Anesthesia for Emergency and Trauma cases

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OUTLINE

- INTRODUCTION
- Definitions
- Types
- Preparation
- Intra-operative management
- Post-operative management
- Examples:
  - ATLS
  - BURN

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INTRODUCTION

Emergency surgery carries a **10-fold higher risk** of adverse events compared to elective surgery

Main goal: **Correct the surgical pathology** while keeping **patient risk minimal**.

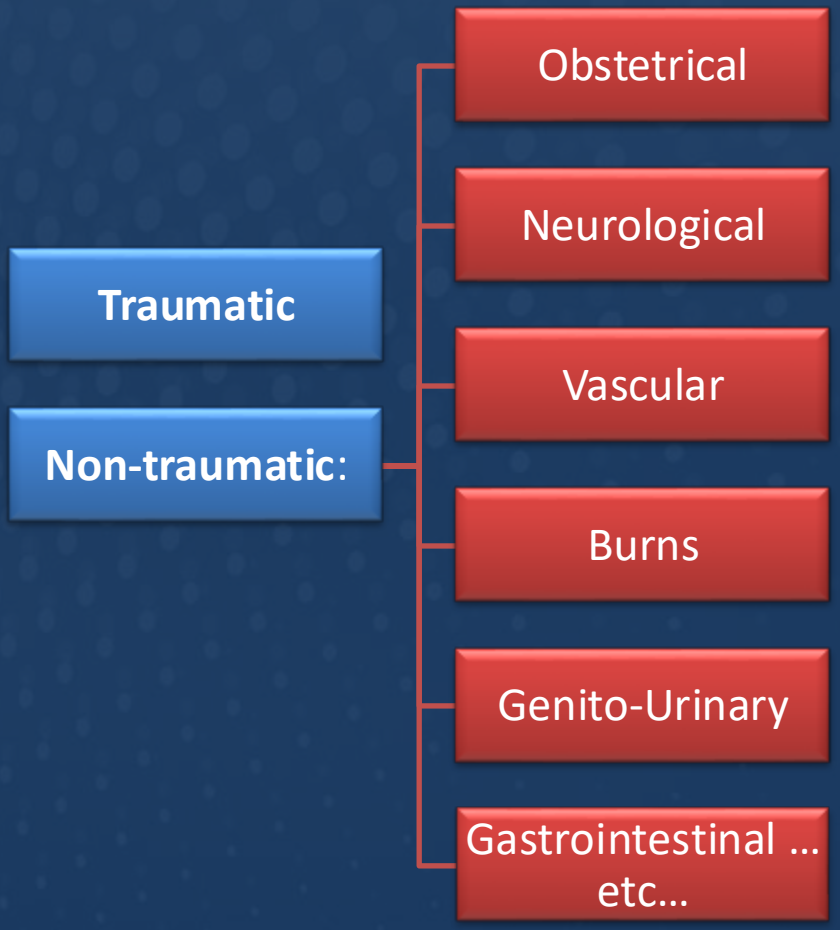
Despite subspecialty differences, basic anesthesia principles apply:

- Careful review of **patient history**
- Thorough **clinical examination**
- Appropriate **special investigations**

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 surgey)
Elective	The surgical procedure can be delayed to permit a complete preoperative evaluation and appropriate management.

Types


Traumatic
Non-traumatic:
Obstetrical
Neurological
Vascular
Burns
Genito-Urinary
Gastrointestinal …
etc…

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General surgery

Appendicectomy
Incision and drainage of an abscess
Laparotomy for small or large bowel obstruction
Strangulated hernia
Acute upper or lower gastro-intestinal bleed
Trauma (blunt or penetrating)

Gynaecological surgery

Ruptured ectopic pregnancy
Evacuation of retained products of conception

Obstetrics

Caesarean section for a variety of indications

Orthopaedic surgery

Open fracture debridement
Poly-trauma

Vascular surgery

Ruptured abdominal aortic aneurysm
Amputation

Neurosurgery

Intracranial haemorrhage with raised intracranial pressure or falling Glasgow coma scale (GCS)

Otorhinolaryngology (ENT)

Epistaxis
Tonsillar abscess

PREOPERATIVE PREPARATION

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Challenge in emergency anesthesia

- ⏱ **Limited time** for patient assessment & preparation
- ❓ **Uncertain diagnoses** (e.g., laparotomy for acute abdomen)
- 🍽 **Aspiration risk**
- 💧 **Fluid, electrolyte & acid–base imbalance**
- 🩸 **Anemia & coagulation disorders**
- 🏥 **Coexisting / poorly controlled chronic diseases**
- ⚡ **Pain & pathophysiological effects**
- 🌙 **After-hours surgery** with junior/inexperienced staff

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Pre-operative Evaluation in Emergency Anesthesia

- 🩺 Assess **anesthetic risks**
- ⚖️ Decide **anesthetic technique** (general / regional / combined)
- 🛏️ Plan **postoperative placement & care**
- 💧 Focus on:
  - **Fluid status**
  - **Metabolic derangements**
  - **Aspiration risk**

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Pre-operative evaluation

- Resuscitation is initiated, if needed, at any time
- Consent for anesthesia , blood transfusions and advice that intraoperative awareness may occur during emergency surgery.
- Discussions should be documented in the patient's record.

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History & Assessment in Emergency Surgery

- 📋 Review notes & charts quickly (time-limited setting)
- ❓❓ Focus on cardio-respiratory symptoms
- 🍽️ Ask about last oral intake
- 🤢 Vomiting/diarrhea → impacts fluid status
- 🌬️ Evaluate aspiration risk
- 💊 Elicit relevant medical, surgical & drug history

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Risk of aspiration

- Inadequate fasting time
- Head & neck trauma
- Unable to protect airway [head or spinal injury ,vocal cord injury]
- Pregnancy
- Intestinal obstruction
- Pain
- Intra abdominal mass
- Obesity

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Prevention of aspiration ASA Fasting Guidelines

Clear fluid	**2 hours**	Water , Fruit juice without pulp,
Milk		
Human	**4 hours**	
Infant formula	**6 hours**	
Light Foods	**6 hours**	Fruits , juice with pulp, Vegetables
Heavy foods	**8 hours**	Fatty meals , meats

Emergency Anesthesia – Clinical Assessment

- 💔🩹 Focus on **cardio-respiratory systems** → anticipate anesthesia difficulties
- 👄 **Always evaluate airway**
- 💧 Assess **intravascular & extracellular volume status** (challenging)
  - Young: **compensated hypovolemia** may mask depletion
  - Elderly: **poor baroreceptor reflex** may hide true status
- 📊 **Check vital signs**:
  - Blood Pressure (BP)
  - Heart Rate (HR)
  - Respiratory Rate (RR)
  - Temperature

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Clinical indices: Extent of blood loss				
Class of hypovolaemia	**1 Minimal**	**2 Mild**	**3 Moderate**	**4 Severe**
% blood loss	10 %	20 %	30 %	> 40 %
Volume loss ml	500	1 000	1 500	> 2 000
Heart rate beats min^{-1}	normal	100 - 120	120 - 140	> 140
Arterial pressure mm"Hg"	normal	Orthostatic hypotension	SBP < 100	SBP < 80
Urinary output ml hr^{-1}	1 ml kg^{-1} hr^{-1}	20 - 30	10 - 20	Nil
Level of consciousness	Normal	Normal	Restless	Impaired
State of peripheral circulation	Normal	Cool and pale	Cold and pale slow capillary refill	Cold & clammy peripheral cyanosis

Clinical indices: Extracellular fluid loss		
% body weight lost as water	**ml of fluid lost per 70 kg**	**Clinical presentation**
> 4 %	> 2 500	Thirst, reduced skin elasticity, decreased intraocular pressure, dry tongue, reduced sweating
> 6 % *(mild)*	> 4 200	Orthostatic hypotension, reduced filling of peripheral veins, oliguria, nausea, dry axillae + groins, ↓ CVP, apathy, haemoconcentration *(higher than expected Hb)*
> 8 % *(moderate)*	> 5 600	Hypotension, thready pulse with cool peripheries.
10 - 15 % *(severe)*	7 000 - 10 000	Coma, then shock followed by death

Lab investigations if possible … usually done as resuscitation is carried on

Prepare to manage any uncontrolled co-morbidities

Ex. D.M, HTN, ASTHMA

Emergency Anesthesia – Timing & Techniques

Only a **few patients** require **immediate surgery**

Most benefit from:

- Correction of **hypovolemia**
- Correction of **electrolyte disturbances**
- Stabilization of **medical conditions**
- Allowing **gastric emptying**

General anesthesia = most common technique

Regional or **sedation** techniques also used in selected cases

O.R

The operating room should be as warm as practical.

Intravenous fluid warmers and rapid infusion devices should be prepared and ready for use..

Patients arriving for trauma surgery **should be presumed to have full stomachs with increased risk for aspiration** of gastric contents.

The presence of a C-collar for cervical spine stabilization may increase intubation difficulty.

Alternative airway devices (eg, fiberoptic bronchoscope, videolaryngoscope) and robust suction equipment must be immediately available and ready for use.

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Emergency Anesthesia – Vascular Access

- **IV access** often established prehospital or in ED
- ✅ If **peripheral lines are good caliber** (can infuse blood under pressure with rapid infuser) → **central line not always needed** initially
- ❓ **Subclavian vein** often preferred for central venous access in profound hypotension
  - Anatomical position (between clavicle & 1st rib) keeps it **stented open** even in hypovolemia
- **Ultrasound guidance** enables safe placement of:
  - Large-bore peripheral lines
  - Central venous catheters (e.g., jugular)
  - Even in severe hypovolemia

Choice of Anaesthetic Agents

Induction Agents

- **Propofol**: causes significant hemodynamic changes → **not advised** in emergency/shock settings.
- **Etomidate** and **Ketamine**: preferred choices → more cardiovascularly stable.

Co-induction with short-acting opioid (e.g., fentanyl):

- Reduces required dose of induction agent (synergistic effect).

Volatile Agents

- Best choices: **Isoflurane, Sevoflurane, or Desflurane**.
- Rationale: most **cardiovascularly stable volatile anesthetics**.

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Choice of anesthetic agents

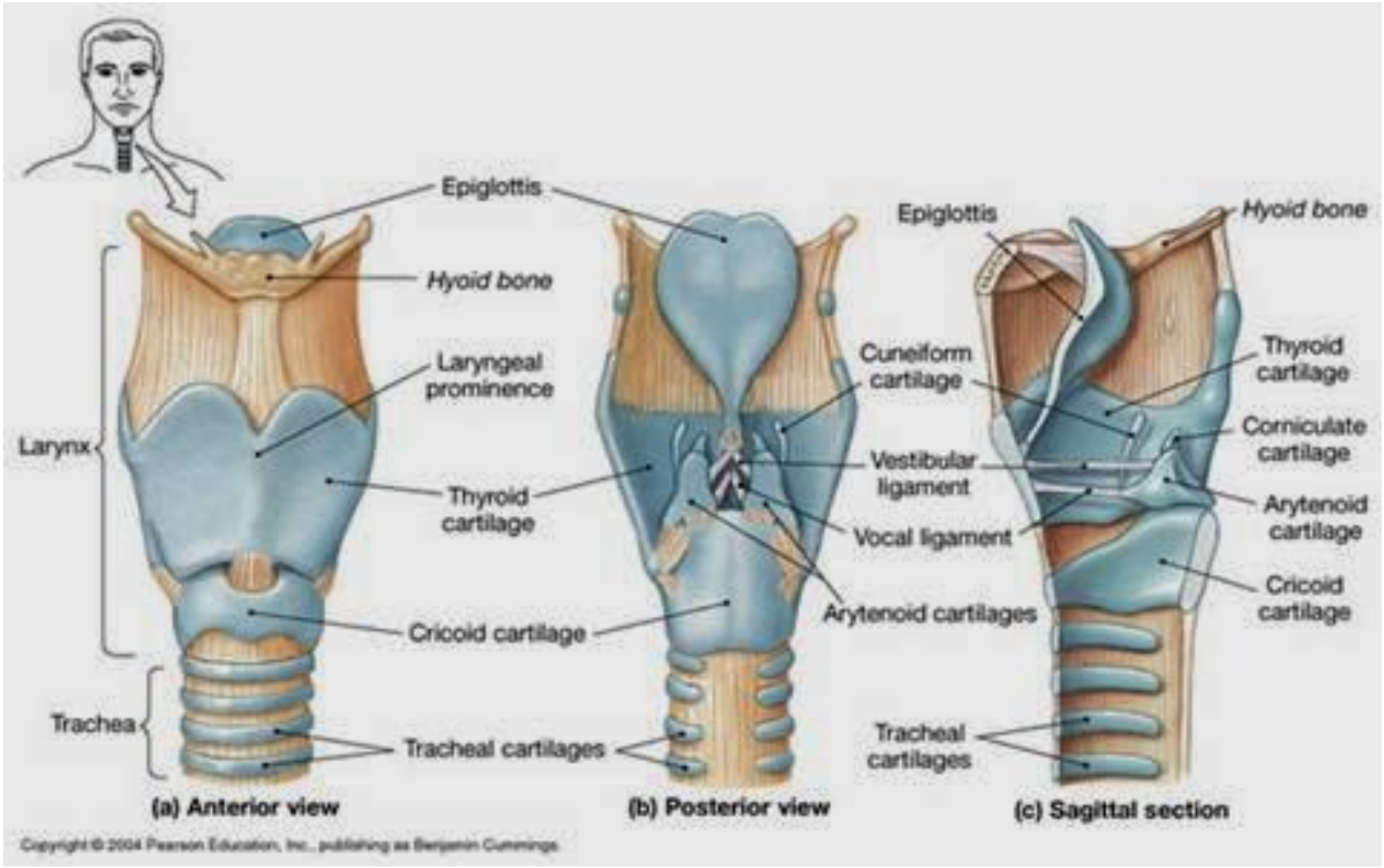
Drug Dosing in Shock

- In **shocked patients** → all drug doses should be **reduced**.
- In **extremely unstable shocked patients** → **high-dose short-acting opioids** alone may be preferred

Rapid Sequence Induction (RSI) – Aspiration Risk Management

- 🎯 **Aim:** Minimize risk of aspiration
- 🧹 Confirm **suction availability** before induction
- 😮‍💨 **Preoxygenate** with 100% O_2 for **3–5 min** or **4 vital breaths**
- 💉 Use **pre-determined rapid IV induction agent**
- 💪 Follow with **rapid-acting muscle relaxant** (e.g., **suxamethonium** or **rocuronium**)
  - **Do not wait** to assess induction effect
- ✋ Apply **cricoid pressure** (optional, with or without)
- 🚫 **Do NOT mask ventilate** before intubation
- 📜 Insert **NG tube after intubation** for gastric emptying

Why Cricoid Cartilage?



Intra-operative management

- Emergency or trauma surgery may be fraught with complications.
- Be vigilant during the case.
- Close monitoring of the patient's
  - ✓ haemodynamic status,
  - ✓ urine output,
  - ✓ haemoglobin and
  - ✓ acid base status with
  - ✓ arterial blood gases (ABGs)
- it is prudent to insert invasive monitoring in the form of an arterial line prior to induction and a central line after induction if necessary.

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Invasive monitoring

- An **arterial line is very helpful** in the initial resuscitation of the trauma victim.
- Even with the assistance of ultrasonography, cannulating an artery in the presence of profound hypotension may prove difficult.
- Although arterial line placement may be a challenge, surgical incision cannot be delayed.
- placement can resume, and are more likely to be successful, as blood pressure improves from operative hemostasis and resuscitative transfusion.

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Fluid Management

- Fluid management in major trauma resuscitations emphasizes blood products rather than crystalloid fluids.
- All fluids should be warmed, except for platelets.
- When blood products are rapidly infused, ionized calcium quickly declines and must be replaced.

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POST-OPERATIVE MANAGEMENT

Postoperative management

- Post-operatively, patients will need
  - ✓ *Analgesia,*
  - ✓ *Fluids and/or*
  - ✓ *Blood products*.
- Decisions on where to place the patient are made based on the patient's pre-operative condition, intra-operative events and available facilities.

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- Atropine and neostigmine are given and patient will breathe in 100% oxygen.*

- Because of the risk of aspiration, extubation is performed only when there is **recovery of airway reflexes**. (when the patient is fully awake).

- Decision for extubation depends on patient's haemodynamic status

Pain Management

- Relief of pain / anxiety as appropriate
- Administer intravenously
- Careful monitoring is essential
- **No NSAIDS for hypovolemic patients**
- **Regional Anaesthesia (Hemodynamic instability, Coagulopathy)**

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ATLS

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- Trauma is a leading cause of morbidity and mortality in all age groups
- The role of the anesthesiologist in trauma is to guide the resuscitation of the trauma patient in the operating room.

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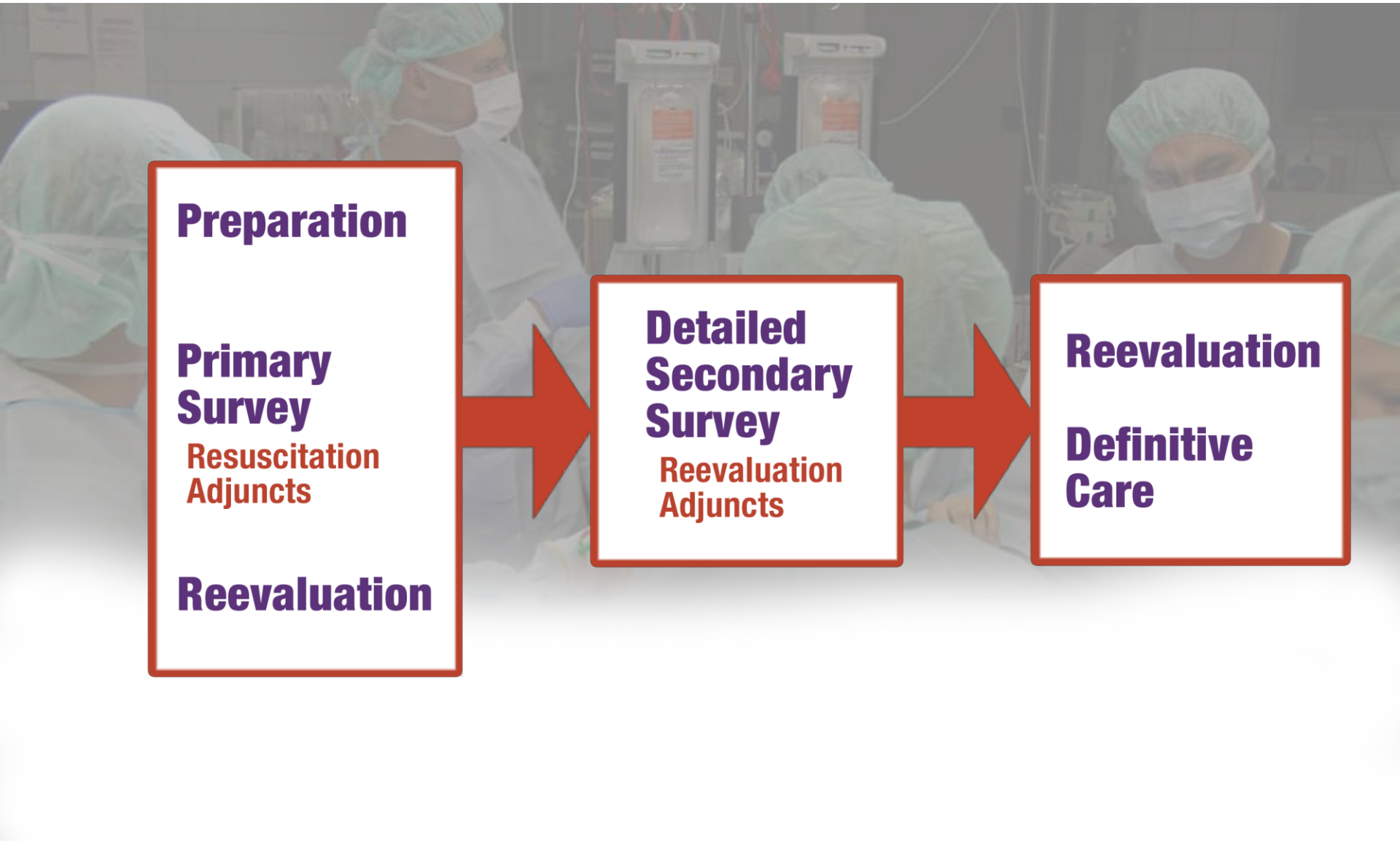
ATLS

- PRIMARY SURVEY
- SECONDARY SURVEY
- RESUSCITATION
- DEFINITIVE TRAUMA INTERVENTIONS

Concepts of Initial Assessment



Primary Survey

Airway with c-spine protection

Breathing and ventilation

Circulation with hemorrhage control

Disability: Neuro status

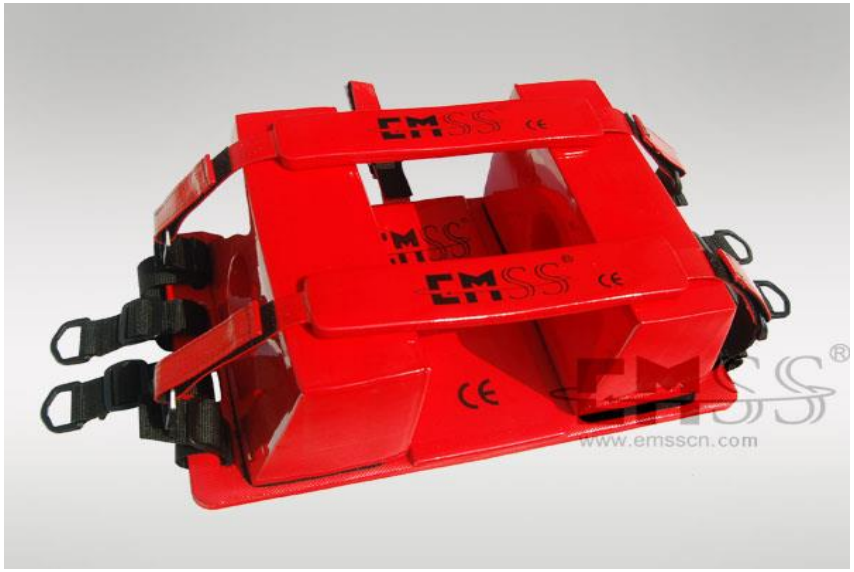
Exposure / **E**nvironmental control

Primary Survey

Airway

- **Establish patent airway**
- **protect c-spine**
- **BLS**

- Occult airway injury
- Progressive loss of airway
- Equipment failure
- Inability to intubate


EMSS
www.emsscn.com

Primary Survey

Breathing and Ventilation

Assess and ensure adequate oxygenation and ventilation

- **Respiratory rate**
- **Chest movement**
- **Air entry**
- **Oxygen saturation**

Primary Survey

Breathing and Ventilation

Airway versus ventilation problem?

Iatrogenic pneumothorax or tension pneumothorax?

Primary Survey

Circulation
(including hemorrhage control)

Assess for organ perfusion

- Level of consciousness
- Skin color and temperature
- Pulse rate and character
- URINE OUTPUT
- CAPILLARY REFILL

Primary Survey

Circulatory Management

- Control hemorrhage
- Restore volume
- Reassess patient

Pitfalls

- Elderly
- Children
- Athletes
- Medications

Primary Survey

Disability

- Baseline neurologic evaluation
- Glasgow Coma Scale score
- Pupillary response

Observe for neurologic deterioration

Primary Survey

Exposure / Environment

Completely undress the patient

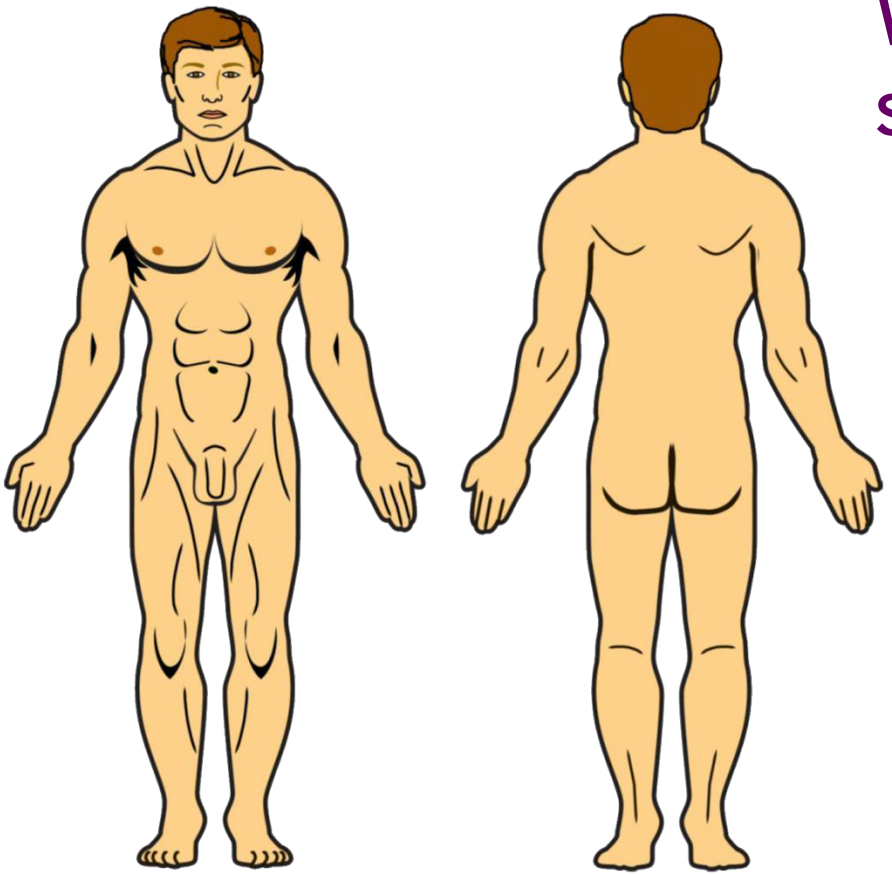
Caution

Prevent hypothermia

Pitfalls

Missed injuries

Secondary Survey



What is the secondary survey?

The <u>complete</u> history and physical examination

Secondary Survey

When do I start the secondary survey?

After

- Primary survey is completed
- ABCDEs are reassessed
- Vital functions are returning to normal

Secondary Survey

Components of the secondary survey

History
Physical exam: Head to toe
Complete neurologic exam
Special diagnostic tests
Reevaluation

Secondary Survey

History

- Allergies
- Medications
- Past illnesses / Pregnancy
- Last meal
- Events / Environment / Mechanism

Secondary Survey

Mechanisms of Injury

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SECONDARY SURVEY

- Head to Toe Examination
- Scalp .. Face .. Ears .. Neck
- Chest
- Abdomen .. Pelvis
- Extremities

Adjuncts to Secondary Survey

Special Diagnostic Tests as Indicated

Pitfalls

- Patient deterioration
- Delay of transfer
- Deterioration during transfer
- Poor communication

Goals for Resuscitation of The Trauma Patient

PARAMETER	GOAL
Blood pressure	Systolic 80 mmHg, mean 50-60mmHg
Heart rate	< 120 bpm
Oxygenation	SaO2 > 95%
Urine output	0.5ml/kg/h
Mental status	Following commands
Lactate level	<1.6mmol/l
Base deficit	> -5
Haemoglobin	>8.0g/dl

Problems Associated with Trauma Patient

- Risk of aspiration
- Inadequate fasting time
- Pregnancy
- Pain
- Potential difficult airway
- Co-existing disease
- Coagulopathy
- Massive blood loss
- Dilutional coagulopathy

Trauma-Induced Coagulopathy

- Common following major trauma
- Trauma-induced coagulopathy is an independent risk factor for death
- Acute traumatic coagulopathy is only related to severe metabolic acidosis (base deficit ≥6 mEq/L)

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 anticoagulent thrombin activates protein C which reduces further thrombin generation through inhibition of cofactors V and VIII.

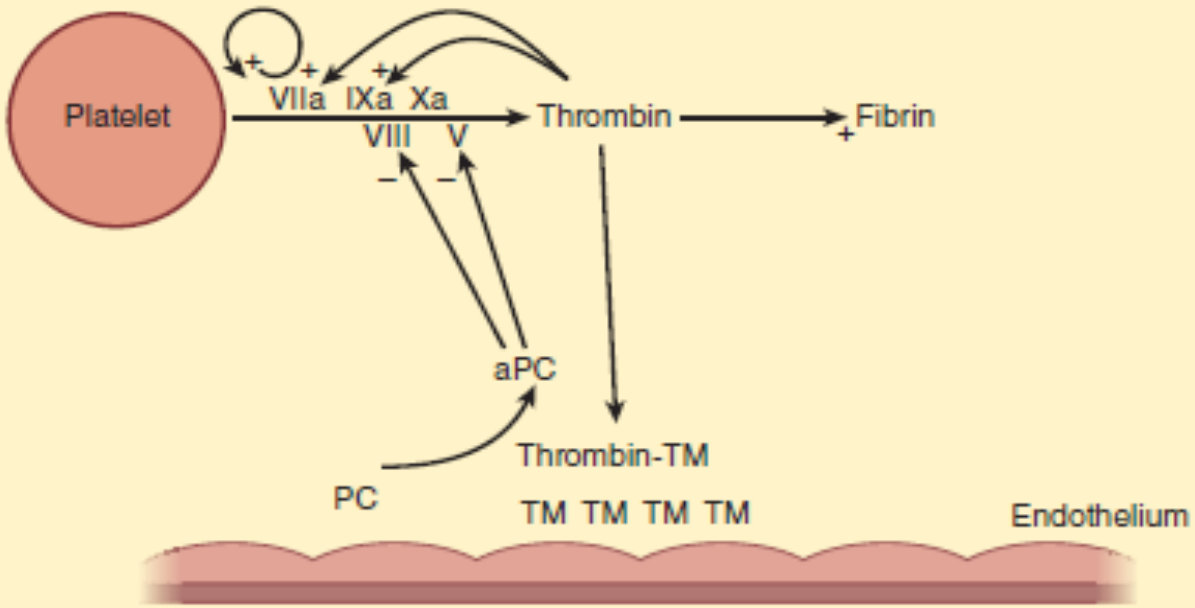

FIGURE 39–2 Mechanism of trauma-induced coagulopathy. During periods of tissue hypoperfusion, thrombomodulin (TM) released by the endothelium complexes with thrombin. The thrombin–TM complexes prevent cleavage of fibrinogen to fibrin and also activate protein C (PC), reducing further thrombin generation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

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Complications of Coagulopathy

- **Uncontrolled bleeding**
- **Hemorrhagic shock**
- **Death**

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Anesthesia and Burn Patients

Presented By: Ryan Awtrey, Ramona Colabianchi, Devon Moore & Samantha Smith

- Burns are second only to motor vehicle accidents as the leading source of accidental death.
- Three risk factors predictive of increased mortality from burns include age greater than 60 years, more than 40% total body surface area (TBSA) burns, and inhalation injury.
- Children, due to an increased body surface area to body mass ratio, and the elderly, due to thinner skin, are both at greater risk for major burn injuries.
- Temperature and duration of heat contact determine the extent of burn injury.

- The pathophysiological and hemodynamic responses to burn injuries are unique and warrant specialized burn care that can be optimally provided only at burn treatment centers

- A basic understanding of burn pathophysiology and of resuscitation requirements, especially **early initiation of therapies** such as oxygen administration and aggressive fluid resuscitation will improve patient survival.

Thermal burns	• Full-thickness burns • Partial-thickness ≥10% TBSA • Any deep partial- or full-thickness burns involving the face, hands, genitalia, feet, perineum or over any joints • Patients with burns and other comorbidities • Patients with concomitant traumatic injuries • Poorly controlled pain
Inhalation injury	• All patients with suspected inhalation injury
Paediatrics <14 y or <30 kg	• All paediatric burns may benefit from burn centre referral due to pain, dressing change needs, rehabilitation, patient/caregiver needs or nonaccidental trauma
Chemical injuries	• All chemical injuries
Electrical injuries	• All high-voltage (≥1000 V) electrical injuries • Lightning injury

e 1. Classifications of Burns Requiring Consideration for Transfer to Specialised Burn Centre. TBSA indicates total body surface area

CLASSIFICATION

FIRST DEGREE

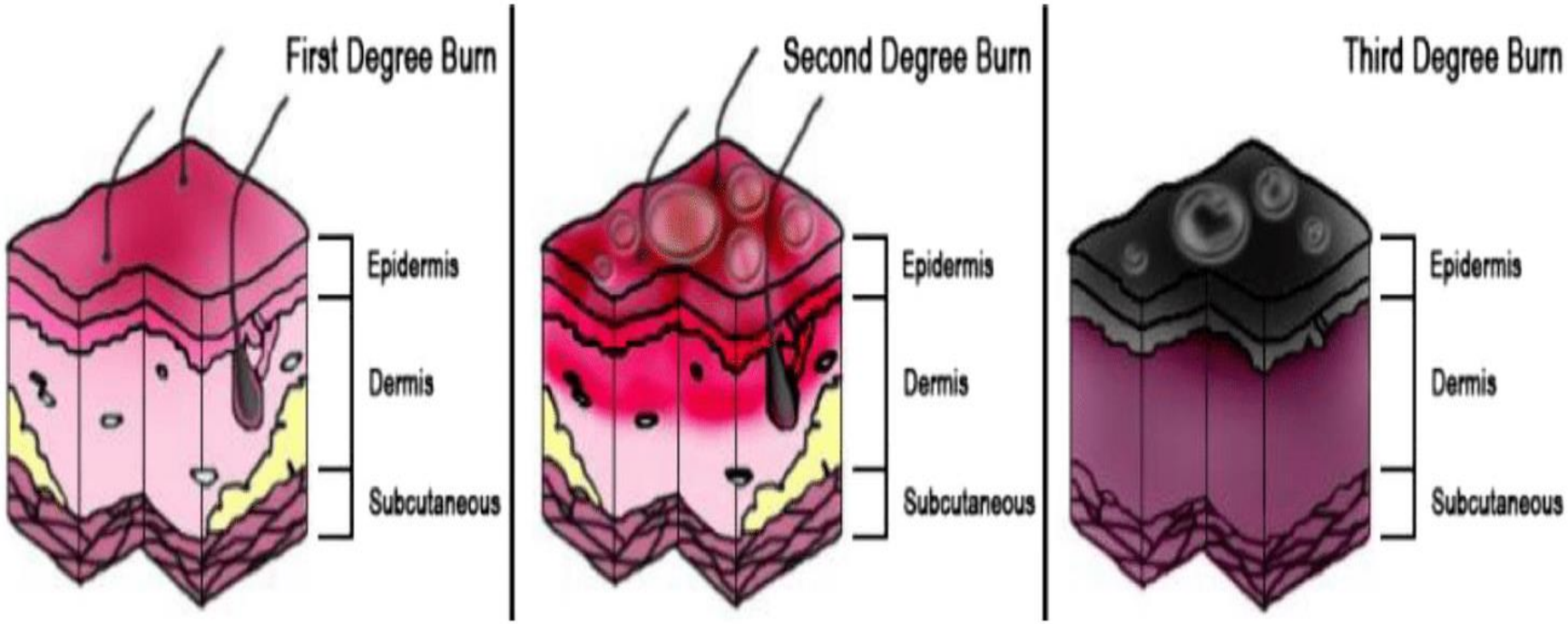
- burns are injuries that do not penetrate the epidermis
- Fluid replacement for these burns is not necessary,

Seconnd degree

- a partial- thickness injuries (superficial or deep) that penetrate the epidermis, extend into the dermis and are associated with blistering
- Fluid replacement therapy is indicated for patients more than 20% of total body surface area (TBSA) is involved.

Third degree

- burns are those in which the thermal injury penetrates the full thickness of the dermis
- . Nerves, blood vessels, lymphatic channels, and other deep structures may have been destroyed,
- Severe, but insensate, wound (although surrounding tissue may be very painful).


First Degree Burn
Epidermis
Dermis
Subcutaneous
Second Degree Burn
Epidermis
Dermis
Subcutaneous
Third Degree Burn
Epidermis
Dermis
Subcutaneous

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The rule of nine:- adults vs pediatrics

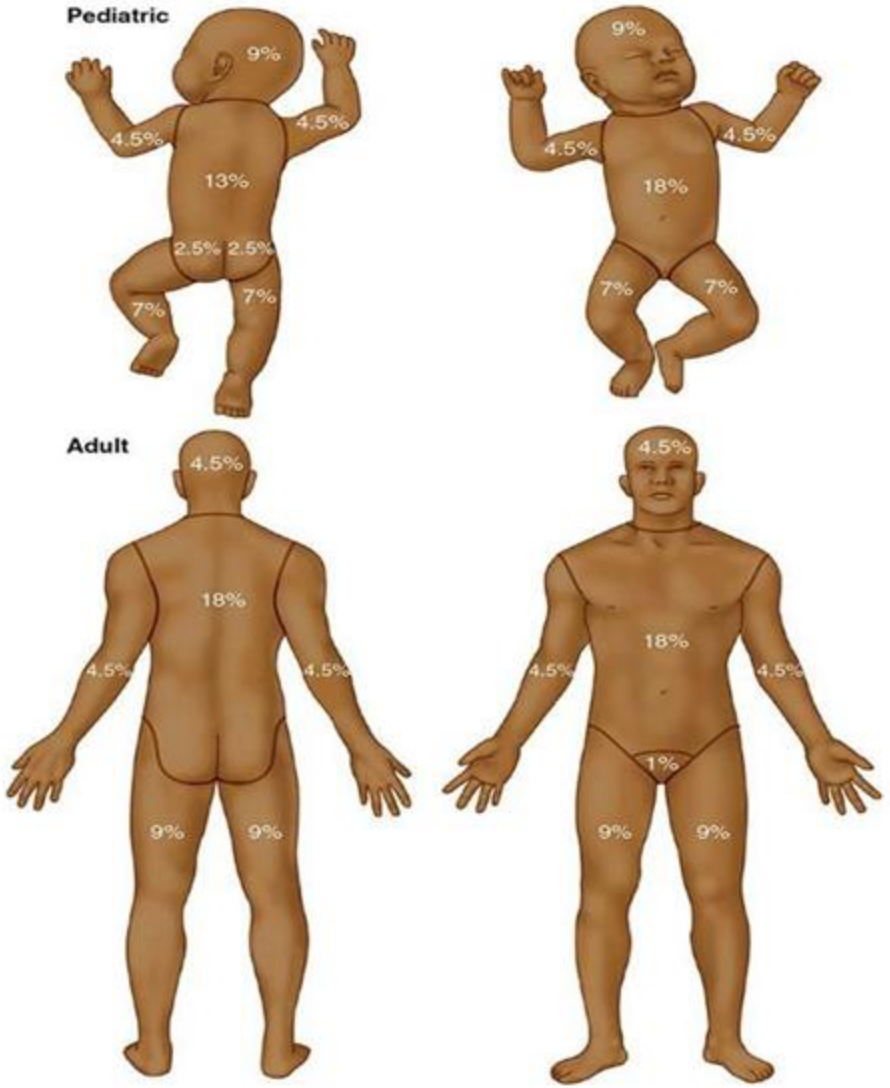
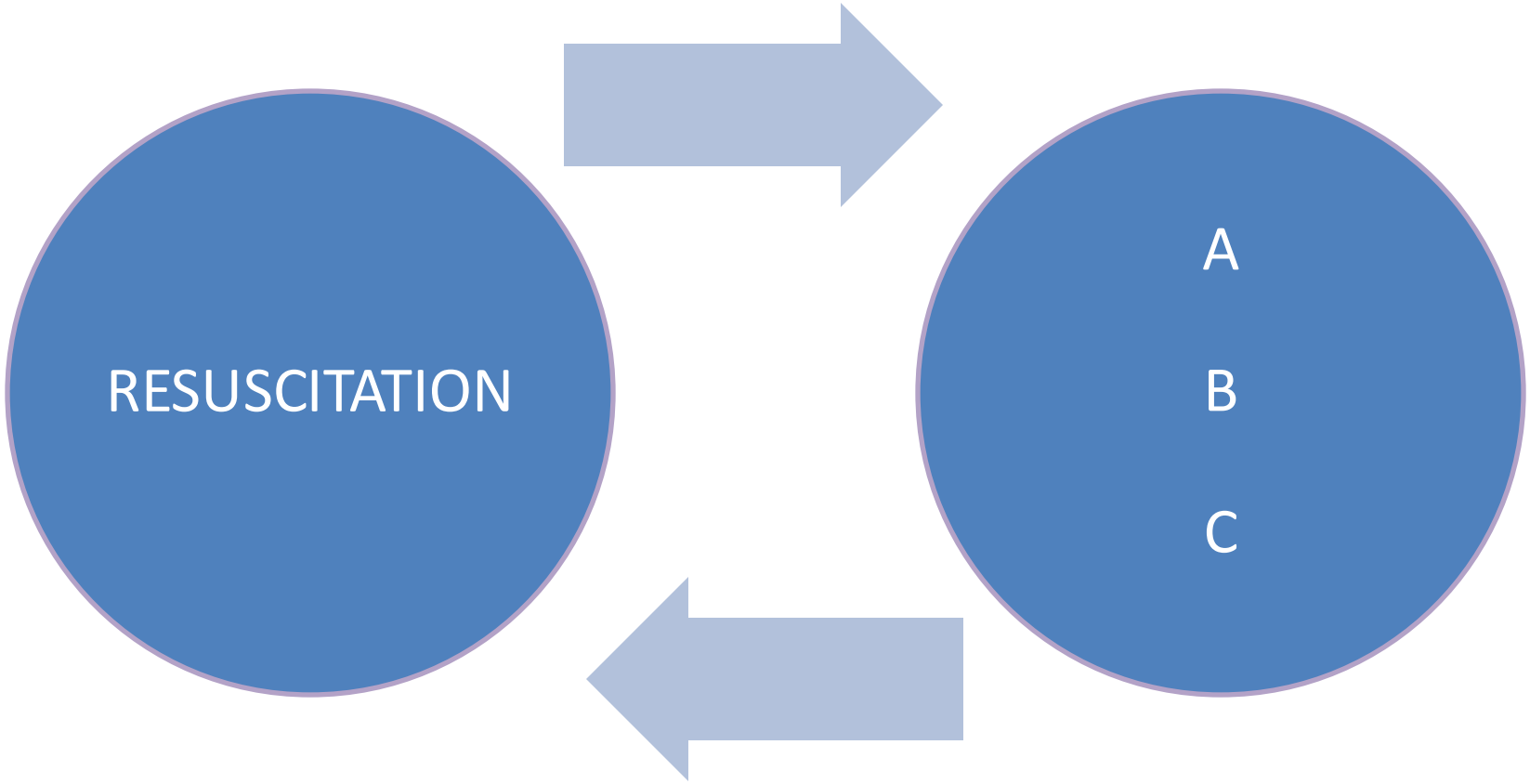


FIGURE 39–6 The Rule of Nines, utilized to estimate burned surface area as a percentage of total body surface area (TBSA). (Reproduced with permission from American College of Surgeons. *ATLS: Advanced Trauma Life Support for Doctors (Student Course Manual)*. 9th ed. Chicago, IL: ACS; 2012.)


RESUSCITATION
A
B
C

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A-AIRWAY

- Patients with a major burn injury often require immediate airway management, which can be challenging.
- Airway management can be complicated by limitation in mouth opening, airway and facial edema and difficulties interpreting airway anatomy.
- A need to secure airway devices with suturing, as tape or ties may not adhere to inflamed tissues or may interfere with burned areas that will require ongoing surgical management.

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A-AIRWAY

- The role of early intubation in patients with burn injury has been recently questioned.
- Current guidelines from the International Society for Burn Injury suggest the only indication for intubation or tracheostomy should be for cases of current or evolving impairment of airway patency.
- Clinical signs include airway swelling, soot contamination of airway secretions, increasing work of breathing, hoarseness, stridor, dysphagia or increased salivation.

B-breathing

- Pulmonary complications, such as pulmonary oedema, remain a major cause of mortality after severe or inhalational burn injury.

- Pulmonary oedema after burn injury can arise from 2 mechanisms: ***direct irritation*** by heat, smoke or chemicals or as part of ***a stereotypical lung*** response to severe injury, through systemic inflammation ***(SIRS).***

- Patients with signs of inhalation injury or compromised pulmonary function may require oxygen therapy, continuous positive airway pressure or intubation and controlled ventilation.

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C-CIRCULATION/FLUID RESUSCITATION

- Bleeding from wounds, evaporative losses and systemic responses involving vasoactive and inflammatory mediators can lead to impaired organ perfusion after burn injury.
- The phenomenon, known as ‘burn shock’, presents as marked hypoperfusion and hypovolemia occurring within the first 24 hours after a major burn and necessitating aggressive fluid resuscitation.
- Inadequate fluid resuscitation results in worsening burn injury and higher mortality.
- Burn shock remains the most common cause of death from severe burn injury in the first week.

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C-CIRCULATION/FLUID RESUSCITATION

- Crystalloid is an accepted form of therapy for volume loss after burn injury
- It may be more appropriate to transfuse colloid when intravascular volume levels are critical as part of a restrictive fluid strategy.
- Various formulas have been devised to provide estimates of both rate and volume of fluid resuscitation.
- DIC…

	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

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Burn management considerations

- Abdominal Compartment Abdominal Syndrome. (circumferential abdominal burns, and patients receiving intravenous fluid volumes greater than 6 mL/kg/% TBSA)
- Pulmonary complications.
- Carbon monoxide and cyanide poisoning. (shifts the O 2 –Hb dissociation curve to the left)

Anesthetic Considerations for Burn Therapy

- A primary characteristic of all burn patients is an inability to regulate temperature.
- The resuscitation environment must be maintained near body temperature through the use of a radiant warning, forced air warming devices, and fluid warming devices.
- All burn care environments must be maintained near 40’C.

PHARMACOLOGIC CONSIDERATIONS

- Patients with significant burn injuries have altered pharmacodynamic responses as well as alterations in pharmacokinetic parameters.
- These pathophysiological changes mean that careful titration and monitoring of commonly used anaesthetic drugs may be require.

PHARMACOLOGIC CONSIDERATIONS

- Burn injury–related changes cause proliferation of extrajunctional acetylcholine receptors that release more potassium into the extracellular space.
- This predisposing to life-threatening hyperkalaemia when suxamethonium is used.
- This risk appears to be greatest in patients more than 48 hours after and for up to 2 years postinjury.

PHARMACOLOGIC CONSIDERATIONS

- Plasma protein concentration and binding capabilities may be drastically altered after severe burn injury.
- Significant hypoalbuminemia can occur. *(Drugs bound to albumin may be present in a higher free concentration*)
- alpha 1-acid glycoprotein(AAG)concentrations can increase.(*Drugs bound to AAG may be present in a lower free concentration eg. LA, alfentanyl)*

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Analgesia

- Analgesia for burn patients is challenging.
- **Multimodal approaches** are often advantageous.
- Regionl analgesia may provide benefit(masking effect)

Take Home Messages

Systematic patient assessment

- Primary survey
- Secondary survey
- Rapid sequence intubation
- Reduce risk of aspiration
- Continuous hemodynamic assessment of patient intraoperatively

COMUNICATION

Thank You

for listening