Burns: Pathophysiology, Classification, and Management

Burns are a common form of injury that can range from minor to life-threatening. They are caused by a variety of agents, including heat, chemicals, electricity, and radiation. Understanding the pathophysiology, classification, and management of burns is crucial for any medical professional. This lecture will cover the epidemiology, pathophysiology, classification, clinical assessment, and management of burns.

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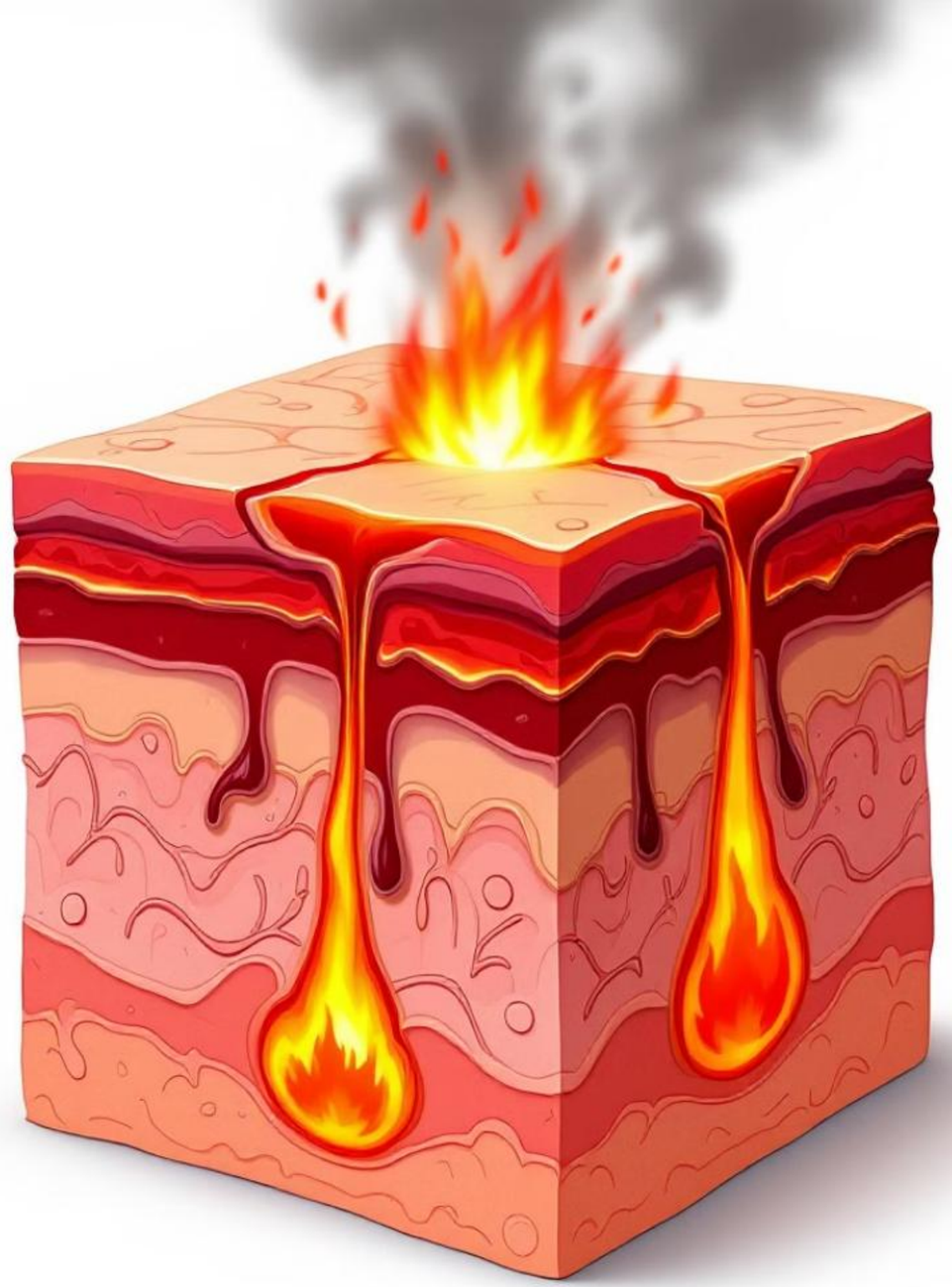
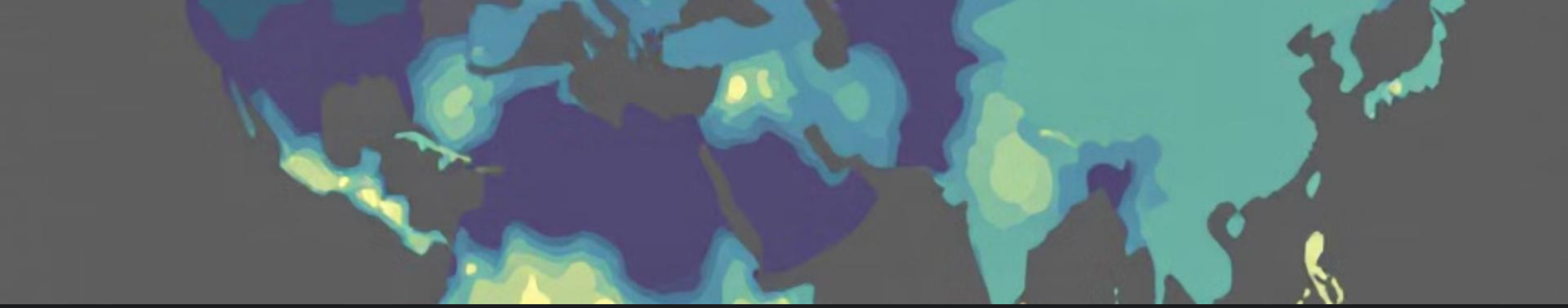




Epidemiology of Burns

1 Global Burden

Burns are a significant public health issue worldwide, with millions of cases reported annually. They are particularly prevalent in low- and middle-income countries.

2 Risk Factors

Common risk factors include poverty, lack of safety measures, occupational hazards, and domestic accidents.

3 Mortality

Severe burns can lead to high mortality rates, especially in cases involving large total body surface area (TBSA) burns, inhalation injuries, and infections.

Pathophysiology of Burns

Burns cause tissue damage through direct cellular injury and the release of inflammatory mediators. The pathophysiology can be divided into three zones:

Zone of Coagulation

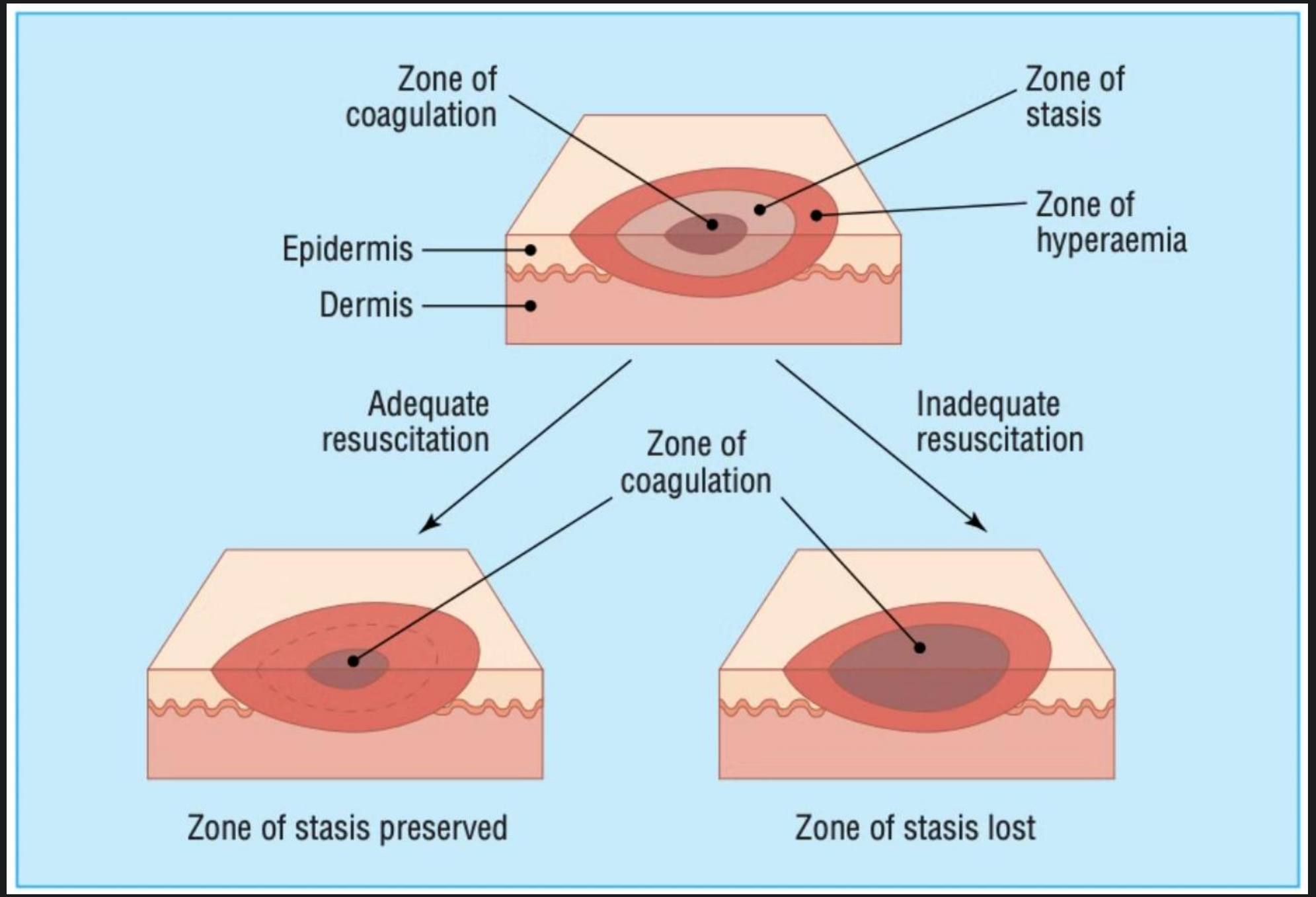
The central area of the burn where tissue is irreversibly damaged due to protein denaturation and coagulation.

Zone of Stasis

Surrounding the zone of coagulation, this area has decreased blood flow and is at risk of progression to necrosis if not properly managed.

Zone of Hyperemia

The outermost area with increased blood flow and inflammation, which usually recovers if the burn is managed appropriately.


Zone of coagulation
Zone of stasis
Zone of hyperaemia
Epidermis
Dermis
Adequate resuscitation
Inadequate resuscitation
Zone of coagulation
Zone of stasis preserved
Zone of stasis lost

Classification of Burns by Depth

First-Degree (Superficial) Burns

Depth: Epidermis only

Appearance: Red, dry, and painful

Healing: 3-6 days without scarring

Second-Degree (Partial Thickness) Burns

Superficial Partial-Thickness:

- Involves epidermis and upper dermis
- Appears red, blistered, and moist
- Heals in 7-21 days with minimal scarring

Deep Partial-Thickness:

- Involves epidermis and deeper dermis
- Appears pale, mottled, and less painful
- Heals in 3-8 weeks with scarring

Third-Degree (Full Thickness) Burns

Depth: Entire epidermis and dermis, extending into subcutaneous tissue

Appearance: White, charred, or leathery; painless due to destroyed nerve endings

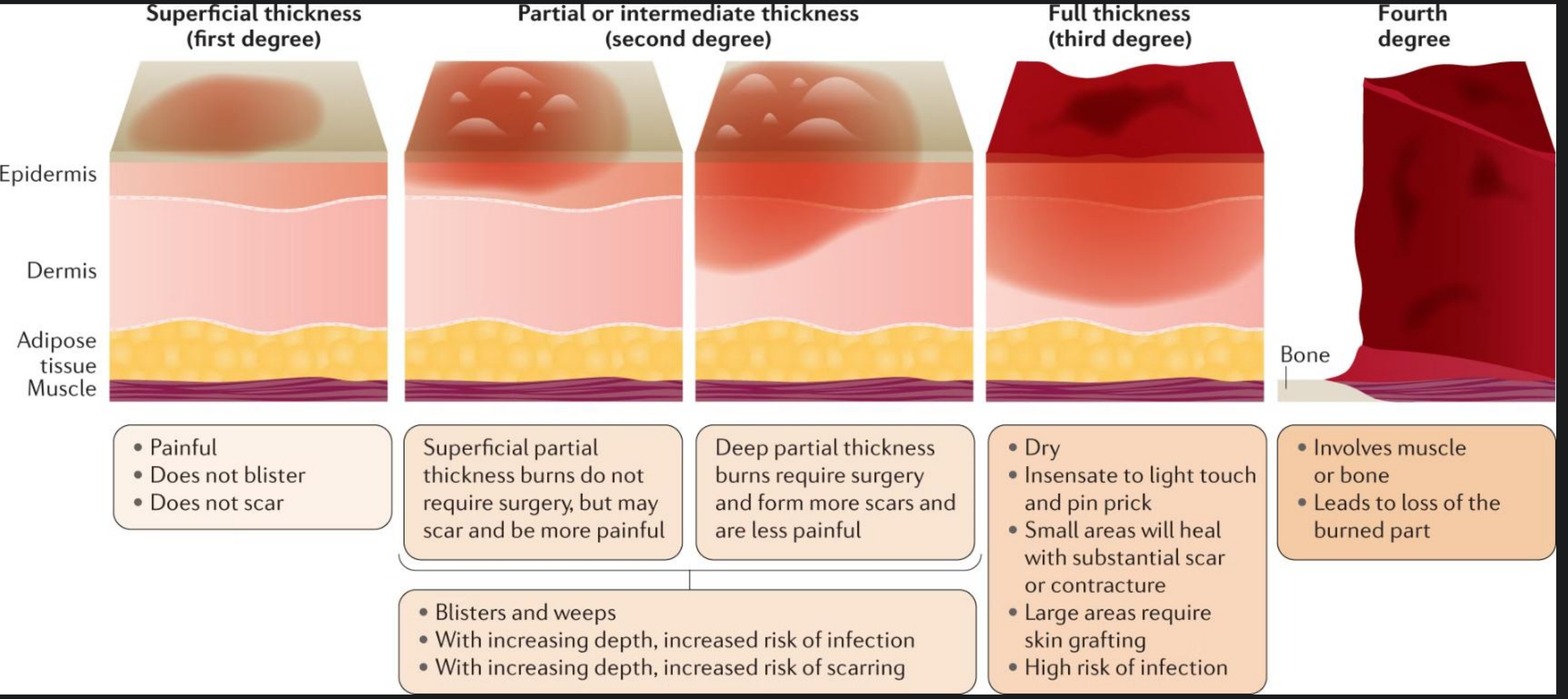
Healing: Requires surgical intervention and skin grafting

Fourth-Degree Burns

Depth: Extends into muscle, bone, and other deep structures

Appearance: Charred and blackened

Healing: Requires extensive surgical intervention; often results in significant disability


Superficial thickness (first degree)
Partial or intermediate thickness (second degree)
Full thickness (third degree)
Fourth degree
Epidermis
Dermis
Adipose tissue
Muscle
Bone
• Painful
• Does not blister
• Does not scar
Superficial partial thickness burns do not require surgery, but may scar and be more painful
Deep partial thickness burns require surgery and form more scars and are less painful
• Blisters and weeps
• With increasing depth, increased risk of infection
• With increasing depth, increased risk of scarring
• Dry
• Insensate to light touch and pin prick
• Small areas will heal with substantial scar or contracture
• Large areas require skin grafting
• High risk of infection
• Involves muscle or bone
• Leads to loss of the burned part

Epidermal burn:
erythema, blanches to pressure, painful

Superficial dermal burn:
pale pink, mottled and blistered, blanches, painful

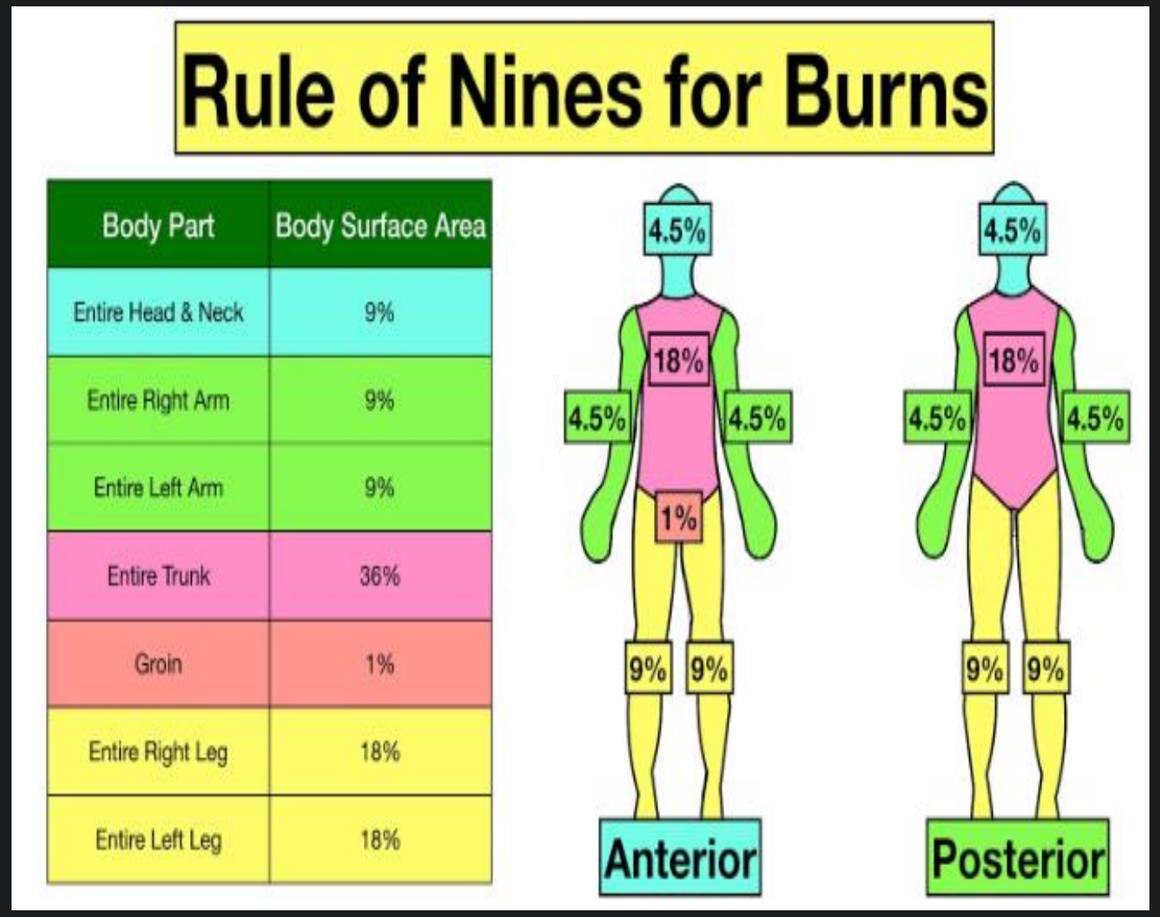
Deep dermal burn:
cherry red, blistered, does not blanch, dull sensation

Full thickness burn:
white, does not blanch, no sensation

Classification of Burns by Extent

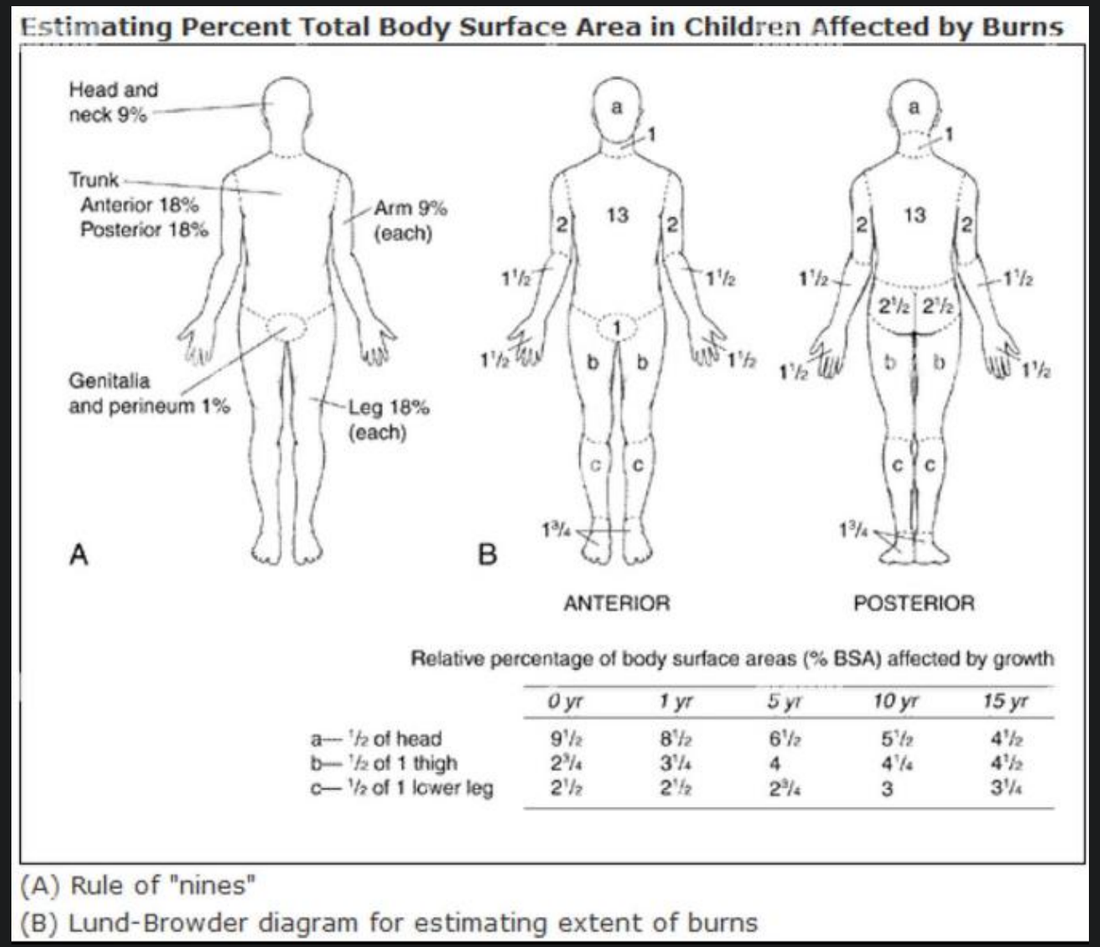
Rule of Nines

A quick method to estimate the TBSA affected by burns. The body is divided into regions, each representing 9% or multiples of 9% of the TBSA.



Lund and Browder Chart

A more accurate method, especially in children, as it accounts for age-related differences in body proportions.



(A) Rule of "nines"
(B) Lund-Browder diagram for estimating extent of burns

Clinical Assessment: History

Mechanism of Injury

Determine the cause (thermal, chemical, electrical, radiation).

Duration and Timing

When did the burn occur?

Associated Injuries

Inhalation injury, trauma, etc.

Past Medical History

Pre-existing conditions that may affect management (e.g., diabetes, immunosuppression).

Clinical Assessment: Physical Examination

When examining burn patients, focus on these critical areas:

Burn Depth and Extent

Assess using the classification systems mentioned.

Signs of Inhalation Injury

Soot in the airway, singed nasal hairs, hoarseness, stridor.

Circumferential Burns

Assess for compartment syndrome, especially in limbs and chest.

Clinical Assessment: Investigations

1

Laboratory Tests

CBC, electrolytes, renal function, arterial blood gas (ABG), carboxyhemoglobin levels.

2

Imaging

Chest X-ray for suspected inhalation injury, CT/MRI for associated trauma.

3

Bronchoscopy

For definitive diagnosis of inhalation injury.

Management: Initial Resuscitation

1

Airway

Secure the airway early, especially in cases of inhalation injury. Consider early intubation.

2

Breathing

Administer 100% oxygen if carbon monoxide poisoning is suspected.

3

Circulation

Establish IV access and begin fluid resuscitation using the Parkland formula.

Total Fluid Requirement (mL): 4 mL x TBSA (%) x body weight (kg). Half of the total fluid is given in the first 8 hours, and the remainder over the next 16 hours.

Parkland Formula for Fluid Resuscitation

4	%	24
mL per kg	TBSA	Hours
Multiply by patient's weight in kg	Percentage of total body surface area burned	Total duration of fluid administration

The Parkland formula is a critical tool for calculating fluid requirements in burn patients. The total fluid requirement (in mL) equals 4 mL multiplied by the percentage of TBSA burned, multiplied by the patient's body weight in kg. Half of this calculated volume is administered in the first 8 hours after the burn, with the remaining half given over the next 16 hours.

Parkland Formula Calculation Example

Let's calculate the fluid requirement for a **70 kg man** with **30% TBSA burns** using the Parkland formula.

Calculate Total Fluid Requirement (TFR)

The Parkland formula is: TFR (mL) = 4 mL × TBSA (%) × Body Weight (kg)

TFR = 4 mL × 30 × 70 kg = 8,400 mL

First 8 Hours Fluid Administration

Give **half** of the total fluid in the first 8 hours.

Fluid for first 8 hours = 8,400 mL ÷ 2 = 4,200 mL

Fluid rate = 4,200 mL ÷ 8 hours = 525 mL/hour

Next 16 Hours Fluid Administration

Give the **remaining half** over the next 16 hours.

Fluid for next 16 hours = 4,200 mL

Fluid rate = 4,200 mL ÷ 16 hours = 262.5 mL/hour

Summary of Fluid Resuscitation

Total Fluid Requirement

8,400 mL over 24 hours

First 8 Hours

4,200 mL at 525 mL/hour

Next 16 Hours

4,200 mL at 262.5 mL/hour

Management: Wound Care

1

Cleaning

Gently clean the burn with saline or mild antiseptic.

2

Debridement

Remove necrotic tissue and blisters.

3

Dressings

Apply appropriate dressings (e.g., silver sulfadiazine for partial-thickness burns, biological dressings for deeper burns).

4

Escharotomy

Perform in cases of circumferential full-thickness burns to prevent compartment syndrome.

Management: Pain Management

Analgesia

Administer opioids (e.g., morphine) and non-opioid analgesics (e.g., acetaminophen, NSAIDs).

Anxiolytics

Consider benzodiazepines for anxiety.

Management: Infection Control

1 **Prophylactic Antibiotics**

Generally not recommended unless there is evidence of infection.

2 **Tetanus Prophylaxis**

Ensure tetanus immunization is up to date.

3 **Topical Antimicrobials**

Use agents like silver sulfadiazine, mafenide acetate, or bacitracin.

Management: Nutritional Support

Hypermetabolic State

Burns increase metabolic demands. Provide high-calorie, high-protein nutrition.

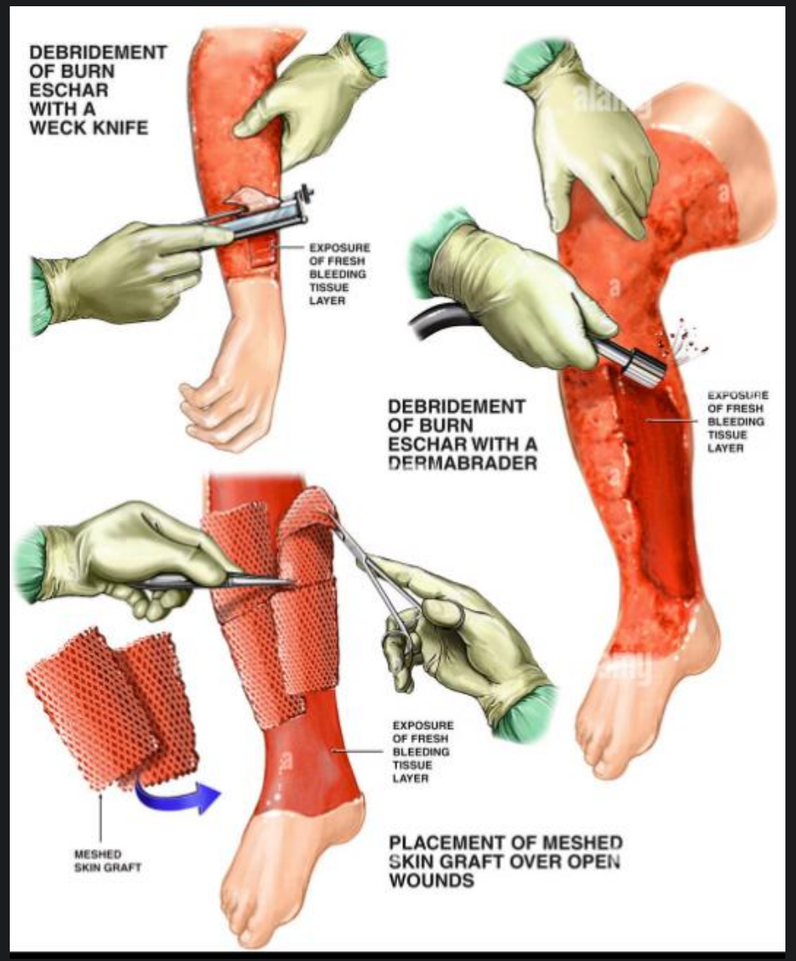
Enteral Feeding

Preferred over parenteral nutrition to maintain gut integrity.

Management: Surgical Management

Early Excision and Grafting

Recommended for deep partial-thickness and full-thickness burns to reduce infection risk and improve outcomes.



Reconstructive Surgery

May be needed for functional and cosmetic rehabilitation.

Management: Rehabilitation

Physical Therapy

Essential to prevent contractures and maintain range of motion.

Occupational Therapy

Helps patients regain independence.

Psychological Support

Address the emotional and psychological impact of burns.

Complications of Burns

1

Infection

Leading cause of morbidity and mortality in burn patients.

2

Sepsis

Systemic inflammatory response syndrome (SIRS) due to infection.

3

Scarring and Contractures

Can lead to functional impairment.

4

Psychological Issues

PTSD, depression, and anxiety are common.

5

Multiorgan Failure

Due to systemic inflammatory response and shock.

Burn Center Referral Criteria

1. **Partial thickness >10% TBSA**

   Burns covering more than 10% of total body surface area

2. **Full thickness burns**

   Any full thickness (third-degree) burns

3. **Face, hands, feet, genitalia**

   Burns to functionally or cosmetically important areas

4. **Electrical burns**

   Including lightning injury

5. **Chemical burns**

   Especially those with risk of functional impairment

6. **Inhalation injury**

   Smoke or chemical inhalation affecting airways

Burn Prevention Strategies

Prevention is a crucial aspect of burn management. Public education, safety measures in homes and workplaces, and proper handling of flammable materials can significantly reduce the incidence of burn injuries.

Conclusion and References

Conclusion

Burns are complex injuries that require a multidisciplinary approach for optimal management. Early and appropriate resuscitation, wound care, infection control, and rehabilitation are key to improving outcomes. Understanding the pathophysiology and classification of burns is essential for effective treatment and prevention of complications.

References

- American Burn Association Guidelines
- Advanced Trauma Life Support (ATLS) Manual
- World Health Organization (WHO) Burn Guidelines