Surgical & Critical Care Essentials

Key Points

- The **phases of wound healing** and the cellular players that drive repair.
- Prevention and risk factors for **surgical site infection** and strategies to mitigate them.
- Recognizing and managing **septic and distributive shock**, including fluid resuscitation and monitoring.
- Identifying complications of **blood transfusion** and massive transfusion protocols.
- Essentials of **fluid and electrolyte balance**, nutrition, and common postoperative complications.

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1. Immunology & Inflammation 🛡️

Phagocytic Cells

> **Primary phagocytes** – cells that actively engulf microbes and debris.

- **Neutrophils** – first responders in acute inflammation.
- **Macrophages** – dominate chronic inflammation; present antigen to lymphocytes.
- **Microglial cells** – resident macrophages of the central nervous system.
- **Kupffer cells** – hepatic macrophages for clearing portal blood.

Non-phagocytic Cells

> **Lymphocytes** – mediate adaptive immunity (B-cells → antibodies; T-cells → cell-mediated response).

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2. Surgical Site Infection (SSI) 🚑

Risk Factors

- Age > 70 yr
- Malnutrition
- Diabetes mellitus (especially uncontrolled)
- Smoking (vasoconstriction, impaired healing)
- Obesity
- Immunosuppression (steroids, chemotherapy)
- Remote infection
- Prolonged surgery duration

Prevention Strategies

- **Antibiotic prophylaxis** – administered ≤ 60 min before incision.
- **Glycemic control** – maintain blood glucose < 180 mg/dL.
- **Normothermia** – keep core temperature ≥ 36 °C.
- Strict **sterile technique**.

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3. Wound Classification 📊

Classification	Definition	Typical Example
Clean	No entry into viscera; sterile technique maintained.	Elective orthopedic incision.
Clean-contaminated	Controlled entry into respiratory, alimentary, or genitourinary tracts.	GI surgery with intact mucosa.
Contaminated	Spillage of contents or inflamed tissue present.	Bowel perforation with spillage.
Dirty	Pre-existing infection or perforation.	Perforated appendicitis with pus.

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4. Wound Healing 🪡

Phases

1. **Inflammatory** (0–3 days) – neutrophils/macrophages clear debris.
2. **Proliferative** – fibroblasts lay down collagen; angiogenesis restores blood flow.
3. **Remodeling** – collagen maturation and tensile strength increase.

Key Cells

- **Fibroblasts** – synthesize collagen.
- **Endothelial cells** – drive angiogenesis.

Essential Nutrients

- **Protein** – substrate for collagen.
- **Vitamin C** – hydroxylates proline/lysine in collagen.
- **Zinc** – supports immune function and protein synthesis.
- **Vitamin B12** – required for DNA synthesis in proliferating cells.

Factors That Impair Healing

- Infection
- Poor perfusion (ischemia)
- Diabetes mellitus
- Smoking
- Chronic **steroid** therapy

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5. Shock ⚡

Distributive Shock

> **Mechanism** – marked vasodilation → maldistribution of blood flow.

- **Septic shock**
- **Anaphylactic shock**
- **Neurogenic shock**
- **Addisonian crisis** (cortisol deficiency)

Hypovolemic (Hemorrhagic) Shock

> **Cause** – loss of circulating volume, most commonly blood.

- Common bleeding sites: chest, abdomen, pelvis, femur (intracranial bleeding is limited by skull rigidity).

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6. Septic Shock 🦠

Definition

> Life-threatening organ dysfunction caused by a dysregulated host response to infection.

Management

- **IV fluids**: $20–30\ \mathrm{mL/kg}$ crystalloids (initial bolus).
- **Broad-spectrum antibiotics** – start as early as possible.
- **Source control** – drainage or operative debridement.

Monitoring Parameters

- **Lactate clearance** – aim for decrease > 10 % per 2 h.
- **Central venous O_2 saturation ($ScvO_2$)** – target ≥ 70 %.

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7. SIRS & Sepsis 📋

SIRS Criteria (≥ 2 required)

- Temperature > 38 °C **or** < 36 °C
- Heart rate > 90 bpm
- Respiratory rate > 20 /min **or** $PaCO_2$ < 32 mmHg
- White-blood-cell count > 12 000 /µL **or** < 4 000 /µL

Clinical Definitions

- **Sepsis** = SIRS + infection.
- **Severe sepsis** = sepsis with organ dysfunction.
- **Septic shock** = sepsis with persistent hypotension despite adequate fluid resuscitation.

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8. Blood Transfusion 💉

Major Complications

- **Hemolytic reaction** – ABO incompatibility (most dangerous).
- **Febrile non-hemolytic reaction**.
- **Allergic reactions**.
- **Transfusion-related infections**.
- **Iron overload** (chronic transfusion).
- **Microvascular thrombosis**.

TRALI (Transfusion-Related Acute Lung Injury) – Critical 🚨

> Onset 1–6 h post-transfusion; donor antibodies activate recipient neutrophils → pulmonary capillary leakage, mimicking ARDS.

- **Management** – supportive: supplemental O_2, ventilatory support if needed.
- Note: **Does NOT significantly increase platelet count**.

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9. Massive Transfusion 📦

Definition (any one)

- ≥ 10 units PRBCs in 24 h.
- ≥ 4 units PRBCs in 1 h.
- ≥ 50 % total blood volume replaced in 3 h.

Common Complications

- **Hypothermia** – rapid cooling of blood products.
- **Coagulopathy** – dilution of clotting factors.
- **Hypocalcemia** – citrate binding calcium.
- **Dilutional thrombocytopenia**.

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10. Fluid & Electrolyte Management 💧

Urine Output Target

> ≥ 0.5 mL/kg/hr (adequate renal perfusion).

Maintenance Fluids – 4-2-1 Rule

Weight (kg)	Rate (mL/hr)

First 10 kg	4 mL/kg/hr
Next 10 kg	2 mL/kg/hr
Remaining	1 mL/kg/hr

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11. Electrolyte Disorders ⚖️

Disorder	Typical Causes	Primary Metabolic Effect
Vomiting	Loss of gastric HCl	Hypokalemia, hypochloremia, metabolic alkalosis
Diarrhea	Loss of bicarbonate-rich fluid	Metabolic acidosis, hypovolemia
Hypernatremia	Free water loss (e.g., diabetes insipidus)	↑ serum Na^+; treat with hypotonic fluids (≤ 0.5 mOsm/L/hr) to avoid cerebral edema

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12. Nutrition 🍽️

Enteral Feeding

- Preferred when gut functional.
- **Complication** – diarrhea (10–20 %).

Parenteral Nutrition

- Reserved for non-functional GI tract.
- Higher risk of catheter-related infections.

Protein-Sparing Effect

> Begins after ~ 100 g glucose intake; excess glucose reduces proteolysis.

Refeeding Syndrome

- **Most critical lab abnormality** – hypophosphatemia.

- Also: hypokalemia, hypomagnesemia.
- Occurs when nutrition is restarted in severely malnourished patients.

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13. Metabolic Response to Injury 🔥

> **Flow Phase** – prolonged hypermetabolic state with increased catabolism, muscle wasting, and negative nitrogen balance; may last months after major trauma.

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14. Contraindications to Elective Surgery 🚫

- Recent myocardial infarction (< 2 months).
- Recent stroke (< 4–6 months).
- Severe electrolyte imbalance (e.g., hypokalemia).
- Active infection (relative contraindication).

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15. Infections in Surgery 🦠

Infection	Typical Pathogen(s)	Key Management
Cellulitis	Streptococci	Penicillin or appropriate β-lactam
Necrotizing Fasciitis	Polymicrobial (including *Streptococcus* and *Clostridium*)	Urgent surgical debridement + broad-spectrum antibiotics
Fournier's Gangrene	Mixed anaerobes & aerobes	Emergency debridement + broad-spectrum antibiotics; testes usually spared
Peritonitis	*E. coli*, *Bacteroides*, *Clostridium*, *Streptococci*	Prompt source control + appropriate antibiotics

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16. *Clostridioides difficile* Infection 🔥

Risk Factors

- Prolonged broad-spectrum antibiotic exposure.
- Proton-pump inhibitor (PPI) use.
- Systemic steroids.
- Malnutrition.

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17. Head & Neck Emergency – Ludwig's Angina 😷

> **Cellulitis of the floor of the mouth**, usually dental origin.

Management Priorities

1. **Airway** – secure (intubation or tracheostomy) – critical.
2. **IV antibiotics** – broad-spectrum covering anaerobes.
3. **IV fluids** – maintain perfusion.
4. **Surgical drainage** – if abscess develops.

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18. Postoperative Complications 📈

- Fever (common early sign)
- **Atelectasis** – most frequent early pulmonary issue.
- Wound infection
- Deep vein thrombosis / pulmonary embolism
- Urinary tract infection

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19. Vascular & Hernias 🏥

Inguinal Hernia

- **Direct** – medial to the inferior epigastric vessels.

Femoral Hernia

- Located **below** the inguinal ligament; more common in females; high risk of strangulation.

Femoral Canal Boundaries

Boundary	Structure

Anterior	Inguinal ligament
Posterior	Pectineal ligament
Medial	Lacunar ligament
Content	Lymph node of Cloquet

- **Management** – hernioplasty (mesh repair).

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20. Bowel Strangulation 🚨

> Obstruction → ischemia → necrosis → sepsis; high mortality if not promptly addressed.

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21. Anticoagulant Reversal 🩸

Anticoagulant	Reversal Agent
Heparin	Protamine sulfate
Warfarin	Vitamin K ± PCC/FFP
Dabigatran	Idarucizumab
Factor Xa inhibitors	Andexanet alfa

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22. Abdominal Anatomy (High-Yield) 📍

- **Four quadrants** (RUQ, LUQ, RLQ, LLQ).
- **Transpyloric plane** – aligns with L1 vertebral level.
- **McBurney's point** – classic site for appendiceal tenderness.
- **Deep inguinal ring** – lies above the midpoint of the inguinal ligament.

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23. Lower Limb Edema 🌊

Common Causes

- Congestive heart failure
- Liver cirrhosis

- Nephrotic syndrome
- Deep vein thrombosis (DVT) – **not** due to acute limb ischemia.

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24. Case-Based Infection (Forearm) 🩺

Likely diagnosis: Cellulitis (predominantly Gram-positive organisms).

Management

- Limb elevation.
- Appropriate antibiotics (e.g., penicillin).
- Monitor regional lymph nodes for spread.

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25. Obligatory Glucose Users 🍬

- **Brain**
- **Red blood cells**
- **Renal medulla**
- **Bone marrow**

(Cardiac muscle primarily oxidizes fatty acids, not glucose.)