Practical Lecture: Parathyroid Gland & Calcium Metabolism

I. Clinical Disorders – Diagnostic Approach

Step 1: Confirm Abnormal Calcium

- Repeat ionized calcium (gold standard) OR albumin-corrected total Ca
- Check magnesium (hypomagnesemia → functional hypoparathyroidism)

Step 2: Measure PTH – Decision Matrix

Serum Ca^{2+}	PTH Level	Diagnosis
↑	↑ or inappropriately normal	Primary Hyperparathyroidism
↑	↓	Malignancy (PTHrP), granulomatous disease
↓	↑	Secondary Hyperparathyroidism (CKD, Vit D deficiency)
↓	↓/inappropriately normal	Hypoparathyroidism

II. Hyperparathyroidism – Clinical Pearls

Type	Cause	Biochemical Signature	Key Features
Primary	Adenoma (85%), hyperplasia (15%)	↑ Ca^{2+} + ↑/normal PTH	"Stones, bones, groans, moans • Nephrolithiasis/nephrocalcinosis • Osteoporosis (osteitis fibrosa rare now) • >80% asymptomatic (routine labs)
Secondary	CKD, Vit D deficiency, malabsorption	↓ Ca^{2+} + ↑ PTH (appropriate)	Compensatory response to chronic hypocalcemia
Tertiary	Long-standing secondary → autonomy	↑ Ca^{2+} + ↑ PTH (post-renal transplant)	History of CKD required for diagnosis

III. Hypoparathyroidism – Practical Management

Common Causes:

- Postsurgical (75%) – most common
- Autoimmune (isolated or polyglandular)
- Genetic (DiGeorge syndrome)
- Infiltrative (hemochromatosis, Wilson disease)

Clinical Presentation:

Acute (<7 mg/dL)	Chronic
• Paresthesias, carpopedal spasm • Chvostek's sign (facial tap → twitch) • Trousseau's sign (BP cuff → hand spasm) • Prolonged QT → arrhythmias • Seizures, laryngospasm (life-threatening)	• Basal ganglia calcification → parkinsonism • Cataracts • Dental enamel hypoplasia • Dry skin, brittle nails

Diagnosis:

- ↓ Ionized Ca^{2+} + ↓ PTH (inappropriately low)

- ↑ Phosphate (loss of PTH phosphaturic effect)

Management:

1. Acute: IV calcium gluconate 10–20 mL of 10% solution over 10–20 min.
2. Chronic: Calcium carbonate/citrate + calcitriol 0.25–1.0 μg/day.

IV. Practical Teaching Tips

- Always check ionized calcium in hypoalbuminemia, critical illness
- Hypomagnesemia must be corrected first before treating hypocalcemia (Mg required for PTH secretion)
- In hypercalcemia: PTH ↑/normal = primary HPT; PTH ↓ = think malignancy (PTHrP)
- Asymptomatic primary HPT now >80% of cases – screen with routine labs
- CKD patients: Monitor for secondary HPT due to ↓ calcitriol production

Normal serum Ca^{2+} range: 8.5–10.5 mg/dL (ionized ~4.5–5.3 mg/dL)

Practical Adrenal gland

1. THE "BIG FOUR" CLINICAL DISORDERS

A. CUSHING'S SYNDROME (Hypercortisolism)

Most Common Cause: Iatrogenic (steroid medications) > Pituitary adenoma (Cushing's disease)

Spot the Patient:

- Central obesity + moon facies + buffalo hump
- Purple striae (>1 cm), easy bruising
- Proximal muscle weakness (can't rise from chair)
- Hypertension, glucose intolerance, hirsutism

3-Step Diagnosis:

1. Screen: Late-night salivary cortisol OR 1mg overnight dexamethasone suppression test
2. Confirm: Cortisol fails to suppress to <1.8 μg/dL
3. Localize: ACTH level
   - ACTH <10: Adrenal source (tumor/hyperplasia) → CT adrenals
   - ACTH >20: Pituitary vs. ectopic → high-dose dexamethasone test + MRI pituitary

B. ADDISON'S DISEASE (Primary Adrenal Insufficiency)

Most Common Cause: Autoimmune (80% in West), TB (worldwide)

Acute Crisis (Emergency!):

- Refractory hypotension, shock, vomiting, abdominal pain
- Hyponatremia + hyperkalemia (aldosterone deficiency)
- Hypoglycemia

Chronic Clues:

- Hyperpigmentation (palmar creases, buccal mucosa) from ↑ACTH/MSH
- Fatigue, weight loss, salt craving, postural dizziness

Gold Standard Diagnosis: ACTH stimulation (cosyntropin) test

- Give 250 μg cosyntropin IV → measure cortisol at 30/60 min

- Peak <18 μg/dL = adrenal insufficiency

- Confirm: ↑ACTH (>100 pg/mL) in primary AI

Management:

- Hydrocortisone 15-25 mg/day (2/3 AM, 1/3 PM)

- Fludrocortisone 0.1 mg/day (for mineralocorticoid replacement)

- Stress dose: Double/triple for illness/surgery; 100 mg IM for crisis

C. PRIMARY HYPERALDOSTERONISM (Conn's Syndrome)

Key Fact: Most common curable cause of secondary hypertension (5-10% of resistant HTN)

Etiology: Aldosterone-producing adenoma or bilateral hyperplasia

Clinical Clues:

- Resistant hypertension (≥3 drugs)

- Hypokalemia (only 30-50% — absence does NOT rule out!)

- Metabolic alkalosis, NO edema

Diagnosis Algorithm:

1. Screen: Aldosterone-to-renin ratio (ARR)

2. Confirm: Saline suppression test or oral salt loading

3. Subtype: CT/MRI → Adrenal venous sampling (AVS) is gold standard for lateralization if surgery planned

Treatment:

- Unilateral adenoma: Laparoscopic adrenalectomy (cure)

- Bilateral hyperplasia: Spironolactone (or eplerenone)

D. PHEOCHROMOCYTOMA

Definition: Catecholamine-secreting tumor of adrenal medulla (or extra-adrenal paraganglioma)

Classic Triad: (Present in <25% — don't wait for all three!)

1. Episodic headache

2. Diaphoresis (profuse sweating)

3. Palpitations/tachycardia

Red Flags:

- Paroxysmal hypertension with pallor (NOT flushing)

- Anxiety/panic attacks, weight loss despite normal appetite

- Rule of 10: 10% malignant, 10% bilateral, 10% extra-adrenal, 10% familial

Diagnosis:

- First-line: Plasma-free metanephrines OR 24-hr urine fractionated metanephrines

- Imaging: CT/MRI → Functional imaging (MIBG/PET) if metastatic suspected

CRITICAL Preoperative Preparation:

1. α-blockade FIRST (10-14 days): Phenoxybenzamine or doxazosin

   - Target: Orthostatic hypotension, nasal stuffiness, HR 90-100 bpm

2. β-blockade SECOND (only after full α-blockade!)

   - NEVER give β-blocker alone → unopposed α-stimulation → hypertensive crisis

3. Volume expansion: High salt diet + IV fluids (chronic vasoconstriction causes volume depletion)

Practical Lecture: Diabetes Mellitus – Complications & Perioperative Management

I. Acute Complications – Recognition & Emergency Management

Feature	Diabetic Ketoacidosis (DKA)	Hyperosmolar Hyperglycemic State (HHS)
Typical Patient	Type 1 DM (new-onset or insulin omission)	Type 2 DM (elderly, infection, medications)
Key Labs	• Glucose >250 mg/dL • pH <7.3, HCO_3 <18 • Ketones ↑↑ (serum/urine) • Anion gap >12	• Glucose >600 mg/dL • pH >7.3 (no significant acidosis) • Ketones absent/minimal • Osmolality >320 mOsm/kg
Mental Status	Alert to confused	Profound lethargy/coma (more severe)
Fluid Deficit	3–6 L	8–12 L (more severe dehydration)
Mortality	1–5%	10–20% (higher)

DKA/HHS Management Protocol (First 24 Hours):

1. Fluids FIRST (before insulin):

- 1–2 L NS over 1–2 hrs → reassess hemodynamics

- Continue 250–500 mL/hr (adjust for heart/renal failure)

2. Insulin (after initial fluid bolus):

- IV regular insulin 0.1 units/kg/hr (no bolus needed)

- Goal: Glucose ↓ 50–75 mg/dL/hr

- When glucose ~200 mg/dL (DKA) or ~300 mg/dL (HHS): Add D5W + 0.45% NaCl to prevent hypoglycemia while continuing insulin until anion gap closes (DKA)

3. Potassium (critical!):

- K^+ <3.3 mEq/L → hold insulin, give K^+ 20–30 mEq/hr until >3.3

- K^+ 3.3–5.2 → add 20–30 mEq K^+ to each liter of IV fluid

- K^+ >5.2 → hold K^+ replacement, recheck q2h

II. Chronic Complications – Screening Schedule (Practical Checklist)

Complication	Screening Test	Frequency	Action Threshold
Retinopathy	Dilated eye exam OR retinal photography	Annual (T1DM after 5 yrs; T2DM at diagnosis)	Refer to ophthalmology if any retinopathy
Nephropathy	UACR (urine albumin:creatinine ratio) + eGFR	Annual	UACR ≥30 mg/g → start ACEi/ARB regardless of BP
Neuropathy	10-g monofilament + vibration (128-Hz tuning fork)	Annual	Loss of protective sensation → daily foot inspection, footwear referral
ASCVD	Clinical history + lipid panel	At diagnosis, then annually	All diabetics ≥40 yrs: High-intensity statin regardless of LDL

III. Perioperative Management – Step-by-Step Protocol

A. Preoperative Risk Stratification

Parameter	Action
A1C <7%	Proceed with elective surgery
A1C 7–8.9%	Optimize 2–4 weeks if possible; acceptable for urgent surgery
A1C ≥9%	Delay elective surgery (↑ infection, poor wound healing)
Active DKA/HHS	Absolute contraindication – reschedule after metabolic stabilization

B. Medication Hold Times (Day of Surgery)

Drug Class	Hold Time	Rationale
Metformin	Hold 24h pre-op (if contrast planned: 48h)	Prevent lactic acidosis with AKI/contrast
SGLT2 inhibitors	Hold 3 days pre-op	Prevent euglycemic DKA during fasting
GLP-1 RAs (weekly)	Hold 1 week pre-op (semaglutide)	Reduce gastroparesis/aspiration risk
Insulin (basal)	Give 80% usual dose morning of surgery	Prevent fasting hyperglycemia
Insulin (prandial)	Hold (no meal)	Prevent hypoglycemia

C. Intraoperative Glucose Targets & Management

Setting	Target Range	Protocol
All surgical patients	100–180 mg/dL	• Check glucose q1–2h • Correction scale: – 150–200: 2 units regular insulin IV – 201–250: 4 units – 251–300: 6 units – >300: 8 units + recheck in 1h
Avoid	<80 mg/dL OR >250 mg/dL	Hypoglycemia → brain injury; Hyperglycemia → infection, AKI

D. Postoperative Transition to Subcutaneous Insulin

Critical Rule: Overlap IV insulin with subcutaneous dose by 2 hours to prevent rebound hyperglycemia

- Give scheduled basal insulin → wait 2 hours → stop IV insulin

- Resume prandial insulin with first meal

Practical Lecture: Preoperative Preparation in Obstructive Jaundice

Why Preparation is Mandatory

- Unprepared jaundiced patient = 20–40% mortality vs. 2–5% in non-jaundiced
- Bilirubin >10 mg/dL → exponential ↑ in infection, AKI, wound dehiscence
- Never operate without optimization – treat as metabolically poisoned patient

Key Clinical Recognition

Sign	Practical Meaning
Painless jaundice + dark urine + pale stools	"Surgical jaundice" – suspect malignancy until proven otherwise
Courvoisier's sign (palpable, non-tender gallbladder)	Malignant CBD obstruction (NOT stone disease)
Pruritus + bruising	Vitamin K deficiency → anticipate coagulopathy
Fever + jaundice + RUQ pain	Cholangitis → surgical emergency → antibiotics + urgent drainage

5-Step Preoperative Protocol

Step 1: Rule Out Cholangitis (Day 0 – EMERGENCY)

- Charcot's triad: Fever + jaundice + RUQ pain (present in only 50–70%)
- Action: Piperacillin-tazobactam IV + urgent ERCP drainage before any elective surgery

Step 2: Correct Coagulopathy (Day 1)

Intervention	When to Use	Dose	Recheck
Vitamin K IV	INR >1.3 (no active bleed)	10 mg IV over 30 min	INR at 6–12 hrs
FFP	INR >1.5 + active bleeding OR emergency surgery	10–15 mL/kg	INR 30 min post-infusion
PCC	Rapid reversal needed (e.g., intracranial bleed)	25–50 units/kg	INR 15 min post-infusion

Step 3: Nutritional Optimization (Day 2)

- MCT diet (medium-chain triglycerides) – absorbed without bile

- IV multivitamins + vitamin K daily

- Albumin <3.0 g/dL → consider albumin infusion pre-op (controversial but used in major centers)

Step 4: Biliary Drainage? (Day 3) – SELECTIVE Use

Drain IF	Method	Avoid Drainage in
• Cholangitis	ERCP stent/naso-biliary drain	• Simple choledocholithiasis → go straight to ERCP + stone extraction
• Bilirubin >20 mg/dL before major hepatectomy/Whipple	ERCP or PTBD	• Benign strictures (↑ cholangitis risk from stent)
• Severe malnutrition (albumin <2.8)	PTBD preferred	• Palliative surgery for unresectable cancer

Step 5: Final Preoperative Checklist (Day 4–5)

Parameter	Target	Action if Not Met
Total bilirubin	<10 mg/dL (ideally <8)	Delay surgery if >15 without drainage
INR	<1.5	Repeat Vit K ± FFP
Albumin	>3.0 g/dL	Continue nutritional support
Renal function	Stable creatinine	Hydration ± nephrology consult
Infection	Afebrile ×48h	Continue antibiotics until source controlled

Intraoperative Precautions

Risk	Prevention
Bleeding	Have FFP/cryoprecipitate/platelets ready; avoid hypothermia
Hypotension	Preload 1–2 L crystalloid before induction; have vasopressors ready
AKI	Maintain MAP >65 mmHg; avoid nephrotoxins; consider mannitol 12.5–25 g IV
Wound infection	Double antibiotic prophylaxis (e.g., cefazolin + metronidazole)

Practical Lecture: Portal Hypertension in Cirrhosis

I. Screening & Primary Prophylaxis

Finding on Endoscopy	Action
No varices	Repeat EGD in 2–3 years
Small varices	Annual EGD; consider beta-blocker if red wale signs or decompensated cirrhosis
Medium/large varices	Start primary prophylaxis: Non-selective beta-blocker (propranolol 20–80 mg BID or nadolol 20–160 mg daily) OR endoscopic band ligation (if beta-blocker contraindicated)

Key: Target heart rate 55–60 bpm with beta-blockers (max tolerated dose)

II. Acute Variceal Bleed – Emergency Protocol

Immediate Actions (First Hour):

1. Airway protection if encephalopathy present (intubate early)

2. Fluids: Crystalloid bolus 500–1000 mL → then restrictive transfusion

- Target Hb 7–8 g/dL (over-transfusion ↑ rebleeding risk)

3. Pharmacotherapy START IMMEDIATELY (before endoscopy):

- Octreotide 50 mcg IV bolus → 50 mcg/hr infusion × 3–5 days OR

- Terlipressin 2 mg IV q4–6h (if available)

4. Antibiotics MANDATORY (even if afebrile):

- Ceftriaxone 1 g IV daily × 5–7 days (prevents SBP, ↓ mortality 30%)

Definitive Management:

- EGD within 12 hours by experienced endoscopist

- Esophageal varices → band ligation

- Gastric varices → cyanoacrylate injection

- Rescue therapy if bleeding persists:

- Balloon tamponade (Sengstaken-Blakemore) as bridge → TIPS within 72h (Child-Pugh B/C)

III. Secondary Prophylaxis (After First Bleed)

Therapy	Protocol
Beta-blocker	Lifelong (max tolerated dose)
Band ligation	Repeat q1–2 weeks until varices eradicated
TIPS	If rebleeding despite dual therapy (covered stent preferred)

IV. Ascites Management

Scenario	Protocol
New ascites	• Sodium restriction (<2 g/day) • Spironolactone 100 mg → ↑ by 100 mg q7d to max 400 mg • Add furosemide 40 mg if inadequate response (ratio 100:40 spiro:furosemide)
Large-volume ascites	Therapeutic paracentesis + albumin 6–8 g/L removed (prevents circulatory dysfunction)
Refractory ascites	• TIPS if Child-Pugh <12 and no encephalopathy • Otherwise: serial paracentesis + albumin

SBP Prevention & Diagnosis:

- Diagnostic paracentesis for ALL new/worsening ascites (cell count + culture)

- SBP diagnosis: Ascitic fluid PMN ≥250 cells/μL

- Prophylaxis indicated if:

  - Prior SBP episode → norfloxacin 400 mg daily OR ciprofloxacin 750 mg weekly

  - Ascitic protein <1.5 g/dL + Child-Pugh ≥9

V. Hepatic Encephalopathy (HE)

Step	Action
1. Identify precipitant	GI bleed, infection, constipation, electrolyte disturbance, sedatives
2. First-line therapy	Lactulose titrated to 2–3 soft stools/day (start 30 mL BID)
3. Recurrent HE	Add rifaximin 550 mg BID

Practical Lecture: Hematemesis & Melena – Emergency Management

I. Immediate Triage: Stable vs. Unstable

Unstable (ACT NOW)	Stable (Can Delay 12–24h)
• Hypotension/tachycardia • Altered mental status/syncope • Massive fresh blood vomiting • Cirrhosis + any bleeding	• Normal vitals (including orthostatics) • Small amount "coffee grounds" • No comorbidities

II. Resuscitation Protocol – First 30 Minutes

Step	Action	Critical Detail
IV Access	Two large-bore (16–18G) lines	Avoid femoral lines (contamination risk)
Fluids	NS/LR bolus 1–2 L	Caution in cirrhosis: avoid overload → ↑ portal pressure
Transfusion	PRBCs to Hb 7–8 g/dL (restrictive)	↑ Target to 8–9 g/dL if CAD Over-transfusion ↑ rebleeding (especially varices)
Coagulopathy	• INR >1.5 → FFP 10–15 mL/kg OR PCC • Platelets <50k → transfuse before endoscopy • Warfarin → Vitamin K 10 mg IV + PCC	Reverse DOACs/heparin per protocol

III. Empiric Pharmacotherapy – START BEFORE ENDOSCOPY

Drug	Indication	Dose & Duration
PPI IV	ALL UGIB (even before endoscopy)	Bolus 80 mg → infusion 8 mg/hr × 72h if high-risk stigmata
Antibiotics	Cirrhosis + ANY bleed	Ceftriaxone 1 g IV daily × 5–7 days (↓ mortality 30%)
Octreotide	Suspected variceal bleed	50 mcg IV bolus → 50 mcg/hr infusion × 3–5 days

IV. Endoscopy – Timing & Technique

Scenario	Timing	First-Line Therapy
High-risk (unstable, cirrhosis, ongoing bleed)	Within 12 hours	• Varices: Band ligation (esophageal) / cyanoacrylate (gastric) • Ulcer: Epinephrine injection + thermal coagulation/clips
Stable	Within 24 hours	Same as above
High-risk stigmata (active spurting, visible vessel)	Post-therapy	Continue IV PPI 8 mg/hr × 72h

V. Rescue Therapies – When Endoscopy Fails

Therapy	Indication	Critical Limitation
Balloon tamponade (Sengstaken-Blakemore)	Massive variceal bleed uncontrolled by meds/endoscopy	Temporary bridge only (<24h); high complication rate (aspiration, necrosis)
TIPS	Refractory variceal bleed (Child-Pugh B/C)	Place within 72h of failed endoscopy
Angioembolization	Non-variceal arterial bleed	Requires interventional radiology
Surgery	Last resort after all fail	High mortality in cirrhosis

VI. Secondary Prevention – Discharge Planning

Cause	Prevention Strategy
Peptic ulcer	• Oral PPI 4–8 weeks • Test & treat H. pylori • Discontinue NSAIDs
Varices	• Lifelong propranolol (target HR 55–60 bpm) • Repeat banding q1–3 months until eradicated • Refer for transplant evaluation
All patients	• Avoid NSAIDs/anticoagulants unless essential • Educate on red flags (vomiting blood, melena)

Practical Lecture: Hemopneumothorax & Flail Chest

I. Hemopneumothorax – Emergency Recognition & Management

Red Flags Requiring Immediate Action:

Finding	Action
Hypotension + absent breath sounds + tracheal deviation	Tension physiology → needle decompression 2nd ICS MCL → chest tube STAT (do NOT wait for CXR)
Penetrating chest trauma + respiratory distress	Assume hemopneumothorax until proven otherwise

Chest Tube Thoracostomy – Practical Steps:

Step	Key Detail
Tube size	36–40 Fr (adults) – smaller tubes clog with clot
Site	"Triangle of safety": mid-axillary line, 4th–5th ICS, above rib (avoid neurovascular bundle below)
System	Underwater seal + −20 cm H_2O suction (to evacuate air + re-expand lung)
Confirmation	Bubbling (air leak) + blood drainage + repeat CXR within 1 hour

When to Call Surgery (Absolute Indications):

- Initial output ≥1500 mL OR
- Ongoing output >200 mL/hr for 2–4 consecutive hours OR
- Shock unresponsive to 2 L crystalloid + 2 units PRBCs

→ Thoracotomy/VATS within 1 hour

Clotted Hemothorax – Don't Miss:

- Suspect if: lung fails to re-expand on CXR despite tube placement
- Action: VATS evacuation within 48–72 hours (prevents empyema/fibrothorax)

II. Flail Chest – Manage Physiology, Not the Radiograph

Critical Concept: Morbidity driven by pulmonary contusion (not the flail segment itself). Paradoxical motion may be absent due to splinting – maintain high suspicion after significant blunt trauma.

Three-Pillar Management Protocol:

Pillar	First-Line Intervention	Avoid
1. Pain Control	• Regional anesthesia: ESP block or serratus plane block (ultrasound-guided) • Epidural if no coagulopathy/spine injury • Acetaminophen + low-dose ketamine infusion	Oversedation → impaired cough → atelectasis
2. Pulmonary Toilet	• Incentive spirometry hourly while awake • Assisted coughing + chest PT • Early ambulation (within 24h if stable)	Bed rest → pneumonia
3. Respiratory Support	• NIV (CPAP/BiPAP) if alert + PaO_2 >60 on FiO_2 ≤0.5 • Intubation if: – PaO_2 <60 on FiO_2 >0.5 – Altered mental status – Inability to clear secretions	Routine intubation for flail alone (increases pneumonia risk)

Ventilator Settings if Intubated:

- Tidal volume: 6 mL/kg ideal body weight

- Plateau pressure: <30 cm H_2O

Surgical Rib Fixation – Selective Indications:

- Respiratory failure despite optimal medical management

- Failure to wean from ventilator due to chest wall instability

- During same procedure if thoracotomy needed for evacuation

Practical Lecture: Respiratory Failure & ARDS Management

I. Respiratory Failure – Immediate Actions

Type	Diagnostic Clue	Initial Management
Type 1 (Hypoxemic) PaO_2 <60 mmHg	Bilateral infiltrates, shunt physiology	1. O_2 titration: SpO_2 88–92% (COPD) or 94–98% (others) 2. Escalate: NC → Venturi mask → HFNC → NIV → intubation 3. Rule out: PE, pneumonia, ARDS, pulmonary edema
Type 2 (Hypercapnic) $PaCO_2$ >50 mmHg	COPD exacerbation, opioid overdose, neuromuscular disease	1. Avoid aggressive O_2 in COPD → start 24–28% Venturi mask 2. NIV first-line for COPD/asthma exacerbation (BiPAP: IPAP 10–15, EPAP 5–8) 3. Intubate if: pH <7.25, GCS <8, or NIV failure at 1–2h

II. ARDS Diagnosis – Berlin Criteria (All Required)

1. Acute onset within 1 week of known insult (sepsis, pneumonia, aspiration, trauma)

2. Bilateral opacities on CXR/CT not fully explained by effusion/collapse

3. Not fully explained by cardiac failure (echo to rule out hydrostatic edema)

4. Hypoxemia on PEEP ≥5 cmH_2O:

- Mild: PaO_2/FiO_2 200–300
- Moderate: PaO_2/FiO_2 100–200
- Severe: PaO_2/FiO_2 <100

III. ARDS Management – The 5 Pillars (Evidence-Based)

Pillar 1: Lung-Protective Ventilation (MOST CRITICAL)

Parameter	Target	Why
Tidal volume	6 mL/kg predicted body weight (not actual weight)	↓ Volutrauma → 9% absolute mortality reduction
Plateau pressure	<30 cmH_2O	Prevents barotrauma
PEEP	≥5 cmH_2O; ↑ for moderate-severe ARDS	Prevents atelectrauma
FiO_2	Titrate to SpO_2 88–95%	Minimizes oxygen toxicity

Pillar 2: Prone Positioning

- Indication: Moderate-severe ARDS (PaO_2/FiO_2 <150)
- Protocol: ≥16 hours/day for ≥4 days
- Contraindications: Unstable spine, raised ICP, pregnancy, recent sternotomy
- Mortality benefit: 16% absolute reduction

Pillar 3: Conservative Fluid Strategy

- After initial resuscitation → neutral/negative fluid balance
- Avoid routine fluid boluses once hemodynamically stable
- Use diuretics/CRRT to remove excess fluid
- Target CVP ≤4 mmHg if possible

Pillar 4: Adjunctive Therapies (Selected Cases)

Therapy	When to Use	Dose/Duration
Neuromuscular blockade	Early severe ARDS (first 48h)	Cisatracurium 3.5 mcg/kg/min × ≤48h
Corticosteroids	Early moderate-severe ARDS (<14 days)	Methylprednisolone 1–2 mg/kg/day
ECMO	Refractory hypoxemia (PaO_2/FiO_2 <80 on FiO_2 1.0)	Transfer to ECMO center early

Pillar 5: Treat Underlying Cause

- Sepsis: Antibiotics within 1 hour + source control
- Pneumonia: Pathogen-directed antimicrobials
- Aspiration: NPO, HOB elevation, PPI

IV. Ventilator Troubleshooting – Rapid Response

Problem	Likely Cause	Action
↓ SpO_2 + ↑ peak pressure	Mucus plugging, bronchospasm	Suction ETT; bronchodilators
↓ SpO_2 + ↑ peak + ↑ plateau	Pulmonary edema, ARDS worsening	Check fluid status; consider diuresis

↓ SpO_2 + ↑ peak but normal plateau	Pneumothorax, ETT obstruction	STAT CXR; needle decompression if tension
Sudden hypotension	Tension pneumothorax, hypovolemia	Needle decompression 2nd ICS MCL → CXR → chest tube

V. Complications – Prevention Checklist

Complication	Prevention Strategy
Ventilator-associated pneumonia	HOB elevation 30–45°, oral chlorhexidine, sedation holidays
Barotrauma (pneumothorax)	Strict plateau pressure <30 cmH_2O
ICU-acquired weakness	Minimize sedation; early mobilization Day 1
Stress ulcer	PPI or H2 blocker for all mechanically ventilated patients
AKI	Conservative fluids after resuscitation; avoid nephrotoxins

Practical Lecture: Coagulopathy & DIC Management

I. Rapid Recognition – "Don't Miss" Clinical Signs

Bleeding Phenotype	Thrombotic Phenotype
• Oozing from IV sites/surgical wounds • Petechiae/purpura • Mucosal bleeding (epistaxis, gingival) • Hematuria/melena	• Acral cyanosis/ischemic digits • Oliguria (renal cortical necrosis) • Altered mental status (CNS microthrombi) • Respiratory failure (pulmonary microthrombi)

II. Diagnostic Workup – Minimum Essential Labs

Test	Expected in DIC	Action Threshold
Platelet count	↓ (<100,000/μL)	Transfuse if <50,000 with active bleed
PT/INR	Prolonged (>1.5×)	Give FFP if bleeding + INR >1.5
aPTT	Prolonged	Less useful acutely – treat clinically
Fibrinogen	↓ (<150 mg/dL)	Critical: Replace if <100–150 mg/dL
D-dimer	↑↑↑ (markedly elevated)	Confirms fibrinolysis; not quantitative for severity
Peripheral smear	Schistocytes	Suggests microangiopathy (TTP/HUS vs. DIC)

III. General Management – The "Big 3" Correctables

Before giving blood products, FIX these (they impair coagulation):

1. Hypothermia (<34°C) → Warm fluids, forced-air warming → target >36°C

2. Acidosis (pH <7.2) → Correct underlying cause; bicarbonate if severe

3. Hypocalcemia → Give calcium chloride 1 g IV after every 4 units PRBCs (citrate chelation)

IV. Component Therapy Algorithm – What to Give & When

Scenario	First-Line Therapy	Dose	Recheck
Active bleeding + INR >1.5	FFP	15–20 mL/kg (4 units adult)	INR 30 min post-infusion
Platelets <50,000 + bleed	Platelets	1 unit/10 kg (4–6 units adult)	Platelet count 1h post

Fibrinogen <150 mg/dL	Cryoprecipitate OR fibrinogen concentrate	Cryo: 10 units Concentrate: 3–4 g IV	Fibrinogen 1h post
Massive transfusion	Balanced ratio	PRBC:FFP:Platelets = 1:1:1	Labs q4–6h
Warfarin reversal + bleed	4-factor PCC + Vitamin K	PCC 25–50 units/kg + Vit K 10 mg IV	INR 15 min post-PCC

VI. Practical Pearls for ICU/Ward

1. Fibrinogen is the first clotting factor to fall in DIC – check early and replace aggressively
2. Platelet transfusion threshold: <10,000 prophylactic; <50,000 for active bleed/procedure
3. Tranexamic acid: Only if hyperfibrinolysis confirmed (elevated D-dimer + bleeding); avoid in thrombotic-predominant DIC
4. Never give heparin empirically in bleeding DIC – only if clear thrombotic complication (e.g., limb ischemia)
5. Monitor ionized calcium during massive transfusion – hypocalcemia causes refractory hypotension
6. Recheck labs after each round of component therapy – avoid over-transfusion

Practical Lecture: Sepsis & MODS Management

I. Rapid Recognition – Bedside Screening

Tool	Criteria	Action
qSOFA (quick screen)	≥2 of: • Altered mentation • SBP ≤100 mmHg • RR ≥22/min	High suspicion → check lactate + full sepsis workup
Sepsis-3 Definition	Suspected infection + ΔSOFA ≥2 points	Start 1-hour bundle immediately
Septic Shock	Vasopressors needed to maintain MAP ≥65 mmHg + lactate >2 mmol/L after fluids	ICU admission + aggressive resuscitation

II. The 1-Hour Bundle – Critical Actions

Step	Action	Target/Detail
1. Measure lactate	STAT venous lactate	>2 mmol/L = abnormal; repeat if initial >4
2. Blood cultures	2 sets from different sites (aerobic + anaerobic)	Draw before antibiotics if possible; do NOT delay antibiotics
3. Antibiotics	Broad-spectrum IV within 1 hour	• Community-acquired pneumonia: Ceftriaxone + azithromycin • Abdominal source: Piperacillin-tazobactam OR meropenem • UTI: Ceftriaxone OR piperacillin-tazobactam • Neutropenic: Meropenem + vancomycin
4. Fluids	30 mL/kg crystalloid bolus if hypotensive or lactate ≥4	Use balanced crystalloids (LR/Plasma-Lyte) – avoid normal saline (hyperchloremic acidosis)
5. Vasopressors	Start if hypotensive after initial fluid bolus	Norepinephrine first-line via central line; target MAP ≥65 mmHg

III. Resuscitation Targets – First 6 Hours

Parameter	Target	Monitoring
MAP	≥65 mmHg	Continuous arterial line if on vasopressors
Lactate	↓ by 10% at 2h; normalize by 6h	Repeat q2h until <2 mmol/L
Urine output	>0.5 mL/kg/hr	Foley catheter mandatory

$ScvO_2$	≥70% (if available)	Not required per latest guidelines
Fluid balance	Stop aggressive fluids after initial resuscitation	Goal-directed – avoid >3–4 L total in first 24h (↑ mortality)

IV. Source Control – Non-Negotiable

Source	Action Within 12 Hours
Intra-abdominal abscess	CT-guided drainage OR surgery
Cholangitis	ERCP with sphincterotomy/stent
Infected gallbladder/appendix	Cholecystectomy/appendectomy
Infected prosthetic device	Remove device
Infected IV line	Remove immediately

V. Organ Support in MODS

Organ Failure	Practical Management
Lungs (ARDS)	• Lung-protective ventilation: 6 mL/kg PBW, plateau pressure <30 cmH_2O • Prone positioning if PaO_2/FiO_2 <150 • Conservative fluids after resuscitation
Kidneys (AKI)	• Avoid nephrotoxins (NSAIDs, contrast) • RRT indications: severe acidosis (pH <7.15), K^+ >6.5, volume overload, uremic encephalopathy
Coagulopathy/DIC	• Transfuse platelets only if <10k (prophylactic) or <50k with active bleed • FFP if INR >1.5 + bleeding • Avoid prophylactic heparin in bleeding-predominant DIC
Encephalopathy	• Treat sepsis first • Minimize sedatives • Rule out hypoglycemia, intracranial bleed

VI. Antibiotic Stewardship

Timing	Action
0–1 hour	Broad-spectrum empiric coverage
48–72 hours	De-escalate based on culture results
Day 5–7	Stop if source controlled + clinical improvement (shorter courses non-inferior)

Practical Lecture: Electrical Injury Management

I. Critical Recognition – "Don't Miss" Red Flags

Finding	Significance	Action
High-voltage exposure (>1000V) or lightning	Massive tissue destruction, compartment syndrome risk	Admit for 24h cardiac monitoring + serial CK
Transthoracic pathway (hand-to-hand)	VF risk even if asymptomatic	ECG + 24h monitoring mandatory
Loss of consciousness	Cardiac/respiratory arrest risk	Full trauma workup + 24h monitoring
Painless tense compartment	Nerves destroyed first → absence of pain ≠ no compartment syndrome	Check CK + low threshold for fasciotomy
Oral commissure burn (pediatric)	Labial artery erosion → delayed hemorrhage at 2–3 weeks	Parent education + ENT follow-up

II. Emergency Department Protocol – First 60 Minutes

A. Primary Survey (ABCDE with Electrical Twists)

Step	Critical Action
Airway	Early intubation if: altered mental status, oral burns, or respiratory distress (tetany-induced diaphragmatic paralysis)
Breathing	High-flow O_2; watch for pulmonary edema (capillary leak)
Circulation	ECG immediately → continuous monitoring if: • Any abnormality • Loss of consciousness • Transthoracic pathway • High-voltage exposure
Disability	Spinal immobilization if fall mechanism; assess for spinal cord injury
Exposure	Identify entry + exit wounds (often multiple); remove smoldering clothing

B. Fluid Resuscitation – DIFFERENT from Thermal Burns

Parameter	Electrical Injury	Thermal Burn
Goal urine output	75–100 mL/hr	30–50 mL/hr
Rationale	Flush myoglobin to prevent AKI	Maintain perfusion

If myoglobinuria	Mannitol 12.5–25 g IV + alkalinize urine ($NaHCO_3$ to pH >6.5)	Not routinely needed

III. Diagnostic Workup – Minimum Essential

Test	When to Order	Critical Threshold
CK	All significant injuries	>1000 U/L → rhabdomyolysis risk; trend q6h
Urine myoglobin	If CK elevated	Tea-colored urine = late sign → act earlier
ECG	All patients	Any ST change/arrhythmia → 24h monitoring
X-rays	Fall mechanism or pain	Shoulder dislocation, vertebral fracture (tetanic contractions)
ABG	Acidosis/hypoxia	Metabolic acidosis → aggressive hydration

IV. Surgical Indications – Time-Sensitive

Procedure	Indication	Timing
Fasciotomy	Compartment syndrome (rising CK, tense compartment)	Within 6 hours – electrical injuries progress rapidly
Escharotomy	Circumferential chest burn compromising ventilation OR limb burn with vascular compromise	Immediate
Debridement	Non-viable tissue	Delayed 48–72h to demarcate extent
Amputation	"Mummified" limb with no perfusion	After vascular surgery consult

IV. Complications to Anticipate

Timeframe	Complication	Prevention/Monitoring
0–72h	• Rhabdomyolysis → AKI • Cardiac arrhythmias (VF up to 48h) • Compartment syndrome	Aggressive hydration; CK q6h; continuous ECG
1–4 weeks	• GI perforation (delayed necrosis) • Sepsis from necrotic tissue • Cataracts (high-voltage)	Abdominal exam q4h initially; ophthalmology referral
>1 month	• Peripheral neuropathy • Heterotopic ossification • PTSD	Early PT/OT referral; psychiatric screening

Practical Lecture: Coma & Altered Consciousness

I. Rapid Bedside Assessment – First 5 Minutes

Term	Key Clinical Clue	Action
Coma	Unarousable, eyes closed, GCS ≤8	Secure airway immediately; intubate if GCS <8
Stupor	Arousable only with pain; immediately returns to unresponsiveness	Urgent workup – treat as impending coma
Delirium	Acute fluctuating inattention ± agitation/hypoactivity	Check glucose, infection, drugs; avoid physical restraints

II. The "VITAMINS" Mnemonic – Systematic Differential

Category	Must-Not-Miss Causes	Bedside Clue
Vascular	ICH, SAH, large stroke	Sudden onset + headache ± focal signs
Infection	Meningitis, encephalitis, sepsis	Fever (may be absent in elderly) + nuchal rigidity
Trauma	Subdural/epidural hematoma, DAI	Even minor head injury in elderly on anticoagulants
Anoxic	Cardiac arrest, CO poisoning	Witnessed arrest; cherry-red lips (CO)
Metabolic	Hypoglycemia, hyponatremia, hepatic/uremic encephalopathy	Check glucose FIRST; stigmata of liver/kidney disease
Ictal	Non-convulsive status epilepticus	Subtle twitching; prior seizure history → EEG required
Neoplasm	Brain tumor, metastases	Progressive decline + morning headache
Substances	Opioids, benzos, alcohol	Pinpoint pupils (opioids) vs. dilated (anticholinergics)

III. Immediate Interventions – First 5 Minutes (Do Before Imaging)

Action	Dose/Method	When to Give
Check glucose	Bedside glucometer	ALL comatose patients
D50W	25g IV (50 mL of 50% dextrose)	Glucose <60 mg/dL
Naloxone	0.4–2 mg IV push	Suspected opioid overdose (pinpoint pupils + respiratory depression)
Oxygen	High-flow via non-rebreather	Saturation <94%
Thiamine	100 mg IV	Before glucose in alcoholics/malnourished (prevents Wernicke's)

IV. Focused Neuro Exam – Localize the Lesion

Component	Critical Finding	Localization
Pupils	Unilateral dilation + sluggish	Uncal herniation → neurosurgical emergency
	Bilateral pinpoint	Pontine lesion or opioids
	Bilateral fixed/dilated	Severe anoxic injury or brain death
Oculocephalic (Doll's eyes)	Absent movement	Midbrain/pons injury
Motor posturing	Decorticate (arms flexed)	Thalamic/internal capsule
	Decerebrate (arms extended)	Midbrain/upper pons → worse prognosis
	Flaccid	Medulla or diffuse injury

Herniation Red Flags (Call neurosurgery STAT):

- Unilateral dilated pupil + contralateral weakness = uncal herniation

- Cushing triad (HTN + bradycardia + irregular breathing) = tonsillar herniation

V. Diagnostic Workup – Imaging Decisions

Scenario	Action	Timing
Focal signs OR trauma OR sudden headache	Non-contrast Head CT STAT	Within 30 min
Normal CT + no focal signs + suspected seizure	EEG	Within 1–2 hours
Suspected encephalitis (fever + altered mental status)	MRI brain + LP after CT rules out mass	After stabilization
Metabolic suspicion (no focal signs)	Labs first → CT if no improvement	Labs within 15 min

Practical Guide: Venomous Bites & Stings

FIRST AID: DO vs. DON'T

DO	DON'T
• Immobilize limb + keep patient calm • Remove rings/jewelry before swelling • Pressure Immobilization Technique (PIT) for neurotoxic bites (elapids): elastic bandage 40–70 mmHg + splint entire limb • Rapid transport to antivenom-capable facility	• Tourniquets (↑ necrosis/compartment syndrome) • Cutting/sucking wound (no benefit, ↑ infection) • Ice application (↑ tissue damage) • Electric shock/herbal remedies

PIT Note: Use only for elapids (cobras, kraits, coral snakes). Avoid for vipers—worsens local necrosis.

RECOGNIZE LIFE-THREATENING SIGNS ("4 D's")

Domain	Mild	Severe → ACT NOW
Local	Pain, minimal swelling	Rapid edema (>50% limb in 48h), blistering, compartment syndrome
Hematologic	—	Spontaneous bleeding (gums/GI), DIC, platelets <100k
Neurologic	—	Ptosis → diplopia → dysphagia → respiratory paralysis
Systemic	Nausea	Shock, AKI, ARDS

Neurotoxic progression: Ptosis → ophthalmoplegia → bulbar weakness → respiratory failure (hours). Monitor q15–30min.

ANTIVENOM: Key Practical Points

- Indication: Clinical envenomation (not bite mark alone)

- Dosing: Species-specific; severe bites = 4–10 vials initially

- Admin: IV infusion over 1–2h (dilute in NS)

- Premedication: NOT routine (delays treatment; steroids/antihistamines don't prevent anaphylaxis)

- Monitor for:

  → Acute reaction (anaphylaxis: 5–20%)

  → Serum sickness (5–23 days later)

ESSENTIAL LAB MONITORING

Test	Timing	Purpose
INR/PT, aPTT, fibrinogen	Baseline, 1h, 6h, 12h, then q12h	Coagulopathy/DIC
CK	Baseline, 6h, 12h	Rhabdomyolysis (myotoxic venoms)
Creatinine	Baseline, 24h	AKI risk
FBC	Baseline, 6h	Thrombocytopenia

Practical Guide: Anaphylaxis & Transfusion Reactions

ANAPHYLAXIS: Epinephrine-First Protocol

Diagnosis (NIAID Criteria – treat if ≥1 met):

✓ Acute onset + skin/mucosal signs AND respiratory compromise OR hypotension

✓ ≥2 systems involved after allergen exposure (skin, resp, CV, GI)

✓ Hypotension after known allergen exposure

Critical: Skin signs absent in 10–20% of severe reactions—never wait for rash to treat!

Step	Action	Key Details
1. Position	Supine (or recovery if vomiting)	Avoid upright posture → risk of "empty ventricle syndrome" & sudden death
2. Epinephrine	IM 0.3–0.5 mg (adults) 0.01 mg/kg (max 0.3 mg) children	Anterolateral thigh (vastus lateralis) Repeat q5 min if no response First-line—no delay for antihistamines/steroids
3. Supportive	O_2, IV fluids	Crystalloid bolus: 500–1000 mL adults / 10–20 mL/kg children
4. Adjuncts (after epinephrine)	H1-antihistamine (diphenhydramine) H2-blocker (famotidine) Steroids (methylprednisolone)	No acute benefit—steroids may reduce biphasic reactions
5. Monitor	Minimum 4–6 hours observation	Biphasic reaction risk: 1–20% (peaks 8–10h)

Discharge: Epinephrine auto-injector + allergist referral + trigger avoidance plan

TRANSFUSION REACTIONS: Rapid Recognition & Action

Immediate Response to ANY Suspected Reaction:

STOP transfusion → ASSESS ABCs → REPORT to blood bank → INVESTIGATE (labs + return blood bag)

Reaction	Key Features	Differentiators	Management
Acute Hemolytic (AHTR)	Fever + flank pain + hemoglobinuria	↑ free Hb, ↓ haptoglobin, +DAT, hemoglobinuria	STOP → aggressive IV fluids → dialysis if AKI

TACO (Circulatory overload)	Hypertension, ↑ JVP, pulmonary edema	↑ BNP, elevated JVP	Diuretics, O_2, slow future transfusions (<2 mL/kg/hr)
TRALI (Lung injury)	Hypoxemia + bilateral infiltrates	Normal BNP, no JVP elevation	STOP → O_2/PEEP; avoid diuretics (non-cardiogenic)
Anaphylactic	Hypotension + bronchospasm ± urticaria	IgA-deficient patients (anti-IgA Abs)	Epinephrine IM immediately (same as anaphylaxis protocol)
FNHTR (Febrile non-hemolytic)	Fever ± chills only	No hemolysis/hypotension	Slow transfusion + antihistamine; prevent with leukoreduction

Poisoning Management & Rational Drug Therapy

RATIONAL DRUG THERAPY: The "5 Rights + Monitoring"

Principle	Clinical Pearl
Right drug	Match mechanism to pathophysiology (e.g., β-blocker for SVT—not digoxin)
Right dose	Adjust for age, renal/hepatic function (e.g., ↓ digoxin in elderly)
Right route	IV for emergencies; avoid oral in vomiting patients
Right time	Antibiotics within 1h of sepsis; naloxone immediately in opioid overdose
Right patient	Check allergies, pregnancy (e.g., avoid ACEi in pregnancy)
+ Monitoring	Narrow TI drugs require levels: digoxin, warfarin, lithium, theophylline

Therapeutic Index (TI): TI = Toxic dose ÷ Therapeutic dose. Narrow TI → mandatory monitoring.

POISONED PATIENT: ABC-Tox Approach (First 5 Minutes)

Threat	Recognition	Immediate Treatment
Airway	GCS <8, stridor, secretions	Intubate early (avoid succinylcholine in organophosphates)
Breathing	Bradypnea (opioids) vs. tachypnea (salicylates)	Naloxone for opioids; CPAP for salicylate pulmonary edema
Circulation	Hypotension (TCA/β-blocker/CCB)	TCA → Sodium bicarbonate 1–2 mEq/kg IV β-blocker → Glucagon 5–10 mg IV CCB → Calcium + high-dose insulin
Seizures	Benzodiazepines, INH, theophylline	Lorazepam 2–4 mg IV; INH → Pyridoxine 5 g IV
Hyperthermia	Serotonin syndrome, anticholinergics	External cooling (antipyretics ineffective)

Golden Rule: "Treat the patient, not the poison" — stabilize ABCs before decontamination.

TOXIDROMES: "Five Finger" Recognition

Toxidrome	Pupils	Vital Signs	Secretions	Key Clues	Antidote
Anticholinergic	Dilated	↑ HR, ↑ Temp	Dry ("dry as a bone")	Delirium, flushed skin	Supportive

Cholinergic	Pinpoint	↓ HR	Wet (SLUDGE)	Garlic odor, muscle fasciculations	Atropine + 2-PAM
Sympathomimetic	Dilated	↑ HR/BP, ↑ Temp	Dry	Agitation, paranoia	Benzodiazepines
Opioid	Pinpoint	↓ RR, ↓ BP	Normal	Respiratory depression	Naloxone 0.04–0.4 mg IV
Sedative-Hypnotic	Normal/small	↓ RR/BP	Normal	Ataxia, slurred speech	Flumazenil (caution)

DECONTAMINATION & ELIMINATION

Method	Indication	Dose/Protocol	Contraindications
Activated Charcoal	Most ingestions <1–2h (or sustained-release up to 4h)	1 g/kg (max 50 g)	Altered mental status (unprotected airway), caustics, hydrocarbons
Whole Bowel Irrigation	Body packers, iron, sustained-release drugs	PEG (GoLYTELY) 1–2 L/hr until clear effluent	Ileus, bowel obstruction
Urinary Alkalinization	Salicylates, phenobarbital	NS + $NaHCO_3$ to target urine pH 7.5–8.0	Monitor for alkalosis
Hemodialysis	"I STUMBLE": Isoniazid, Salicylates, Theophylline, Uremia, Methanol, Barbiturates, Lithium, Ethylene glycol	—	Low Vd + water-soluble toxins