Burns Pathophysiology

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Definition - Burns are wounds produced by various kinds of agents that cause cutaneous injury and destruction of underlying tissue.

Types of Burns

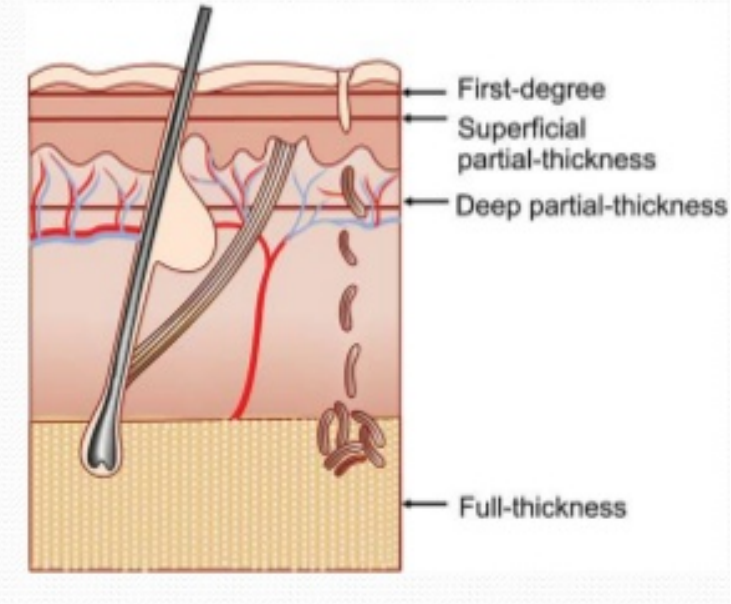
- Thermal injury
  - Scald - spillage of hot liquids
  - Flame burns
  - Flash burns due to exposure of natural gas, alcohol, combustible liquids
  - Contact burns - contact with hot metals/objects/materials
- Electrical injury
- Chemical burns - acid/alkali
- Cold injury - frost bite
- Ionizing radiation
- Sun burns

Classification of Burns - Depending on thickness of skin involved

- First degree
  - Epidermis is red and painful
  - No blisters
  - Heals rapidly in 5-7 days by epithelialization without scarring
- Second degree
  - Mottled, red, painful, with blisters
  - Heals in 14-21 days
  - Superficial burn heals, causing pigmentation.
  - Deep burn heals, causing scarring, and pigmentation
- Third degree
  - Charred, painless and insensitive
  - Thrombosis of superficial vessels
  - It requires grafting
  - Eschar - Charred, denatured, insensitive, contracted full thickness burn
  - These wound must heal by re-epithelialization from wound edge
- Fourth degree
  - Involves the underlying tissues—muscles, bones

Partial vs. Full Burns

- Depending on thickness of skin involved
- Partial thickness burns
    - It is either first or second degree burn which is red and painful, often with blisters
- Full thickness burns
    - It is third degree burns which is charred, insensitive, deep involving all layers of the skin

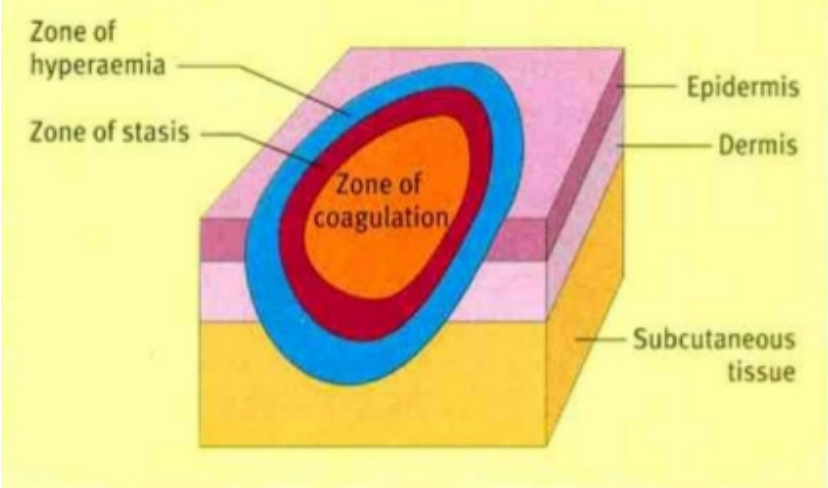


Depending on the Percentage of Burns

- Mild (Minor)
    - Partial thickness burns < 15% in adult or <10% in children
    - Full thickness burns less than 2%
    - Can be treated on outpatient basis
- Moderate
    - Second degree of 15-25% burns (10-20% in children)
    - Third degree between 2-10% burns
    - Burns which are not involving eyes, ears, face, hand, feet, perineum
- Major (severe)
    - Second degree burns more than 25% in adults, in children more than 20%
    - All third degree burns of 10% or more
    - Burns involving eyes, ears, feet, hands, perineum
    - All inhalation and electrical burns
    - Burns with fractures or major mechanical trauma

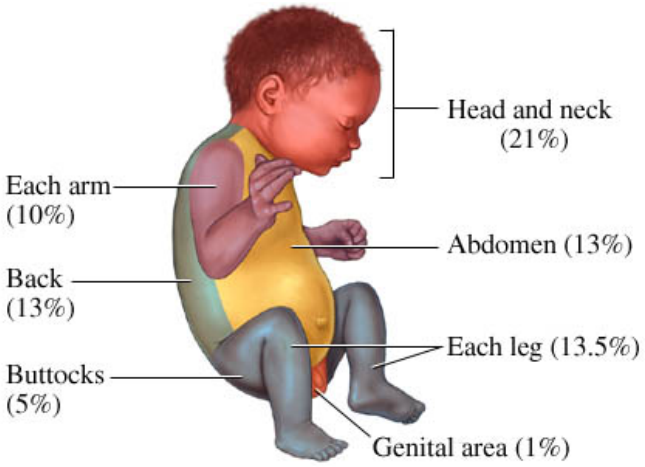
Jackson's thermal wound theory

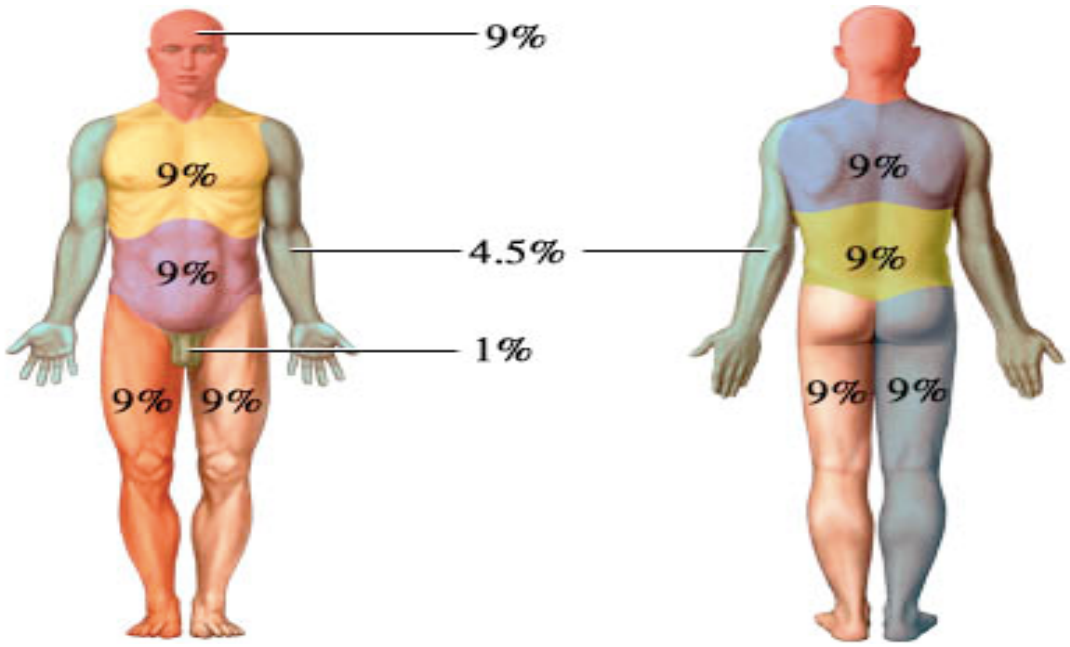
- Zone of coagulation
  - Center area of wound, where all tissues are damaged
- Zone of stasis
  - Surrounds the coagulation area some tissues are damaged
- Zone of hyperemia
  - Unburned area surrounds the stasis but it is red due to inflammation



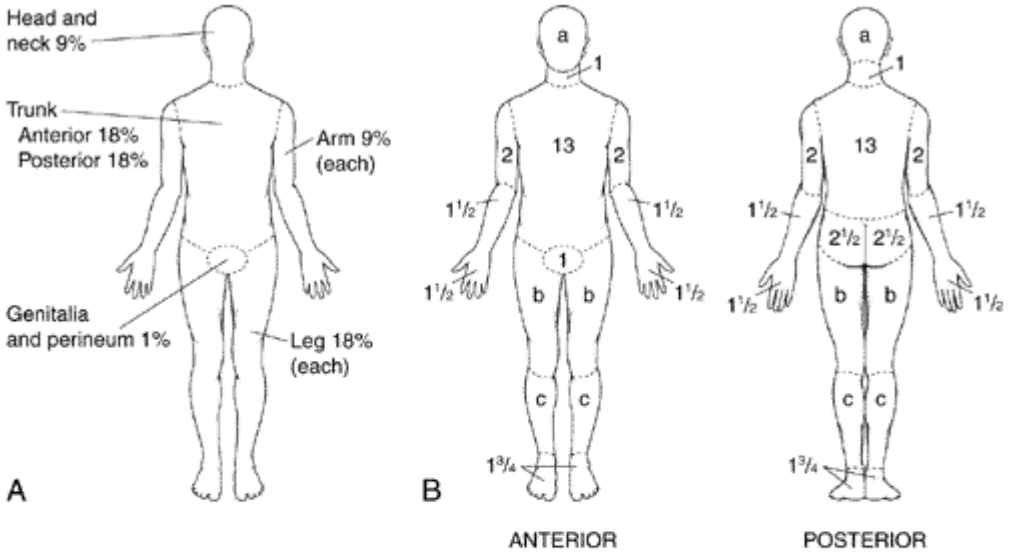
Assessment of Burns

- Rules of nine It is used for early assessment
- The rule of nines assesses the percentage of burn and is used to help guide treatment decisions including fluid resuscitation and becomes part of the guidelines to determine transfer to a burn unit.
- You can estimate the body surface area on an adult that has been burned by using multiples of 9
  - As an example, if both legs (18% x 2 = 36%), the groin (1%) and the front chest and abdomen were burned, this would involve 55% of the body





Estimating Percent Total Body Surface Area in Children Affected by Burns



Relative percentage of body surface areas (% BSA) affected by growth

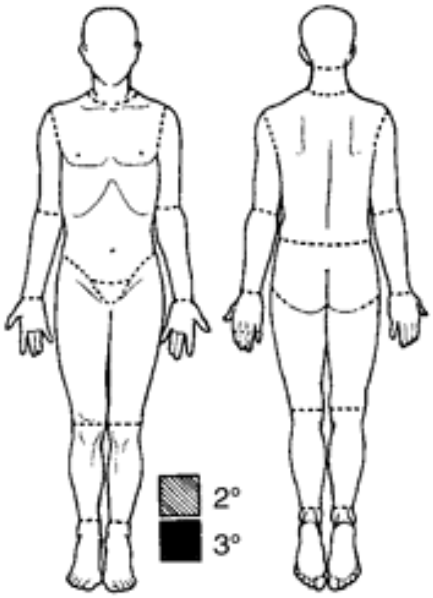
	0 yr	*1 yr*	*5 yr*	*10 yr*	*15 yr*
a— ½ of head	9½	8½	6½	5½	4½
b— ½ of 1 thigh	2¾	3¼	4	4¼	4½
c— ½ of 1 lower leg	2½	2½	2¾	3	3¼

(A) Rule of "nines"

(B) Lund-Browder diagram for estimating extent of burns

Assessment of Burns

- The Lund and Browder chart
    - Better method for assessing the burns wound
    - Here each part of the body is individually assessed



Date: _____

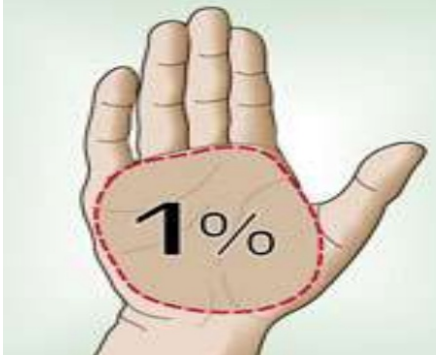
Height: _____ Weight: _____

2° _____ + 3° _____ = _____ %

Percent surface area burned
(Berkow formula)

AREA	0-1 YEAR	1-4 YEARS	5-9 YEARS	10-14 YEARS	15 YEARS	ADULT	2°	3°
Head	19	17	13	11	9	7		
Neck	2	2	2	2	2	2		
Ant. Trunk	13	13	13	13	13	13		
Post. Trunk	13	13	13	13	13	13		
R. Buttock	2 Qw	2 Qw	2 Qw	2 Qw	2 Qw	2 Qw		
L. Buttock	2 Qw	2 Qw	2 Qw	2 Qw	2 Qw	2 Qw		
Genitalia	1	1	1	1	1	1		
R. U. Arm	4	4	4	4	4	4		
L. U. Arm	4	4	4	4	4	4		
R. L. Arm	3	3	3	3	3	3		
L. L. Arm	3	3	3	3	3	3		
R. Hand	2 Qw	2 Qw	2 Qw	2 Qw	2 Qw	2 Qw		
L. Hand	2 Qw	2 Qw	2 Qw	2 Qw	2 Qw	2 Qw		
R. Thigh	5 Qw	6 Qw	8	8 Qw	9	9 Qw		
L. Thigh	5 Qw	6 Qw	8	8 Qw	9	9 Qw		
R. Leg	5	5	5 Qw	6	6 Qw	7		
L. Leg	5	5	5 Qw	6	6 Qw	7		
R. Foot	3 Qw	3 Qw	3 Qw	3 Qw	3 Qw	3 Qw		
L. Foot	3 Qw	3 Qw	3 Qw	3 Qw	3 Qw	3 Qw		
TOTAL								

Assessment of Burns



- Rule of palm
    - The palm of the person who is burned (not fingers or wrist area) is about 1% of the body.
    - Use the person's palm to measure the body surface area burned.
    - It can be hard to estimate the size of a burn.

Clinical Features

- History of burn
- Pain, burning, anxious status, tachycardia, tachypnea
- In severe degrees features of shock
- Tolerable temperature to human skin is 40°C for brief period.

Pathophysiology

- Heat causes coagulation necrosis of skin and subcutaneous tissue ↓ Release of vasoactive peptides ↓ Altered capillary permeability ↓ Loss of fluid → Severe hypovolemia ↓
- Decreased cardiac → Decreased myocardial output function ↓ Decreased renal blood → Oliguria flow (Renal failure) Altered pulmonary resistance causing pulmonary edema ↓ Infection ↓ Systemic inflammatory response syndrome (SIRS) ↓ Multi-organ dysfunction syndrome (MODS).

Massive edema

- Injury to basement membrane Altered pressure gradient Edema

Renal

- Diminished blood flow and cardiac output leads to decreased renal blood flow and GFR
- Toxins released from the wound along with sepsis causes acute tubular necrosis.
- Myoglobin released from muscles (in case of electric injury or often from eschar) is most injurious to kidneys
- Earlier resuscitation decreases renal failure and improves associated mortality

Lungs

- Altered ventilation-perfusion ratio
- Pulmonary edema due to burn injury, fluid overload
- ARDS
- Aspiration
- Septicemia

Gastrointestinal Tract

- Burns >>> mucosal atrophy >>> decreased absorption & increased intestinal permeability >>> increased bacterial translocation >>> septicemia
- Acute gastric dilatation which occurs in 2-4 days
- Paralytic ileus
- Curling's ulcer
- Acute cholecystitis, acute pancreatitis
- Abdominal Compartment syndrome

Immune System

- Decreased function of T and B lymphocytes and macrophages >>> Increased infection rate

Metabolic

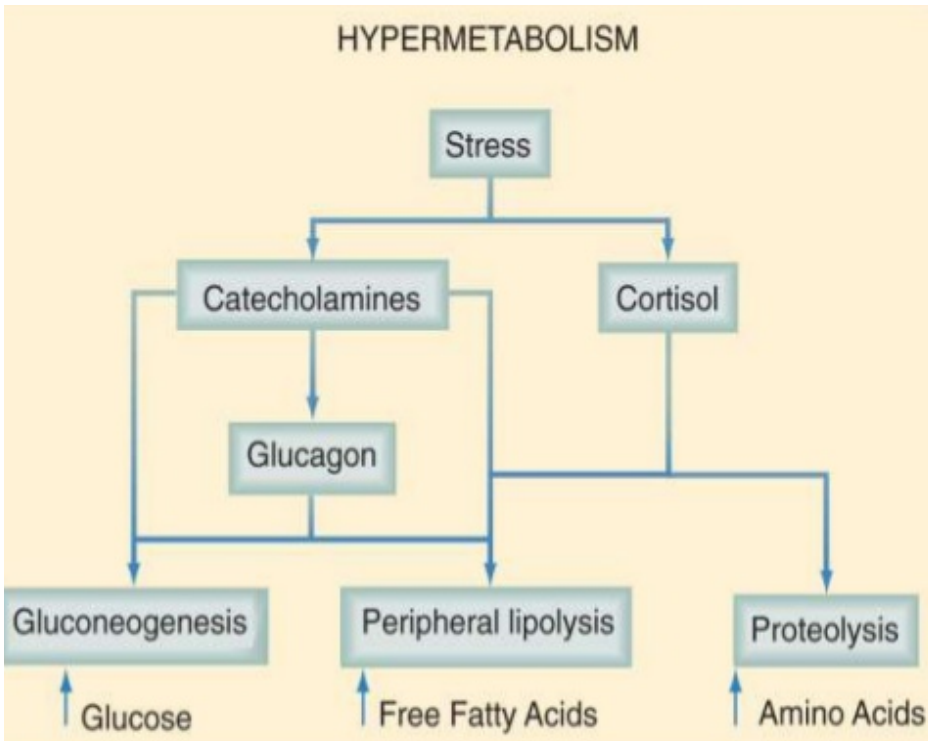
- Hyper metabolic rate (BMR)
- Negative nitrogen balance
- Electrolyte imbalance
- Deficiencies of vitamins and essential elements
- Metabolic acidosis due to hypoxia and lactic acid

Infections

- Streptococci (Beta hemolytic - most common)
- *Pseudomonas*
- *Staphylococci*
- Other gram-negative organisms
- *Candida albicans*

Causes of death

- Hypovolemia (refractory and uncontrolled) and shock
- Renal failure
- Pulmonary edema and ARDS
- Septicemia
- Multiorgan failure
- Acute airway block in head and neck burns



Summary of Pathophysiology