: PTH: bone resorption (Ca+PO4), kidney: Ca reabsorb (DCT), PO4 excrete, 1-alpha-hydroxylase activation. CaSR on chief cells.

Key Associations: High Ca activates CaSR -> decreased PTH. Calcitonin: opposes PTH (lowers Ca), not essential in humans.

High-Yield Fact: *PTH = main Ca regulator. 1,25-(OH)2 D = increases intestinal Ca absorption.*

Board Relevance: Post-thyroidectomy: hypocalcemia (low PTH). Treat: Ca + calcitriol. Accidental parathyroid removal.

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150 Endo #25: DI Workup

Pathophysiology: Water deprivation test: measure Uosm after dehydration. Give DDAVP. Central DI: Uosm increases >50%. Nephrogenic: no response.

Key Associations: Primary polydipsia: concentrates urine normally during deprivation (no DI).

High-Yield Fact: *Central = pituitary (low ADH). Nephrogenic = kidney resistance (lithium). Psychogenic = excessive intake.*

Board Relevance: Polyuria + polydipsia + dilute urine. Deprive water -> stays dilute = DI. DDAVP: concentrates = central.

SECTION 7: MICROBIOLOGY & IMMUNOLOGY

151 Micro #1: Gram+ Cocci

Pathophysiology: S. aureus: catalase+, coagulase+, beta-hemolytic, protein A (binds Fc IgG). GAS: catalase-, beta, bacitracin S, M protein. S. pneumoniae: alpha, optochin S.

Key Associations: S. aureus: abscesses, IE, osteomyelitis, TSS (TSST-1), SSSS (exfoliatin). MRSA = mecA (altered PBP2a). GAS: pharyngitis, NF, PSGN, RF.

High-Yield Fact: *Catalase: bubbles = staph, no bubbles = strep. Coagulase = S. aureus. S. pneumoniae = rusty sputum, meningitis in adults.*

Board Relevance: Gram+ clusters + catalase+ + coagulase+ = S. aureus. Gram+ chains + catalase- + beta-hemolytic + bacitracin S = GAS.

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152 Micro #2: Gram- Bacteria

Pathophysiology: E. coli: lactose+, #1 UTI. Klebsiella: lactose+, mucoid, pneumonia in alcoholics. Pseudomonas: oxidase+, non-lactose, green, nosocomial.

Key Associations: Lactose fermenters (MacConkey pink): E. coli, Klebsiella, Enterobacter, Citrobacter. Non-lactose: Pseudomonas, Salmonella, Shigella, Proteus.

High-Yield Fact: *Pseudomonas = oxidase+ (unique for enteric gram-). E. coli = indole+. Klebsiella = indole-.*

Board Relevance: UTI: gram- rod, lactose+ = E. coli. Alcoholic pneumonia, mucoid = Klebsiella. Burns, green drainage = Pseudomonas.

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153 Micro #3: Antibiotic Mechanisms

Pathophysiology: Cell wall: penicillins/cephalosporins (bind PBPs), vancomycin (D-Ala-D-Ala). Protein: aminoglycosides (30S, bactericidal), tetracyclines (30S, static), macrolides (50S).

Key Associations: DNA: FQ (topoisomerase), rifampin (RNA pol). Metronidazole: toxic radicals in anaerobes. Aminoglycosides require O2 (no effect anaerobes).

High-Yield Fact: *Cell wall drugs = bactericidal. Aminoglycosides bacteriCIDAL despite protein target. Vancomycin = D-Ala-D-Ala.*

Board Relevance: Penicillin mechanism = binds PBPs (transpeptidases). MRSA resistance = altered PBP2a (mecA). VRE = VanA (D-Ala-D-Lac).

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154 Micro #4: Hypersensitivity

Pathophysiology: Type I: IgE (anaphylaxis, atopy). Type II: IgG/IgM vs cell antigens (AIHA, Goodpasture). Type III: immune complexes (SLE, serum sickness). Type IV: T-cell (contact dermatitis, PPD).

Key Associations: I = Immediate/IgE. II = cyto-II-toxic. III = Immune complex. IV = cell-mediated (delayed 48-72h).

High-Yield Fact: *Type I = mast cell degranulation, histamine. Type IV = sensitized T cells (no antibody).*

Board Relevance: Anaphylaxis minutes after bee sting = type I. PPD induration 48h = type IV. Serum sickness 1-2wk after antiserum = type III.

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155 Micro #5: HIV/AIDS

Pathophysiology: Retrovirus: RNA, reverse transcriptase, integrase. Infects CD4+ T cells via CD4 + CCR5/CXCR4. CCR5 delta-32 = resistance.

Key Associations: OI: CD4<200 = PJP (TMP-SMX ppx). CD4<100 = Toxo, Cryptococcus. CD4<50 = CMV retinitis, MAC. HAART: 2 NRTIs + INSTI.

High-Yield Fact: *Diagnosis: ELISA -> Western blot -> viral load. Acute: flu-like, high viral load.*

Board Relevance: CD4 150 + diffuse bilateral interstitial pneumonia = PJP. CD4 40 + retinal hemorrhages = CMV retinitis.

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156 Micro #6: Streptococci

Pathophysiology: Alpha: S. pneumoniae (optochin S), Viridans (optochin R). Beta: GAS (bacitracin S), GBS (bacitracin R, hippurate+). Gamma: Enterococcus.

Key Associations: GAS: M protein, ASO, DNase B. GBS: neonatal sepsis/meningitis, screen pregnant at 35-37wk, intrapartum PCN.

High-Yield Fact: *Alpha = partial (green). Beta = complete (clear). Gamma = none. GBS in pregnancy = PCN prophylaxis.*

Board Relevance: Neonate sepsis, gram+ chains, beta, hippurate+ = GBS. GAS = acute RF + PSGN + NF.

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157 Micro #7: Clostridia

Pathophysiology: Gram+ rods, spore-formers, anaerobes. C. tetani: tetanospasmin (blocks GABA/glycine -> spastic). C. botulinum: blocks ACh release -> flaccid.

Key Associations: C. perfringens: gas gangrene (myonecrosis), crepitus, lecithinase. C. difficile: pseudomembranous colitis, toxins A/B.

High-Yield Fact: *Tetanus = spastic (locked up). Botulinum = flaccid (melted). C. diff = watery diarrhea, pseudomembranes.*

Board Relevance: Unvaccinated, lockjaw, risus sardonicus = tetanus. Infant floppy after honey = botulism.

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158 Micro #8: Mycobacteria

Pathophysiology: M. TB: acid-fast, aerobic, cord factor. M. leprae: can't culture, cooler body areas. MAC: CD4<50, GI.

Key Associations: TB: caseating granulomas, Ghon/Ranke complex. Leprosy: tuberculoid (Th1, paucibacillary) vs lepromatous (Th2, multibacillary, leonine).

High-Yield Fact: *TB = pulmonary, reactivation: apical. MAC = GI in AIDS. Leprosy = skin + nerves (cooler areas).*

Board Relevance: AIDS + CD4 30 + diarrhea + wasting = MAC. Acid-fast blood culture. Azithromycin + ethambutol.

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159 Micro #9: Fungi

Pathophysiology: Candida: yeast + pseudohyphae, thrush, VVC. Aspergillus: septate, 45-degree, aspergilloma, invasive in neutropenia.

Key Associations: Cryptococcus: encapsulated yeast, India ink, meningoencephalitis in HIV. Mucormycosis: non-septate, 90-degree, DKA, rhinocerebral.

High-Yield Fact: *Aspergillus = septate + acute angle. Mucor = non-septate + right angle. Cryptococcus = capsule + India ink.*

Board Relevance: HIV + CD4 50 + headache + +India ink = cryptococcal meningitis. DKA + rhinocerebral = mucormycosis.

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160 Micro #10: Parasites

Pathophysiology: Malaria: Plasmodium, mosquito, cyclic fevers. Toxoplasma: cats, ring-enhancing brain lesions in HIV. Strongyloides: autoinfection, hyperinfection in steroids.

Key Associations: Pneumocystis jirovecii: ground-glass on CT, CD4<200, TMP-SMX. Ascaris: largest roundworm, Loeffler syndrome.

High-Yield Fact: *Falciparum = banana gametocytes, cerebral malaria. Sickle trait protects. Toxo = ring-enhancing lesions.*

Board Relevance: Traveler + cyclic fevers + ring forms on smear = malaria. HIV + CD4 100 + ring-enhancing brain lesions = toxo.

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161 Micro #11: Helminths

Pathophysiology: Nematodes: Enterobius (pinworm, tape test), Ascaris (Loeffler during lung migration), Strongyloides (hyperinfection).

Key Associations: Cestodes: Taenia (tapeworm), Echinococcus (hydatid cysts). Trematodes: Schistosoma (bladder Ca, liver fibrosis).

High-Yield Fact: *Pinworm = perianal itch, tape test. Ascaris = biliary obstruction. Schistosoma = eggs with spines.*

Board Relevance: Child + perianal itching + tape test + = pinworm. Traveler + eosinophilia + Loeffler = Ascaris lung phase.

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162 Micro #12: Viral Hepatitis

Pathophysiology: HAV: picornavirus, RNA, fecal-oral. HBV: hepadnavirus, DNA, parenteral/sexual. HCV: flavivirus, RNA, chronic.

Key Associations: HBV: HBsAg (active), anti-HBs (immune), anti-HBc (exposure). Vaccination = ONLY anti-HBs+. HDV requires HBV. HEV: waterborne, severe in pregnancy.

High-Yield Fact: *HAV/HEV = fecal-oral. HBV/HCV/HDV = blood. HBV DNA integrates = HCC without cirrhosis.*

Board Relevance: Anti-HAV IgM+ = acute HAV. HBsAg+ >6mo = chronic HBV. Anti-HCV+ = confirm with RNA.

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163 Micro #13: Herpesviruses

Pathophysiology: HSV-1: oral, encephalitis (temporal). HSV-2: genital, neonatal. VZV: chickenpox -> shingles (dermatomal). EBV: mono, Burkitt, nasopharyngeal.

Key Associations: CMV: owl's eye inclusions, retinitis in AIDS, transplant. HHV-8: Kaposi sarcoma. Roseola (HHV-6): high fever -> rash.

High-Yield Fact: *EBV = atypical lymphocytes (Downey cells), Monospot+. CMV = Monospot negative. VZV = Tzanck shows multinucleated giant cells.*

Board Relevance: College student mono: fever + pharyngitis + lymphadenopathy + Monospot+ = EBV. AIDS retinitis + owl's eye = CMV.

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164 Micro #14: STIs

Pathophysiology: Gonorrhea: gram- diplococci (intracellular), PCR. Chlamydia: intracellular, most common bacterial STI. Syphilis: T. pallidum, painless chancre.

Key Associations: Syphilis: secondary = rash palms/soles, condyloma lata. Tertiary = gummas, tabes dorsalis, Argyll Robertson pupil.

High-Yield Fact: *GC + CT often co-infect. Ceftriaxone + doxycycline. Syphilis: darkfield microscopy. Jarisch-Herxheimer with PCN.*

Board Relevance: Purulent urethral d/c + intracellular gram- diplococci = GC. Painless genital ulcer + darkfield+ = primary syphilis.

165 Micro #15: Sepsis

Pathophysiology: SIRS -> sepsis (SIRS + infection) -> severe (organ dysfunction) -> septic shock (hypotension despite fluids).

Key Associations: Blood cultures before Abx, lactate, IVF 30mL/kg, broad-spectrum Abx <1h. Norepinephrine first-line pressor.

High-Yield Fact: *qSOFA: RR>22, AMS, SBP<100. Septic shock mortality 30-40%.*

Board Relevance: Febrile + tachycardic + hypotensive after IVF + lactate 4 = septic shock. Abx within 1h + norepinephrine.

166 Micro #16: Nosocomial Infections

Pathophysiology: MRSA, VRE, ESBL (gram-), C. difficile. MRSA = vancomycin/linezolid. VRE = linezolid/daptomycin. ESBL = carbapenems.

Key Associations: C. diff: pseudomembranous colitis, oral vancomycin or fidaxomicin. Prevention: hand hygiene, chlorhexidine baths.

High-Yield Fact: *ESBL = extended-spectrum beta-lactamase. CRE = carbapenem-resistant (colistin last resort).*

Board Relevance: Hospitalized + diarrhea after broad Abx + +C. diff toxin = pseudomembranous colitis. Stop Abx, PO vancomycin.

167 Micro #17: Vaccines

Pathophysiology: Live attenuated: MMR, VZV, rotavirus, intranasal flu, yellow fever. Contraindicated: pregnancy, immunocompromised.

Key Associations: Inactivated: injectable flu, HAV, rabies. Toxoid: tetanus, diphtheria. Conjugate: Hib, PCV. Recombinant: HBV, HPV.

High-Yield Fact: *Live vaccines = mild disease possible, CI in pregnancy/immunocompromised. Inactivated = safe in both.*

Board Relevance: Pregnant: only Tdap + inactivated flu. HIV CD4<200: avoid live vaccines.

168 Micro #18: Malaria

Pathophysiology: P. falciparum: most severe, cerebral, drug resistance, banana gametocytes, infects all RBC ages. P. vivax/ovale: dormant hypnozoites in liver.

Key Associations: Diagnosis: thick/thin smears. Falciparum: multiple rings per RBC, high parasitemia. Vivax: enlarged RBCs, Schuffner dots.

High-Yield Fact: *Falciparum = high parasitemia. Vivax/ovale need primaquine (check G6PD first) to clear hypnozoites.*

Board Relevance: Traveler + fever + ring forms, banana gametocytes = P. falciparum. Chloroquine resistance common.

169 Micro #19: Antibiotic Resistance

Pathophysiology: Beta-lactamase: hydrolyzes ring. ESBL: extended. Carbapenemase (KPC, NDM). MRSA: mecA -> altered PBP2a. VRE: VanA (D-Ala-D-Lac).

Key Associations: Efflux: tetracycline. Target modification: macrolides (erm gene methylates 50S). Enzymatic mod: aminoglycoside-modifying enzymes.

High-Yield Fact: *CRE = 'superbugs.' Colistin = last resort. Stewardship: narrowest effective Abx, shortest duration.*

Board Relevance: MRSA = vancomycin. VRE = linezolid/daptomycin. ESBL = carbapenem. CRE = colistin.

170 Micro #20: Innate vs Adaptive

Pathophysiology: Innate: immediate, non-specific, no memory (barriers, complement, phagocytes, NK cells). Adaptive: delayed, specific, memory (B cells: Ab, T cells: cellular).

Key Associations: MHC I: all nucleated cells, CD8+. MHC II: APCs (macrophages, dendritic, B cells), CD4+.

High-Yield Fact: *Innate = minutes-hours. Adaptive = 5-7 days primary response, memory for decades. Vaccines leverage this.*

Board Relevance: Recurrent pyogenic = B-cell deficiency. Recurrent viral/fungal = T-cell deficiency. Recurrent Neisseria = complement deficiency.

171 Micro #21: Immunodeficiency

Pathophysiology: Bruton (XLA): no B cells, low all Ig, recurrent bacterial after 6mo (maternal Ab wanes). CVID: low Ig, adult onset. DiGeorge: thymic aplasia, T-cell, cardiac, hypocalcemia.

Key Associations: SCID: absent T + B cells, bubble boy, ADA deficiency most common. Wiskott-Aldrich: eczema + thrombocytopenia + recurrent infections.

High-Yield Fact: *Ataxia-telangiectasia: cerebellar ataxia + telangiectasias + IgA deficiency. Hyper-IgM: CD40L defect.*

Board Relevance: Male infant recurrent bacterial after 6mo + absent B cells + low Igs = Bruton. Newborn cardiac + hypocalcemia + infections = DiGeorge.

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172 Micro #22: Complement

Pathophysiology: C1qrs -> C4,2 (classical) -> C3 -> C5 -> C5b-9 (MAC). Alternative: direct C3. Lectin: MBL.

Key Associations: C3 deficiency = recurrent pyogenic. C5b-9 = recurrent Neisseria. C1 esterase inhibitor deficiency = hereditary angioedema.

High-Yield Fact: *C3a/C5a = anaphylatoxins. C3b = opsonization. C5b-9 = lysis. C1 INH deficiency = uncontrolled bradykinin.*

Board Relevance: Recurrent meningococcal = C5b-9 deficiency. Recurrent swelling without urticaria + family history = HAE.

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173 Micro #23: Transplant Immunology

Pathophysiology: Hyperacute: preformed Ab (minutes). Acute: T-cell (days-weeks). Chronic: Ab + cellular, fibrosis (months-years). GVHD: donor T cells attack host.

Key Associations: GVHD: maculopapular rash, diarrhea, jaundice (skin, gut, liver). Most common in BMT. Immunosuppression: tacrolimus, MMF, steroids.

High-Yield Fact: *Hyperacute = cross-match positive (pre-existing anti-HLA). GVHD = bone marrow transplant complication.*

Board Relevance: Renal transplant: hyperacute minutes after anastomosis (preformed Ab). BMT patient: rash + diarrhea + jaundice = GVHD.

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174 Micro #24: Autoantibodies

Pathophysiology: ANA: SLE (sensitive, not specific). Anti-dsDNA: SLE (specific, disease activity). Anti-Smith: SLE (highly specific). Anti-histone: drug-induced lupus.

Key Associations: Anti-centromere: CREST. Anti-Scl-70: diffuse scleroderma. Anti-Ro/SSA + La/SSB: Sjogren, neonatal lupus (congenital heart block).

High-Yield Fact: *c-ANCA (PR3): GPA (Wegener). p-ANCA (MPO): MPA, Churg-Strauss. Anti-GBM: Goodpasture (linear IgG).*

Board Relevance: Malar rash + oral ulcers + +dsDNA/+Smith = SLE. Sinusitis + hemoptysis + +c-ANCA = GPA. Hemoptysis + hematuria + +anti-GBM = Goodpasture.

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175 Micro #25: Rheumatoid Arthritis

Pathophysiology: Autoimmune symmetric polyarthritis. Anti-CCP (highly specific), RF (IgM anti-IgG Fc). Pannus -> joint destruction.

Key Associations: MCP + PIP (DIP spared). Morning stiffness >1h. Rheumatoid nodules. Felty: RA + splenomegaly + neutropenia.

High-Yield Fact: *HLA-DR4. Treat: MTX first-line, biologics (TNFi). Anti-CCP > RF for specificity.*

Board Relevance: Woman + morning stiffness + symmetric MCP/PIP swelling + +anti-CCP/+RF = RA. MTX first-line.

SECTION 8: PHARMACOLOGY

176 Pharm #1: Autonomics

Pathophysiology: Sympathetic: alpha-1 (vasoconstriction), alpha-2 (decrease NE), beta-1 (heart rate/contractility), beta-2 (bronchodilation). Parasympathetic: muscarinic, nicotinic.

Key Associations: Alpha-1 blocker (prazosin): vasodilation. BB: decreased HR. Beta-2 agonist (albuterol): bronchodilation. Atropine: antimuscarinic.

High-Yield Fact: *Sympathetic = fight/flight (NE/Epi). Parasympathetic = rest/digest (ACh).*

Board Relevance: Anaphylaxis: epinephrine (alpha-1 + beta-2). BB OD: glucagon. Organophosphate: atropine + pralidoxime.

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177 Pharm #2: Drug Toxicities

Pathophysiology: Acetaminophen: hepatotoxicity (NAPQI), NAC. Aspirin: met acidosis + resp alkalosis, tinnitus. Aminoglycosides: nephro/oto.

Key Associations: Vancomycin: Red man (histamine). Metformin: lactic acidosis. Amiodarone: pulmonary fibrosis, thyroid, liver.

High-Yield Fact: *APAP = Ace the liver. Vanco = Red man (slow infusion). Metformin = hold before contrast.*

Board Relevance: APAP OD: RUQ pain + elevated LFTs = NAC. Aspirin OD: tinnitus + mixed acid-base. Amiodarone: PFTs/LFTs/TFTs.

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178 Pharm #3: CYP450 Interactions

Pathophysiology: Inducers (increase metabolism): barbiturates, phenytoin, rifampin, carbamazepine, St John's Wort, chronic EtOH. Inhibitors: cimetidine, ketoconazole, macrolides, grapefruit.

Key Associations: Warfarin: inducers decrease INR, inhibitors increase INR (bleeding). OCPs: inducers decrease efficacy.

High-Yield Fact: *'SICKFACES.COM' inhibitors. 'RBC PGS' inducers.*

Board Relevance: Warfarin + rifampin = decreased INR. Warfarin + fluconazole = increased INR.

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179 Pharm #4: Adverse Drug Reactions

Pathophysiology: ACEi: cough (bradykinin), angioedema, hyperkalemia. ARB: no cough. Amiodarone: pulmonary, thyroid, liver, corneal, blue skin.

Key Associations: Statins: myopathy, hepatotoxicity. Metformin: lactic acidosis. ACEi CI in bilateral RAS.

High-Yield Fact: *ACEi cough = bradykinin accumulation. ARB = no bradykinin effect = no cough.*

Board Relevance: Lisinopril -> dry cough = switch to ARB. Metformin + contrast = lactic acidosis risk.

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180 Pharm #5: Anticoagulants

Pathophysiology: Heparin: activates ATIII, inhibits IIa + Xa, aPTT, protamine reversal. LMWH: mainly Xa. Warfarin: vit K epoxide reductase inh, factors II/VII/IX/X + protein C/S.

Key Associations: HIT: Ab vs PF4-heparin, thrombosis. Stop heparin, start argatroban. Warfarin skin necrosis: protein C deficiency.

High-Yield Fact: *Heparin = rapid, IV. Warfarin = slow, PO. Bridge with heparin (warfarin initially prothrombotic).*

Board Relevance: Heparin day 5: thrombocytopenia + thrombosis = HIT. Argatroban. Warfarin skin necrosis = protein C deficiency.

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181 Pharm #6: Diabetes Meds

Pathophysiology: Metformin: decrease hepatic gluconeogenesis, first-line T2DM. SUs: increase insulin secretion (hypoglycemia). DPP-4i: increase GLP-1.

Key Associations: SGLT2i: glycosuria, weight loss, UTI. GLP-1 agonists: injectable, weight loss. Insulin: T1DM + advanced T2DM.

High-Yield Fact: *Metformin = weight neutral, no hypoglycemia. SUs = hypoglycemia, weight gain. SGLT2i = euglycemic DKA possible.*

Board Relevance: T2DM: start metformin. A1c >7.5% = dual therapy. A1c >9% = insulin. SGLT2i for CVD/CKD benefit.

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182 Pharm #7: Asthma/COPD Meds

Pathophysiology: SABA (albuterol): rescue. LABA (salmeterol): never monotherapy. ICS (fluticasone): cornerstone persistent asthma. LAMA (tiotropium): long-acting anticholinergic.

Key Associations: COPD: LAMA or LABA first, add ICS for frequent exacerbations. Theophylline: narrow TI, seizures/arrhythmia.

High-Yield Fact: *Never LABA alone (increased mortality). ICS always with LABA.*

Board Relevance: Asthma step: SABA -> ICS -> ICS+LABA. COPD: LAMA first. Theophylline toxicity: nausea, tremor, seizure.

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183 Pharm #8: Antidepressants

Pathophysiology: SSRIs (fluoxetine, sertraline): 5-HT reuptake inhibition, first-line. SNRIs (venlafaxine): also NE. TCAs: cardiotoxic (Na channel), lethal OD.

Key Associations: MAOIs: hypertensive crisis with tyramine. Serotonin syndrome: hyperthermia, rigidity, clonus (SSRI + MAOI).

High-Yield Fact: *SSRIs = safest, sexual SE. TCAs = 3 C's (Cardio, Convulsions, Coma). MAOIs = tyramine avoidance.*

Board Relevance: SSRI + MAOI = serotonin syndrome. TCA OD: wide QRS + hypotension = NaHCO3.

184 Pharm #9: Antipsychotics

Pathophysiology: 1st gen (typical): haloperidol, D2 blockade -> EPS (dystonia, akathisia, parkinsonism, tardive dyskinesia), hyperprolactinemia.

Key Associations: 2nd gen (atypical): risperidone, olanzapine, clozapine. Clozapine: agranulocytosis (ANC monitoring), most effective.

High-Yield Fact: *EPS: dystonia (acute, hrs), parkinsonism (wks), TD (months-yrs, potentially irreversible). NMS: hyperthermia + rigidity + high CK.*

Board Relevance: Haloperidol -> oculogyric crisis = acute dystonia (benztropine). Clozapine + fever + no ANC = agranulocytosis.

185 Pharm #10: Opioids

Pathophysiology: Mu agonists: morphine, fentanyl, oxycodone. Analgesia, euphoria, respiratory depression, constipation, miosis.

Key Associations: OD triad: coma, respiratory depression, pinpoint pupils. Naloxone reversal. Withdrawal: not lethal (rhinorrhea, lacrimation, yawning).

High-Yield Fact: *Respiratory depression = cause of death. Naloxone short t1/2, may need repeat. Methadone/buprenorphine for maintenance.*

Board Relevance: Unresponsive + RR 4 + pinpoint pupils = opioid OD. Naloxone 0.4-2mg IV.

186 Pharm #11: Antiepileptics

Pathophysiology: Na channel: phenytoin, carbamazepine. GABA: BZDs, phenobarbital. Ca channel: ethosuximide (absence only). Valproate: broad spectrum.

Key Associations: Phenytoin: zero-order kinetics, nystagmus, gingival hyperplasia, hirsutism. Valproate: hepatotoxic, NTD. Ethosuximide: absence only.

High-Yield Fact: *Phenytoin = fetal hydantoin syndrome, CYP inducer. Valproate = avoid in pregnancy. Ethosuximide = only absence.*

Board Relevance: Phenytoin toxicity: nystagmus + ataxia. First-line GTC = valproate or lamotrigine.

187 Pharm #12: NSAIDs

Pathophysiology: Inhibit COX-1 (GI protection, platelets) and COX-2 (inflammation). Non-selective (ibuprofen) vs COX-2 selective (celecoxib).

Key Associations: GI: ulcers (COX-1). Renal: decreased GFR. Celecoxib = less GI but CV risk. Aspirin irreversibly inhibits COX.

High-Yield Fact: *PGE2 = gastric mucosa + renal blood flow. Aspirin = irreversible = antiplatelet. Other NSAIDs = reversible.*

Board Relevance: Chronic ibuprofen + epigastric pain = PUD. Avoid NSAIDs in CKD. Aspirin = only NSAID for CV prevention.

188 Pharm #13: Pharmacokinetics

Pathophysiology: Vd = amount / plasma concentration. High Vd = lipophilic (tissue distribution). Low Vd = hydrophilic (plasma). CL = volume cleared/unit time.

Key Associations: t1/2 = 0.693 * Vd / CL. Steady state = 4-5 t1/2. Bioavailability (F): fraction reaching systemic circulation.

High-Yield Fact: *Loading dose = Vd * target conc. Maintenance dose = CL * target conc.*

Board Relevance: IV F = 100%. First-pass metabolism reduces oral F. Loading dose fills Vd rapidly.

189 Pharm #14: Antimicrobial Spectrum

Pathophysiology: Pen G: gram+ cocci, spirochetes. Amoxicillin: broader gram-. Ampicillin: Listeria (add aminoglycoside synergy). Pip-tazo: Pseudomonas.

Key Associations: Cephalosporins: 1st (cefazolin), 2nd (cefuroxime), 3rd (ceftriaxone, crosses BBB), 4th (cefepime, Pseudomonas), 5th (ceftaroline, MRSA).

High-Yield Fact: *Ceftriaxone = meningitis, gonorrhea. Cefepime = nosocomial. Ceftaroline = only ceph active vs MRSA.*

Board Relevance: CAP meningitis: ceftriaxone + vancomycin. HAP: cefepime or pip-tazo.

190 Pharm #15: CV Drug Classes

Pathophysiology: ACEi/ARB: decrease afterload/preload. BB (carvedilol, metoprolol): HFrEF. Spironolactone: RALES trial. Digoxin: Na/K-ATPase inhibitor.

Key Associations: Digoxin: increased contractility, slows AV node. Toxicity: yellow vision, bidirectional VT, hypokalemia worsens. Dig-specific Fab.

High-Yield Fact: *GDMT for HFrEF: ACEi + BB + spironolactone + SGLT2i. Digoxin for AFib rate control.*

Board Relevance: HFrEF: ACEi/ARB + BB + MRA + SGLT2i. Digoxin: yellow vision + EKG changes = toxicity.

191 Pharm #16: Chemotherapy

Pathophysiology: Alkylating agents (cyclophosphamide): cross-link DNA, hemorrhagic cystitis (mesna). Antimetabolites (MTX, 5-FU): S-phase.

Key Associations: Doxorubicin: cardiotoxicity (cumulative). Bleomycin: pulmonary fibrosis. Cisplatin: nephro/ototoxicity. Vincristine: neuropathy.

High-Yield Fact: *VinCRIstine = CRIs-crosses nerves (neuropathy). VinBLAStine = BLASTS bone marrow (myelosuppression). MTX rescued by leucovorin.*

Board Relevance: Cyclophosphamide + mesna. Doxorubicin: cumulative cardiotoxicity -> echo monitoring. Bleomycin: avoid high FiO2.

192 Pharm #17: Immunosuppressants

Pathophysiology: CNIs: tacrolimus, cyclosporine (nephrotoxic, HTN, hyperglycemia). MMF: GI, myelosuppression. Sirolimus: mTOR inhibitor.

Key Associations: Cyclosporine: gingival hyperplasia, hirsutism. Tacrolimus: more neurotoxic, diabetogenic. Both require TDM.

High-Yield Fact: *Tacrolimus > cyclosporine for current regimens. MMF = no TDM needed.*

Board Relevance: Renal transplant: tacrolimus + MMF + prednisone. Check trough levels.

193 Pharm #18: Anesthetics

Pathophysiology: Inhaled: isoflurane, sevoflurane. MAC = potency. IV induction: propofol (rapid), etomidate (stable), ketamine (dissociative).

Key Associations: Malignant hyperthermia: succinylcholine or inhaled trigger. Hyperthermia, rigidity, tachycardia. Dantrolene (ryanodine receptor antag).

High-Yield Fact: *Succinylcholine = depolarizing NMB, fasciculations, hyperkalemia risk (burns, denervation).*

Board Relevance: Child develops hyperthermia + rigidity after succinylcholine = MH. Dantrolene STAT. AD.

194 Pharm #19: Psychiatric Meds

Pathophysiology: BZDs: GABA-A agonists, anxiolytic/sedation/amnestic. Flumazenil reversal. Lithium: mood stabilizer, narrow TI.

Key Associations: Lithium toxicity: tremor, nephrogenic DI, hypothyroid, Ebstein anomaly (teratogenic). Levels: 0.6-1.2 mEq/L.

High-Yield Fact: *Lithium toxicity treatment: hydration, dialysis if severe. Lithium-induced NDI: amiloride.*

Board Relevance: Bipolar on lithium develops polyuria + tremor = toxicity. Check level. Lithium NDI = amiloride.

195 Pharm #20: Antifungals

Pathophysiology: Azoles (fluconazole, voriconazole): CYP51 inhibition. Amphotericin B: binds ergosterol -> pores. Echinocandins: beta-glucan synthase.

Key Associations: Amphotericin B: nephrotoxic ('amphoterrible'), liposomal less toxic. Voriconazole: visual, CYP interactions.

High-Yield Fact: *Fluconazole = Candida (not Aspergillus). Voriconazole = Aspergillus. Echinocandin = Candida (azole-resistant).*

Board Relevance: Invasive aspergillosis = voriconazole. Cryptococcal meningitis = amphotericin B + flucytosine.

196 Pharm #21: Antivirals

Pathophysiology: Acyclovir: HSV/VZV, needs viral TK. Ganciclovir: CMV, needs viral kinase. Foscarnet: CMV resistant (no TK needed).

Key Associations: HAART: 2 NRTIs + INSTI (dolutegravir). NNRTI (efavirenz): CNS, CYP inducer. PI (ritonavir): CYP inhibitor (boosting).

High-Yield Fact: *Acyclovir = HSV/VZV only. Foscarnet = resistant CMV. Oseltamivir = influenza neuraminidase inhibitor.*

Board Relevance: Genital herpes: acyclovir 400mg TID. Shingles: 800mg 5x/day. CMV retinitis: ganciclovir or valganciclovir.

197 Pharm #22: Special Anticoagulation

Pathophysiology: Pregnancy: LMWH (does NOT cross placenta). Warfarin = teratogenic (nasal hypoplasia). DOACs = limited data.

Key Associations: HIT: stop all heparin, start argatroban or danaparoid. NO warfarin alone (protein C depletion).

High-Yield Fact: *Mechanical valve: warfarin (higher INR). AFib: DOACs preferred (less ICH, no monitoring).*

Board Relevance: Pregnant + DVT = LMWH. Mechanical mitral valve = warfarin INR 2.5-3.5. HIT: argatroban, warfarin after recovery.

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198 Pharm #23: Pediatric Pharmacology

Pathophysiology: Children: increased TBW (higher Vd hydrophilic), immature CYP450 (neonates), reduced protein binding.

Key Associations: Sulfonamides: kernicterus in neonates. Tetracyclines: tooth discoloration (<8yr). Chloramphenicol: gray baby. Aspirin: Reye.

High-Yield Fact: *Immature glucuronidation in neonates. Avoid sulfa (bilirubin displacement), tetracycline (teeth/bones), aspirin (Reye).*

Board Relevance: Neonate + jaundice = avoid sulfa. Child <8yr = avoid tetracycline. Febrile child = avoid aspirin.

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199 Pharm #24: Drugs in Pregnancy

Pathophysiology: Safe: PCN, cephalosporins, APAP, LMWH. Contraindicated: ACEi/ARB (renal dysgenesis), warfarin (embryopathy), valproate (NTD), isotretinoin.

Key Associations: Lithium: Ebstein anomaly. MTX: abortifacient, teratogenic. Statins: cat X. SSRIs: possible PPHN (small risk).

High-Yield Fact: *Most important = avoid known teratogens. Benefit vs risk.*

Board Relevance: UTI in pregnancy: nitrofurantoin (not at term) or cephalexin. Avoid TMP-SMX (1st: antifolate, 3rd: kernicterus).

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