STEM-S



NEET-SS

CRITICAL CARE MEDICINE

GROUP

Essential Notes

PRESENTED BY

STEM-S

STEM-S

NEET-SS Critical Care Group

ESSENTIAL NOTES · DETAILED INDEX

Critical Care Medicine

Chapter-by-chapter guide to every section, with the page number printed on the notes so you can turn straight to a topic.

PAGES	CHAPTERS	SECTIONS INDEXED
1–776	64	365

DIVISION I	General Critical Care	pp. 1–238
DIVISION II	Systemic Critical Care	pp. 239–594
DIVISION III	Surgical Critical Care	pp. 595–776

CONTENTS

Chapters at a glance

How to use this index: page numbers are the numbers printed in the blue circle at the top right of each notes page. Find the chapter here, then turn to the detailed section list for the exact page of each topic, table and visual anchor.

DIVISION I General Critical Care pp. 1–238

FOUNDATIONS OF CRITICAL CARE pp. 1–21

1 Basics of Critical Care 1

2 Shock and Acid-Base Disorders 10

CRITICAL CARE PROCEDURES pp. 22–71

3 Procedures 1: Critical Care Ultrasound 22

4 Procedures 2: Airway Procedures 29

5 Procedures 3: Interventional Bronchoscopy, Lung US & Pleural Procedures 37

6 Procedures 4: Pericardiocentesis, Chest Tube & Pacing 50

7 Procedures 5: Vascular Access & Abdominal Procedures 60

INFECTIOUS DISEASES IN CRITICAL CARE pp. 72–159

8 Basics of Antimicrobial Therapy in Critical Care 72

9 Gram-Positive and Gram-Negative Infections 84

10 Skin and Soft Tissue Infections in Critical Care 97

11 Dengue, Malaria and Enteric Fever 107

12 Endocarditis, HIV, TB, Influenza and COVID in Critical Care 118

13 Fungal Infections in Critical Care 135

14 Miscellaneous Infections in Critical Care 149

TOXICOLOGY pp. 160–238

15 General Poisoning and Toxidromes 160
16 Irritants and Miscellaneous Poisons 172
17 General Principles of Toxicology 184
18 Toxicology: Drug Overdose and Envenomation 195
19 Pharmacological Drug Overdose; Envenomation 214
20 Acid, Alkali, OP and Paraquat 227

DIVISION II Systemic Critical Care pp. 239–594

CARDIOVASCULAR CRITICAL CARE pp. 239–278

21 Acute Coronary Syndrome, Complications and Heart Failure 239
22 Cardiogenic Shock and Mechanical Circulatory Support 252
23 Arrhythmias, Hypertensive and Aortic Crises 260
24 Myocarditis, Pericarditis and Other Topics 271

RESPIRATORY CRITICAL CARE pp. 279–319

25 Oxygen Therapy, Devices and Modes 279
26 Airway, Pulmonary Embolism and Airway Management 292
27 Pathologies of the Respiratory System 303
28 Pathophysiology of the Respiratory System in Critical Care 310

NEUROCRITICAL CARE pp. 320–363

29 Neuroanatomy, Stroke, CVST & SAH 320
30 Disorders of Consciousness & Muscle in the ICU 336
31 Traumatic Brain & Spinal Cord Injury 347
32 CNS Infections 356

NEPHROCRITICAL CARE pp. 364–423

33 Acute Kidney Injury & Critical Care Nephrology 364
34 Renal Replacement Therapy (RRT) in the ICU 384
35 Nephrocritical Care: Syndromes, RTA & Electrolyte Emergencies 400

GASTROINTESTINAL & HEPATIC CRITICAL CARE pp. 424–481

36 Pancreas: Acute Pancreatitis 424

37 GI Tract 437

38 Liver 465

ONCO-HEMATOLOGICAL CRITICAL CARE pp. 482–523

39 Oncological Emergencies 482

40 Oncological Drug Toxicities 492

41 Systemic Complications of Malignancy 502

42 Hematological Malignancy and Critical Care 518

RHEUMATOLOGY & IMMUNOLOGY IN THE ICU pp. 524–558

43 Lupus and APLA 524

44 Systemic Connective Tissue Disorders 532

45 Hyperinflammatory Disorders 541

46 Vasculitis 549

ENDOCRINE CRITICAL CARE pp. 559–594

47 Thyroid 559

48 Adrenal Gland 572

49 Glycemia in the ICU 583

DIVISION III Surgical Critical Care pp. 595–776

GENERAL & VASCULAR SURGERY pp. 595–622

50 Abdominal Surgery 595

51 Limb Surgery 608

OBSTETRIC CRITICAL CARE pp. 623–652

52 Pre-eclampsia, Eclampsia and HELLP Syndrome 623

53 Obstetric Emergencies in the ICU 638

TRAUMA CRITICAL CARE pp. 653–723

54 Basics of Trauma 653

55 Head, Neck and Spine Trauma 663

56 Torso, Pelvic and Extremity Trauma 674

57 Trauma Critical Care: Brain, Spine and Chest 686

58 Traumatic Abdominal and Extremity Injury 701

59 ATLS 11th Edition: XABCDE Resuscitation 714

TRANSPLANT CRITICAL CARE pp. 724–776

60 Management of Organ Donors 724

61 Kidney and Liver Transplantation 733

62 Heart and Lung Transplantation 747

63 Immunosuppressive Drugs in Transplantation 758

64 Hematopoietic Stem Cell Transplantation 767

DIVISION I

General Critical Care

Pages 1–238

Foundations of Critical Care	pp. 1–21	Critical Care Procedures	pp. 22–71
Infectious Diseases in Critical Care	pp. 72–159	Toxicology	pp. 160–238

FOUNDATIONS OF CRITICAL CARE pp. 1–21

CHAPTER 1

Basics of Critical Care pp. 1–9

PAGE	SECTION	KEY SUBTOPICS
1	**Severity scores and sepsis definitions**	ICU severity scores (APACHE II, SOFA), Sepsis-3 definitions
2	**Sepsis resuscitation and hemodynamics**	Cultures & early antibiotics, fluids, vasopressors, dynamic indices (PPV / SVV)
5	**Mechanical ventilation, ARDS and extracorporeal support**	Lung-protective ventilation, stress index, VV-ECMO vs VA-ECMO, $ECCO_2R$
7	**ICU prevention bundles and supportive care**	VTE prophylaxis, stress ulcer prophylaxis, ICU-acquired weakness, early mobilisation, glucose control
9	**Visual anchors**	PPV / SVV tracings, APACHE II grid

CHAPTER 2

Shock and Acid-Base Disorders pp. 10–21

PAGE	SECTION	KEY SUBTOPICS
10	**Shock: pathophysiology and hemodynamics**	Hypovolemic / hemorrhagic, septic, neurogenic, cardiogenic and obstructive shock; hemodynamic profiles; lethal triad
14	**Acid-base disorders and ABG interpretation**	High-AG vs normal-AG metabolic acidosis, Winter's formula, AKA vs DKA
17	**Resuscitation hierarchies**	Hemorrhagic trauma vs septic shock: fluids, blood components, TXA, vasopressors
19	**Visual anchors**	Pneumothorax, hemothorax, hyperkalemia ECG, radiopaque ingestions (CHIPES)

CRITICAL CARE PROCEDURES pp. 22–71

CHAPTER 3

Procedures 1: Critical Care Ultrasound pp. 22–28

PAGE	SECTION	KEY SUBTOPICS
22	**The basics**	Transducer triad; transducer types, frequency / depth and ICU indications
23	**Diagnosis: the step-ladder**	**Table 1:** Lung US artifacts & signatures; **Table 2:** Acute respiratory failure etiologies; **Table 3:** Focused echo (5 standard views)
26	**Traps & special scenarios**	Pneumothorax, air bronchograms, effusion on PSL view
27	**Visual anchors**	Ventilated patient; procedures in obese / edematous patients

CHAPTER 4

Procedures 2: Airway Procedures pp. 29–36

PAGE	SECTION	KEY SUBTOPICS
29	**Why airways fail; The airway step-ladder**	Stepwise airway management algorithm
31	**Comparison tables**	**Table 1:** Specialised endotracheal tubes; **Table 2:** Emergency surgical airway & FONA; **Table 3:** Tracheostomy complications
34	**Traps**	CICO & FONA, needle cricothyrotomy, cuff pressure, double-lumen tube
35	**Visual anchors**	Bleeding after tracheostomy; can't suction a fresh trach

CHAPTER 5

Procedures 3: Interventional Bronchoscopy, Lung US & Pleural Procedures

pp. 37–49

PAGE	SECTION	KEY SUBTOPICS
37	**Where breathing breaks: airways, alveoli & pleura**	Airways, alveoli & interstitium, pleura
38	**Diagnosis: POCUS first**	Lung POCUS, absent lung sliding (pneumothorax hunt); **Table 3:** Thoracic US Artifacts & Signs
41	**Pleural fluid: thoracentesis & what the fluid tells you**	**Table 2:** Pleural Fluid Etiologies (transudate, exudate, empyema, chylothorax)
44	**Interventional bronchoscopy: picking the tool**	**Table 1:** Interventional Bronchoscopy Modalities; BAL limits
47	**Special scenario: crashing right after thoracentesis**	Iatrogenic pneumothorax, re-expansion pulmonary edema
47	**Visual anchors**	Seashore vs barcode sign, lung point, air bronchograms, sinusoid sign, shred sign
49	**Last-minute checklist**	POCUS and pleura recap

CHAPTER 6

Procedures 4: Pericardiocentesis, Chest Tube & Pacing pp. 50–59

PAGE	SECTION	KEY SUBTOPICS
50	**Why the heart and chest crash: obstructive shock & collapse**	Tamponade (Beck's triad), tension pneumothorax, bradyarrhythmias
50	**Workup: the emergency step-ladder**	Emergency drug bridge, LEMON airway risk, cardiac & thoracic windows
52	**Pericardiocentesis**	**Table 1:** Pericardiocentesis Approaches & Guidance
54	**Chest tube thoracostomy**	**Table 2:** Tube Positioning, Anatomy & Underwater Seal
56	**Temporary cardiac pacing**	**Table 3:** Temporary Pacing Modalities & Modes
57	**Visual anchors**	RV diastolic collapse, triangle of safety
58	**Last-minute checklist**	Paced ECG, underwater-seal air leak; pericardiocentesis, chest tube, pacing recap

CHAPTER 7

Procedures 5: Vascular Access & Abdominal Procedures pp. 60–71

PAGE	SECTION	KEY SUBTOPICS
60	**The basics: why we put lines in, and how they go wrong**	Poiseuille's law, line complications, venous air embolism, arterial catheters
61	**Workup: picking the site & doing the line**	IJV, subclavian & femoral sites; radial & femoral arterial lines; maximal barrier precautions, Seldinger
63	**The sites & the waveforms**	**Table 1:** Central Venous Access Sites; **Table 2:** Arterial Line Sites & Waveforms
66	**Abdominal procedures & management**	**Table 3:** Abdominal Invasive Procedures & Source Control; Z-track paracentesis
68	**Visual anchors**	IJV vs carotid on ultrasound
69	**Last-minute checklist**	Overdamped vs underdamped tracings; lines, arterial lines, abdomen recap

INFECTIOUS DISEASES IN CRITICAL CARE pp. 72–159

CHAPTER 8

Basics of Antimicrobial Therapy in Critical Care pp. 72–83

PAGE	SECTION	KEY SUBTOPICS
72	**ICU pharmacokinetics and pathogen dynamics**	Subtherapeutic exposure vs toxic accumulation
74	**The diagnostic and therapeutic step-ladder**	Cultures, MALDI-TOF, multiplex PCR, de-escalation
75	**Core PK/PD killing patterns and optimization**	Time-, concentration- and AUC-dependent killing
76	**Class-specific high-yield review**	Penicillins & BL/BLI, cephalosporins, carbapenems & monobactams, glycopeptides, aminoglycosides, fluoroquinolones, other ICU agents
80	**Comparison tables**	**Table 1:** Pathogen Coverage & Drug Selection; **Table 2:** Dosing on CRRT / SLED and ARC
81	**Visual anchors**	PD target profiles, CT in opportunistic pneumonias, endocarditis vegetations

CHAPTER 9

Gram-Positive and Gram-Negative Infections pp. 84–96

PAGE	SECTION	KEY SUBTOPICS
84	**Structural virulence and systemic response**	Gram-positive superantigens, gram-negative endotoxin & capillary leak
86	**Diagnostic step-ladder: workup in ICU sepsis**	Five-step sepsis workup
87	**Gram-positive ICU pathogens**	S. aureus (MSSA / MRSA), Enterococcus & VRE, S. pyogenes and S. gallolyticus
90	**Gram-negative ICU pathogens**	Enterobacterales, Pseudomonas & non-fermenters, emphysematous pyelonephritis, RMSF
93	**Comparison tables**	**Table 1:** Antimicrobial Spectrum; **Table 2:** Diagnostic & Prophylactic Rules

94	Visual anchors	Endocarditis embolic phenotypes, emphysematous pyelonephritis, RMSF rash

CHAPTER 10

Skin and Soft Tissue Infections in Critical Care pp. 97–106

PAGE	SECTION	KEY SUBTOPICS
97	Anatomic depth, virulence and systemic collapse	Superficial infections, NSTI, marine bullous sepsis
98	Diagnostic and therapeutic step-ladder	Bedside ultrasound, NSTI recognition, PWID
100	Core SSTI entities and high-yield pathology	Erysipelas vs cellulitis, abscesses, necrotizing fasciitis, Vibrio vulnificus
103	Comparison tables	**Table 1:** Clinical Differentiators; **Table 2:** Antimicrobial Matrix in SSTIs
104	Visual anchors	Soft tissue infiltration, soft tissue gas, hemorrhagic bullae

CHAPTER 11

Dengue, Malaria and Enteric Fever pp. 107–117

PAGE	SECTION	KEY SUBTOPICS
107	Microvascular permeability, sequestration and intestinal necrosis	Dengue, severe falciparum malaria, enteric fever
108	Diagnostic step-ladder	Stepwise workup of tropical febrile illness
110	Dengue and Expanded Dengue Syndrome	Phases & hemodynamics, fluid strategy, expanded dengue (hepatitis, encephalopathy, myocarditis)
111	Severe Plasmodium falciparum malaria	Severity criteria, smears & diagnostics, artesunate therapy, prophylaxis
114	Enteric fever (Salmonella Typhi / Paratyphi)	Course & complications, resistance & antibiotic choice
115	Comparison table; Visual anchors	Malaria blood film, ileal perforation, dengue hematocrit curve

CHAPTER 12

Endocarditis, HIV, TB, Influenza and COVID in Critical Care pp. 118–134

PAGE	SECTION	KEY SUBTOPICS
118	**Endothelial dysfunction, immune failure and hyperinflammation**	Shared pathophysiology across IE, HIV, TB, influenza & COVID
119	**ICU diagnostic step-ladder**	CD4, inflammatory markers, sputum / ETA, echo
121	**Infective endocarditis in the ICU**	Etiology & risk, modified Duke criteria, antibiotics, surgical indications
123	**Advanced HIV and opportunistic infections**	ICU spectrum & ART timing, PJP, cryptococcal meningitis, toxoplasmosis, CMV
126	**Tuberculosis in critical care**	Spectrum, diagnostics, drugs & toxicity
127	**Influenza and severe epidemic viral pneumonias**	Neuraminidase inhibitors, ICU dosing, bacterial superinfection
128	**COVID-19 and critical care hyperinflammation**	Disease phases, immunomodulation, awake proning, thromboprophylaxis
130	**Comparison tables**	**Table 1:** Infective Endocarditis; **Table 2:** HIV Opportunistic Infections; **Table 3:** Severe Viral Pneumonias
132	**Visual anchors**	Periannular abscess, ICU pulmonary patterns, CNS opportunistic pathology

CHAPTER 13

Fungal Infections in Critical Care pp. 135–148

PAGE	SECTION	KEY SUBTOPICS
135	**Invasive fungal virulence, angioinvasion and systemic collapse**	Candidiasis, aspergillosis, mucormycosis
136	**Diagnostic and therapeutic step-ladder**	Galactomannan, β-D-glucan, chest HRCT
138	**Invasive candidiasis and candidemia**	Candida score, species & resistance, cultures vs biomarkers, management
141	**Invasive pulmonary aspergillosis (IPA)**	Hosts, diagnosis, treatment

143	**Invasive mucormycosis**	Clinical syndromes, diagnosis, debridement & liposomal amphotericin B
145	**Comparison tables**	**Table 1:** ICU Invasive Fungal Pathogens; **Table 2:** Antifungal Classes & Toxicity
146	**Visual anchors**	Halo / air-crescent signs, ROCM imaging, candidemia fundus

CHAPTER 14

Miscellaneous Infections in Critical Care pp. 149–159

PAGE	SECTION	KEY SUBTOPICS
149	**Microvascular injury, intracellular invasion and immune dysregulation**	Legionella, Leptospira, scrub typhus, Zika, asplenia
151	**Diagnostic and therapeutic step-ladder**	Urine antigen, electrolytes, chest imaging
152	**Legionella and severe leptospirosis**	Legionnaires' disease; Weil disease triad & pulmonary hemorrhage
153	**Scrub typhus (Orientia tsutsugamushi)**	Eschar, systemic complications, doxycycline
154	**Zika virus; Unique ICU host syndromes**	Congenital Zika, GBS; OPSI & Capnocytophaga, meningococcal prophylaxis, noninfectious fever
156	**Comparison tables**	**Table 1:** Zoonotic & Atypical Pathogens; **Table 2:** Diagnostic & Infection Control Rules
157	**Visual anchors**	Atypical pneumonias, Weil disease labs, Zika

TOXICOLOGY pp. 160–238

CHAPTER 15

General Poisoning and Toxidromes pp. 160–171

PAGE	SECTION	KEY SUBTOPICS
160	General approach and decontamination	Activated charcoal, gastric lavage, whole-bowel irrigation
163	Cholinergic and anticholinergic crises	Toxidrome comparison, atropine & oximes, atropinisation endpoints
165	Opioids, sedative-hypnotics and neuropsychiatric toxins	Opioids & naloxone, meperidine, isoniazid & pyridoxine
167	Cardiovascular toxins and toxic alcohols	TCA & CCB toxicity, digoxin & Fab, methanol & ethylene glycol, fomepizole
170	Visual anchors	Lavage tube, radiopaque agents (CHIPES), TCA ECG, antidote kit

CHAPTER 16

Irritants and Miscellaneous Poisons pp. 172–183

PAGE	SECTION	KEY SUBTOPICS
172	Corrosives and chemical irritants	Alkali vs acid, hydrofluoric acid
173	Heavy metals and inorganic irritants	Arsenic, arsine gas, mercury, lead
176	Plant poisons, organic irritants and deliriants	Datura, Abrus, cannabis
179	Animal envenomation	Viper, elapid, sea snake, bark scorpion
181	Visual anchors	Abrus seeds, Datura, Burtonian line, saw-scaled viper bite

CHAPTER 17

General Principles of Toxicology pp. 184–194

PAGE	SECTION	KEY SUBTOPICS
184	**Acetaminophen (paracetamol)**	NAPQI & zone 3 necrosis, NAC regimens
186	**Salicylates (aspirin)**	Mixed respiratory alkalosis + AGMA, alkalinisation, haemodialysis
187	**TCA toxicity**	Na^+-channel blockade, ECG (aVR), sodium bicarbonate, lipid emulsion
189	**Carbon monoxide poisoning**	COHb, delayed neuropsychiatric sequelae, HBOT
190	**Methemoglobinemia**	Oxidant triggers, saturation gap, co-oximetry, methylene blue
193	**Visual anchors**	Toxin, ECG clue and antidote summary

CHAPTER 18

Toxicology: Drug Overdose and Envenomation pp. 195–213

PAGE	SECTION	KEY SUBTOPICS
195	**General principles**	Absorption, receptor binding
196	**Cardiovascular overdoses**	Beta-blockers, calcium channel blockers, digoxin & oleander
201	**Sedatives, opioids, local anesthetics**	Benzodiazepines, opioids, LAST & lipid emulsion, methemoglobinemia
203	**Terrestrial envenomation**	Pit viper, coral snake, widow vs recluse spider, bark scorpion
208	**Comparison tables**	Cardiotoxic drug overdoses (beta-blocker vs CCB vs digoxin)
210	**Visual anchors**	North American terrestrial envenomations

CHAPTER 19

Pharmacological Drug Overdose; Envenomation pp. 214–226

PAGE	SECTION	KEY SUBTOPICS
214	**Viperidae (pit vipers, hemotoxic / cytotoxic snakes)**	Venom enzymes, local & systemic effects, antivenom (CroFab, Anavip)
216	**Elapidae (neurotoxic and myotoxic snakes)**	Krait, cobra, coral snake; Indian polyvalent ASV, antivenom reactions, ventilation
219	**Scorpions (Mesobuthus tamulus, Centruroides)**	Autonomic storm, grading I–IV, prazosin, antivenom
222	**Comparison tables**	Neurotoxic snake envenomations
223	**Visual anchors**	Terrestrial scorpions comparison

CHAPTER 20

Acid, Alkali, OP and Paraquat pp. 227–238

PAGE	SECTION	KEY SUBTOPICS
227	**Corrosive poisoning: acid vs alkali**	Coagulative vs liquefactive necrosis, endoscopy, stricture prevention
229	**Organophosphate (OP) and carbamate poisoning**	Muscarinic & nicotinic features, RBC AChE, atropine & pralidoxime, intermediate syndrome, OPIDN
232	**Paraquat poisoning**	Redox cycling, pulmonary fibrosis, dithionite test, oxygen restriction
235	**Comparison tables**	Caustic ingestions: acid vs alkali
236	**Visual anchors**	OP syndromes vs paraquat

DIVISION II

Systemic Critical Care

Pages 239–594

Cardiovascular Critical Care	pp. 239–278	Respiratory Critical Care	pp. 279–319
Neurocritical Care	pp. 320–363	Nephrocritical Care	pp. 364–423
Gastrointestinal & Hepatic Critical Care	pp. 424–481	Onco-Hematological Critical Care	pp. 482–523
Rheumatology & Immunology in the ICU	pp. 524–558	Endocrine Critical Care	pp. 559–594

CARDIOVASCULAR CRITICAL CARE pp. 239–278

CHAPTER 21

Acute Coronary Syndrome, Complications and Heart Failure

pp. 239–251

PAGE	SECTION	KEY SUBTOPICS
239	**Acute coronary syndromes (ACS)**	Plaque rupture, type 1 vs type 2 MI, UA vs NSTEMI, ECG localisation, STEMI reperfusion
243	**Mechanical & electrical complications of MI**	Free wall rupture, VSR, papillary muscle rupture, conduction blocks
246	**Acute decompensated heart failure & cardiogenic shock**	Nohria-Stevenson profiles, loop diuretics (DOSE), vasodilators, inotropes, IABP / Impella / VA-ECMO
248	**In-hospital GDMT for HFrEF**	Quadruple therapy, IV iron; visual anchors (LV shape, VSR, LV thrombus)

CHAPTER 22

Cardiogenic Shock and Mechanical Circulatory Support pp. 252–259

PAGE	SECTION	KEY SUBTOPICS
252	**The cardiogenic shock spiral**	Triggers and the downward spiral
253	**Diagnostic step-ladder**	Clinical triad, SCAI stages, hemodynamic thresholds
254	**Vasoactive drugs**	Norepinephrine, dobutamine, milrinone, dopamine: comparison
256	**Mechanical circulatory support (MCS)**	IABP (IABP-SHOCK II), Impella, VA-ECMO, ECPELLA
257	**Visual anchors**	IABP waveforms, ECMO, ECPELLA cannulation

CHAPTER 23

Arrhythmias, Hypertensive and Aortic Crises pp. 260–270

PAGE	SECTION	KEY SUBTOPICS
260	**Cardiac arrhythmias & conduction disorders**	Tachyarrhythmias, cardioversion energies, pre-excited AF, arrhythmia comparison
263	**Hypertensive crises: emergency vs urgency**	Step-ladder, organ-specific IV agents, cocaine toxicity
265	**Acute aortic syndromes & dissection**	Stanford A vs B, anti-impulse therapy, malperfusion
268	**Visual anchors**	Dissection imaging, widened mediastinum

CHAPTER 24

Myocarditis, Pericarditis and Other Topics pp. 271–278

PAGE	SECTION	KEY SUBTOPICS
271	**Acute & fulminant myocarditis**	Diagnostic step-ladder, cardiac MRI, MCS
272	**Pericarditis, pericardial effusion & cardiac tamponade**	ECG stages, NSAIDs / colchicine, pericardiocentesis
274	**Cardiorenal syndromes & cardiopulmonary interactions**	CRS types, venous congestion

276	**Critical care POCUS protocols**	BLUE, RUSH, VExUS
277	**Visual anchors**	Myocarditis LGE, swinging heart, hepatic vein flow reversal

RESPIRATORY CRITICAL CARE pp. 279–319

CHAPTER 25

Oxygen Therapy, Devices and Modes pp. 279–291

PAGE	SECTION	KEY SUBTOPICS
279	**The physiology first**	Causes of hypoxemia (V/Q, shunt, hypoventilation, diffusion); trigger, limit & cycle
279	**Oxygen delivery devices**	Low- vs high-flow devices, HFNC; **Table 1:** Oxygen Delivery Devices
282	**Non-invasive ventilation (NIV / NIPPV)**	Oxygen escalation, indications by evidence, BiPAP settings
284	**Invasive ventilation: core modes**	Volume vs pressure assist-control, interface troubleshooting
285	**Advanced & dual-control modes**	Peak vs plateau pressure, PRVC, APRV, proportional modes, HFOV; **Table 2:** Ventilator Modes
288	**Special scenarios**	Oxygen toxicity, hyperoxia in COPD, CO poisoning
289	**Visual anchors**	Device and waveform images

CHAPTER 26

Airway, Pulmonary Embolism and Airway Management pp. 292–302

PAGE	SECTION	KEY SUBTOPICS
292	**Airway management & acute upper airway obstruction**	Physiological vs anatomical difficult airway, airway rescue, tracheostomy care, upper airway emergencies
295	**Acute pulmonary embolism & hemodynamic collapse**	RV failure, diagnostic step-ladder, ESC risk categories, thrombolysis
298	**ARDS & mechanical ventilation**	Capillary leak & VILI, evidence-based management hierarchy

300	**Visual anchors**	Rescue therapies in ARDS

CHAPTER 27

Pathologies of the Respiratory System pp. 303–309

PAGE	SECTION	KEY SUBTOPICS
303	**ARDS & permeability edema**	Berlin definition, exudative phase, baby lung & VILI
305	**Severe obstructive disease: status asthmaticus & AECOPD**	Auto-PEEP, pump failure, escalation
307	**Pulmonary hypertension & RV collapse**	PH groups 1–5, RV failure mechanism, workup
308	**Massive hemoptysis & diffuse alveolar hemorrhage**	Emergent management, bronchial artery embolisation

CHAPTER 28

Pathophysiology of the Respiratory System in Critical Care pp. 310–319

PAGE	SECTION	KEY SUBTOPICS
310	**Respiratory mechanics, V/Q matching & gas exchange failure**	Diagnostic step-ladder
312	**ARDS & VILI mechanics**	Five mechanisms of VILI
313	**Obstructive airway mechanics & dynamic hyperinflation**	Intrinsic PEEP
314	**Comparison tables**	VILI subtypes; peak vs plateau pressure patterns
316	**Pleural emergencies, massive hemoptysis & pleural collections**	Tension pneumothorax on the ventilator, parapneumonic effusion & empyema
317	**Visual anchors**	Tube thoracostomy, Light's criteria

NEUROCRITICAL CARE pp. 320–363

CHAPTER 29

Neuroanatomy, Stroke, CVST & SAH pp. 320–335

PAGE	SECTION	KEY SUBTOPICS
320	**Neuroanatomy, intracranial dynamics & ischemia**	Monro-Kellie, ischemic cascade, localisation, initial stroke workup, TOAST subtypes
323	**Hyperacute ischemic stroke & reperfusion**	Core vs penumbra, IV thrombolysis, thrombectomy, malignant MCA infarction
326	**Cerebral venous sinus thrombosis (CVST)**	Risk factors, pathway, CVST vs stroke vs IIH
328	**Aneurysmal subarachnoid hemorrhage (aSAH)**	Grading scales, repair, rebleeding, vasospasm / DCI, hydrocephalus, hyponatremia
333	**Visual anchors**	Stroke, CVST and SAH imaging

CHAPTER 30

Disorders of Consciousness & Muscle in the ICU pp. 336–346

PAGE	SECTION	KEY SUBTOPICS
336	**Disorders of consciousness & encephalopathy**	Arousal vs awareness, herniation, posturing, metabolic encephalopathy, delirium, status epilepticus
340	**Comparison table**	**Table 1:** Brain death vs PVS vs locked-in syndrome
341	**Neuromuscular disorders & ICU-acquired weakness**	CIM, CIP, GBS, myasthenic vs cholinergic crisis; **Table 2:** ICU Neuromuscular Disorders
345	**Visual anchors**	GBS, myasthenia

CHAPTER 31

Traumatic Brain & Spinal Cord Injury pp. 347–355

PAGE	SECTION	KEY SUBTOPICS
347	**TBI & intracranial dynamics**	Primary vs secondary injury, herniation, GCS, EDH vs SDH
349	**Targeted ICP management & post-TBI complications**	BTF targets, tiered ICP protocol, osmotherapy, post-TBI endocrine problems
350	**Spinal cord injury (SCI) & autonomic dysfunction**	Cervical level & breathing, spinal vs neurogenic shock
352	**Comparison tables**	**Table 1:** Traumatic Intracranial Lesions; ASIA grading; **Table 2:** Shock States in Trauma
354	**Visual anchors**	Crescentic hyperdensity, uncal herniation pupil, bulbocavernosus reflex

CHAPTER 32

CNS Infections pp. 356–363

PAGE	SECTION	KEY SUBTOPICS
356	**Acute bacterial meningitis**	Pathogens by age, empiric therapy, timing traps
358	**Viral encephalitis & autoimmune encephalopathy**	HSV-1 encephalitis, acyclovir
359	**Brain abscess**	Autoimmune limbic encephalitis, NORSE
360	**Comparison tables**	**Table 1:** CSF Profiles; **Table 2:** CNS Infection Syndromes & Therapy
362	**Visual anchors**	Temporal lobe FLAIR change, purpura fulminans

NEPHROCRITICAL CARE pp. 364–423

CHAPTER 33

Acute Kidney Injury & Critical Care Nephrology pp. 364–383

PAGE	SECTION	KEY SUBTOPICS
364	**Renal hemodynamics & why nephrons get hurt**	Filtration barrier, segment-by-segment physiology
365	**Classification & staging**	KDIGO, RIFLE, AKIN; acute kidney disease
368	**Pathophysiology: prerenal, intrinsic, postrenal**	Autoregulation, NSAIDs & ACEi, ischemic / septic ATN, nephrotoxins
372	**Diagnostic step-ladder**	Urine sediment: muddy brown, WBC and RBC casts; schistocytes
375	**Comparison tables**	**Table 1:** Prerenal vs ATI vs AIN; **Table 2:** Glomerular & Vascular AKI
377	**Test traps**	FENa on diuretics, rhabdo dipstick, contrast AKI vs atheroembolism
378	**ICU management & RRT**	Management hierarchy, nephrotoxin stewardship, hyperkalemia, AEIOU indications
381	**Visual anchors**	Urinary casts

CHAPTER 34

Renal Replacement Therapy (RRT) in the ICU pp. 384–399

PAGE	SECTION	KEY SUBTOPICS
384	**Why the kidneys fall behind: uremia & fluid overload**	Emergency RRT indications (AEIOU)
385	**Physics: how solutes and water move**	Diffusion, convection, ultrafiltration, sieving coefficient
386	**RRT modalities**	IHD, SLED, SCUF, CVVH, CVVHD, CVVHDF, peritoneal dialysis; modality comparison
389	**Timing & dose: the trials**	RENAL, ATN, IVOIRE; timing trials
390	**Circuit mechanics**	Delivered vs prescribed dose, blood flow, filtration fraction

391	**Anticoagulation & citrate problems**	Pre- vs post-filter replacement, regional citrate, heparin, argatroban, citrate accumulation
393	**Vascular access & troubleshooting**	Access hierarchy, pressure alarms, TMP
395	**Complications & ICU management**	Intradialytic hypotension, DDS, hypothermia, hypophosphatemia
397	**Drug dosing & toxins**	Dialysability, antimicrobial dosing, toxic alcohols, lithium, salicylates
398	**Visual anchors**	Hollow-fibre flow, catheter obstruction, CXR before & after CRRT

CHAPTER 35

Nephrocritical Care: Syndromes, RTA & Electrolyte Emergencies

pp. 400–423

PAGE	SECTION	KEY SUBTOPICS
400	**Acute interstitial nephritis (AIN)**	Causes (antibiotics, PPIs, NSAIDs), step-ladder, steroids
403	**Dialysis disequilibrium syndrome (DDS)**	Mechanism, high-risk patients, prevention
406	**Contrast-induced AKI (CI-AKI)**	Mechanism, risk factors, prevention (and what not to use)
408	**Rhabdomyolysis & pigment nephropathy**	Cast formation, fluids, bicarbonate, dialysis
411	**Renal tubular acidosis (types 1, 2, 4) & Fanconi**	RTA master comparison
414	**Abdominal compartment syndrome & hepatorenal syndrome**	ACS definition & management; HRS-AKI criteria & therapy
416	**Tumor lysis syndrome & crystal nephropathies**	Rasburicase vs allopurinol, drug crystals
417	**Acid-base & electrolyte emergencies**	Delta-delta, urinary anion gap, hyperkalemia protocol
419	**Comparison tables**	Differential diagnosis of AKI in the ICU

421	Visual anchors	Pigment & crystal nephropathies

GASTROINTESTINAL & HEPATIC CRITICAL CARE pp. 424–481

CHAPTER 36

Pancreas: Acute Pancreatitis pp. 424–436

PAGE	SECTION	KEY SUBTOPICS
424	Pathophysiology & etiology of acute pancreatitis	Zymogen activation to MODS, etiologies
426	Clinical signs, severity & diagnosis	Revised Atlanta classification, bedside severity scores
429	Resuscitation, nutrition & antibiotics	WATERFALL trial, abdominal compartment syndrome, enteral nutrition
431	Local complications & walled-off necrosis	Antibiotic policy, collections, infected necrosis, step-up approach
434	Biliary pancreatitis, vascular & late complications	ERCP & cholecystectomy timing, splenic artery pseudoaneurysm
435	Visual anchors	Exocrine insufficiency, disconnected duct syndrome

CHAPTER 37

GI Tract pp. 437–464

PAGE	SECTION	KEY SUBTOPICS
437	Resuscitation & GI hemorrhage	Upper, lower & small-bowel bleeding; restrictive transfusion; Glasgow-Blatchford; Forrest classification; variceal UGIB
443	Stress ulcer disease & acid suppression	Stress ulceration cascade, risk factors, SUP regimens, downsides of overuse
447	GI motility & functional disorders	AGI grades, gastroparesis, ileus vs obstruction vs Ogilvie, PONV, anti-emetics
452	Severe biliary tract disease & acute pancreatitis	Calculous vs acalculous cholecystitis

454	**Acute liver failure & cirrhotic decompensation**	Hepatic encephalopathy, SBP, portal decompression (TIPS)
457	**Endocrine, metabolic, infectious & pulmonary mimics**	Adrenal crisis, thyroid storm, COVID-19, Boerhaave syndrome
460	**Acute GI injury & intestinal vascular insufficiency**	Mesenteric ischemia (CTA), splanchnic shunting, hospital-acquired diarrhea, opioid bowel dysfunction
462	**Visual anchors**	GI bleeding, stress ulcers, bowel emergencies, biliopancreatic, bowel ischemia

CHAPTER 38

Liver pp. 465–481

PAGE	SECTION	KEY SUBTOPICS
465	**Acute liver failure (ALF) & drug-induced liver injury**	ALF step-ladder; **Table 1:** ALF vs Decompensated Cirrhosis
468	**Critical complications: neurocritical care & coagulopathy**	Cerebral edema, viscoelastic testing; **Table 2:** Coagulation & Transfusion in Liver Disease
472	**Severe alcohol-associated hepatitis & severity scores**	Severity scores incl. MELD; **Table 3:** Risk Scores in GI & Liver Care
475	**Decompensated cirrhosis, portal hypertension, SBP, HRS & SUP**	Variceal hemorrhage algorithm; **Table 4:** Variceal Interventions; **Table 5:** SUP Agents
481	**Visual anchors**	Portal hypertension, varices, stress-related mucosal disease

ONCO-HEMATOLOGICAL CRITICAL CARE pp. 482–523

CHAPTER 39

Oncological Emergencies pp. 482–491

PAGE	SECTION	KEY SUBTOPICS
482	**Hematologic and rheologic**	Leukostasis, hyperviscosity syndrome, APL & DIC
484	**Metabolic and endocrine**	Tumor lysis syndrome (Cairo-Bishop), hypercalcemia of malignancy
486	**Structural, cardiovascular and airway**	SVC syndrome, malignant spinal cord compression
488	**GI, neurologic and immunotherapy**	Malignant airway obstruction, mediastinal mass, malignant bowel obstruction
489	**Comparison tables**	Vasogenic edema & raised ICP; CRS & ICANS
490	**Visual anchors**	Image-based recap

CHAPTER 40

Oncological Drug Toxicities pp. 492–501

PAGE	SECTION	KEY SUBTOPICS
492	**Cardiovascular**	Anthracyclines, 5-FU & capecitabine, VEGF TKIs
494	**Pulmonary**	Bleomycin
495	**Renal and urologic**	Cisplatin, high-dose methotrexate & glucarpidase, cyclophosphamide / ifosfamide
497	**Immunotherapy, targeted agents and antibodies**	Rituximab reactions, immune checkpoint inhibitors, CAR-T (CRS & ICANS)
499	**Comparison tables**	Cardiotoxic and nephrotoxic agents
500	**Visual anchors**	Image-based recap

CHAPTER 41

Systemic Complications of Malignancy pp. 502–517

PAGE	SECTION	KEY SUBTOPICS
502	**Infectious & pulmonary complications**	Febrile neutropenia & sepsis, IPA & mucormycosis, CMV pneumonitis & PJP, leukostasis & DAH, radiation pneumonitis
507	**GI & hepatic complications**	Neutropenic enterocolitis & mucositis, SOS / VOD, malignant ALF, radiation proctopathy
510	**Neurological & neuro-oncologic emergencies**	PRES, brain metastases & herniation, leptomeningeal disease
513	**Haemostatic, coagulopathic & metabolic complications**	DIC & massive transfusion coagulopathy
514	**Comparison tables**	Pulmonary, hepatic / GI and neuro-oncologic complications
516	**Visual anchors**	Key imaging findings

CHAPTER 42

Hematological Malignancy and Critical Care pp. 518–523

PAGE	SECTION	KEY SUBTOPICS
518	**Acute leukemia emergencies**	Leukostasis, APL & DIC, differentiation syndrome
519	**Cellular immunotherapy toxicities and hyperinflammation**	CAR-T CRS & ICANS, HLH
520	**Febrile neutropenia and HSCT complications**	Post-HSCT infection timeline, engraftment syndrome, GVHD, SOS / VOD
521	**Paraproteinemias; ICU triage, prognosis and transfusion**	Hyperviscosity (Waldenström), ICU admission & prognosis
522	**Comparison tables**	Hyperviscosity vs leukostasis vs TLS; post-HSCT non-infectious complications
523	**Visual anchors**	Image-based recap

RHEUMATOLOGY & IMMUNOLOGY IN THE ICU pp. 524–558

CHAPTER 43

Lupus and APLA pp. 524–531

PAGE	SECTION	KEY SUBTOPICS
524	**Core mechanisms; SLE emergencies**	Lupus nephritis crisis, DAH, NPSLE, cardiac lupus
526	**APS and CAPS; Diagnostic step-ladders**	Pulmonary microthrombosis, lupus anticoagulant paradox
527	**Comparison tables**	**Table 1:** Renal & Microvascular Crises; **Table 2:** Pulmonary Complications in SLE & APS
529	**Management and drug traps**	ALMS, Euro-Lupus, voclosporin, heparin in CAPS
530	**Visual anchors**	Skin & valve, pathology, lung & brain

CHAPTER 44

Systemic Connective Tissue Disorders pp. 532–540

PAGE	SECTION	KEY SUBTOPICS
532	**Core mechanisms; SLE and CAPS**	Flare vs sepsis, DAH, class IV nephritis
534	**Systemic sclerosis**	Scleroderma renal crisis, SSc-ILD, SSc-PAH, digital ischemia
535	**Inflammatory myopathies**	Dermatomyositis, polymyositis; workup, biopsy & treatment
536	**Comparison tables**	**Table 1:** Pulmonary Complications; **Table 2:** Renal & Microangiopathic Crises; **Table 3:** Myopathy Subtypes
537	**Drug traps**	Cyclophosphamide, methotrexate, tocilizumab, anakinra
538	**Visual anchors**	Dermatomyositis and other images

CHAPTER 45

Hyperinflammatory Disorders pp. 541–548

PAGE	SECTION	KEY SUBTOPICS
541	**Core mechanisms**	Cytokine storm, triggers
542	**Clinical picture**	Hallmark triad, organ involvement
543	**Diagnosis**	Diagnostic step-ladder, HLH-2004 criteria
545	**Management**	Steroids, anakinra, cyclosporine, etoposide, rituximab, emapalumab
546	**Comparison tables**	**Table 1:** Hyperinflammatory Crises vs Mimics; **Table 2:** HLH Subtypes
547	**Visual anchors**	Marrow & smear, CNS HLH, hyperinflammatory ARDS

CHAPTER 46

Vasculitis pp. 549–558

PAGE	SECTION	KEY SUBTOPICS
549	**Core mechanisms**	Vessel-size classification
550	**Large-vessel: GCA and Takayasu**	AION, workup, steroid-sparing therapy
551	**Medium-vessel: PAN and Kawasaki**	Mononeuritis multiplex, mesenteric ischemia, hepatitis B
552	**Small-vessel vasculitis**	ANCA-associated; immune-complex (IgA vasculitis, cryoglobulinemia), EGPA
553	**Vasculitic storm and pulmonary-renal syndrome**	Triage, induction, PEXIVAS
555	**Comparison tables**	**Table 1:** ANCA Vasculitides; **Table 2:** Vasculitis Differentiator Matrix; **Table 3:** Pharmacotherapy & Traps
557	**Visual anchors**	GCA, Takayasu & PAN imaging, GPA chest, kidney & skin

ENDOCRINE CRITICAL CARE pp. 559–594

CHAPTER 47

Thyroid pp. 559–571

PAGE	SECTION	KEY SUBTOPICS
559	**How thyroid hormone normally works**	Transport, metabolic & cardiovascular actions
560	**Thyroid storm (severe hyperthyroidism)**	Triggers, Burch-Wartofsky, stepwise management (β-blocker, thionamides, iodine, steroids, TPE)
564	**Myxedema coma (severe hypothyroidism)**	Triage, IV hydrocortisone first, IV levothyroxine, ventilation
567	**Nonthyroidal illness syndrome (sick euthyroid)**	Low T3, low T4 and recovery phases
568	**Comparison tables**	**Table 1:** Thyroid Crises vs NTIS; **Table 2:** ICU Thyroid Drugs & Traps
570	**Visual anchors**	Image-based recap

CHAPTER 48

Adrenal Gland pp. 572–582

PAGE	SECTION	KEY SUBTOPICS
572	**Core adrenal physiology**	Cortisol kinetics & the stress response
573	**Adrenal insufficiency and adrenal crisis**	Primary (Addison), Waterhouse-Friderichsen, secondary AI, CIRCI
574	**Diagnosis and treatment of crisis / CIRCI**	Clinical picture, step-ladder, hydrocortisone
576	**Hypercortisolism (Cushing syndrome)**	Exogenous (iatrogenic) Cushing; cardiovascular, metabolic, infective & thrombotic risks
577	**Pheochromocytoma**	Triad, screening, perioperative management, post-op hypoglycemia
579	**Comparison tables**	**Table 1:** Adrenal Insufficiency Types; **Table 2:** Endogenous vs Exogenous Cushing; **Table 3:** Pheochromocytoma Phases
581	**Visual anchors**	Adrenal CT, Addison skin, Cushingoid phenotype

CHAPTER 49

Glycemia in the ICU pp. 583–594

PAGE	SECTION	KEY SUBTOPICS
583	**Core mechanisms**	Three glycemic emergencies
584	**Stress hyperglycemia and targets**	Insulin infusion safeguards, transition to subcutaneous insulin
586	**DKA and HHS**	Five-step resuscitation: fluids, potassium, insulin, dextrose, resolution
589	**Complications and electrolytes**	Insulin-induced hypokalemia & hypophosphatemia, cerebral edema
590	**ICU hypoglycemia and monitoring traps**	Hyperchloremic non-gap acidosis, emergency protocol
592	**Comparison tables**	**Table 1:** Hyperglycemic Crises vs Hypoglycemia; **Table 2:** Electrolyte Complications of Insulin
593	**Visual anchors**	Laboratory and ECG

DIVISION III

Surgical Critical Care

Pages 595–776

General & Vascular Surgery	pp. 595–622	Obstetric Critical Care	pp. 623–652
Trauma Critical Care	pp. 653–723	Transplant Critical Care	pp. 724–776

GENERAL & VASCULAR SURGERY pp. 595–622

CHAPTER 50

Abdominal Surgery pp. 595–607

PAGE	SECTION	KEY SUBTOPICS
595	**Peritonitis**	Primary, secondary & tertiary peritonitis; **Table 1:** Peritonitis Subtypes
597	**Intra-abdominal hypertension and abdominal compartment syndrome**	Primary vs secondary ACS; **Table 2:** IAH & ACS Thresholds
599	**Damage control surgery**	Physiologic failure as the trigger, staged surgery
601	**Critical surgical emergencies in the ICU**	Acute mesenteric ischemia, acalculous cholecystitis, Fournier gangrene
602	**Oncologic resections and postoperative complications**	Esophagectomy & gastrectomy, anastomotic leak, chylothorax, Whipple, sentinel bleed; **Table 3:** Upper GI Surgical Complications
605	**Abdominal transplant in the ICU**	Kidney, liver, pancreas, intestine / multivisceral
606	**Visual anchors**	Peritonitis CT, ACS manometry, pseudoaneurysm, chylothorax

CHAPTER 51

Limb Surgery pp. 608–622

PAGE	SECTION	KEY SUBTOPICS
608	**Acute limb ischemia: causes**	Bedside & Doppler workup, CTA; **Table 1:** Etiologies
612	**Rutherford classification**	**Table 2:** Rutherford Categories
614	**Emergency management and reperfusion**	Heparin, catheter-directed thrombolysis, Fogarty embolectomy, reperfusion injury; **Table 3:** Revascularisation Strategies
617	**Necrotizing soft tissue infection**	Empiric antibiotics, debridement; **Table 4:** Necrotizing Fasciitis Subtypes
621	**Visual anchors**	Cholesterol emboli, embolic ALI on CTA, fasciotomy, necrotising fasciitis

OBSTETRIC CRITICAL CARE pp. 623–652

CHAPTER 52

Pre-eclampsia, Eclampsia and HELLP Syndrome pp. 623–637

PAGE	SECTION	KEY SUBTOPICS
623	**Pathophysiology and the disease spectrum**	**Table 1:** Hypertensive Disorders of Pregnancy
626	**Neurological complications**	Eclampsia, PRES; **Table 2:** Anticonvulsants in Obstetric Critical Care
629	**Systemic organ dysfunction**	HELLP (Tennessee criteria), pulmonary edema, renal endotheliosis, hepatic rupture; **Table 3:** Critical Organ Complications
633	**Pharmacotherapy and ICU management**	Magnesium, acute BP control; **Table 4:** Antihypertensives & Emergency Drugs
635	**Visual anchors**	PRES MRI, HELLP smear, hepatic rupture, pulmonary edema

CHAPTER 53

Obstetric Emergencies in the ICU pp. 638–652

PAGE	SECTION	KEY SUBTOPICS
638	**Massive obstetric hemorrhage and coagulopathy**	Workup, uterotonics (oxytocin, carboprost); **Table 1:** PPH Therapies
641	**Amniotic fluid embolism and DIC**	**Table 2:** Causes of Postpartum Collapse
643	**Peripartum cardiomyopathy and ECMO**	PPCM vs pre-eclampsia, VV-ECMO and mechanical support
645	**AFLP versus HELLP**	Swansea criteria; **Table 3:** AFLP vs HELLP
648	**Maternal cardiac arrest**	Aortocaval compression beyond 20 weeks, modified resuscitation
649	**Respiratory physiology and ventilation**	Pregnancy mechanics, progesterone drive, ventilator rules
650	**Visual anchors**	ROTEM in PPH, AFE echo, PPCM echo, AFLP biopsy

TRAUMA CRITICAL CARE pp. 653–723

CHAPTER 54

Basics of Trauma pp. 653–662

PAGE	SECTION	KEY SUBTOPICS
653	**Pathophysiology and the XABCDE approach**	Trimodal deaths, SBP estimate by palpation
655	**Primary survey life threats and shock**	Hemorrhage classes, massive transfusion, tension pneumothorax, tamponade
658	**Secondary survey, scores and pitfalls**	GCS, RTS, ISS
661	**Visual anchors**	Image-based recap

CHAPTER 55

Head, Neck and Spine Trauma pp. 663–673

PAGE	SECTION	KEY SUBTOPICS
663	**TBI, cerebral perfusion and herniation**	NICE CT triggers
664	**Focal and diffuse intracranial lesions**	EDH, acute & chronic SDH, DAI
667	**Pediatric, facial and orbital emergencies**	Mandible fractures, oculocardiac reflex, retrobulbar hematoma
669	**Cervical spine and cord syndromes**	Brown-Séquard, anterior, posterior and central cord syndromes
671	**Visual anchors**	Image-based recap

CHAPTER 56

Torso, Pelvic and Extremity Trauma pp. 674–685

PAGE	SECTION	KEY SUBTOPICS
674	**Torso trauma: resuscitation and life threats**	Tension pneumothorax, blunt aortic injury, tracheobronchial tear, massive hemothorax
676	**Abdominal trauma and compartment syndrome**	Pancreatic, hepatic and visceral injuries
679	**Pelvic ring disruption**	Binder, angioembolisation, preperitoneal packing
680	**Extremity trauma, nerve injury and infection**	Nerve injury classes (neurapraxia, axonotmesis, neurotmesis)
684	**Visual anchors**	Image-based recap

CHAPTER 57

Trauma Critical Care: Brain, Spine and Chest pp. 686–700

PAGE	SECTION	KEY SUBTOPICS
686	**Traumatic brain injury and neuromonitoring**	**Table 1:** CBF & Neuromonitoring Thresholds; **Table 2:** Marshall CT Classes
690	**Traumatic spinal cord injury**	Neurogenic shock; **Table 3:** Incomplete Cord Syndromes
695	**Thoracic and cardiac trauma**	**Table 4:** Life-Threatening Thoracic Emergencies
699	**Visual anchors**	DAI on SWI, Marshall IV CT, central cord syndrome, autonomic dysreflexia, eFAST

CHAPTER 58

Traumatic Abdominal and Extremity Injury pp. 701–713

PAGE	SECTION	KEY SUBTOPICS
701	**Abdominal trauma and ACS**	Hollow viscus & retroperitoneal injury; **Table 1:** Visceral Injuries & Management
706	**Pelvic ring disruption**	Hemorrhage control
707	**Extremity ischemia and compartment syndrome**	Fasciotomy; **Table 2:** Extremity Ischemia & Compartment Syndromes
709	**Polytrauma physiology, DCO and fat embolism**	Damage control orthopaedics; **Table 3:** Fat Embolism Syndrome
712	**Visual anchors**	ACS manometry, liver trauma CT, splenic pseudoaneurysm, fat embolism rash

CHAPTER 59

ATLS 11th Edition: XABCDE Resuscitation pp. 714–723

PAGE	SECTION	KEY SUBTOPICS
714	**Philosophy and physiology**	ATLS 11 principles
715	**The XABCDE sequence**	Catastrophic hemorrhage first; **Table 1:** Primary Survey Priorities & Traps
721	**Damage control resuscitation and surgery**	Lethal triad; **Table 2:** DCR vs Conventional Resuscitation

722	Visual anchors	Catastrophic hemorrhage, tension pneumothorax, unstable pelvis

TRANSPLANT CRITICAL CARE pp. 724–776

CHAPTER 60

Management of Organ Donors pp. 724–732

PAGE	SECTION	KEY SUBTOPICS
724	Physiology of brain death; Confirming brain death	Brain death physiology, excluding confounders, apnea test
727	Donor types and polyuria	**Table 1:** DBD vs DCD; **Table 2:** Polyuria in a Potential Donor (central DI)
728	Donor optimization	Hemodynamic, oxygenation, endocrine & fluid targets; organ-specific goals
731	Visual anchors	Central DI labs, apnea test, ancillary perfusion studies

CHAPTER 61

Kidney and Liver Transplantation pp. 733–746

PAGE	SECTION	KEY SUBTOPICS
733	Kidney: evaluation and intraoperative resuscitation	Recipient workup, perfusion before unclamping
735	Early kidney graft dysfunction and rejection	DGF / ischemic ATN, renal vein thrombosis, TCMR, AMR, CNI toxicity
738	Immunosuppression, metabolic and infectious complications	Triple maintenance therapy, opportunistic infections
740	Liver: evaluation, allocation and donor selection	MELD-Na, PELD, King's College criteria
742	Intraoperative liver transplant phases	Dissection, anhepatic and reperfusion phases
743	Early post-liver-transplant catastrophes	Primary non-function, hepatic artery thrombosis, outflow obstruction, biliary complications

745	**Visual anchors**	RVT & HAT Doppler, TCMR biopsy, BK nephropathy, hepatopulmonary syndrome

CHAPTER 62

Heart and Lung Transplantation pp. 747–757

PAGE	SECTION	KEY SUBTOPICS
747	**Indications, recipient selection and allocation**	Risk stratification, absolute contraindications, allocation
749	**Denervation physiology and immediate postoperative care**	Denervated heart, ICU monitoring, lung graft care
751	**Early complications: PGD, airway and acute rejection**	Primary graft dysfunction, anastomotic complications, ACR
754	**Late complications: CAV, CLAD / BOS and infection**	Cardiac allograft vasculopathy, bronchiolitis obliterans
756	**Visual anchors**	PGD grade 3, ACR biopsy, CAV, BOS

CHAPTER 63

Immunosuppressive Drugs in Transplantation pp. 758–766

PAGE	SECTION	KEY SUBTOPICS
758	**The alloimmune cascade and where drugs act; Induction agents**	Induction by risk (ATG, alemtuzumab, basiliximab), maintenance backbone
760	**Calcineurin inhibitors**	Tacrolimus, cyclosporine; nephrotoxicity, neurotoxicity, PRES
762	**Antimetabolites and other agents**	Mycophenolate, azathioprine, mTOR inhibitors, belatacept, steroids, rituximab
765	**Visual anchors**	PRES, chronic CNI nephrotoxicity, ACR, MMF colitis, BK inclusions

CHAPTER 64

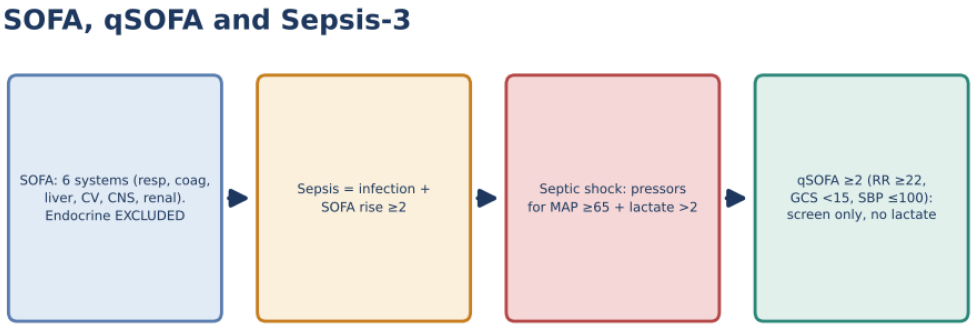
Hematopoietic Stem Cell Transplantation pp. 767–776

PAGE	SECTION	KEY SUBTOPICS
767	**Transplant immunology; Donors, graft sources and processing**	Donor hierarchy, bone marrow vs peripheral blood vs cord blood
770	**Conditioning, ABO and engraftment**	Conditioning goals, major vs minor ABO mismatch
771	**Early complications: SOS and TMA**	SOS / VOD, transplant-associated TMA
772	**GVHD**	Acute vs chronic GVHD
774	**Infections and CAR T-cell toxicity**	Prophylaxis, CRS
775	**Visual anchors**	GVHD biopsy, SOS histology, BOS HRCT, TA-TMA smear

Basics of Critical Care

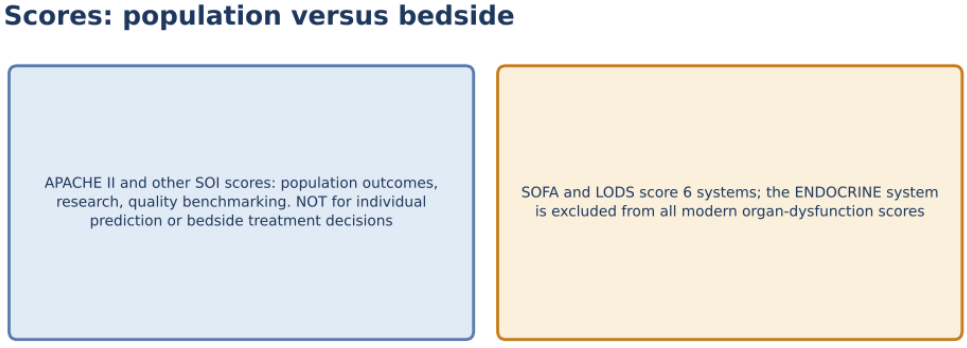
1. Severity scores and sepsis definitions

Critical illness is systemic physiological derangement: hypoperfusion, runaway inflammation or organ dysfunction. In sepsis, pathogen-associated patterns injure the endothelium (glycocalyx shedding, vasoplegia, microvascular thrombosis, dysoxia). **Severity-of-illness (SOI) scores** quantify this across populations. **SOFA** covers **six systems**: respiratory (PaO_2/FiO_2), coagulation (platelets), liver (bilirubin), cardiovascular (BP/vasopressors), CNS (GCS) and renal (creatinine/urine output). **Sepsis-3** defines **sepsis** as life-threatening organ dysfunction from a dysregulated host response to infection, shown by an **acute SOFA rise ≥2**. **Septic shock** needs **vasopressors for MAP ≥65 mmHg and lactate >2 mmol/L** despite fluids.



Schematic: the definitions. Illustration only, not a real clinical image.

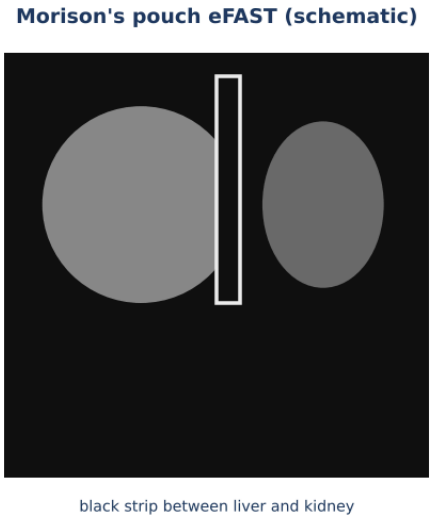
💡 **Heads up:**
APACHE II and other SOI scores are for **population outcomes, research and benchmarking**, not for predicting an individual's outcome or guiding bedside treatment. SOFA and LODS use 6 organ systems; the **endocrine system is excluded** from all modern organ-dysfunction scores.



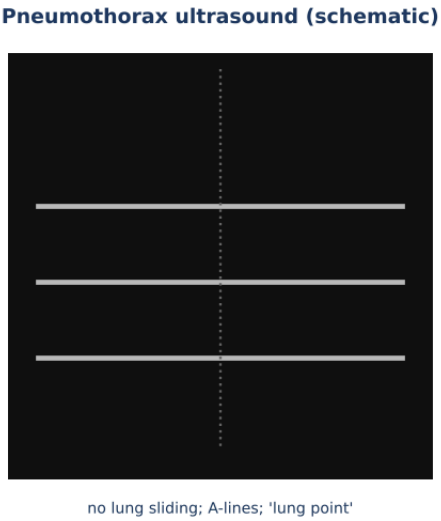
Schematic: population versus bedside. Illustration only, not a real clinical image.

Schematic: hemodynamic profiles. Illustration only, not a real clinical image.

- **Workup:** ABCs, **eFAST** (tamponade, hemothorax, pneumothorax, free fluid), BP, pulse pressure, MAP, pulse, ABG with **base deficit**, **lactate** and **anion gap**, then permissive hypotension or targeted vasopressors.



Schematic: eFAST Morison's pouch (schematic, not a real image). Illustration only, not a real clinical image.



Schematic: pneumothorax ultrasound (schematic, not a real image). Illustration only, not a real clinical image.

💡 **Heads up:**

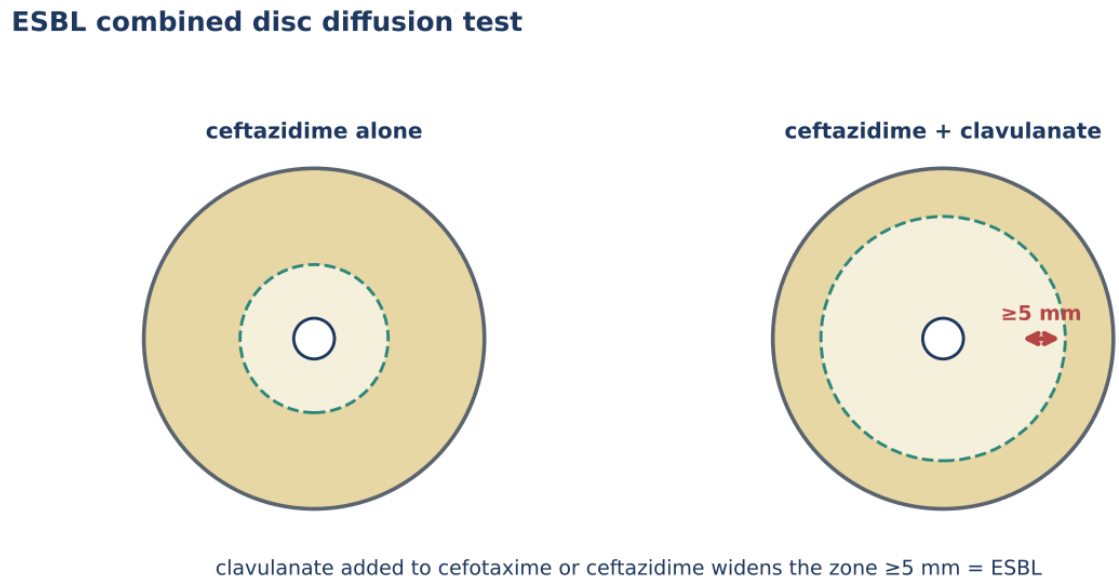
Base deficit >6 mEq/L reliably predicts massive transfusion and damage control. **IV bicarbonate makes the base deficit inaccurate**, does not improve mortality in lactic acidosis and is reserved for **pH <7.20** to restore vasopressor responsiveness.

4. Chest tube thoracostomy

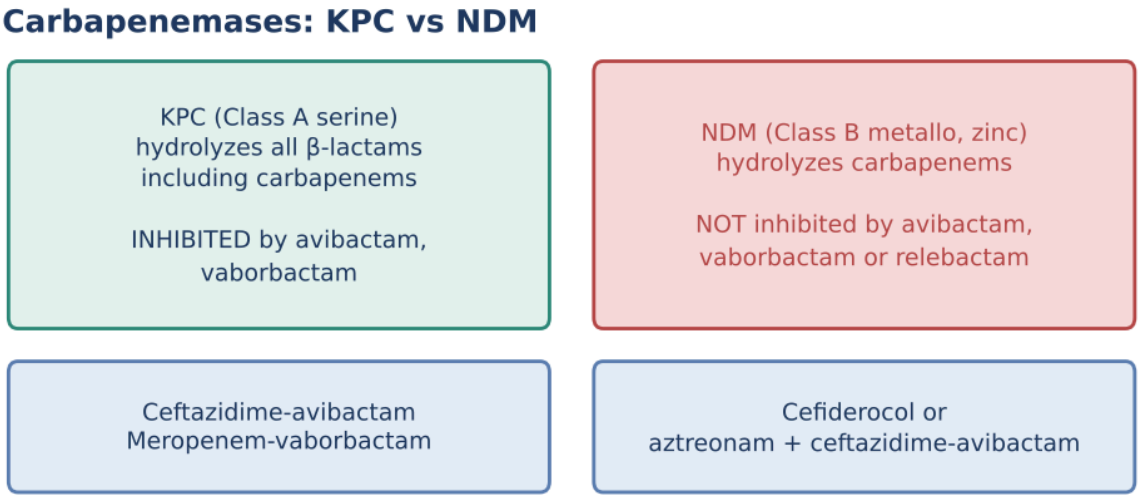
Find the "Triangle of Safety"
(latissimus dorsi, pectoralis major, 5th intercostal space)
↓
Incise skin, blunt dissect over UPPER border of rib below
(avoids intercostal neurovascular bundle)
↓
Direct tube APICALLY for pneumothorax,
DEPENDENTLY for fluid/hemothorax
↓
Secure tube, confirm ALL side holes inside pleural space,
attach underwater seal

Table 2: Tube Thoracostomy Positioning, Anatomy, & Underwater Seal Troubleshooting

Feature / Sign	Anatomical / Clinical Finding	Mechanical Mechanism	Key Clinical Significance
Triangle of Safety	Latissimus dorsi anteriorly, Pectoralis major laterally, **5th intercostal space** inferiorly.	Anatomical area with minimal muscle mass and absence of major vascular structures.	**Standard safe entry zone**; placement below 5th ICS risks **diaphragmatic and abdominal organ injury**.
Side Hole Position	All drainage holes located **deep to the parietal pleura** within the chest cavity.	Ensures sealed pleural evacuation without atmospheric air bridging.	**Side holes residing within soft tissue cause severe subcutaneous emphysema** and air leaks.
Continuous Seal Bubbling	Persistent, unbroken bubbling in the underwater seal chamber.	Air continuously entering drainage system from an active pulmonary or structural leak.	**Indicates a persistent air leak** (bronchopleural fistula or loose connection).



Schematic: combined disc test, zone widens ≥5 mm with clavulanate. Illustration only, not a real clinical image.



Schematic: KPC versus NDM and what covers each. Illustration only, not a real clinical image.

4.2 Non-fermenters (Pseudomonas aeruginosa and Acinetobacter)

- **Pseudomonas aeruginosa:** leading cause of nosocomial VAP and CLABSI. Preferred antipseudomonal β-lactams: **cefepime, ceftazidime, piperacillin-tazobactam, meropenem**. For multidrug-resistant Pseudomonas (CRPA), **ceftolozane-tazobactam** is the ideal backbone.
- **Acinetobacter baumannii (CRAB):** highly resistant, and resistant to most novel β-lactam combinations. Options: **cefiderocol, eravacycline, high-dose ampicillin-sulbactam, colistin**.

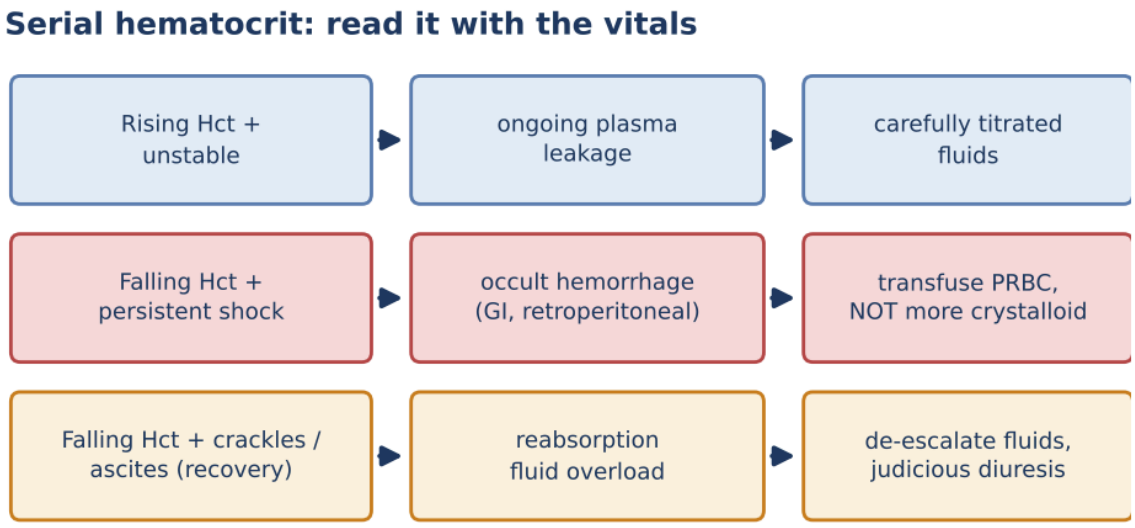
3. Dengue and Expanded Dengue Syndrome

3.1 Phases and hemodynamics

- Three phases: **febrile**, **critical** (plasma leakage around defervescence), **recovery/reabsorption**.
- **Early bedside clue for shock: narrowing pulse pressure (≤20 mmHg)** is the earliest indicator of impending DSS, reflecting plasma leakage and falling intravascular volume. Systolic BP may stay normal initially due to compensatory vasoconstriction, so relying on systolic pressure alone delays recognition of shock.

Serial hematocrit rule:

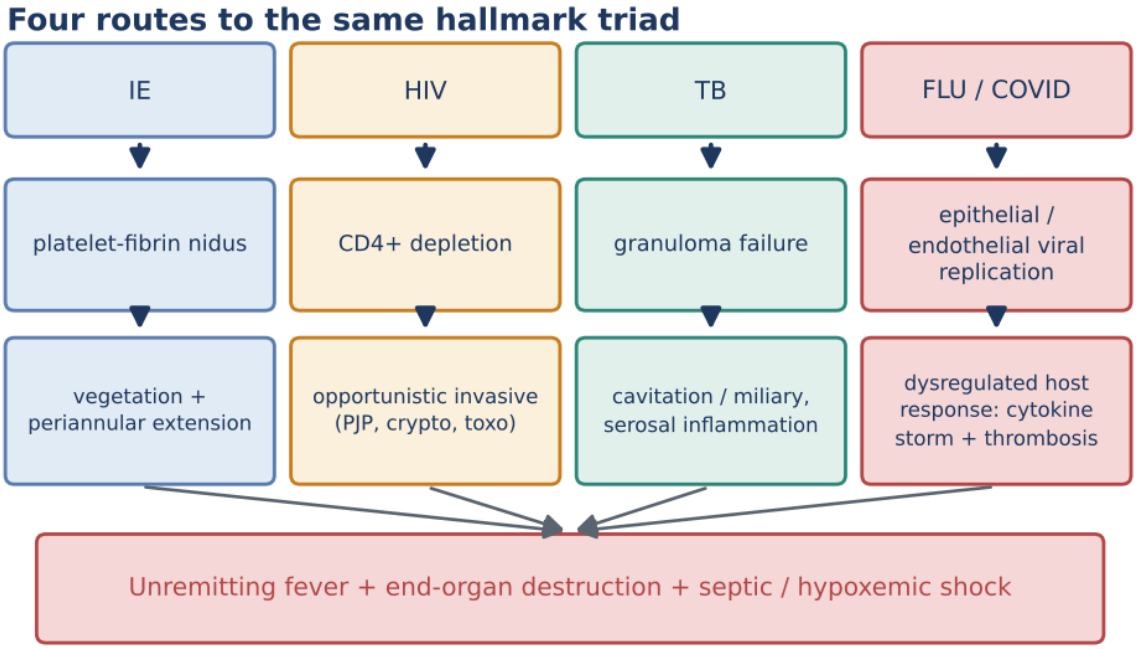
- **Rising Hct + hemodynamic instability: ongoing plasma leakage**, needs carefully titrated fluids.
- **Falling Hct + persistent shock:** strongly suggests **significant occult hemorrhage** (GI or retroperitoneal). Give **blood component transfusion (PRBCs)** rather than escalating crystalloids.
- **Falling Hct + respiratory distress / crackles / ascites (during recovery): reversal phase fluid overload** as extravasated fluid re-enters the vascular space. De-escalate fluids, judicious diuresis.



Schematic: reading serial hematocrit together with the hemodynamics. Illustration only, not a real clinical image.

3.2 Fluid strategy

- Compensated dengue shock (WHO): **isotonic crystalloids 10–20 mL/kg/hour over 1 hour**, then frequent reassessment of pulse pressure, hematocrit and urine output.



Schematic: four mechanisms, one hallmark triad. Illustration only, not a real clinical image.

Endocardial nidus (platelet-fibrin) → vegetation and periannular extension

↓

CD4+ depletion (<200 cells/μL) → opportunistic invasive disease (PJP, crypto, toxoplasma)

↓

Granuloma failure → caseation (cavitation/miliary) and serosal inflammation (TB)

↓

Epithelial/endothelial viral replication → dysregulated host response (cytokine storm and thrombosis)

↓

Hallmark triad: unremitting fever + end-organ destruction + septic/hypoxemic shock

2. ICU diagnostic step-ladder

In suspected severe endovascular, opportunistic or viral infection, work through a rapid, structured sequence without delaying life-saving therapy.

Table 2: Antifungal classes, toxicity and ICU rules

Class	Agents	Mechanism	Key toxicity	ICU rule
Echinocandins	Caspofungin, micafungin, anidulafungin	Inhibit β-(1,3)-D-glucan synthase (cell wall)	Minimal; mild transaminitis, histamine release	First line for ICU candidemia. No renal adjustment. POOR urinary levels (no UTI use).
Triazoles (2nd gen)	Voriconazole, isavuconazole, posaconazole	Inhibit 14-α-demethylase (ergosterol synthesis)	Voriconazole: neuro/visual toxicity, QTc prolongation, liver toxicity	Voriconazole first line for IPA (needs TDM). Isavuconazole SHORTENS QTc.
Polyenes	Liposomal amphotericin B, deoxycholate	Bind ergosterol, forming membrane pores	Nephrotoxicity, hypokalemia, hypomagnesemia, rigors	First line for mucormycosis and cryptococcal induction. Pretreat with hydrocortisone/antihistamines.
Pyrimidines	Flucytosine (5-FC)	Converted to 5-FU; blocks fungal RNA/DNA synthesis	Bone marrow suppression, hepatotoxicity	Synergistic with amphotericin B for cryptococcal and Candida meningitis. Never monotherapy.

7. Visual anchors

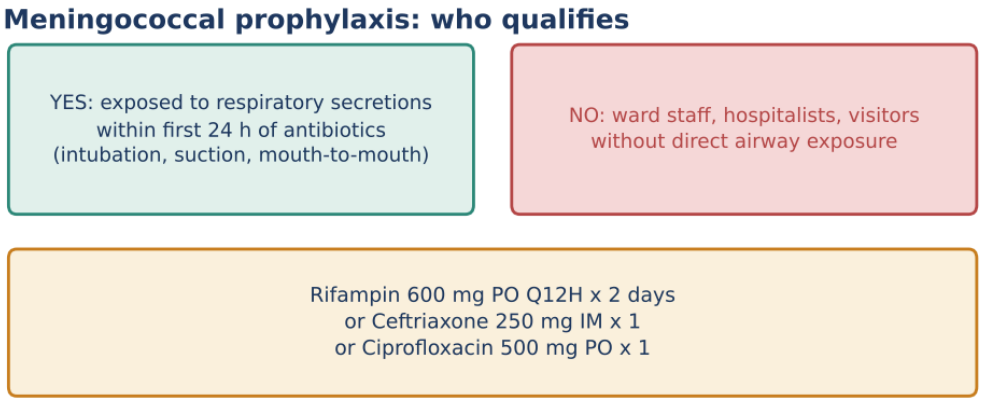
Each item below has a drawn schematic of the finding. They are illustrations to fix the pattern in your head, not real clinical images.

Visual anchor 1: radiographic signs of IPA

- **Halo sign (early IPA):** dense nodular opacity ringed by ground-glass (**perilesional hemorrhage** from angioinvasive destruction).
- **Air crescent sign (late/recovery IPA):** crescent of gas around a central necrotic sequestrum, classically as the neutrophil count recovers.

7.2 Meningococcal post-exposure prophylaxis

- **Indication:** healthcare workers exposed to respiratory secretions of a patient with N. meningitidis **within the first 24 hours of antibiotic therapy** (intubation, airway suctioning, mouth-to-mouth). Ward staff without direct airway exposure do NOT need prophylaxis.
- **Regimens: rifampin 600 mg PO Q12H for 2 days**, **ceftriaxone 250 mg IM x 1**, or **ciprofloxacin 500 mg PO x 1**.



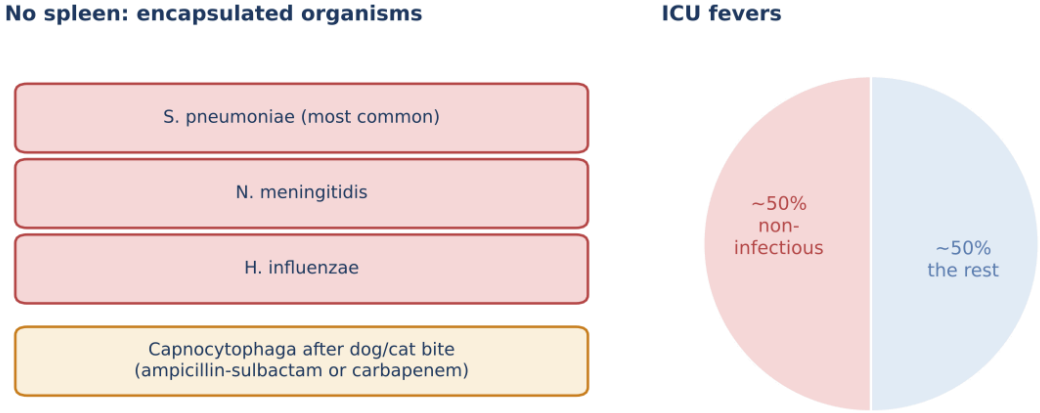
Schematic: who needs meningococcal prophylaxis and with what. Illustration only, not a real clinical image.

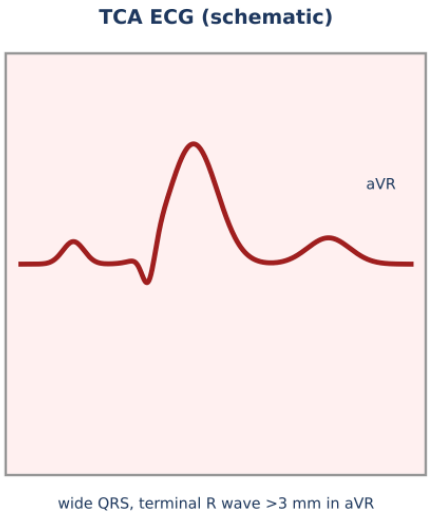
7.3 Noninfectious fever in the ICU

- About **50% of ICU fevers are noninfectious**: SIRS from tissue injury, hematoma, pancreatitis, blood product transfusion, or drug fever.
- **Drug fever:** temporal link to medication and **prompt resolution when the drug is stopped**.

💡 Heads up:

Atelectasis does not cause postoperative fever. Evidence is scarce and multiple prospective studies found no causal link. Do not reflexively blame atelectasis. Search for drug fever, line infection, UTI, or a deep operative complication.

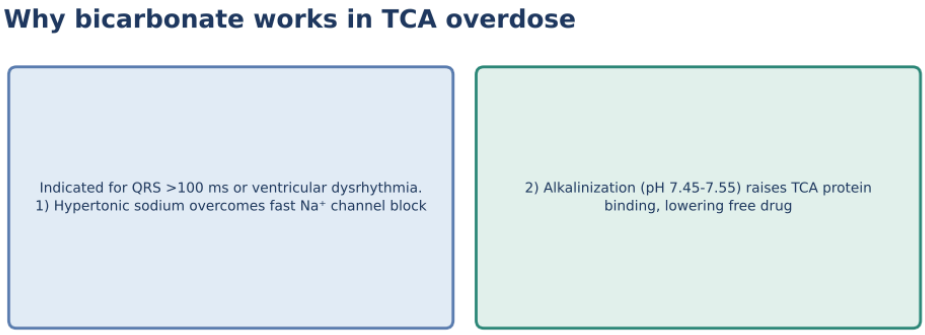




Schematic: TCA ECG (schematic, not a real image). Illustration only, not a real clinical image.

💡 Heads up:

Bicarbonate in TCA overdose (QRS >100 ms or ventricular arrhythmia) works two ways: the **hypertonic sodium load** overcomes the fast Na^+ channel block, and **alkalinization (pH 7.45-7.55)** raises TCA protein binding, lowering free drug.



Schematic: how bicarbonate helps. Illustration only, not a real clinical image.

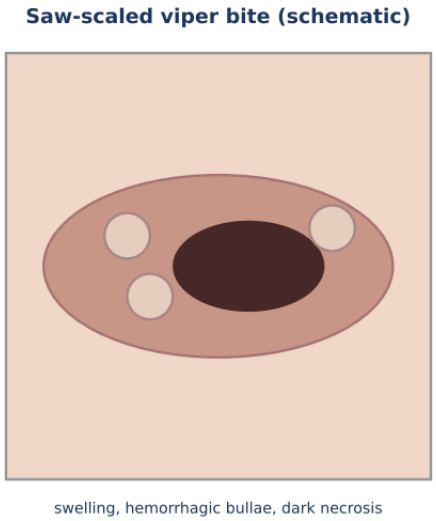
💡 Heads up:

In acute digoxin poisoning, **K^+ >5.0 mEq/L is the best predictor of mortality and an absolute indication for Fab fragments.** Do not prioritize insulin/glucose or bicarbonate over Fab. In toxic alcohols, the **parent compounds are harmless; the acid metabolites do the damage**, so **ethanol and fomepizole competitively inhibit ADH** and let the parent be excreted or dialyzed.

Schematic: four patterns. Illustration only, not a real clinical image.

Envenomation	Local reaction	Systemic toxicity	Clue
Saw-scaled viper	Severe swelling, hemorrhagic bullae, dark necrosis	Hemotoxicity, capillary leak, persistent bleeding, VICC	Reaction out of proportion to snake size; divided subcaudal shields, continuous hissing
Elapid	Minimal or none	Postsynaptic neuroparalysis, respiratory failure	Early ptosis, ophthalmoplegia, descending paralysis
Sea snake	Minimal or none	Myotoxicity, rhabdomyolysis, myoglobinuria	Muscle pain, fasciculations, dark urine, hyperkalemia
Bark scorpion	Pain, no visible mark	Autonomic and cranial nerve hyperactivity	Positive tap test; opsoclonus, thick secretions; Anascorp

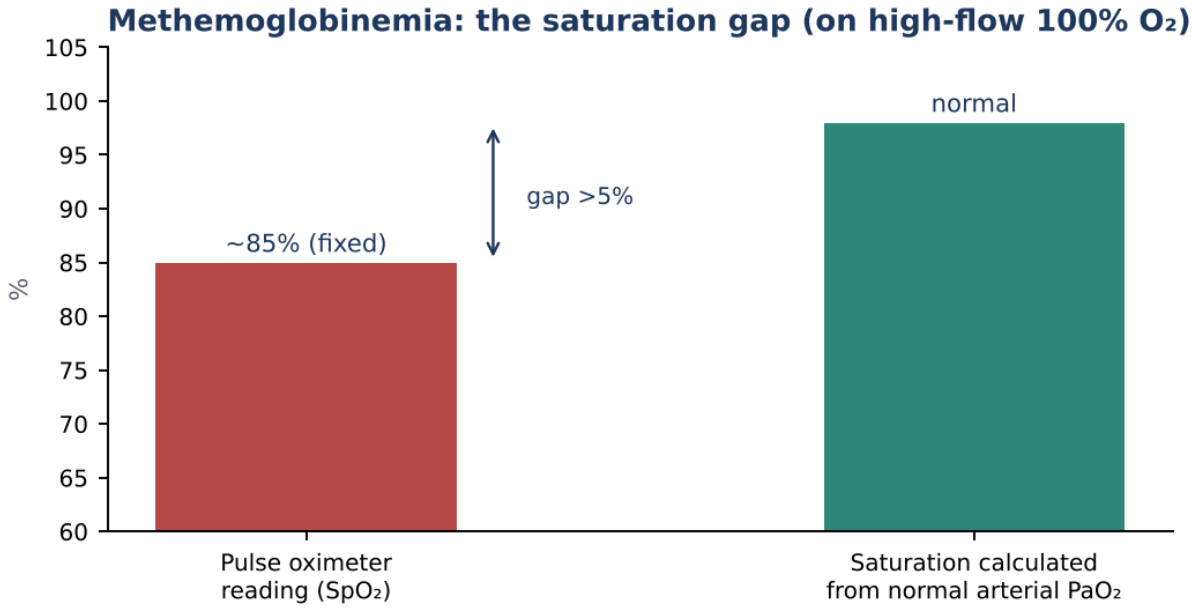
- **Labs:** PT/INR, fibrinogen, platelets for vipers; CPK and potassium for sea snakes. **Antisnake venom (ASV)** polyvalent; **Anascorp** for grade III-IV scorpion envenomation.



Schematic: viper bite (schematic, not a real image). Illustration only, not a real clinical image.

3.4 Methemoglobinemia

- Oxidants (**topical benzocaine spray, dapsone, nitrites**) turn Fe^{2+} into Fe^{3+}, which can't bind O_2 and shifts the curve left.
- **Hallmarks: cyanosis refractory to high-flow O_2, chocolate-brown blood, "saturation gap"** (SpO_2 fixed ~85%, normal arterial PaO_2).
- **Antidote: methylene blue 1% 1–2 mg/kg IV over 5 min.** (Contraindicated in G6PD deficiency: severe intravascular hemolysis.)



Schematic: pulse oximeter reading stuck near 85% while the value calculated from a normal arterial PaO_2 is normal. Illustration only, not a real clinical image.

4. Terrestrial envenomation

4.1 Pit viper

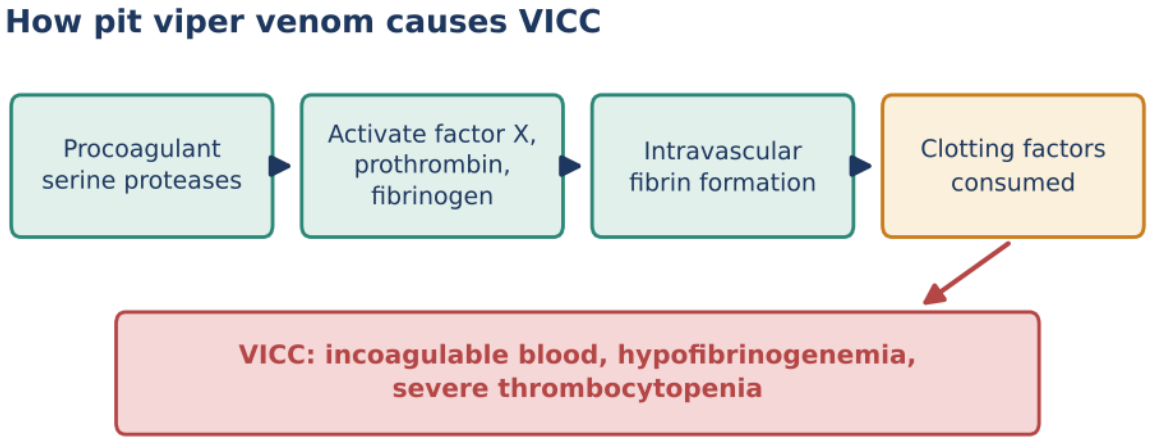
Pathophysiology

- Crotalinae: **rattlesnakes, copperheads, cottonmouths/water moccasins**. Venom: metalloproteinases, kallikrein-like enzymes, phospholipases. They destroy capillary endothelium, cause local necrosis and microvascular leak, and activate and consume coagulation factors.

1. Viperidae (pit vipers and hemotoxic/cytotoxic snakes)

Pathophysiology

- **Crotalinae:** *rattlesnakes, copperheads, cottonmouths (North America);* ***Russell's viper*****,** ***saw-scaled viper*** *(Asia).*
- ***Venom enzymes:*** ***hyaluronidase*** *("spreading factor"),* ***phospholipase A2*** *(membrane disruption, myonecrosis, neurotoxicity), kallikrein-like enzymes,* ***metalloproteinases*** *(disintegrins).*
- *Metalloproteinases degrade vascular basement membranes and capillary endothelium, so direct tissue destruction, severe microvascular leak, local swelling.*
- ***Procoagulant serine proteases*** *activate factor X, prothrombin and fibrinogen, forming intravascular fibrin and consuming clotting factors. End result is* ***Venom-Induced Consumption Coagulopathy (VICC):*** *incoagulable blood, hypofibrinogenemia, severe thrombocytopenia.*



Schematic: how pit viper venom leads to VICC. Illustration only, not a real clinical image.

Capillary endothelial damage + disintegrin activation

↓

Local necrosis / ecchymosis + VICC + hypovolemic / vasodilatory shock

Presentation

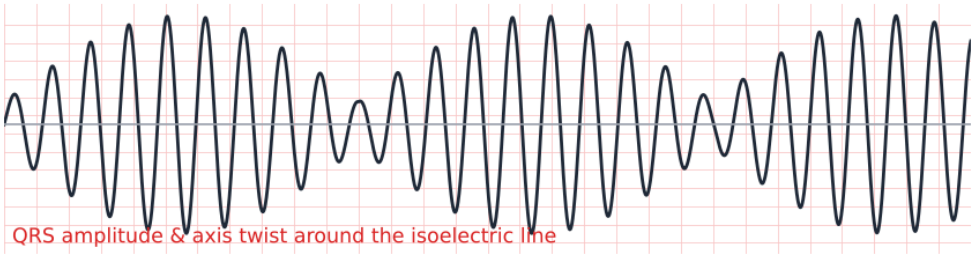
- **Local:** *severe burning pain along the limb within minutes, then rapid progressive edema and ecchymosis. At 24–36 h: vesicles, petechiae,*

Pharmacological management & comparison

Agent	Primary Mechanism	Hemodynamic Effects (CO / SVR / HR)	High-Yield Clinical Indications & Exam Context
Norepinephrine	Potent α1 >> β1 agonist	CO: ↔/↑ | SVR: ↑↑↑ | HR: ↔/↓	First-line vasopressor in hypotensive CS. Superior to Dopamine with significantly lower 28-day mortality and fewer tachyarrhythmias (SOAP II trial).
Dobutamine	Direct β1 > β2 agonist	CO: ↑↑↑ | SVR: ↓ (mild) | HR: ↑↑	First-line inotrope for low CO with preserved BP (SBP >90 mm Hg). Increases contractility and reduces afterload. Increases myocardial O2 demand.
Milrinone	PDE-3 inhibitor (cAMP ↑)	CO: ↑↑↑ | SVR: ↓↓ | HR: ↑	Inodilator. Ideal for patients on chronic β-blockers (bypasses β-receptors). Renally eliminated, causes severe hypotension/arrhythmias if unadjusted in CKD.
Dopamine	Dose-dependent α1, β1, DA1	CO: ↑↑ | SVR: ↑↑ | HR: ↑↑↑	Associated with increased mortality and tachyarrhythmias in cardiogenic shock (SOAP II). Largely historical; NOT recommended first-line.
Vasopressin	V1 vascular smooth muscle	CO: ↔/↓ | SVR: ↑↑↑ | HR: ↔	Non-adrenergic vasopressor. Adjunct in vasodilatory/refractory shock. Causes less pulmonary vasoconstriction than NE, preferred in acute RV shock.

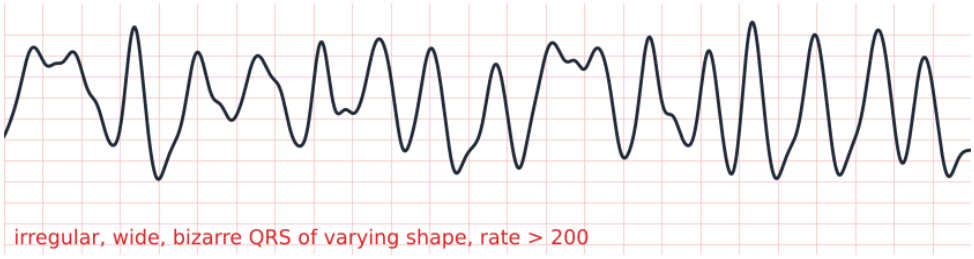
💡 Heads up:

On **chronic beta-blockers** or in **beta-blocker overdose**, dobutamine's inotropic effect is badly blunted.



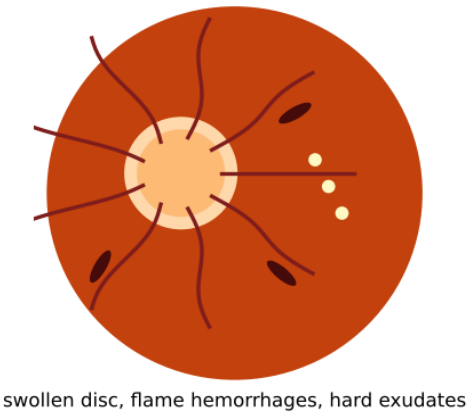
Torsades de pointes (schematic)

- **Irregular WCT with variable QRS shapes = pre-excited AF (WPW):** bizarre irregular wide-complex rhythm at **>200 bpm**. AV nodal blockers fatal; treat with IV **procainamide**.



Pre-excited AF (schematic)

- **Papilledema & flame hemorrhages = hypertensive encephalopathy / crisis:** fundoscopy shows optic disc swelling, **hard exudates**, **flame-shaped** microhemorrhages = acute CNS end-organ damage.



Hypertensive fundus (schematic)

Table 2: Comparative hemodynamic & neurological features in trauma

Shock / State Type	Heart Rate	Blood Pressure	Skin / Reflexes	Primary ICU Management
Neurogenic Shock (High SCI >T6)	Bradycardia (<60/min)	Hypotension (SBP <90)	Warm, Dry Skin; Loss of sympathetic tone	Fluid resuscitation + Vasopressors (Target MAP ≥85)
Hypovolemic Shock (Hemorrhage)	Tachycardia (>100/min)	Hypotension (SBP <90)	Cold, Clammy Skin; Pale extremities	Blood transfusion + Hemorrhage control
Spinal Shock (Electrical)	Normal / Variable	Normal / Variable	Flaccid Paralysis + Areflexia below lesion	Supportive; Monitor Bulbocavernosus reflex
Cushing Reflex (Severe ↑ ICP)	Bradycardia	Hypertension (Wide PP)	Irregular Respirations; Herniation risk	Tiered Osmotherapy (Mannitol / HTS) + Surgery

Acute suspected bacterial meningitis

Suspected bacterial meningitis
(fever, severe headache, nuchal rigidity)
↓
Blood cultures immediately
(never delay for imaging or LP!)
↓
Check CT indications before LP:
focal deficit, altered sensorium (GCS <14), papilledema,
new seizures, immunocompromised
↓
CT INDICATED:
dexamethasone + empiric ABX → CT head → lumbar puncture
↓
NO CT INDICATED:
dexamethasone + empiric ABX + immediate lumbar puncture

Timing traps

Heads up:

Empiric antibiotics go in within 1 hour of hospital presentation. Never hold them for neuroimaging or LP.

Heads up:

CT before LP is needed ONLY with: focal deficits, altered consciousness (GCS <14), papilledema, new-onset seizures, or severe immunocompromise.

Fever, headache, leukocytosis and nuchal rigidity alone are NOT CT indications and don't stop you doing an immediate LP.

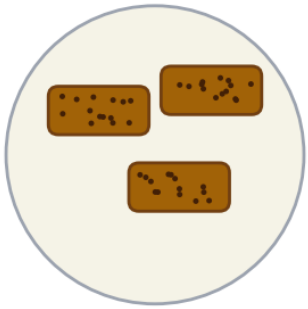
Heads up:

Dexamethasone 10 mg IV goes 10 to 20 minutes before or with the first antibiotic dose, then 10 mg IV q6h for 4 days.

It blunts antibiotic-induced inflammatory lysis and dramatically cuts sensorineural hearing loss and mortality in pneumococcal meningitis.

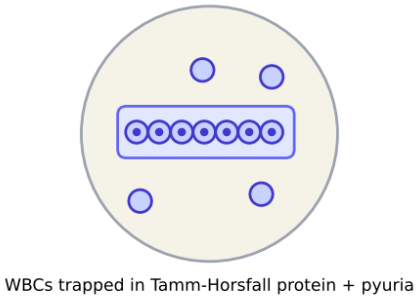
Step 1: urine sediment

- **Muddy brown granular casts:** pathognomonic for **ischemic, septic or nephrotoxic ATI**.



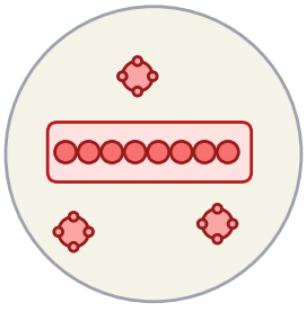
Muddy brown granular casts (schematic)

- **WBC casts & pyuria:** tubulointerstitial inflammation; **AIN** or severe **pyelonephritis**.



WBC cast with pyuria (schematic)

- **RBC casts & dysmorphic RBCs:** active glomerular capillary injury (nephritic / GN / **RPGN**).



RBC cast and dysmorphic RBCs (schematic)

- **Heme-positive dipstick, few/no RBCs:** free **myoglobin** (rhabdo) or free **hemoglobin** (intravascular hemolysis).

- **1.0–2.0:** pure uncomplicated high-AG acidosis (lactic acidosis, ketoacidosis).
- **<1.0:** combined high-AG **and** normal-AG (hyperchloremic) acidosis (e.g. severe diarrhea or RTA + septic lactic acidosis).

```
UAG = Na⁺ + K⁺ − Cl⁻
```

- Normal-AG acidosis: **negative UAG** (e.g. **−20 to −50 mEq/L**) = appropriate renal NH_4^+ excretion with Cl^- → **GI cause** (severe diarrhea). **Positive UAG** = impaired renal acid excretion (**distal type 1 RTA** or advanced renal failure).

💡 Heads up:

FENa on diuretics is misleading. Loop diuretics block NKCC2 in the TAL and force natriuresis (**urine Na^+ >20–40 mEq/L**, **FENa >2%**) even in pure prerenal or cardiorenal states.

Use **FEUrea** instead: **FEUrea <35%** reliably confirms prerenal avidity, since proximal urea reabsorption is untouched by loop diuretics.

```
FEUrea (%) = (Urine Urea × Serum Cr) / (Serum Urea × Urine Cr) × 100
```

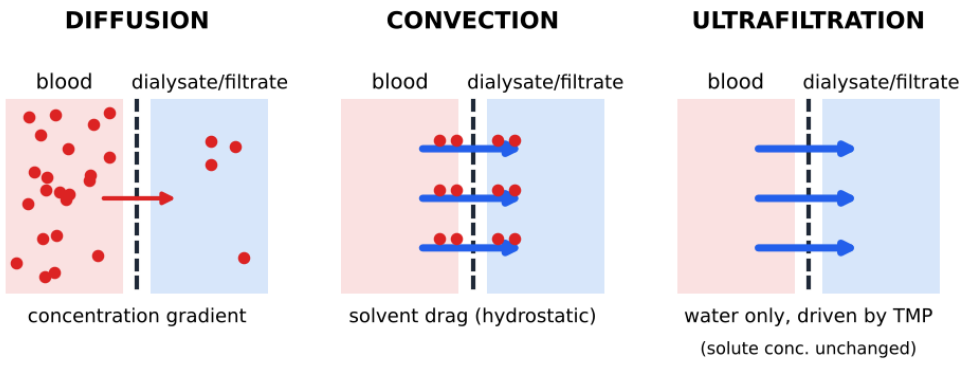
💡 Heads up:

Septic AKI paradox: intense RAAS, sympathetic and ADH activation plus microvascular shunting can make tubules avidly hold sodium (**urine Na^+ <10–20 mEq/L, FENa <1%**) despite established **ATN** on histology.

Never rule out ATN in septic shock on a low FENa alone. **Muddy brown granular casts** on urine microscopy are more accurate than electrolyte cut-offs.

2. Physics: how solutes and water move

- Three mechanisms across a synthetic semipermeable membrane inside a **hollow-fibre dialyzer**:



Diffusion, convection, ultrafiltration (schematic)

Prevention & management

- **Prevention is the gold standard** (better than treating established edema):
  - gentle first HD: **2 hours**, **Qb 150–200 mL/min**, smaller dialyzer surface area, lower **Qd**, gradual urea reduction over several days
  - **CRRT** or **SLED** in severely uremic critically ill patients to avoid rapid osmotic shifts
- **If DDS happens:** stop or slow HD now; secure ABCs; **osmotherapy**: **3% saline 100 mL IV bolus** or **mannitol** to pull water out of brain parenchyma.

💡 Heads up:

> DDS is driven by **solute (urea) clearance, not fluid removal**. Too much UF gives intradialytic hypotension and cramps, not brain edema.

> So prevention means limiting **urea clearance rate (Qb)**, not limiting ultrafiltration volume.

3. Contrast-induced AKI (CI-AKI)

Pathophysiology: the triad

- **Intrarenal vasoconstriction:** iodinated contrast releases vasoconstrictors (**endothelin**, **adenosine**) and suppresses **nitric oxide** → profound **medullary ischemia**.
- **ROS:** medullary hypoxia impairs mitochondrial respiration → oxidative stress.
- **Direct tubular cytotoxicity:** concentrated luminal contrast damages tubular epithelium and endothelium.

Type 2 (proximal) & Fanconi

- Impaired proximal **HCO_3^- reclamation**. Once serum HCO_3^- settles at a lower steady state (**~12–18 mEq/L**), filtered HCO_3^- matches the reduced capacity and the distal nephron can drop urine pH **below 5.5**.
- **Fanconi syndrome** (generalised proximal injury):
  - **normoglycemic glycosuria** (normal blood glucose, positive urine glucose)
  - **aminoaciduria**, **phosphaturia** (hypophosphatemia → rickets/osteomalacia)
  - **uricosuria** (hypouricemia)

💡 Heads up:

Glucose in the urine with normal blood glucose = generalised proximal tubular dysfunction (**Fanconi**).

Type 4 (hyperkalemic)

- Aldosterone **deficiency or resistance** → impaired distal Na^+ reabsorption and K^+/H^+ excretion.
- **Why acidosis:** hyperkalemia directly **inhibits proximal ammoniagenesis** (NH_3 from glutamine) → less NH_3 buffer → ↓ NH_4^+ excretion → normal-AG acidosis despite working distal H^+-ATPases (so **urine pH <5.5**).

💡 Heads up:

Hyperkalemia + normal-AG acidosis in a diabetic = type 4 RTA (hyporeninemic hypoaldosteronism) until proven otherwise.

6. Abdominal compartment syndrome & hepatorenal syndrome

Abdominal compartment syndrome (ACS)

- **Definition:** sustained **IAP >20 mmHg** + **new organ dysfunction** (e.g. oliguric AKI, high peak airway pressures).
- ↑ IAP compresses low-pressure vessels, especially **renal veins** → venous congestion → ↓ renal perfusion pressure:

```
RPP = MAP – IAP
```

- → rapid GFR fall, oliguria, prerenal-looking hemodynamics that **don't respond to fluid boluses**.

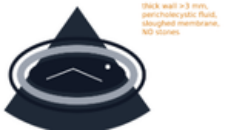
Revised Atlanta classification

Mild: no organ failure, no local or systemic complications; recovers without specialised ICU care.
Moderately severe: transient organ failure (<48 h) OR local/systemic complications (e.g. acute peripancreatic fluid collections, acute necrotic collections, splenic vein thrombosis), without persistent organ failure.
Severe: persistent organ failure (>48 h), single or multiple (respiratory, cardiovascular, renal) → immediate ICU and aggressive support.

Bedside severity scores

Score / System	Key Components	Timing / Application	Strategic ICU Value / Limitations
BISAP Score	BUN >25 mg/dL, Impaired mental status (GCS <15), SIRS ≥2, Age >60, Pleural effusion on chest radiograph.	Calculated within the first 24 hours of admission.	Premier bedside triage score. A score ≥3 strongly predicts persistent organ failure and high in-hospital mortality, serving as a decisive trigger for immediate ICU admission.
Ranson Criteria	11 variables total: 5 at admission (Age, WBC, Glucose, AST, LDH); 6 evaluated at 48 hours (Hct drop, BUN rise, Ca^{2+}, PaO_2, Base deficit, Fluid sequestration).	Requires a full 48 hours for complete scoring.	Historically referenced, but severely limited for acute ICU triage due to the mandatory 48-hour delay required for complete score calculation.

obstruction/stasis.
CT / MRCP: complicated extension, abscess, perforation.
Surgical candidate → urgent/early cholecystectomy. Unstable/high-risk → percutaneous cholecystostomy (US/CT guided) as a bridge to definitive surgery.



Heads up:
Think AAC in any septic ICU patient on prolonged TPN or ventilation with no obvious infectious source.

5. Acute liver failure & cirrhotic decompensation

ALF: rapid, catastrophic insult → massive hepatocyte necrosis and organ failure without preexisting liver disease.
Cirrhotic decompensation: loss of homeostasis in chronic liver disease, from progressive portal hypertension and systemic vasodilation.
Hyperammonemia, poor toxin clearance, portosystemic shunting, coagulopathy and SBP drive the life-threatening complications (HE, cerebral edema).

Liver failure: pathways to critical illness

Acute liver injury / cirrhotic decompensation
(A) Massive hepatocyte necrosis: hyperammonemia, systemic vasodilation
(B) Severe portal hypertension: portosystemic collaterals, splanchnic pooling & ascites
↓
Systemic decompensation & critical illness
↓
Complications & key treatment:
HE & cerebral edema → lactulose & rifaximin, hypertonic saline, plasma exchange
SBP → prophylactic ceftriaxone (1 g/day IV × 7 days)
Refractory variceal hemorrhage → early TIPS (< 72 h) vs rescue TIPS vs BRTO

GBS ≤ 1 → outpatient candidate; higher → inpatient
AIMS65 flags high risk of inpatient death and long ICU stay
CTP class B or C = advanced cirrhosis needing early aggressive intervention (e.g. early TIPS within 72 hours in active variceal bleeding)
Endoscopy: emergency therapeutic EGD within 12 hours for variceal bleeding, keeping up systemic perfusion and metabolic monitoring.

Table 3: Risk stratification scores in GI & liver critical care

Risk Score	Timing / Setting	Core Components / Variables Measured	Primary Clinical Application & High-Yield Cutoffs
Glasgow-Blatchford Score (GBS)	Pre-endoscopic upper GI bleed triage	BUN, Hgb (men & women), SBP, Pulse ≥ 100, Melena, Syncope, Hepatic Disease, Cardiac Failure (Score 0–23)	Score ≤ 1: Low risk (outpatient candidate); Higher scores: Inpatient ICU care/EGD required
AIMS65 Score	Pre-endoscopic upper GI bleed scoring	Albumin < 3 g/dL, INR > 1.5, Mental status change, Systolic BP < 90 mmHg, Age > 65 years	Predicts inpatient mortality, extended length of stay, and hospital costs
Rockall Score	Pre- & Post-endoscopic risk scoring	Age, Shock (HR/SBP), Coexisting Illness (Renal/Hepatic failure), Endoscopic Diagnosis, Stigmata of Bleeding	Clinical score 0 or Complete score < 2: Low risk of rebleeding/death. High scores predict short-term mortality
Child-Turcotte-Pugh (CTP)	Cirrhosis severity assessment	Bilirubin, Albumin, INR, Ascites, Encephalopathy (Class A, B, C)	Class B/C: Advanced cirrhosis. Class C or Class B with active bleeding guides early TIPS (< 72h)

Heads up: The CT halo sign = angioinvasion + local pulmonary haemorrhage. Pathognomonic for early IPA. For Mucormycosis, antifungals alone are not enough. Surgical debridement is the main determinant of survival.

3. CMV Pneumonitis and PJP

Why it happens

T-cell dysfunction (post-allogeneic HSCT, calcineurin inhibitors, fludarabine) opens the door to opportunistic viral and fungal pneumonias.
CMV reactivation post-HSCT causes pneumonitis and GI ulceration via viral endothelial and parenchymal destruction
PJP fills alveoli with proteinaceous exudate and trophic forms, impairing gas exchange

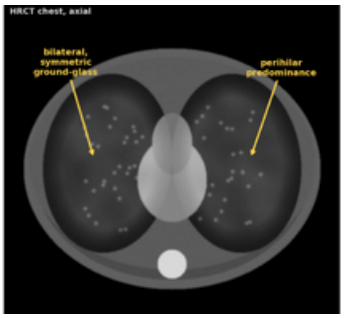
Diagnosis and management

CMV Pneumonitis:

Diagnosis: BAL PCR positive for CMV in a post-HSCT patient with bilateral pulmonary infiltrates
First-line: IV ganciclovir
Alternatives: foscarnet or cidofovir for resistance or severe myelosuppression
Letermovir is for CMV prophylaxis only — not for active disease

PJP:

Diagnosis: HRCT showing bilateral, symmetric diffuse ground-glass opacities + confirmed by BAL DFA or PCR
First-line: high-dose trimethoprim-sulfamethoxazole (TMP-SMX) + adjunctive corticosteroids if PaO2 <70 mmHg or A-a gradient >=35 mmHg



3. Acute Liver Failure via Diffuse Malignant Infiltration

Metastatic carcinoma (breast, small cell lung) or haematologic malignancies (lymphoma, leukaemia) massively replace functional hepatocytes, triggering ALF with severe lactic acidosis (Warburg effect), profound coagulopathy (INR >3.0), and encephalopathy.
Physical exam hallmark: massive hepatomegaly palpable 6-8 cm below the costal margin — distinguishes from viral or ischaemic hepatitis.
If imaging inconclusive: transjugular liver biopsy (not percutaneous). Prognosis extremely poor; management is supportive and palliative.

4. Radiation Proctopathy and Oncologic GI Haemorrhage

Pelvic radiotherapy causes chronic endarteritis obliterans in submucosal rectal vessels — mucosal ischaemia, friability, and telangiectasias — recurrent lower GI bleeding.
Severe thrombocytopenia is the main driver of persistent oozing.
Radiation proctopathy: endoscopic argon plasma coagulation (APC) — first-line
Coagulopathy: transfuse platelets to >50,000/uL before endoscopy; cryoprecipitate to maintain fibrinogen >150 mg/dL

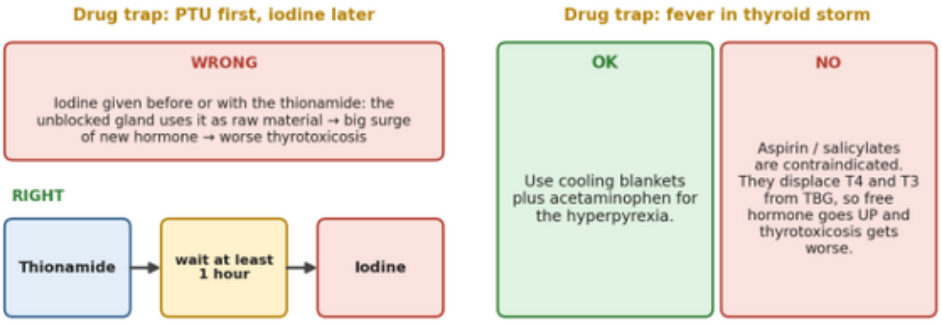
SECTION 3 — NEUROLOGICAL AND NEURO-ONCOLOGIC EMERGENCIES

1. Posterior Reversible Encephalopathy Syndrome (PRES)

Triggered by acute hypertensive emergency, calcineurin inhibitors (tacrolimus, cyclosporine), VEGF inhibitors, or cytotoxic chemotherapy. Severe BP elevation overwhelms cerebral blood flow autoregulation. Arterioles dilate passively — hyperperfusion, BBB breakdown, plasma extravasation into interstitium — vasogenic edema. Posterior circulation selectively vulnerable (sparse sympathetic innervation).

Clinical presentation

New-onset generalised tonic-clonic seizures (most common presenting feature)
Cortical blindness, visual field deficits
Severe occipital headache, altered mental status, confusion



Step 4: glucocorticoids (cut T4→T3 conversion, cover the adrenals)

Hydrocortisone 100 mg IV q8h (300 mg/day) or dexamethasone 2 mg IV q6h. They inhibit outer-ring 5'-deiodination of T4 to T3, reduce thyroidal hormone secretion, and treat the relative adrenal insufficiency from faster cortisol clearance in hypermetabolism.

Step 5: interrupt enterohepatic recirculation (adjunct)

Cholestyramine 4 g PO q6h. Binds T4 and T3 in the gut, blocks recirculation and speeds fecal excretion. Extra clearance in refractory storm or thyroid hormone overdose (thyrotoxicosis factitia).

Step 6: rescue for refractory storm (therapeutic plasma exchange, TPE)

Use when thionamides are contraindicated (fulminant agranulocytosis or severe hepatotoxicity) or storm does not respond to medical therapy. TPE removes protein-bound T4/T3, autoantibodies and inflammatory cytokines. Hemodialysis and peritoneal dialysis do not work because over 99% of thyroid hormone is protein-bound.

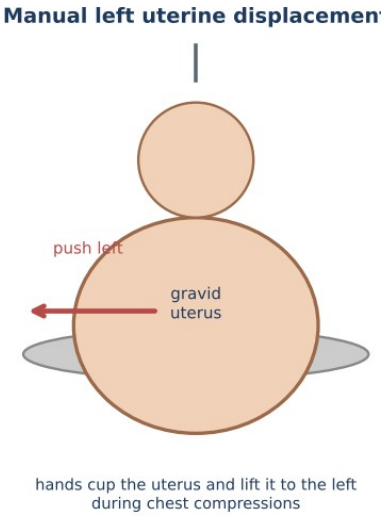
Special scenario: heart failure

In severe thyrotoxic cardiomyopathy or reduced EF, start β-blockers with extreme caution using a titratable short-acting agent (esmolol) plus cardiotropic support. Aggressive long-acting β-blockade can precipitate cardiogenic collapse.

Reverse T3 (rT3)	Elevated	Depressed	Markedly elevated	Normalizing
Thermoregulation	Hyperpyrexia (>100-104°F)	Profound hypothermia (<32-35°C)	Variable, depends on underlying illness	Normalizing
Cardiovascular	Severe tachycardia, AF, high-output HF	Sinus bradycardia, low voltage, Osborn waves	Variable / tachycardia from sepsis	Normalizing
CNS	Agitation, delirium, psychosis	Lethargy, obtundation, coma	Encephalopathy from primary illness	Normalizing
Primary ICU action	β-blocker → PTU → iodine → steroid	IV hydrocortisone → IV L-T4 + passive rewarm	Treat underlying illness; DO NOT give T4/T3	Recheck TFTs after discharge

Table 2: ICU thyroid drugs and their traps

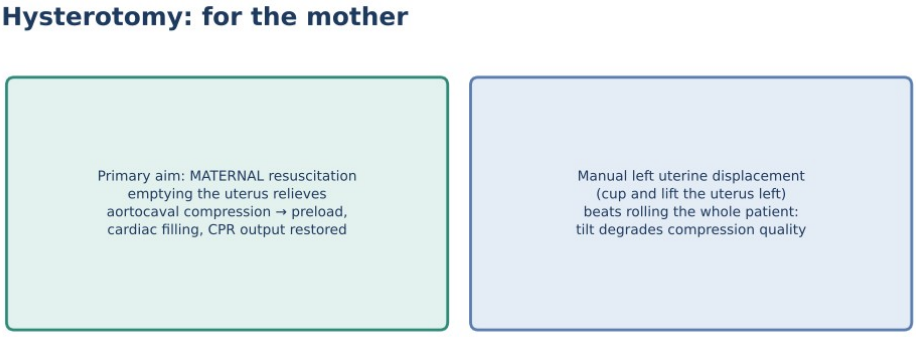
Agent	Mechanism in thyroid emergencies	Key ICU use	Traps and toxicities
Propylthiouracil (PTU)	Inhibits thyroid peroxidase (synthesis) AND Type 1 deiodinase (peripheral T4→T3)	First-line thionamide in thyroid storm	Dual action makes it preferred initially. Risk of fulminant hepatic necrosis and agranulocytosis.
Methimazole (MMI)	Potent inhibitor of thyroid peroxidase (blocks synthesis)	Storm alternative / long-term Graves	Longer half-life than PTU, but does NOT inhibit peripheral T4→T3 conversion.
Inorganic iodine (SSKI / Lugol's)	Blocks hormone proteolysis and release via Wolff-Chaikoff effect	Thyroid storm (Step 3)	MUST give ≥1 hour AFTER the thionamide! Giving it first fuels new hormone synthesis.
Propranolol	Nonselective β-blocker; reduces adrenergic drive; high dose blocks T4→T3	Thyroid storm symptom control	Caution in severe LV dysfunction / cardiogenic shock.



Schematic: manual left uterine displacement (schematic). Illustration only, not a real clinical image.

💡 **Heads up:**
The purpose of **resuscitative hysterotomy is maternal resuscitation, not fetal rescue.** Emptying the uterus relieves aortocaval compression and restores venous return, cardiac filling and CPR output.

💡 **Heads up:**
Use **manual left uterine displacement** (cup the uterus and lift it left). Rolling the whole patient into left tilt is inferior during arrest because it degrades compression quality.



Schematic: why hysterotomy, and how to displace. Illustration only, not a real clinical image.

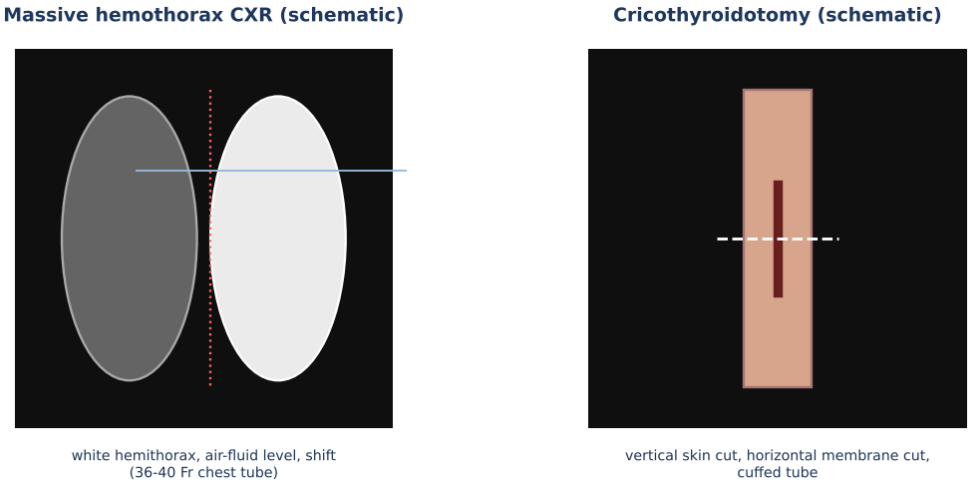
6. Respiratory physiology and ventilation

- **Mechanics:** the uterus lifts the diaphragm, **FRC falls about 20%**, while **oxygen consumption rises 20-30%**. Result: **very rapid desaturation in apnea or during airway management**. Mucosal edema and engorgement make intubation harder.
- **Progesterone drive:** tidal volume and minute ventilation rise about 50%. Normal ABG: **$PaCO_2$ 28-32 mmHg**, HCO_3^- 18-21, pH 7.40-7.45 (compensated respiratory alkalosis).
- **Ventilator rule: $PaCO_2$ of 40 is relative hypoventilation.** Aim near **30**. Avoid **<25**: alkalosis constricts uteroplacental vessels and left-shifts the oxyhemoglobin curve, impairing fetal oxygen delivery.

4. Visual anchors

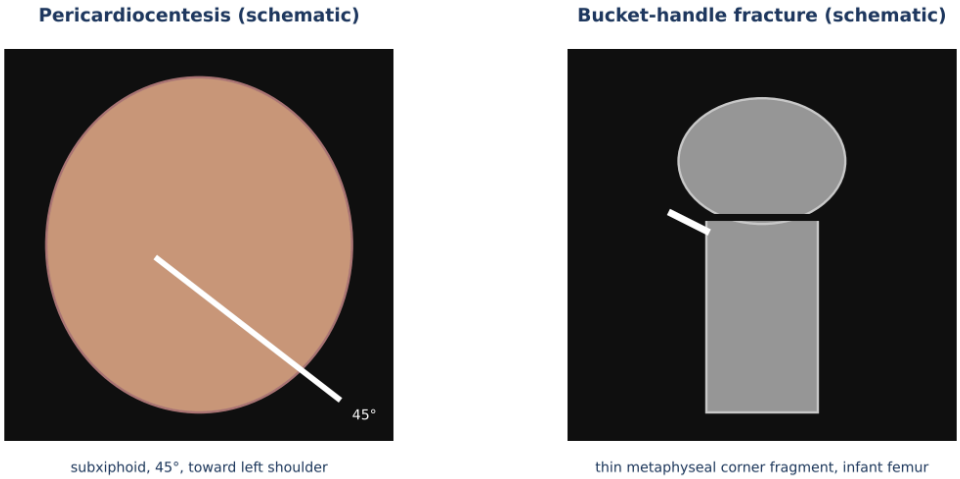
What to recognize on sight. Illustrations only, not real clinical images.

- **Tension pneumothorax:** hypotension, tachycardia, distress, marked JVD, silent hemithorax: needle or finger thoracostomy, no film.
- **Massive hemothorax CXR:** opacified hemithorax with air-fluid level and contralateral shift: 36-40 Fr chest tube.
- **Cricothyroidotomy (cannot intubate, cannot oxygenate):** vertical skin incision, horizontal cut through the cricothyroid membrane, dilate, cuffed tube.

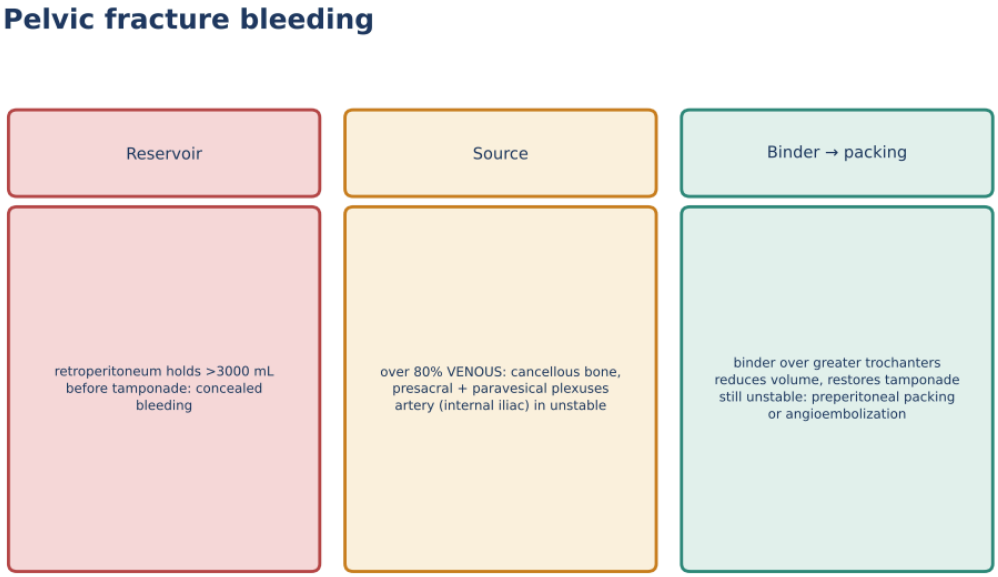


Schematic: hemothorax and cricothyroidotomy (schematic). Illustration only, not a real clinical image.

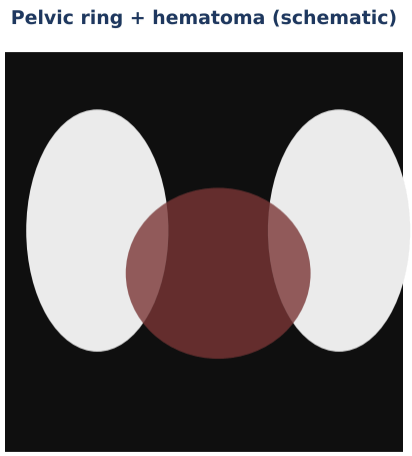
- **Pericardiocentesis:** subxiphoid, 45° to the skin, aiming at the left shoulder, aspirating continuously.
- **Bucket-handle fracture:** thin planar metaphyseal fragment in an infant's distal femur.



Schematic: pericardiocentesis and bucket-handle fracture (schematic). Illustration only, not a real clinical image.



Schematic: bleeding and control. Illustration only, not a real clinical image.

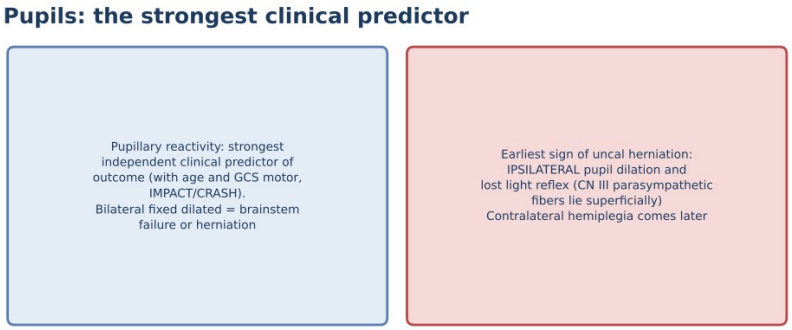


Schematic: pelvic ring and hematoma (schematic, not a real image). Illustration only, not a real clinical image.

4. Extremity trauma, nerve injury and infection

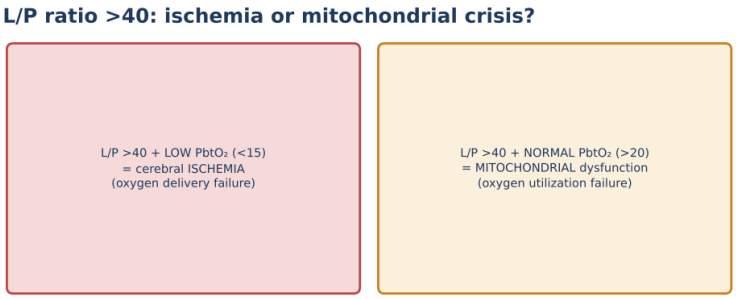
Extremity emergencies run from vascular injury and **compartment syndrome** (rising pressure in rigid fascia chokes capillaries, then muscle and nerve) to **necrotizing fasciitis / Fournier gangrene** (virulent organisms, toxins, microvascular thrombosis, rapid necrosis along fascial planes). Both are limb- and life-threatening, and delay brings paralysis, amputation or septic shock.

💡 **Heads up:**
The **earliest sign of uncal herniation** is **ipsilateral pupillary dilation and loss of light reflex**. CN III compression hits the superficial parasympathetic fibers first. Contralateral hemiplegia comes later.



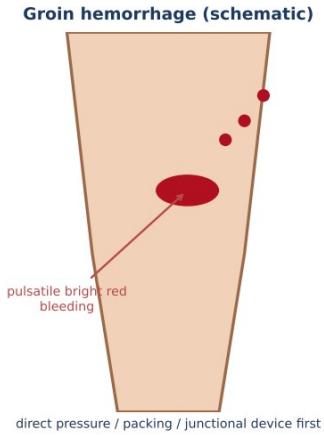
Schematic: pupil signs. Illustration only, not a real clinical image.

💡 **Heads up:**
L/P ratio >40 with LOW $PbtO_2$ (<15) is ischemia (delivery failure). **L/P >40 with NORMAL $PbtO_2$ (>20) is mitochondrial dysfunction** (utilization failure).



Schematic: ischemia versus metabolic crisis. Illustration only, not a real clinical image.

💡 **Heads up:**
TBI distractors: **high-dose steroids are contraindicated** (CRASH: more deaths). **Avoid prophylactic hyperventilation ($PaCO_2$ <30)**: vasoconstriction causes ischemia, rescue only in acute herniation. **Barbiturate coma** lowers ICP but drops MAP and CPP. **Continuous EEG** is needed when metabolic distress persists despite normal ICP, to find nonconvulsive seizures (excitotoxic glutamate).

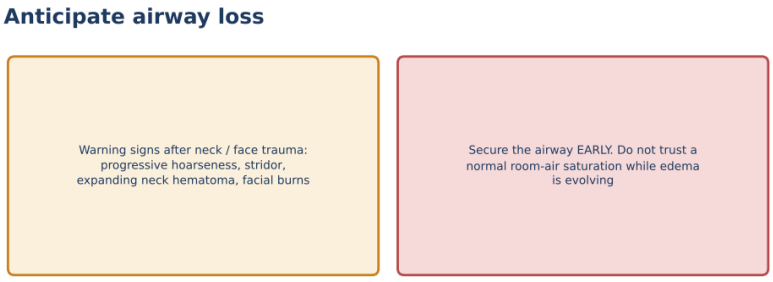


Schematic: groin hemorrhage (schematic, illustration only, not a real clinical image). Illustration only, not a real clinical image.

A: airway with C-spine protection

Oxygen delivery matters because hypoxemia quickly causes secondary brain injury and cardiac arrest. In neck or face trauma, secure the airway on **anticipated loss, not on complete obstruction**.

> 💡 **Heads up:**
> **Progressive hoarseness, stridor, expanding neck hematoma or facial burns** predict evolving laryngeal edema or disruption. Secure the airway **early**, rather than relying on a normal room-air saturation.



Schematic: warning signs. Illustration only, not a real clinical image.

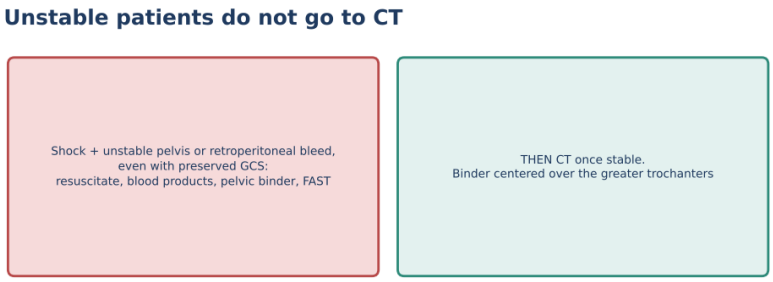
B: breathing and ventilation

Tension pneumothorax is the most immediately lethal cause of respiratory failure and obstructive shock: rising intrathoracic pressure collapses the lung, shifts the mediastinum and compresses the vena cava.

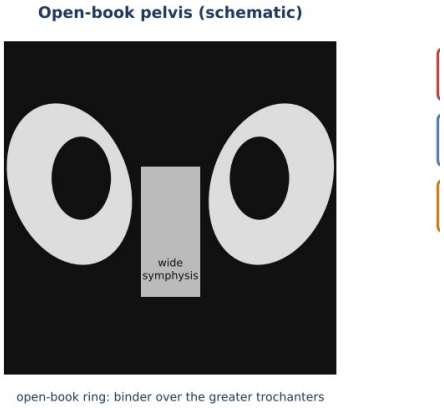
C: circulation and hemorrhage control

Look for occult internal bleeding (pelvic fracture, abdomen, hemothorax) and assess perfusion. Instability means rapid volume resuscitation with **balanced blood products** and mechanical control such as a **pelvic binder**.

💡 **Heads up:**
A patient in profound shock with an **unstable pelvis or retroperitoneal bleed must NOT go straight to whole-body CT**, even if GCS is preserved. **Resuscitate, give blood, stabilize the pelvis and do a FAST first.** CT comes after.



Schematic: no CT while unstable. Illustration only, not a real clinical image.

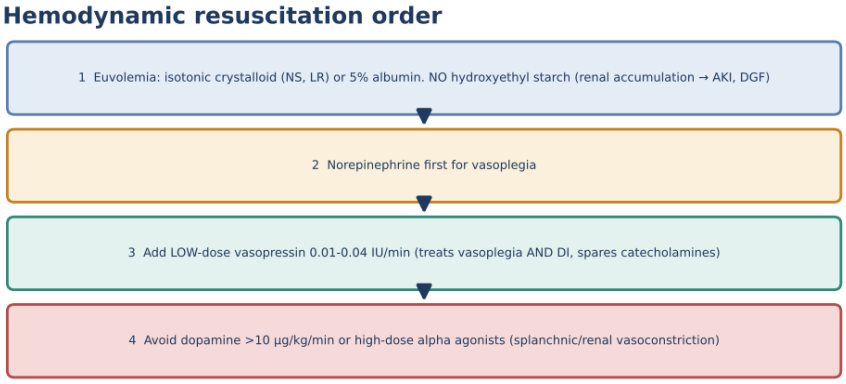


Schematic: open-book pelvis, binder over the greater trochanters (schematic). Illustration only, not a real clinical image.

💡 **Heads up:**
Lactate clearance and improving base deficit are the most reliable markers of adequate resuscitation. HR, BP and urine output can look falsely normal from compensatory vasoconstriction, hiding **occult hemorrhagic shock**.

- **Oxygenation:** PaO_2 80-100 (or P/F >300), SaO_2 >95%, Hb 8-10 g/dL.
- **Endocrine:** core temp >35 (aim 36-37.5), Na^+ 135-145 (avoid >155), glucose 120-180.

Hemodynamic and pharmacologic hierarchy



Schematic: the order. Illustration only, not a real clinical image.

- Fluid: **0.9% saline, lactated Ringer's or 5% albumin**. **Hydroxyethyl starch is contraindicated**: it accumulates in renal reticuloendothelial cells, causing AKI and delayed graft function.
- **Norepinephrine** is the preferred first pressor. **Low-dose vasopressin (0.01-0.04 IU/min)** is the preferred first-line adjunct: it treats vasoplegia and DI and lowers catecholamine needs.
- **Dopamine >10 µg/kg/min** or high-dose alpha agonists cause splanchnic and renal vasoconstriction. Low fixed-dose dopamine (4 µg/kg/min) may be used in stable renal donors.

💡 **Heads up:**
With **both vasoplegic hypotension and central DI**, the best initial agent is **arginine vasopressin**, not desmopressin alone. AVP acts on **V1 (vascular tone) and V2 (urine concentration)**. DDAVP is V2 only and has no pressor effect.



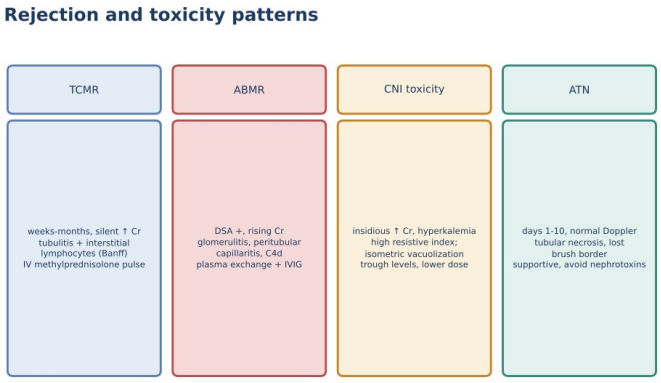
Schematic: AVP versus DDAVP. Illustration only, not a real clinical image.

Hormonal resuscitation

For **persistent hemodynamic instability or LVEF <45%**.

Kidney and Liver Transplantation

Pathology	Onset / presentation	Doppler or histology	First-line management
Ischemic ATN	Days 1-10; slow creatinine fall or oliguria in deceased-donor graft	Normal flow. Biopsy: tubular necrosis, lost brush border	Supportive care, volume, avoid nephrotoxins, dialysis as needed
Renal vein thrombosis	Days 1-7; abrupt anuria, graft swelling and pain, hematuria	Absent venous flow, reversed diastolic arterial flow, big kidney	Urgent exploration: thrombectomy if partial, nephrectomy if complete
TCMR	Weeks to months; silent creatinine rise	Tubulitis + interstitial lymphocytes (Banff)	IV methylprednisolone pulse
ABMR	Days to months; rising creatinine, DSA positive	Glomerulitis, peritubular capillaritis, C4d	Plasma exchange + IVIG
CNI toxicity	Variable; insidious rise, hyperkalemia	High resistive index; isometric tubular vacuolization, arteriopathy	Trough monitoring and dose reduction

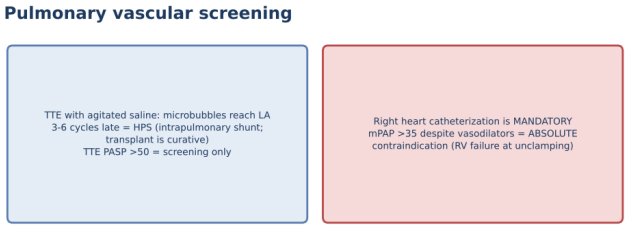


Schematic: rejection and toxicity patterns. Illustration only, not a real clinical image.

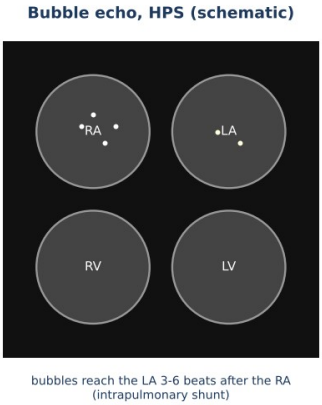
💡 **Heads up:**
Delayed graft function = dialysis within the first week. Urine output alone is unreliable because kidneys with severe tubular injury can stay non-oliguric.

💡 **Heads up:**
Abrupt anuria + severe graft tenderness/swelling + ipsilateral leg edema is renal vein thrombosis until proven otherwise. Doppler signature: **absent venous flow with REVERSAL of diastolic flow in the renal artery**.

💡 **Heads up:**
King's College: **pH <7.30 after adequate fluids is a single sufficient criterion.** The alternative route needs **all three**: INR >6.5, creatinine >3.4 mg/dL and grade III/IV encephalopathy.



Schematic: pulmonary vascular screening. Illustration only, not a real clinical image.

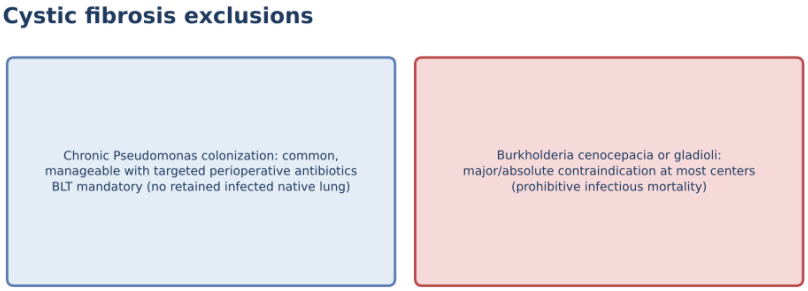


Schematic: bubble echo in HPS (schematic, not a real image). Illustration only, not a real clinical image.

💡 **Heads up:**
TTE is only a screen for POPH (PASP >50 mmHg). **Right heart catheterization is the mandatory gold standard**, and **mPAP >35 despite vasodilators is an absolute contraindication** because RV failure mortality approaches 100%.

💡 **Heads up:**
In living donation, if CT volumetry predicts a remnant of about **24% (below 25-30%)**, the donation is **declined**, however sick the recipient or high the MELD.

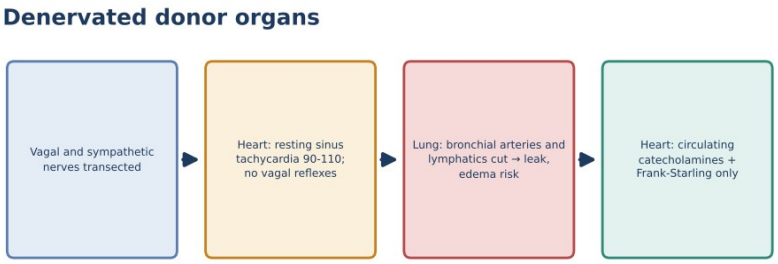
💡 **Heads up:**
Chronic **Pseudomonas** colonization in CF is manageable with targeted perioperative antibiotics. Chronic **Burkholderia cenocepacia or gladioli** is a major or absolute contraindication at most centers.



Schematic: CF exclusions. Illustration only, not a real clinical image.

2. Denervation physiology and immediate postoperative care

Transplant transects vagal and sympathetic fibers. The denervated heart has no vagal tone, so it sits at a **resting sinus tachycardia of 90-110 bpm** with no respiratory sinus arrhythmia or carotid reflexes, and it increases rate and contractility only through circulating catecholamines and Frank-Starling. The lung loses its bronchial arteries and lymphatics, so it is prone to **microvascular leak and noncardiogenic edema** at reperfusion, which makes **restrictive fluids and lung-protective ventilation** mandatory.



Schematic: what denervation does. Illustration only, not a real clinical image.

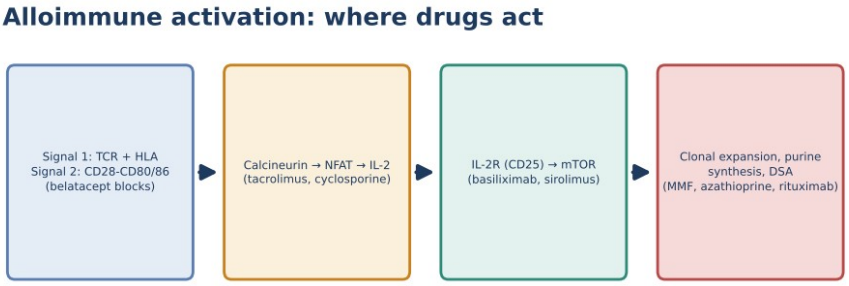
- **ICU monitoring:** arterial line + PA catheter; heart rate target **100-120** with isoproterenol or pacing.
- **Lung:** low Vt **6-8 mL/kg** (donor size), PEEP **5-7.5 cmH_2O**, neutral or slightly negative fluid balance, extubate within **12-24 h**.

💡 **Heads up:**
Resting tachycardia of 90-110 is **normal** in a new heart; do not read it as hypovolemia or sepsis. **Atropine does nothing** for bradycardia because the vagus is cut: use isoproterenol, epinephrine or pacing.

Immunosuppressive Drugs in Transplantation

1. The alloimmune cascade and where drugs act

Recipient T cells meet donor HLA on antigen-presenting cells and get **signal 1** (TCR binding) and **signal 2** (CD28 with CD80/CD86). Calcineurin then dephosphorylates **NFAT**, which drives **IL-2** transcription. IL-2 binds CD25, activates **mTOR**, and fuels clonal expansion, cytotoxic T cells and B-cell DSA production. Untreated, this ends in **acute loss of organ function, inflammatory markers and lymphocytic infiltration or endothelial damage**. Each drug class blocks a different checkpoint, so regimens are combined to prevent rejection while limiting toxicity, infection and malignancy.

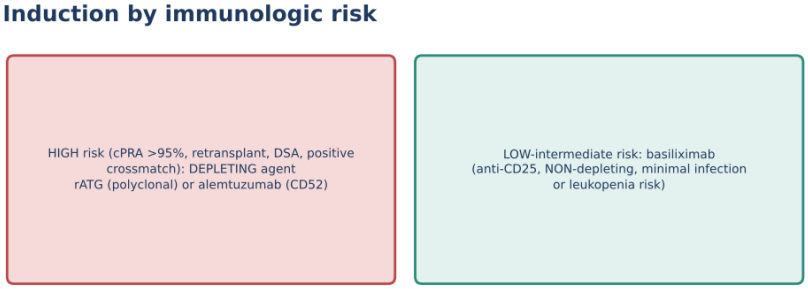


Schematic: checkpoints and their drugs. Illustration only, not a real clinical image.

- **Induction** by risk: **high** (cPRA >95%, retransplant, positive crossmatch) gets a depleting agent (**rATG or alemtuzumab**); **low-intermediate** gets **basiliximab**.
- **Maintenance backbone:** CNI (tacrolimus preferred) + antimetabolite (MMF preferred) + steroid (IV methylprednisolone then oral prednisone taper).
- **Surveillance:** trough levels, CBC, K^+, Mg^{2+}, glucose, renal and hepatic function.
- **Dysfunction work-up:** rising creatinine + tremor/seizures/PRES + normal biopsy = CNI toxicity; high viral load + inclusions = BK; lymphocytic infiltrate = ACR (pulse methylprednisolone).

2. Induction agents

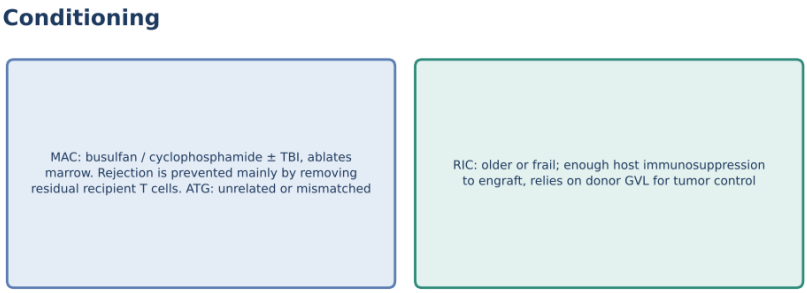
Induction gives intense short-term suppression when alloimmune activation peaks. The choice depends on immunologic risk.



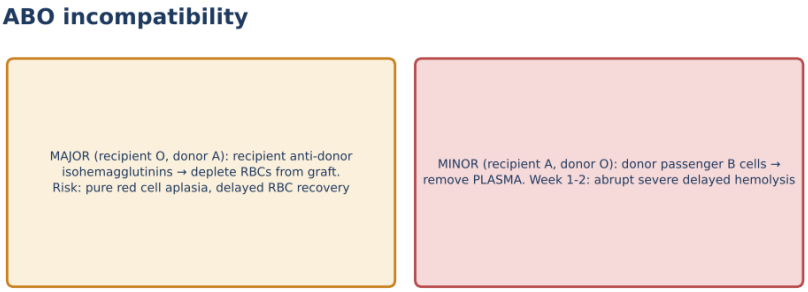
Schematic: risk-based choice. Illustration only, not a real clinical image.

3. Conditioning, ABO and engraftment

Conditioning has three goals: eradicate tumor, clear marrow space, and suppress the host so the graft is not rejected, which depends mainly on **removing residual recipient T cells**. **MAC** (busulfan, cyclophosphamide ± TBI) ablates the marrow. **RIC** suits older or frail patients and relies on **donor GVL** to finish the job. **ATG** in unrelated or mismatched transplants depletes host T cells (less rejection) and partly donor T cells (less GVHD).



Schematic: MAC versus RIC. Illustration only, not a real clinical image.

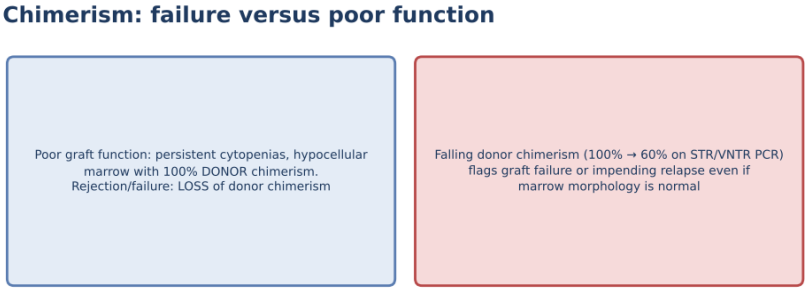


Schematic: ABO processing. Illustration only, not a real clinical image.

- **Major mismatch:** deplete graft RBCs to prevent acute hemolysis; risk of pure red cell aplasia.
- **Minor mismatch:** remove plasma; passenger lymphocytes can cause abrupt severe hemolysis at 1-2 weeks.

💡 **Heads up:**
Persistent cytopenias with a hypocellular marrow and 100% donor chimerism = poor graft function, not rejection. Rejection shows **loss of donor chimerism** and recipient T-cell dominance.

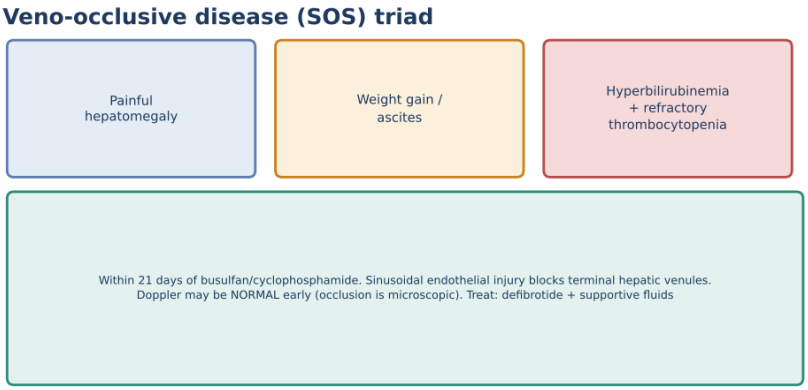
💡 **Heads up:**
Falling donor chimerism (100% to 60% on STR/VNTR PCR) signals graft failure or **impending relapse**, even when marrow morphology looks normal.



Schematic: chimerism. Illustration only, not a real clinical image.

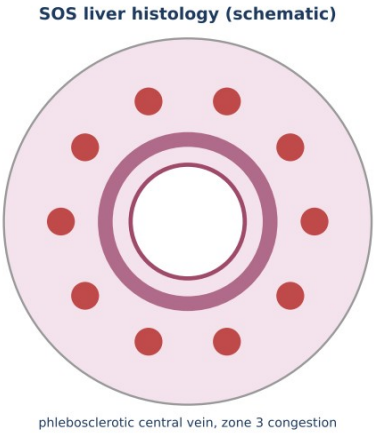
4. Early complications: SOS and TMA

Sinusoidal obstruction syndrome (SOS/VOD) starts as conditioning injury to sinusoidal endothelium. Sloughed cells block terminal hepatic venules, causing post-sinusoidal portal hypertension. It appears within **21 days**.



Schematic: the triad. Illustration only, not a real clinical image.

💡 **Heads up:**
Doppler can be NORMAL in early severe SOS because the occlusion is in sinusoids and microscopic venules, not the main hepatic veins. Normal large-vessel patency does not exclude SOS.



Schematic: SOS liver histology (schematic, not a real image). Illustration only, not a real clinical image.