BURN

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- **A burn** is an injury to the skin or other organic tissue**.**
- **Primarily caused by** :

• Flame—damage from superheated oxidized air
• Scald—damage from contact with hot liquids
• Contact—damage from contact with hot or cold solid materials
• Chemicals—contact with noxious chemicals
• Electricity—conduction of electrical current through tissues

Pathophysiology of burn injury :

- Coagulation of protein due to intense heat
- Release of local mediators
- Change in blood flow due to vasoconstriction and thrombosis
- Tissue edema

- Loss of skin's barrier function leads to fluid loss and massive fluid shifts.
- Injured tissues release vasoactive mediators with secondary interstitial edema, hypoproteinemia, fluid shifts, and organ dysfunction.
- Bacterial translocation
- Immune function: Hypermetabolic state

Immune function: Hypermetabolic state

1) Initial response: Decreased cardiac output, decreased metabolic rate
2) 24 to 48 hour after injury: Increased cardiac output (2 times normal),increased metabolic rate (2 times normal).
3) Hypothalamic function altered: Increased glucagon/cortisol/Catecholamines
4) GI barrier function breaks down, leads to bacterial translocation
5) Nutritional needs dramatically increase (2 to 3 times normal)

Severity

→ Total body surface area (TBSA) burned and presence of inhalation injury are the most important.
→ Depth of burn can be affected by temperature, duration of contact, and thickness of skin.
→ Patient comorbidities and age are other important factors
→ Patients may have coexisting traumatic injury (motor vehicle accidents ,explosions, etc.)

How to estimate TBSA ?

1) “Rule of nines”

The Rule of Nines is altered for children and infants whose heads are larger and extremities smaller than adult patients.

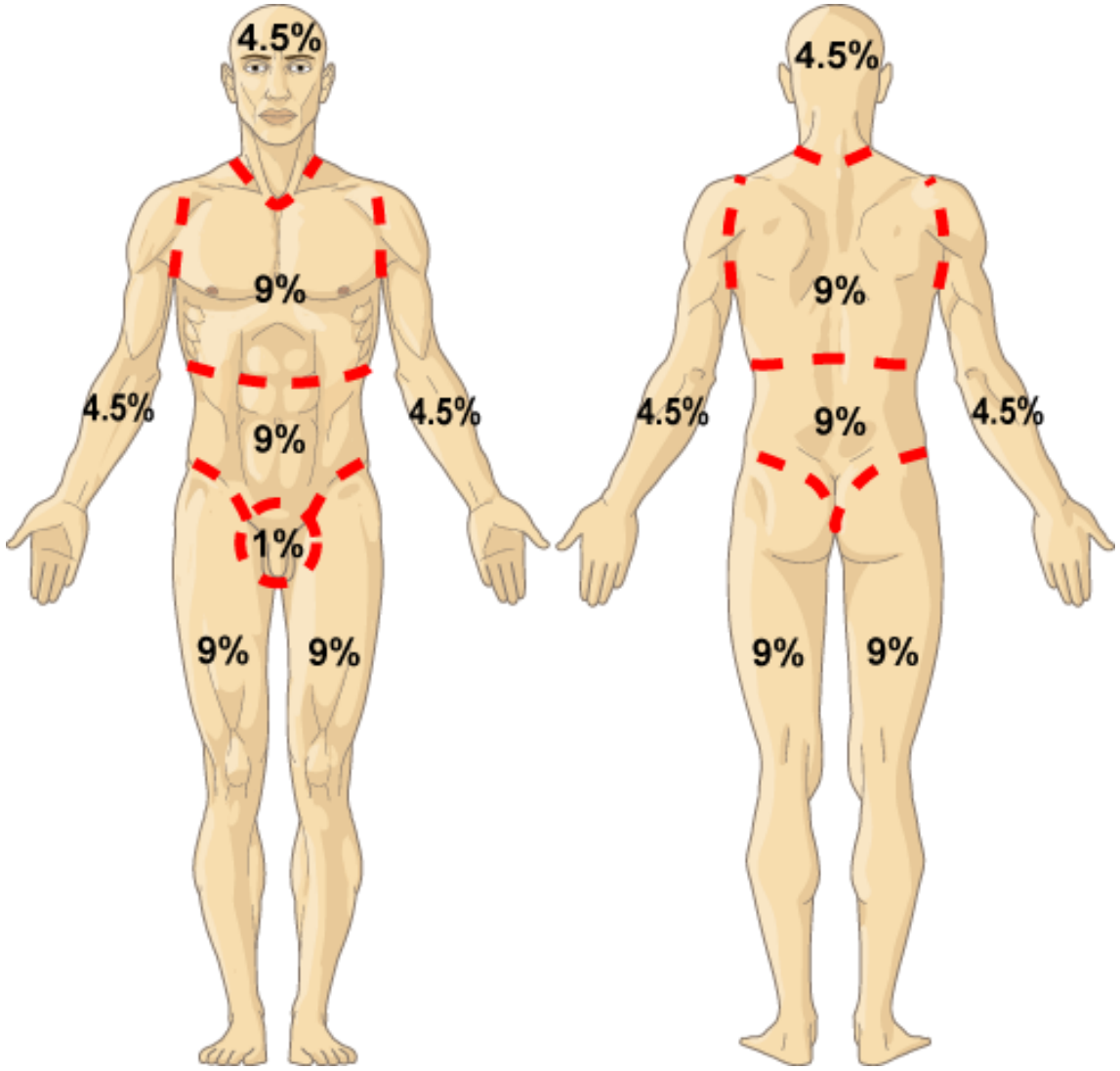
Each upper limb = 9%

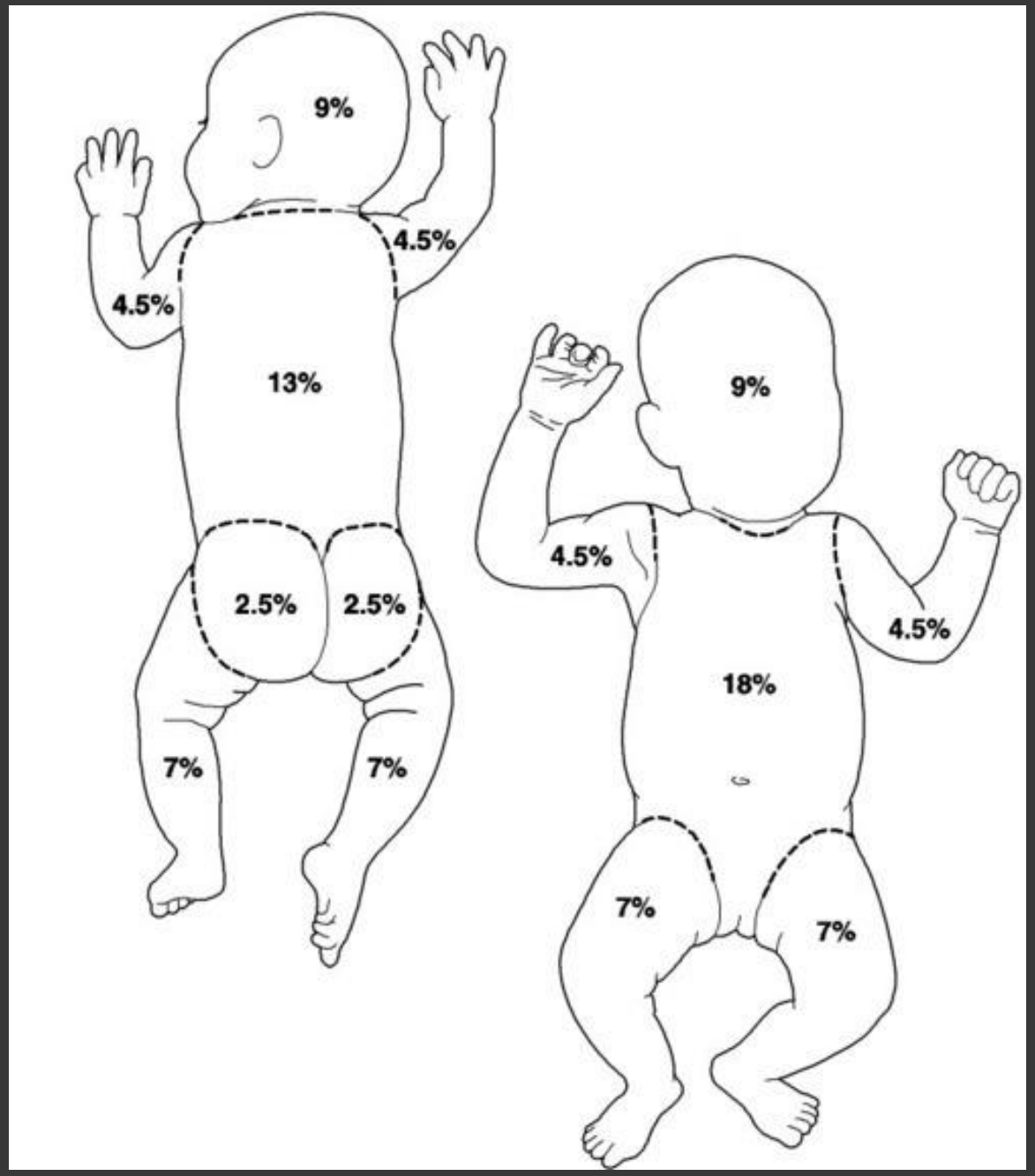
Each lower limb = 18%

Anterior and posterior trunk = 18%

each Head and neck = 9%

Perineum and genitalia = 1%

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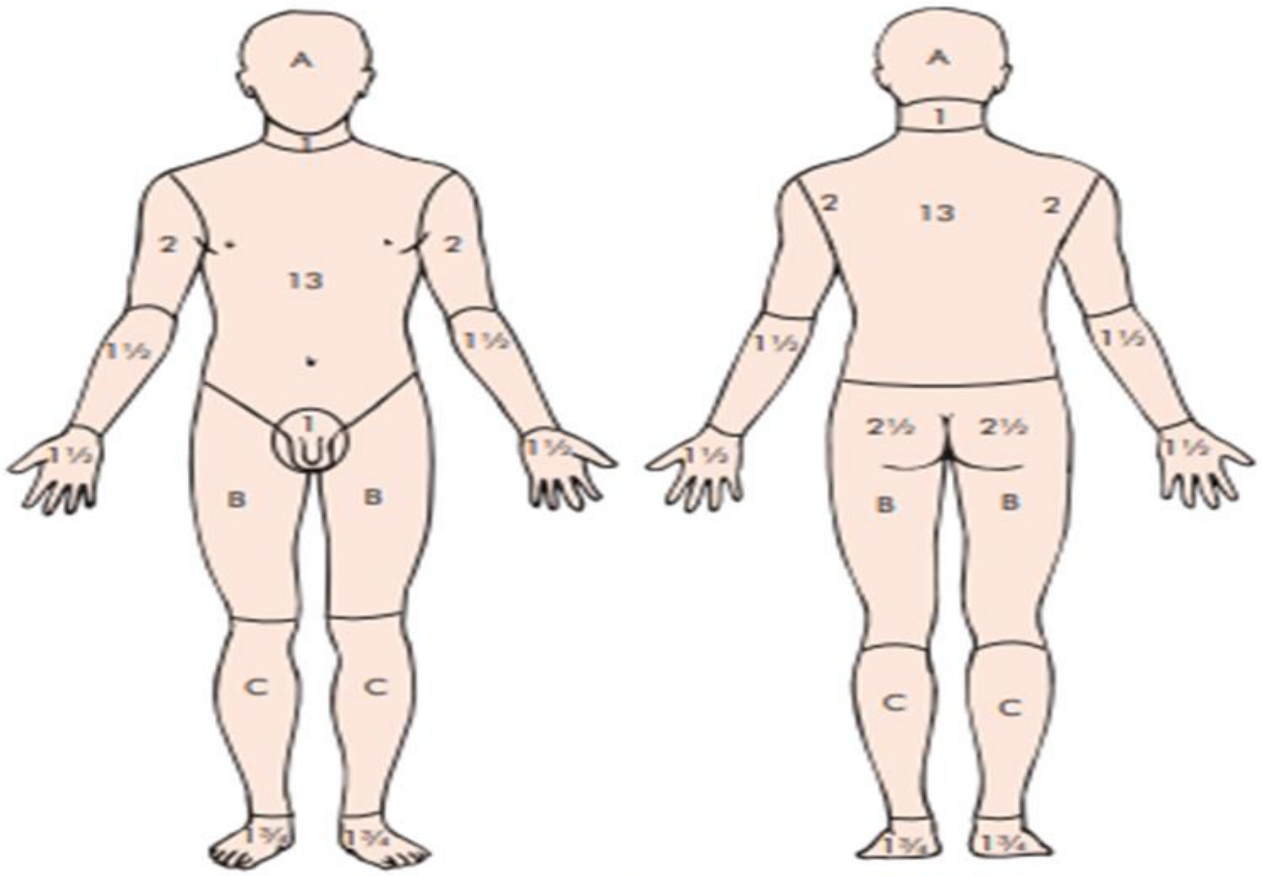


Relative percentage of area affected by growth

Age in years	0	1	5	10	15	Adult
A Head	9	8	6	5	4	3
B Thigh	2	3	4	4	4	4
C leg	2	2	3	3	3	3

Figure 30.3 The Lund and Browder chart.

2) “Rule of the palm”

Surface area of the patient’s palm is ≈1% of the TBSA used for estimating size of small burns.

Superficial burns

- Involve the epidermis
- Blisters are not present
- Symptoms similar to a bad sunburn and include hyperemia, blanching skin ,and tenderness to palpation.

Partial-thickness burns (Superficial)

- Papillary dermis involved without involvement of skin appendages
- Raw surfaces are deeper red and tender to palpation
- Blisters (either intact or ruptured) will be present
- Blanches with pressure
- If the dermal appendages are intact, then healing without skin grafting is possible

Partial-thickness burns (Deep)

- Reticular dermis involved with skin appendages
- No capillary refill
- White
- Decreased sensation
- Blisters present

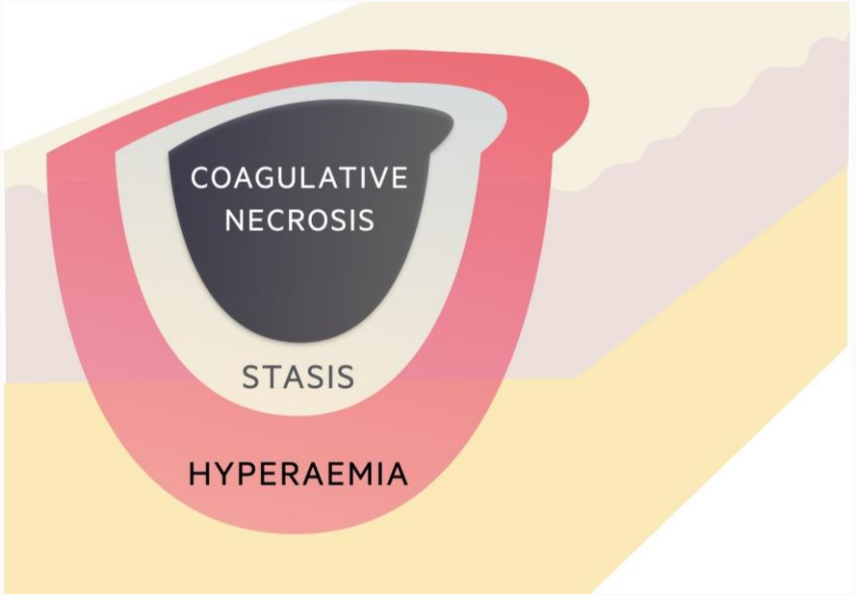
Full thickness burns

- Result in destruction of the epidermal and dermal layers Burns extend into the subcutaneous tissues, muscle, or bone.
- Skin is white and non blanching or, in deeper burns, dry and leathery in appearance no sensation is present (If a burn is painful, it is not full thickness sensory nerves are preserved)
- Will not heal on own and will require surgery for coverage or closure

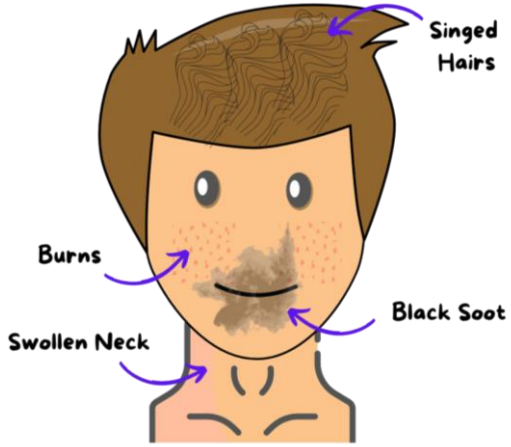
Jackson burn model

Describes the distinct areas within every burn wound

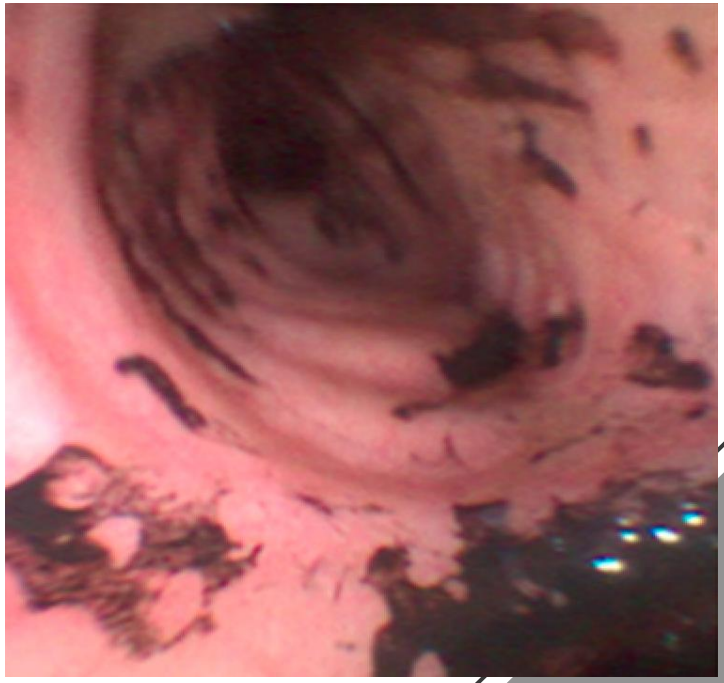
1. **Zone of coagulation**: Tissue is severely damaged and will not recover Treatment: excision and grafting
2. **Zone of stasis**: Tissue is inflamed with impaired vasculature Tissue may recover with appropriate resuscitation Surrounds zone of coagulation Treatment: Aggressive resuscitation
3. **Zone of hyperemia**: Tissue has intense vasodilation with increased blood flow and should recover, treatment: Aggressive resuscitation



Inhalation Injury



- Occurs in ~10% of burn patients.
- Present in ~70% of patients who die of their burn injury.
- History :often includes fire in an enclosed space such as a basement.
- Physical examination : singed nasal hairs, facial burns, carbonaceous sputum, hoarseness, Agitation or shortness of breath may be caused by hypoxia.



- Definitive diagnosis is made by direct airway examination using nasopharyngeal scope or fiberoptic bronchoscopy.
- Early intubation for airway protection is mandatory.
- Intubation becomes much harder when the airway swells.
- Fluorescein eye examination is mandatory for patients with facial burns

Inhalation injury can be divided into three categories :-

- **Injury above the glottis**: from inhalation of superheated air.
- **Injury below the glottis** : smoke particles damaging large airway epithelium.
- **Carbon monoxide CO poisoning**: CO will shift oxygen disassociation curve to the left and create tissue hypoxia, occurs because CO has 200 times affinity for hemoglobin compared to O2.

Physical examination:-

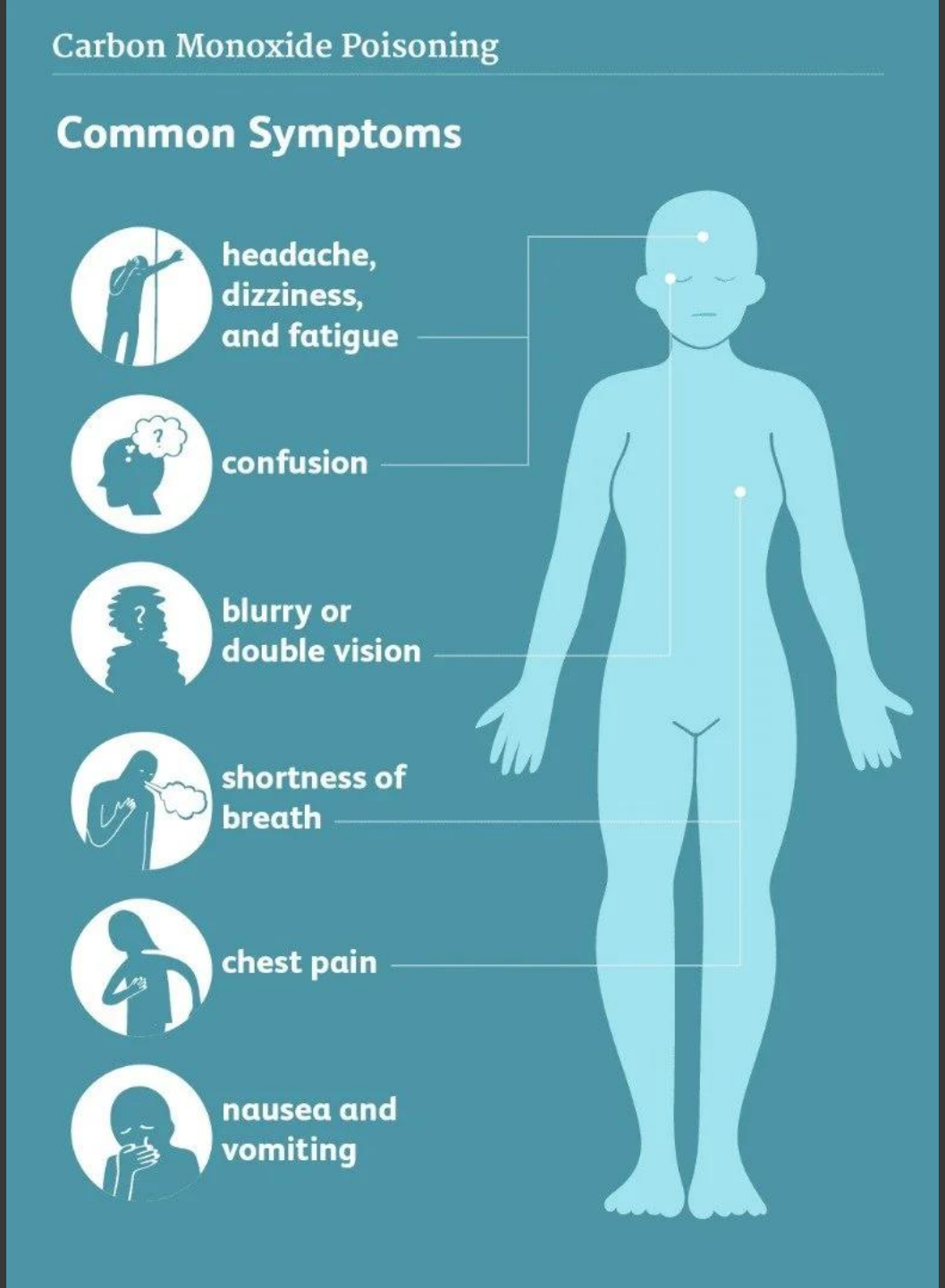
cherry red color of mucous membranes
altered level of consciousness
agitation

Pulse oximetry may be normal ; why ?

cannot distinguish between CO and O2
Carbon dioxide removal is unaffected, so cyanosis and tachypnea are less likely

Treatment :

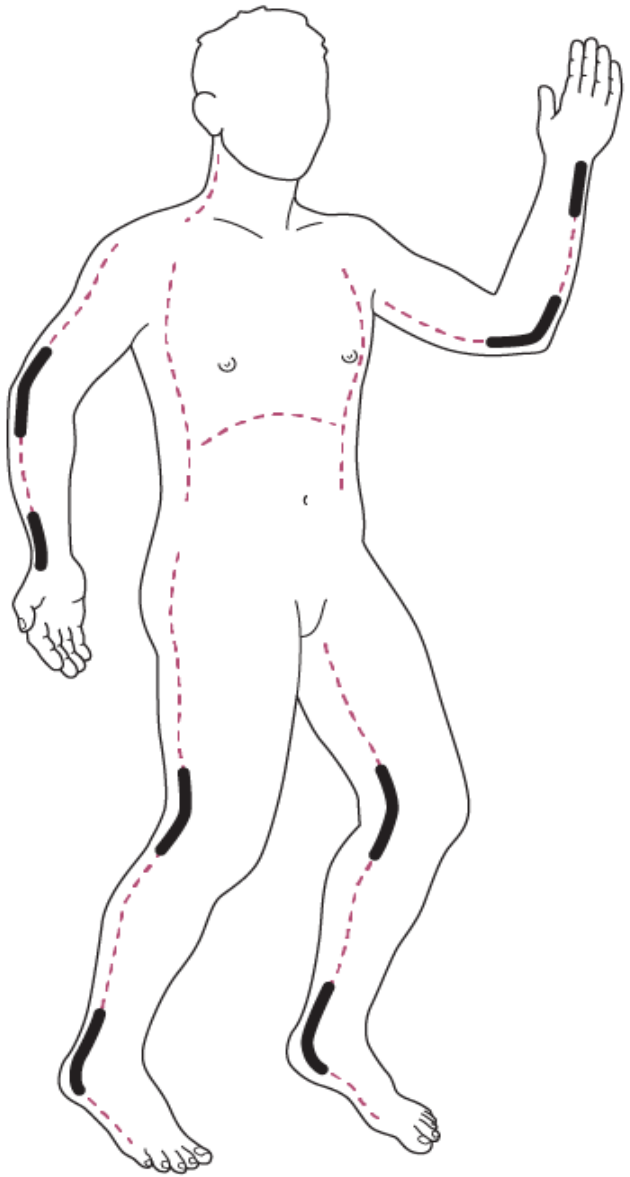
100% oxygen because CO half life is 4 hours on room air versus 1 hour on 100% FiO2.



Circumferential burns

It can produce a tight, inelastic contraction with limited ability for expansion of tissues. so; as tissue edema develops during resuscitation, supraphysiologic pressures can develop with subsequent tissue ischemia and necrosis.

- ✓ Escharotomy : is an incision of burned skin to relieve constriction



- **Burned extremities**

1. Physical signs are often obscured by the burn injury or tissue edema. However, physical examination remains your best clinical diagnostic tool.
2. Doppler examination is unreliable in estimating tissue perfusion.

- **Burned chest**: Circumferential burns can cause difficulty in ventilation with high peak pulmonary pressures.

- **Burned abdomen** 1. Circumferential burns can create an abdominal compartment syndrome.

2. Bladder pressure is a good estimate of intra-abdominal pressure and can be measured via the foley catheter.

- **Arms and legs** Can be decompressed with axially oriented medial and lateral incisions. Digital escharotomies are not typically needed.

- **Chest and upper abdomen** Can be decompressed with bilateral midaxillary releases. These can be connected with one or multiple horizontal incision toform an “H”

Special burn areas

1)face :

- The central face has deeper skin appendages and excellent blood supply, resulting in a greater healing capacity.
- Assessed using the subunit principle: When greater than 50% of a subunit requires grafting, use unmeshed sheet grafts.
- Thicker grafts are preferable on the face.
- Full thickness graft is the choice.
- Facial grafting should be performed less than 2 weeks from the time of injury to decrease scarring.

2)eye :

- Lid edema usually protects the eyes in the early stages.
- Patients are at risk of corneal exposure and corneal abrasion as edema subsides.
- Fluorescent staining often indicated to assess for corneal abrasions.
- Electrical burn could make glaucoma so consultation is a must.
- Goals: Restore the lid to the proper functional position.
- Covering the inferior margin of the corneoscleral limbus in neutral gaze

Don't forget :
Ophthalmology consult
Eye lubrication
Tarsorrhaphy
Definitive surgical correction

3)ears :

- If no cartilage exposure → split-thickness skin grafting and a bolster are appropriate.
- Small amounts of exposed cartilage → debrided to allow primary wound closure.
- Large amounts of exposed cartilage→ necessitate vascularized coverage prior to grafting (An ipsilateral temporal-parietal fascia flap is ideal.)

4)hands & feet:

- After 5 days of immobilization, ROM exercises should be restarted
- Burns of the feet are managed similarly to hand burns

5)Genital area

1. Place burned foreskin into its normal position to prevent paraphimosis.
2. Topical antibiotic for several weeks as needed.
3. Any remaining open wounds should then be sheet-grafted.
4. Early urologist consultation is recommended.

The criteria for acute admission to a burns unit:

- Suspected airway or inhalational injury
- Any burn likely to require fluid resuscitation
- Any burn likely to require surgery
- Patients with burns of any significance to the hands, face, feet or perineum
- Patients whose psychiatric or social background makes it inadvisable to send them home
- Any suspicion of non-accidental injury
- Any burn in a patient at the extremes of age
- Any burn with associated potentially serious sequelae, including high-tension electrical burns and concentrated hydrofluoric acid burns

Burn wound care

1-Fluid resuscitation

The simplest and most widely used formula is the Parkland formula. This calculates the fluid to be replaced in the first 24 hours by the following formula:

total percentage body surface area × weight (kg) × 4 = volume (mL).

Administer half of the above volume during the first 8 hours (calculated from the time of injury, not the time of hospital admission),and the other half over the next 16 hours

Do not include superficial/first degree burns.

Lactated Ringer’s solution (LR) should be used as its composition is closest to extracellular fluid.

DO NOT resuscitate with colloids.

The adequacy of resuscitation is best judged by hourly urine output (0.5 mL/kg/h in adults or 1 mL/kg/h in children.

Also important to follow trend of base deficit, lactate and pH.
These should continue to go down with adequate resuscitation.
Swan Ganz Catheter or bedside ultrasound (IVC filling and cardiac contractility) can also be used to assess fluid status

Pediatric patients :

Add maintenance fluid with D5 LR

Infants and children have limited stores of glycogen which can quickly lead to hypoglycemia.

2- Debridement

All blisters and nonviable tissue should be :

1- debrided at the bedside.

2- dressed with a topical antimicrobial agent.

- Initial debridement of blisters should be performed at the bedside prior to initial wound dressing.
- Formal debridement and grafting in the operating room is performed after adequate resuscitation and when the patient is hemodynamically stable

- Early debridement can prevent burn wound infection; the first debridement (formal) is often within 2 to 4 days of injury.
- For large burns, sequential debridement and grafting is appropriate.
- Ideally, all burn wounds would be grafted by 3 weeks to prevent hypertrophic scar formation that lead to form fibrotic bands that lead to contractures , however, in very large burns, it is important to perform early escharotomies to remove the large bioburden of dead tissue

- Tangential excision allows sequential excision of thin layers of nonviable tissue until bleeding, healthy tissue is reached.

1. Thin layer sequential excision of all nonviable tissue, until a viable tissue level is reached
2. At debridement, the most important distinction is between superficial and deep partial-thickness burns.

- Deep partial-thickness burns require skin grafting.
- Superficial partial-thickness injuries will heal on their own without grafting.
- Delayed grafting can be performed if inadequate donor skin is present.

Dressing used materials

1) Silvadene (1% silver sulfadiazine)
2) Sulfamylon : 10% mafenide acetate (a carbonic anhydrase inhibitor)
3) Silver nitrate (0.5%)
4) Acticoat a silver impregnated
5) Bacitracin zinc

Grafting

1) Autograft: It is tissue transfer from one location to another on the same patient.

2) Isograft: Tissue transfer between two genetically identical individuals : monozygotic twins.

3) Allograft (Homograft): Tissue transfer between two genetically different members, same species : kidney transplant.

4) Xenograft (Heterograft): Tissue transfer from a donor of one species to a recipient of another species , The donor and recipient are of different species

Partial Thickness Graft

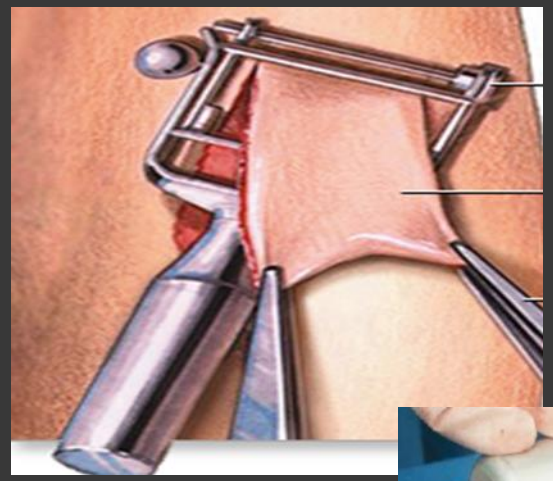
It is removal of full epidermis plus part of dermis from the donor area, leaving some skin appendages in the remaining dermis.

Advantages	Disadvantages
It is technically easier.	Infection
Graft take up is better	Contracture
Donor area heals on its own.	Loss of hair growth
	hematoma formation will prevent graft take up

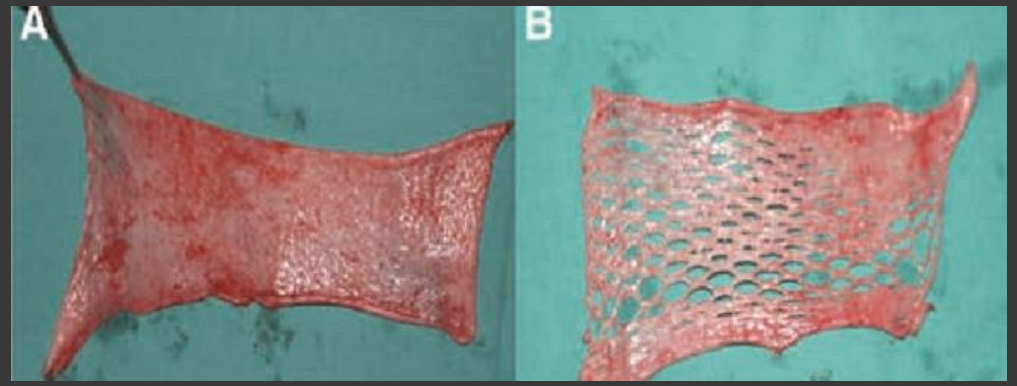
Full Thickness Graft

A full-thickness skin graft (FTSGs) removes epidermis and the entire thickness of the dermis and leaves a donor defect (which needs to be sutured or grafted)

Advantages	Disadvantages
Color match is good	Used only for small areas
Sensation and function of sebaceous gland, hair follicles retained better.	Wider donor area has to be covered with SSG



cut with a special guarded freehand knife or an electric dermatome.



Meshing

Is typically performed at a 1:1.5 ratio to increase surface area and decrease fluid collection beneath the graft.

Meshing decrease hematoma and seroma

Higher mesh ratios (e.g., 1:2, 1:3, or 1:4) can be used but prolong healing.

Graft failure

1. Inadequate wound debridement prior to graft application is the primary cause.
2. Quantitative cultures showing more than 105 cells will result in graft loss.(infection)
3. Fluid collection beneath the graft, including hematoma (most common) or seroma.
4. Shear force to graft from inadequate immobilization and compression.
5. Poor nutrition or overall physiologic status

Differences between grafts and flaps

Grafts	Flaps
Depends on recipient site for nutrition.	Has own blood supply.
Cosmetic may discolor or contract.	Better color take, less likely to contract.
Less adaptable to weight bearing.	More adaptable to weight bearing
Less able to survive on a bed with questionable nutrition.	Can be used on a bed with questionable nutrition.
Requires pressure dressing.	Requires no pressure dressing.

3.Nutritional supplementation

A hypermetabolic response is common to all large burns

1. The metabolic rate is proportional to the size of the burn, up to 60% TBSA, and remains constant thereafter.
2. This response begins soon after injury, reaching a plateau by the end of the first week.
3. Most burns >30% TBSA require intensive nutritional support until wound healing is complete.
4. *Curreri formula for caloric requirements: 24 hour caloric requirement = (25 kcal × kg body weight) + (40 kcal × %TBSA).
5. Protein requirements: 2.5 to 3 g/kg/day are recommended. In children, requirements are 3 to 4 g/kg/day

B**. Intestinal feeding** should be performed early

1. Initial feeds can be performed using a nasogastric tube.

2. If feeds are administered to the stomach, feeding should be held 6 hours prior to the OR.

3. A post-pyloric Dobhoff tube is appropriate for long-term feeding. Post-pyloric feeds can be continued in the perioperative period.

C. Weekly nutrition labs, prealbumin levels are drawn to monitor nutrition status.

D. Early involvement of a registered dietician is imperative.

Thank you