

Anesthesia for Emergency and Trauma cases

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Learning objectives

- Perform a focused pre-anesthetic assessment in an emergency patient.
- Recognize aspiration risk and explain the principles of rapid sequence induction (RSI).
- Apply an ABCDE approach to trauma while identifying immediate anesthetic priorities.
- Describe initial management of hemorrhagic shock and major bleeding.
- Estimate burn size and explain early airway, breathing and fluid priorities.

Definitions of Surgical Timing

Timing	Definition
Emergency	Immediate threat to life or limb without surgical intervention, where there is very limited or no time for preoperative clinical evaluation, typically <2 h.
Urgent	Threat to life or limb without surgical intervention, where there may be time for preoperative clinical evaluation to allow interventions that could reduce risk of MACE or other postoperative complications, typically ≥ 2 to <24 h.
Time-sensitive	surgery may be delayed up to 3 months to allow for preoperative evaluation and management without negatively impacting outcomes.(cancer surgery)
Elective	The surgical procedure can be delayed to permit a complete preoperative evaluation and appropriate management.

PART 1

Emergency anesthesia

Focus: what a 4th-year medical student should recognize, prioritize, and explain.

Why emergency anesthesia is different

- Limited time for assessment and preparation.
- Diagnosis and physiology may still be evolving.
- Aspiration risk is often increased.
- Hypovolemia, electrolyte/acid–base disturbance, anemia or coagulopathy may coexist.
- Chronic disease may be poorly controlled or incompletely documented.
- Pain, anxiety and after-hours logistics add risk.

Focused pre-anesthetic assessment

Use a problem-oriented approach when time is limited

- Airway: anticipated difficulty, cervical spine concerns, ability to protect the airway.
- Breathing: oxygenation, ventilation, chest injury or respiratory disease.
- Circulation: perfusion, bleeding, volume status and vascular access.
- Disability: consciousness, neurologic injury, intoxication and analgesic/sedative effects.
- Exposure: injuries, temperature and relevant examination findings.

History: ask what can change management

- Last oral intake—but do not use fasting time alone to decide aspiration risk.
- Vomiting, obstruction, reflux, pregnancy or other factors that may delay gastric emptying.
- Allergies and previous anesthesia/airway problems.
- Medications: anticoagulants, antiplatelets, insulin/diabetes drugs and relevant chronic therapy.
- Comorbidities, baseline function and recent deterioration.
- Mechanism of injury or surgical pathology.

Aspiration risk in emergency patients

- Emergency care itself may increase aspiration risk.
- Important risk factors include bowel obstruction/ileus, active vomiting, impaired consciousness, pregnancy and conditions associated with delayed gastric emptying.
- Elective fasting guidelines are designed for selected elective patients and may need modification in emergency care.
- When aspiration risk is significant, plan airway management accordingly.

Think risk profile, not simply “NPO hours”.

Preparation before induction

People

Call for appropriate help early.
Clarify surgical urgency,
anticipated blood loss and
postoperative destination.

Equipment

Airway plan A/B/C, suction on,
monitors ready, warming and
rapid infusion capability when
indicated.

Patient

Preoxygenate, establish suitable
IV access, start resuscitation,
give indicated
antibiotics/analgesia and correct
immediately reversible
problems.

Monitoring and vascular access

- Standard monitoring for all patients; add invasive monitoring according to physiology and procedure.
- Large-bore peripheral IV access is often faster and provides excellent flow for resuscitation.
- Do not delay life-saving surgery solely to obtain an arterial or central line.
- Ultrasound can facilitate difficult vascular access.
- Reassess perfusion continuously: blood pressure, mental state, skin perfusion, urine output, lactate/base deficit and operative blood loss as appropriate.

Choosing induction drugs: physiology first

- There is no single “best” induction drug for every emergency.
- Reduce and titrate doses in hypovolemia or shock.
- Propofol may cause marked hypotension in unstable patients.
- Ketamine and etomidate can provide greater hemodynamic stability in selected patients, but each has limitations.
- The airway plan, cardiovascular reserve and available expertise should guide drug choice.

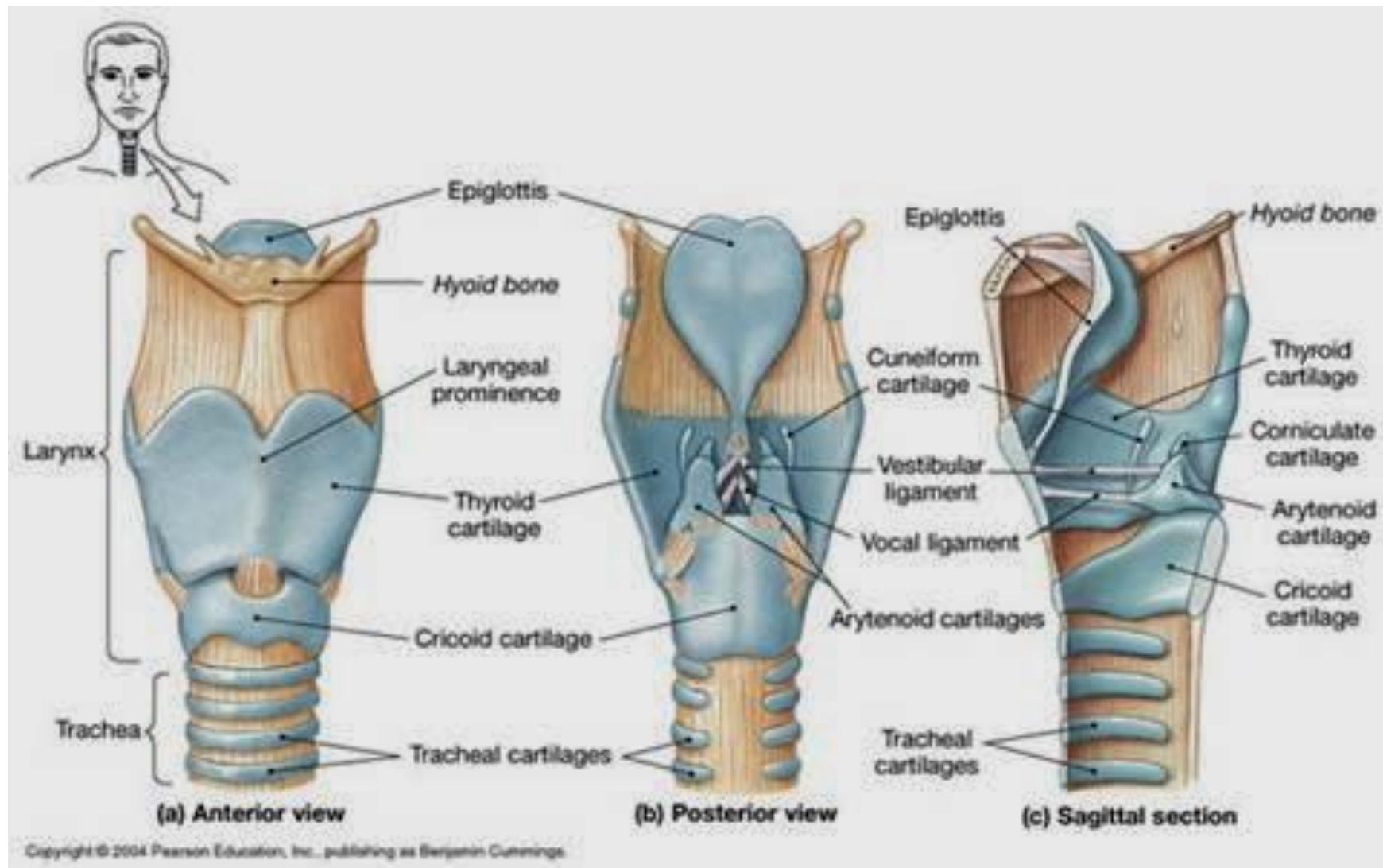
Rapid sequence induction: the core idea

- Goal: secure a cuffed tracheal tube promptly while minimizing regurgitation/aspiration risk.
- Prepare suction and a failed-airway plan before induction.
- Preoxygenate effectively; optimize position and oxygen delivery.
- Use an induction agent and rapid-onset neuromuscular blocker appropriate to the patient.
- Avoid prolonged apnea: gentle mask ventilation may be appropriate when hypoxemia risk outweighs insufflation risk.
- Cricoid pressure is not an absolute requirement; if used, release it if it worsens ventilation or laryngoscopy.

RSI: a practical sequence

- 1. Team brief: aspiration risk, airway difficulty, hemodynamic plan and rescue plan.
- 2. Position + monitors + suction + preoxygenation.
- 3. Optimize circulation before induction when possible.
- 4. Induction + neuromuscular blockade.
- 5. Laryngoscopy/intubation; confirm with waveform capnography.
- 6. Secure tube, ventilate, reassess hemodynamics and continue resuscitation.

Why Cricoid Cartilage?



Intraoperative priorities

- Hemorrhage control and surgery proceed alongside resuscitation.
- Prevent hypothermia: warm patient, room when appropriate, and IV/blood products.
- Trend hemoglobin, blood gases, lactate/base deficit, electrolytes and coagulation when major bleeding is present.
- Replace calcium when ionized calcium falls during major transfusion.
- Avoid excessive crystalloid in major hemorrhage; activate the local massive transfusion protocol when indicated.

Postoperative plan and extubation

- Postoperative destination depends on physiology, procedure, intraoperative events and ongoing support needs.
- Provide multimodal analgesia while considering renal function, bleeding risk and hemodynamics.
- Confirm adequate neuromuscular recovery and reverse residual blockade appropriately.
- Extubate only when ventilation, oxygenation, hemodynamics and airway protection are satisfactory.
- Some patients should remain intubated for ongoing resuscitation, edema, neurologic injury or planned re-operation.

Case 1: emergency laparotomy

Clinical application

CASE

A 62-year-old patient with bowel obstruction has repeated vomiting, HR 118/min and BP 92/58 mmHg. Surgery cannot be delayed. The patient drank water 2 hours ago.

Discuss

- What are your immediate priorities?
- How do you assess aspiration risk?
- How would you prepare for induction?
- What factors influence the induction drug/dose?

PART 2

Trauma: anesthesia priorities

Trauma assessment: ABCDE

- A — Airway with cervical spine protection.
- B — Breathing and ventilation.
- C — Circulation with hemorrhage control.
- D — Disability: rapid neurologic assessment.
- E — Exposure / environmental control, including prevention of hypothermia.

Treat life-threatening problems as you find them.

A — Airway with cervical spine protection

- Look for obstruction, facial/neck trauma, blood/vomit, burns and progressive swelling.
- Assume cervical spine injury when mechanism/assessment warrants it and minimize unnecessary movement.
- Preoxygenate and prepare for a difficult airway when indicated.
- Have suction and rescue airway equipment immediately available.
- Failure to oxygenate is the emergency; the technique must adapt to the patient.

B — Breathing and ventilation

- Assess respiratory rate, chest movement, air entry, oxygen saturation and signs of respiratory distress.
- Immediately recognize and treat life-threatening thoracic problems such as tension pneumothorax.
- After intubation, deterioration should trigger a rapid check for tube problems, pneumothorax, equipment failure and evolving injury.
- Ventilation strategy should account for associated chest and brain injury.

C — Circulation: control bleeding first

- Identify external bleeding and obtain rapid surgical/interventional control of internal hemorrhage.
- Assess perfusion rather than relying on a single blood-pressure value.
- Young patients and athletes may compensate until late; older patients and medications may blunt tachycardia.
- Establish rapid-access resuscitation and activate major hemorrhage pathways early when indicated.

D and E — neurologic status and exposure

- Record a baseline Glasgow Coma Scale and pupil examination.
- Avoid secondary brain injury: prevent hypoxemia and major hypotension.
- Fully expose the patient to identify injuries, then actively prevent heat loss.
- Hypothermia worsens coagulopathy and is an avoidable contributor to poor resuscitation.

Secondary survey: after immediate threats are addressed

- Perform a head-to-toe examination after the primary survey and initial resuscitation.
- Use AMPLE history: Allergies, Medications, Past history/Pregnancy, Last meal, Events/environment related to injury.
- Mechanism of injury helps predict occult injuries but does not replace examination.
- If the patient deteriorates, return immediately to ABCDE rather than continuing the secondary survey.

Hemorrhagic shock: what should recognize

- Tachycardia, cool peripheries, altered mental state, oliguria and hypotension suggest impaired perfusion—but findings vary.
- A normal initial hemoglobin does not exclude major acute blood loss.
- Lactate and base deficit can help assess shock and response to resuscitation.
- The definitive treatment is hemorrhage control plus appropriate resuscitation—not fluids alone.

Major hemorrhage / massive transfusion principles

- Activate the institution's major hemorrhage protocol early when severe ongoing bleeding is suspected.
- Use balanced blood-component resuscitation according to the local protocol; avoid large-volume crystalloid resuscitation.
- Warm blood/products and the patient; monitor temperature.
- Measure and correct ionized hypocalcemia.
- Reassess coagulation and fibrinogen; use conventional tests and/or viscoelastic testing where available.
- Give tranexamic acid early in appropriate bleeding trauma patients according to local trauma protocol.

The lethal physiology of bleeding

Hypothermia

Heat loss, cold fluids and exposure impair coagulation and cardiovascular performance.

Acidosis

Poor perfusion and shock generate metabolic acidosis, which further impairs hemostasis.

Coagulopathy

Trauma, shock, dilution and consumption can all contribute; fibrinogen may fall early.

Hypocalcemia

Citrate in transfused blood products lowers ionized calcium and can worsen coagulation and cardiac function.

Trauma-induced coagulopathy

- Coagulopathy after major trauma is multifactorial—not simply a consequence of acidosis.
- Contributors include tissue injury, shock, dilution, hypothermia, acidosis, fibrinogen depletion and platelet dysfunction.
- Major bleeding requires repeated assessment rather than a single laboratory result.
- Early hemorrhage control, temperature management and targeted hemostatic resuscitation are central.

Thrombin is generated primarily via the 'extrinsic' pathway with multiple feed-forward loops. When thrombomodulin (TM) is presented by the endothelium, it complexes thrombin which is no longer available to cleave fibrinogen. This anticoagulant thrombin activates protein C which reduces further thrombin generation through inhibition of cofactors V and VIII.

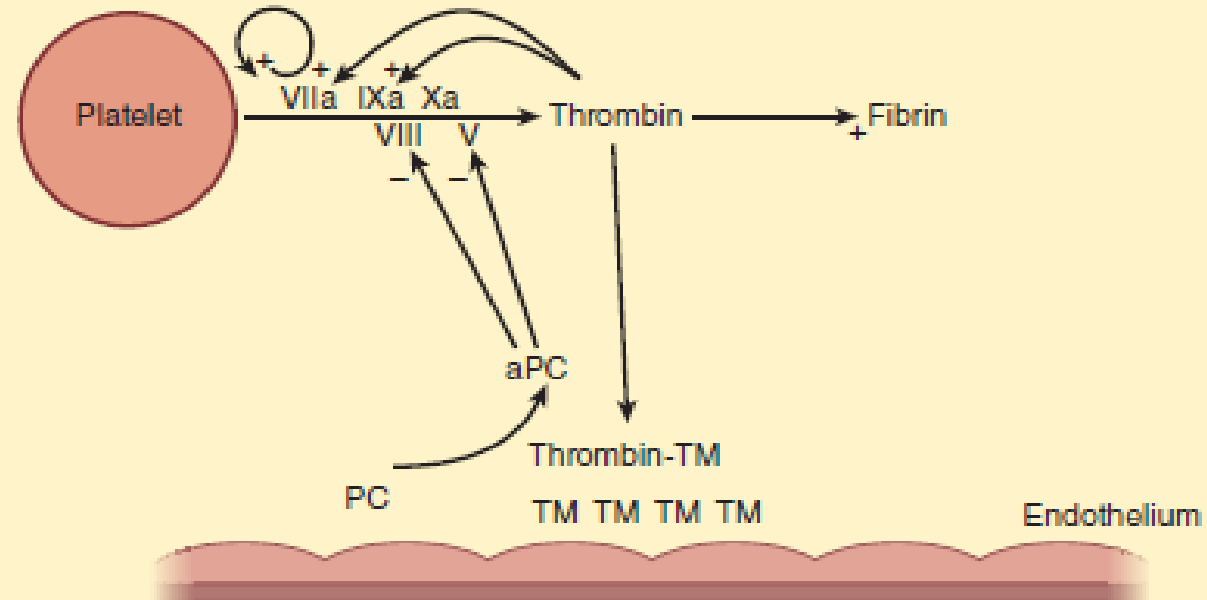


FIGURE 39-2 Mechanism of trauma-induced coagulopathy. During periods of tissue hypoperfusion, thrombomodulin (TM) released by the endothelium complexes with thrombin. The thrombin-TM complexes prevent cleavage of fibrinogen to fibrin and also activate

protein C (PC), reducing further thrombin generation through cofactors V and VIII. (Reproduced, with permission, from Brohi K, Cohen MJ, Davenport RA: Acute coagulopathy of trauma: mechanism, identification and effect. *Curr Opin Crit Care* 2007;13:680.)

Anesthetic goals in major trauma

- Maintain oxygen delivery while definitive hemorrhage control proceeds.
- Avoid severe hypotension after induction; anticipate cardiovascular collapse in profoundly hypovolemic patients.
- Use appropriately reduced anesthetic doses and have vasopressors/resuscitation immediately available.
- Coordinate continuously with surgery, transfusion services and critical care.
- Plan postoperative ventilation/ICU care early.

Case 2: major trauma

Clinical application

CASE

A 25-year-old after a road traffic collision has BP 75/40 mmHg, HR 135/min, abdominal tenderness and a positive FAST. He is transferred directly to theatre and is not fasted.

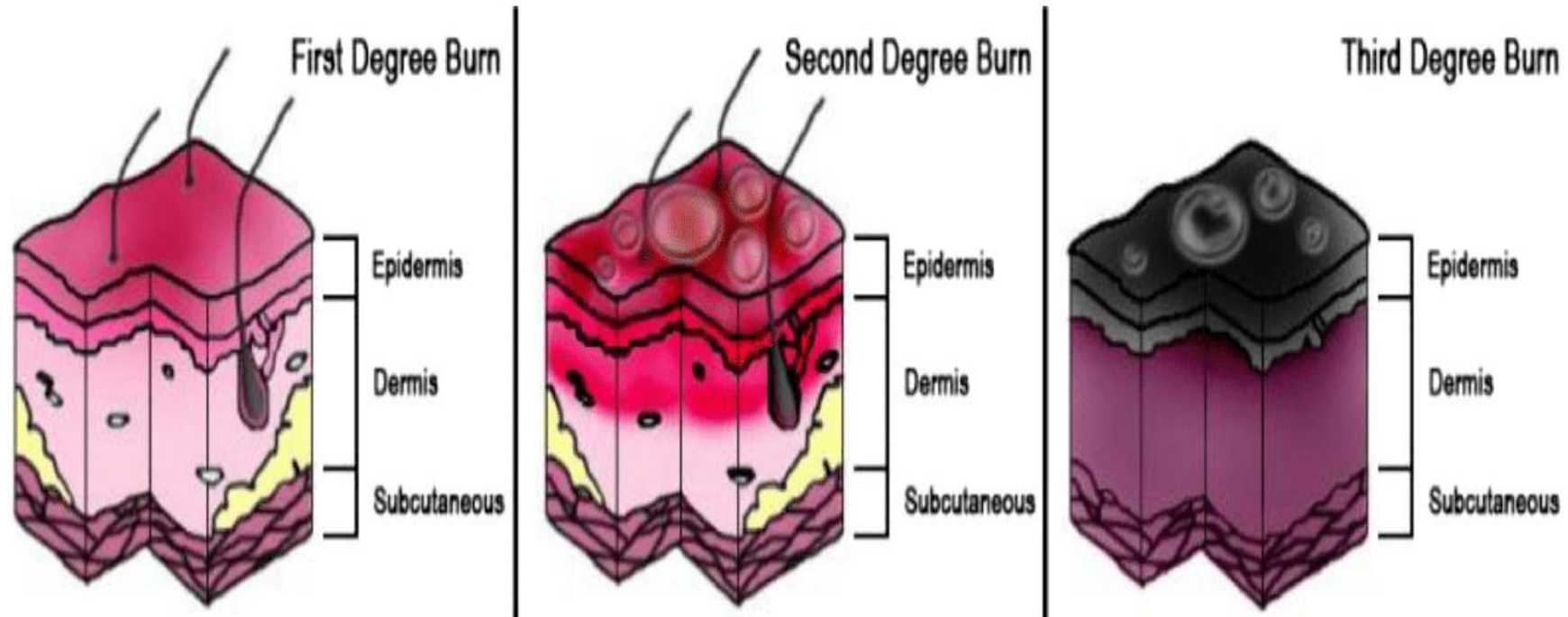
- ABCDE priorities?
- What access/monitoring is essential now?
- How would you induce anesthesia?
- What are the major transfusion priorities?

PART 3

Burns: early priorities

Burn assessment: three questions

- How deep is the burn? — superficial, partial thickness or full thickness.
- How large is it? — estimate % total body surface area (TBSA) of partial- and full-thickness burns.
- Is there inhalation injury or another associated trauma? — this may be more immediately life-threatening than the skin injury.



Estimating burn size

- Rule of Nines provides a rapid adult estimate.
- Lund–Browder chart is more accurate in children because body proportions differ with age.
- For small or scattered burns, the patient's palm can provide a rough ~1% TBSA reference.
- Do not include simple erythema/superficial burns in fluid-resuscitation TBSA calculations.

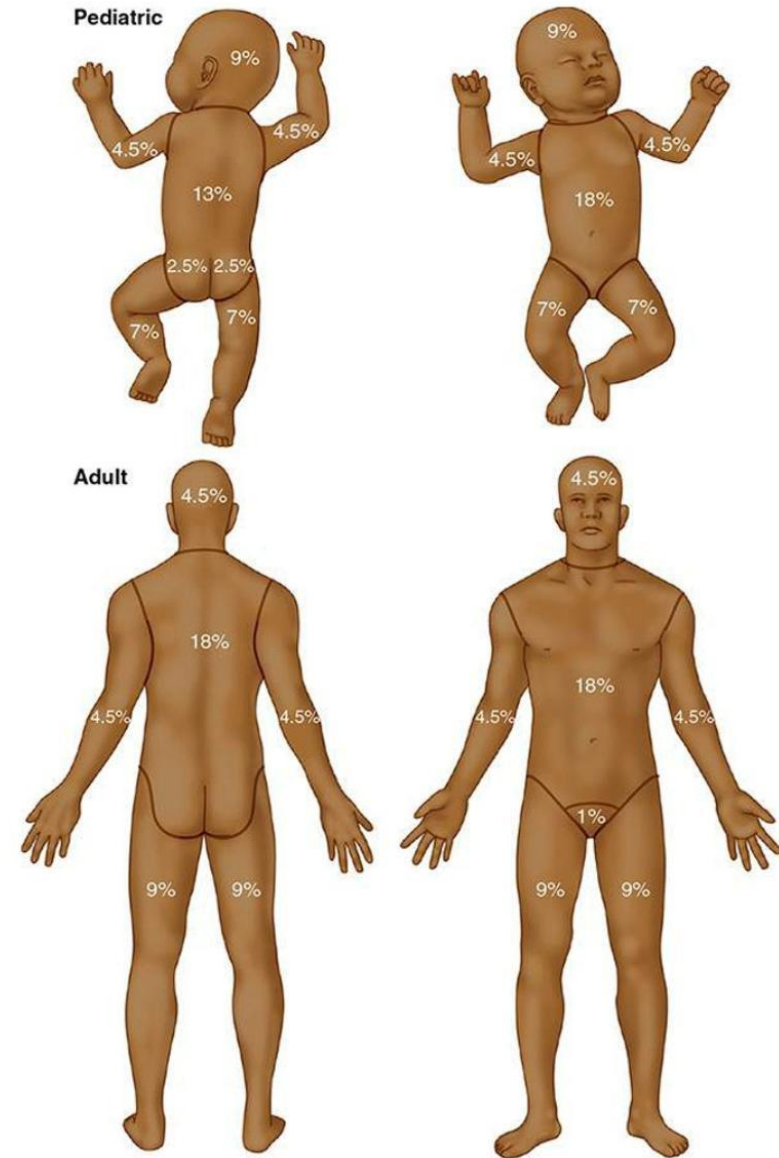


FIGURE 39–6 The Rule of Nines, utilized to estimate burned surface area as a percentage of total body surface area (TBSA). (Reproduced with permission from American College of Surgeons. *ATLS: Advanced Trauma Life Support for Doctors (Student Course Manual)*. 9th ed. Chicago, IL: ACS; 2012.)

A — Airway in burns

- Look for facial/neck burns, soot, hoarseness, stridor, dysphagia, increasing secretions and progressive edema.
- Airway edema may evolve; repeated reassessment is essential.
- Intubate when airway patency is threatened or evolving impairment is likely—not solely because a burn is present.
- Anticipate difficult tube fixation and distorted anatomy in significant facial burns.

B — Breathing and inhalation injury

- Give high-concentration oxygen when smoke inhalation or carbon monoxide exposure is suspected.
- Pulse oximetry can be misleading in carbon monoxide poisoning.
- Consider associated blast/chest injury and bronchospasm.
- Ventilatory support ranges from supplemental oxygen to invasive ventilation depending on respiratory status.

C — Burn shock and fluid resuscitation

- Major burns cause capillary leak and intravascular volume depletion during the early phase.
- For significant burns, isotonic crystalloid is the usual initial resuscitation fluid.
- Formula-based estimates are a starting point—not a fixed prescription.
- Titrate fluids to clinical response and urine output while avoiding both under-resuscitation and ‘fluid creep’.



A simple fluid framework

- Estimate TBSA and body weight.
- Use burn formula to estimate the first 24-hour requirement.
- Time is counted from the burn injury—not from hospital arrival.
- Give the appropriate fraction during the first 8 hours, then the remainder over the next 16 hours when using a Parkland-type approach.
- Adjust the infusion to physiologic endpoints, especially urine output.

	20% TBSA	40% TBSA	60% TBSA	80% TBSA	Formula
Parkland	4800 mL	9600 mL	14 400 mL	19,200 mL	4 mL/kg/% TBSA, Hartmann's
Brooke	2400 mL	4800 mL	7700 mL	9600 mL	2 mL/kg/% TBSA, Hartmann's
Rule of 10	4800 mL	9600 mL	14,400 mL	19,200 mL	%TBSA × 10 mL/h

Table 2. Commonly Used Fluid Resuscitation Formulas for a 60-kg Person Over 24 hours. Half of the total calculated volume should be administered in the first 8 hours in both the Parkland and Brooke formula. TBSA indicates total body surface area

Temperature management in burns

- Burn patients lose heat rapidly and often require aggressive warming.
- Use a warm environment, forced-air warming when feasible and warmed IV fluids/blood products.
- warming should be individualized and monitored.
- Temperature is a vital sign and a resuscitation target.

Burn complications to anticipate

- Hypothermia due to loss of skin barrier and exposure.
- Pulmonary complications from inhalation injury and systemic inflammation.
- Compartment syndromes with circumferential burns or excessive edema/resuscitation.
- Carbon monoxide toxicity; cyanide toxicity may occur in selected enclosed-space fire exposures.
- Associated trauma can coexist and must not be overlooked.

Pharmacologic considerations in major burns

- Drug pharmacokinetics and pharmacodynamics change over time after major burn injury.
- Hypoalbuminemia and changes in acute-phase proteins alter protein binding.
- Neuromuscular-blocker responses may change substantially.
- Titrate anesthetic and analgesic drugs to effect and physiology rather than relying on routine doses.

Succinylcholine after major burns

- Burn injury causes proliferation of extrajunctional acetylcholine receptors.
- After the early post-burn period, succinylcholine can trigger dangerous potassium release and severe hyperkalemia.
- Avoid succinylcholine once this risk is established; use an appropriate non-depolarizing alternative.
- The risk can persist for a prolonged period in patients with major burns.

Analgesia in burn patients

- Burn pain is severe, dynamic and procedure-dependent.
- Use multimodal analgesia and reassess frequently.
- IV opioids are often needed for acute severe pain; titrate carefully.
- Regional techniques may be useful in selected patients when anatomy, coagulation and infection considerations permit.
- Anxiety and repeated painful procedures also require a patient-centered plan.

Case 3: inhalation injury

Clinical application

CASE

A patient with a 40% TBSA burn after an enclosed-space house fire has facial burns, soot around the mouth and progressive hoarseness.

Discuss

- What is the immediate airway concern?
- What oxygen therapy is appropriate?
- How would you estimate TBSA?
- What are the first fluid-resuscitation principles?

PART 4

Putting it together

One mental model for emergency anesthesia

- 1. Identify immediate threats: ABCDE.
- 2. Resuscitate while preparing—do not wait for a ‘perfect’ patient.
- 3. Anticipate aspiration and airway difficulty.
- 4. Choose anesthetic drugs and doses according to physiology.
- 5. Control hemorrhage and use protocolized blood-product resuscitation when needed.
- 6. Prevent hypothermia and reassess continuously.
- 7. Plan postoperative disposition before the end of surgery.

“Fasted = safe”

Fasting time is only one part of aspiration risk, especially in emergency patients.

“Normal BP = no shock”

Compensation can mask major volume loss, particularly in young patients.

“Give lots of crystalloid”

Major hemorrhage needs bleeding control and blood-product-focused resuscitation.

“Burn = intubate”

Airway management is based on current or evolving airway compromise, not the burn label alone.

Take-home messages

- Emergency anesthesia is a parallel process: assessment, resuscitation and preparation occur together.
- RSI is a strategy to reduce aspiration risk, but details should adapt to oxygenation, airway difficulty and physiology.
- In trauma, ABCDE identifies immediate threats; deterioration means return to ABCDE.
- Major bleeding requires rapid hemorrhage control, warmed blood-product resuscitation, calcium and coagulation reassessment.
- In burns, prioritize airway/inhalation injury, TBSA estimation, response-guided fluids and temperature control.
- Communication and repeated reassessment are core clinical skills.

Thank you

Questions?
