Burn

Objectives

- Define burn.
- Discuss the incidence of burn.
- Discuss the pathophysiology of burn
- Recognize the calculation.
- List the types of burn.
- Explain the inhalation injury.
- Discuss the burn management:
  - Non-Surgical: Tetanus, Analgesia, Dressing, Nutrition, Fluid, Foley Catheter.
  - Surgical: Escharotomy, skin grafting.
- Identify the complications of burn.
- Explain the electrical Burn.
- Explain the chemical Burn.

Colour Index

- Main Text
- Males slides
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- Textbook
- Important
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Summary File

Editing File

Skin Anatomy (overview)

Functions of the skin:

- Protection of muscles, bones, ligament and organs.
- Forms a barrier to infectious pathogens
- Prevent water loss

Structure of the skin:

Epidermis

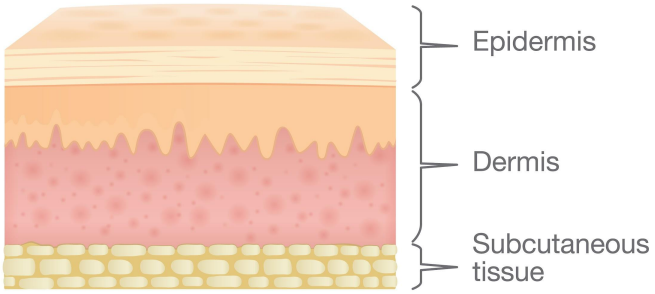
- The outer protective layer of the skin.
- Composed of keratinised, stratified squamous epithelium through which three appendages (hair follicles, sweat glands and sebaceous glands) pass to subcutaneous tissue.
- These appendages can escape destruction in partial-thickness burns and are therefore a source of new epidermal cells for reconstitution of the epidermis.
- The basal layer of the epidermis generates keratin-producing cells (keratinocytes) and pigment cells (melanocytes) that produce melanin, which is passed to the keratinocytes and protects the basal layer from ultraviolet light and determines hair colour.

Dermis

- Subclassified into two layers:
  1- Papillary Dermis (upper part of the dermis).
  2- Reticular Dermis (lower part of the dermis).
  Healing process happen here (by blood > healing by whatever left in the skin)
- The Dermis, which is bound to the epidermis through a basement membrane, is composed of three cell types (fibroblasts,macrophages and adipocytes), collagen, elastic fibres and an extracellular gel-like matrix.
- It supports the blood vessels, lymphatics, nerves and the epidermal appendages as well as pressure and temperature receptors.

Subcutaneous tissue (Hypodermis)

- Made of fat and connective tissue.
- It insulates & pads deeper tissue.
- It anchors the skin to the muscle.



Burn

Definition:

- Destruction of tissues caused by various etiologies including flames, and hot liquids, that ranges from trivial to life threatening which requires extensive treatment and rehabilitation with the chances of permanent dysfunction and distortion.

incidence:

1
- Estimated 2 million burns per year in the US.

2
- 500K burns treated in the ER.
- 70K burn hospital admissions.
- Third quarter of burns are managed at home .

3
- Mortality is highest in the age groups: 2-4 years & 17-25 years .
  High mortality rate among younger groups .

4
- Deep hand burns are a criteria for referral to burn center or hand specialist.The treatment depends on how deep and how much it penetrates the tissue.

5
- Industrial accidents account for the majority of electrical and chemical burns.
- Alcohol and smoking are a common contributing factors in local burn injuries.
- Frost bites have the same physiology and the same presentation as burns but it has a completely different treatment as frost bites is limited on the skin and is non invasive (no systematic effect).

Burn

Pathophysiology of burn:

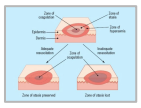
01 The local effects are the result of tissue destruction and inflammatory response.

02 The inflammatory response (inflammatory cells will produce cytokines) to injury causes capillary dilation (manifested as erythema) in mild cases, or if there is capillary damage, that leads to protein leakage and edema.

★ 03 Insensible fluid loss can cause severe hypovolemia which might progress to hypovolemic shock (when > 15% of the body surface area is burned) and decreased preload.

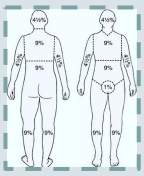
04 Destruction of the Epidermis causes impairment of the physical barriers and predispose to infections which can delay healing and increase energy demand.

★ 05 **Burns have 3 zones :**



1-Zone of coagulations: a central area of irreversible coagulative necrosis, its extent is determined by the duration of contact with the heat source and the degree of heat transfer to the skin.
2-Zone of stasis: an area of potential reversible cell damage surrounding the central zone (tissue is damaged with decreased perfusion but still viable).
3-Zone of hyperemia: an area characterized by inflammation and increased blood flow surrounding the stasis zone.

Calculations:

★ **Rule of nines**  Click here for a table	• Used to approximate burn size. • Divides the body into areas that each represent approximately 9% of the total body surface area (TBSA) of an adult • less useful in children because of the relatively large head size (and the relatively small limbs. ★ Palm without fingers = 1% **(Palmer method "rule of palm")** it's another way to estimate the size of a burn ★ Head in kids = 18% (9% in adults) ★ Single leg in kids = 9% (18% in adults) **-In summary:** give 2L IV line → adjust according to your measurements → adjust according to urine output.
Mortality	Mortality = (body surface area % + age)/100
★ **Parkland formula**	• Fluid volume of crystalloid administration during the first 24 hours of admission • **Volume of lactated Ringer's = 4 mL × weight (kg) × TBSA%** • 50% given in the first 8 hours • 50% given in the next 16 hours • Start counting the hours from the start of injury not from the time patient reach the hospital • And check if he received any fluid before 24 hours starting from time of injure" • Crystalloid is preferred because of the tendency to hyponatremia after the injury • The parkland formula is used to calculate the loss of fluid but the maintenance fluid should also be calculated (given to unconscious patient) e.g. In case of trauma burns ,the patient is given 1 to 2 liters of fluid through 2 large bore IV lines 14 or 16 (larger than 18) so they can be given quickly .
4-2-1 rule	The "4-2-1 rule" for maintaining fluid :It is the calculation of hourly fluid need according to weight . (4 ml/kg/ hour for the first 10 kg , 2 ml/kg/ hour for the next 10 kg and 1 ml/kg/ hour for every kilogram after that.)

Classification of Burns Based on the Depth of Skin Injury [1] (main clinical classification):

	Degree	Treatment

First Degree (superficial burn) 	• Epidermal injury only.
	• Clinically characterized by: **edema** and **erythema**. No fluid collection occur at this degree (no blister).
	• Most common presentation is kitchen burns and sunburns.
		• Symptomatic treatment:
		  ○ Mild analgesics/NSAIDs pain is the commonest presentation
		• Local wound care:
		  ○ Daily cleansing.
		  ○ Topical **antibiotics** (**silver sulfadiazine**)[2] if needed.
		• Elevation (raise patient's hand up to reduce edema)
		• Occupational therapy
		  ○ Splints in functional position.
		  ○ Early range of motion.[3]

Second Degree (superficial/deep partial thickness) 	• Injury to epidermal +/- dermal[4] layers. • Clinically characterized by: painful because the nerve is affected partially **blisters** [4] (Hallmark of Second degree burns). • Skin is repopulated by viable germinal cells in follicles (has stratified squamous epithelium).[5]	• Similar to first degree burns. • **Leave blisters intact** they are the best natural dressing [7]. If debrided, cover with an occlusive dressing. • Compression garment after wound epithelialization.
Third Degree [6] (full thickness) 	• Entire dermal layer and subdermal fat injury the entire content of the skin+nerve endings are completely burnt here so covering the burn is better to prevent infections . • Clinically characterized by: **dry, inelastic and waxy appearing scar** skin is similar to commercial leather.	• Early tangential skin excision and meshed split thickness skin grafting (within 7 days). • We have to surgically debride and skin graft. We remove the eschar (the white patch) we clean the wound until we reach healthy tissue then we remove a skin patch from one area of the body and transplant it to the burned area.
Fourth Degree (full thickness) 	• Dermis and deep tissue injury. • Clinically characterized by: **injury to all skin layers**, and **injury to tendon, nerve, bone and joint** In addition to Muscles and subcutaneous fat . basically injury to vital structures underneath the skin . • Caused when the patient is unable to move away from the burning agent eg: unconscious patients/disabled patients/infants, car accident . It's rare but has a bad outcome .	• Skin grafts not adequate for exposed deep structures. Treatment options: • Amputation. • Flap coverage with salvage procedures. will be explained further

1- In clinical practice, most burns are a mix of types. Any burn is surrounded by lighter zones eg: 2nd degree burns are surrounded by 1st degree burns and 3rd degree burns are surrounded by an engorge erythematous area (2nd degree burns). First site to come in contact with the burning agent is the deepest site of the burn. Retainment of sensations at the site of the burn suggest more superficial injury.

2-AKA: Flamazine is the **gold standard** in preventing infections due to its broad spectrum activity (covers both gram negative and gram positive bacteria).

3-Start early physical therapy if burns and edema are near a joint.

4-Blistering occur when the burn exceed the basement membrane of the epidermis going down to the dermis.The burn is painful due to the exposure of the nerve endings in the dermis.

5-In partial thickness burns the epithelium lining the skin appendages is preserved and heals the wound by creating new epithelium in a process called (**epithelization**)so the burn has the ability to heal by it self, unlike full thickness burn where there's no remaining appendages to heal the skin eg: Deep 2nd degree burn > "the burn has exceeded reticular layer of the dermis" leading to delayed healing and scarring and surgical intervention is indicated.

6-Whitish in color; Skin has 5 vascular plexuses, the most important are the Sub-dermal and Sub-epidermal plexuses, these Plexuses provide blood to the skin (give the reddish appearance of the skin).In 3rd ° burn These plexus are gone = no blood supply = skin looks white.
white skin = no skin content to re-Heal = Surgery is required.

7- The closed intact blisters if kept in a dry & clean environment is better for wound healing except if the blister is infected then a certain medications that should be used for treating the infection and if there is open area or open wound you have to treat the infection.

Burn

Wound Closure:

- **First** degree and **superficial second** [1] degree burns:
  - Local wound care only.
- **Deep second** [2] degree burns:
  - Controversial.
  - Functional results worse than superficial second degree burns.
  - Consider excision and skin grafting if hand burns will take 14 days to "close". [3]

Objectives of treatment:

01 Prevention of Edema [4]

02 Prevention of contractures[5] due to poor positioning and prolonged immobilization

03 Prevention of infection

04 Preserve viable tissue

When to transfer to a burn center (transfer criteria): ★

- >25% body surface area (BSA).
- >20% BSA in children.
- High voltage burns.
- Inhalation injuries. [6]
- Burns in the genital area, face, neck, feet and hands in addition to full thickness burns.
- Chemical burns.
- Circumferential burn

Burn Center Referral Criteria

1. Partial-thickness and full-thickness burns totaling greater than 10% TBSA in patients under 10 or over 50 years of age.
2. Partial-thickness and full-thickness burns totaling greater than 20% TBSA in other age groups.
3. Partial-thickness and full-thickness burns involving the face, hands, feet, genitalia, perineum, or major joints.
4. Full-thickness burns greater than 5% TBSA in any age group.
5. Electrical burns, including lightning injury.
6. Chemical burns.
7. Burn injury in patients with preexisting medical disorders that could complicate management, prolong the recovery period, or affect mortality.
9. Any burn with concomitant trauma (e.g., fractures) in which the burn injury poses the greatest risk of morbidity or mortality. If the trauma poses the greater immediate risk, the patient may be treated initially in a trauma center until stable, before being transferred to a burn center. The physician's decisions should be made with the regional medical control plan and triage protocols in mind.
10. Burn injury in children admitted to a hospital without qualified personnel or equipment for pediatric care.
11. Burn injury in patients requiring special social, emotional, and/or long-term rehabilitative support, including cases involving suspected child abuse.

1- Has the ability to heal by themselves because the blood vessels and skin appendages are still intact .
2-Grey zone !
we don't know whether the burn will heal by itself or not so we wait for 14 days, if it didn't heal we use grafts.
During these 14 days we maximize resuscitation and give topical antibiotics
3-They are deeper so more skin appendages will be affected , causing less epithelization making it harder to heal as the number of skin appendages left are less .
4-Edema usually happens within 24-48 hours after trauma and then comes down. It happens due to loss of capillary permeability which leads to a decrease in the oncotic pressure causing third spacing . The more the patient is given fluids the more the edema increases.
5- A condition of shortening and tightening of muscles, tendons or other tissues causing a deformity.
6-Should be incubated before the manifestation of signs of acute hypoxia due to occluded airway by edema and before an emergency tracheotomy is needed.

Management of Burns:

Surgical

- Escharotomy
- Skin grafting

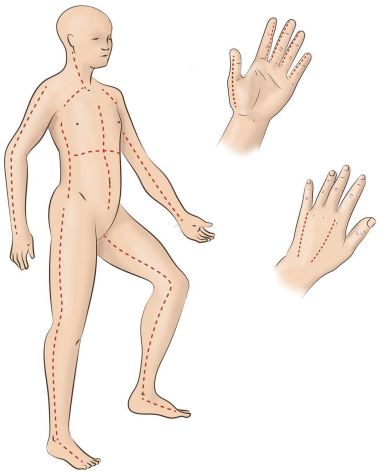
Non surgical

- Tetanus prophylaxis[1] (lockjaw)
- Analgesia
- Dressing
- Nutrition
- Fluid
- Foley Catheter [2]

01

Escharotomy [3]:

- Indication:
  - Poor tissue perfusion.
  - Threat to perfusion after volume resuscitation.
  - Deep Circumferential burns.
- Use mid-axial incisions.



Digital Escharotomy:

- Use mid-axial incisions:
  - Index, long → ulnar incision.
  - Ring → radial or ulnar incision.
  - Little → radial incision.
- Leave wounds open
- Consider carpal tunnel release.
- Consider intrinsic muscle release.

Skin Grafting & Flap:

- Skin grafting is a surgical procedure that involves removing skin from one area of the body and moving it, or transplanting it, to a different area of the body.
- **Grafts** are similar to first degree burns (First layer is removed and appendages are preserved in both of them so healing and epithelialization is possible) the difference is that grafts occur in a controlled environment unlike burns.

Grafts	VS	Flaps
- are thin sheet of skin (paper thin) - used more with 3rd degree - do not contain blood vessels (the injury site needs to be well vascular e.g.above muscle or dermis)		- is a bulky tissue (e.g. muscle flap, subcutaneous tissue flap) - used when there's a deep burn (4th degree burns) or when a deep reconstruction following cancer ablation is needed. - Contain blood vessels (so they are used to cover deep structures like bones, tendon, or joints)

1- An infection caused by Clostridium tetani. When the bacteria invade the body, they produce a toxin that causes painful muscle contractions.
⭐2-the urine output shows how well the patient resuscitated (feedback mechanism) . The minimum urine output for adults ½ ml per kg/hr.
⭐3- The most important indication of escharotomy is circumferential burn (which causes hypoperfusion due to edema).
-Circumferential burns :are seen in cases where full thickness burn affects the entire circumference of digit, extremity, or even the torso. which means it has a bad prognosis.
-As oedema forms the inelastic Eschar can cause a buildup of pressure and act like tourniquet (impairs blood flow). This pressure can lead to significant complications such as respiratory compromisation and loss of tissue perfusion requiring a surgical procedure known as an " escharotomy".
-An escharotomy performed by making an incision through the eschar to release the pressure

02

Antibiotics: [1]

- Intravenous or oral antibiotics should cover skin flora for initial treatment.
- Topical antibiotics [2] (silver sulfadiazine) for prevention of infection.
- Topical application of (mafenide acetate) penetrates through eschar and may be effective against a wider variety of organisms.

03

Non-Surgical Management:

- The first Priority would be **maintaining an adequate airway** and first Aid (ABCDE) especially in case of risk of inhalation injury, with continuous observation for signs of respiratory failure.
- **IV fluid resuscitation** if > 15% of BSA is affected (Parkland formula).
- **Analgesic** (eg: opioids).
- placing the patient in a warm room (to reduce energy expenditure) and **enteral feeding using nasogastric tube** with **vitamin** supplements and **iron** (Better to eat normally after 48 hours).
- **Prophylaxis against Tetanus** (eg: Clostridium Tetani) by Tetanus Immunoglobulins (TIG)
- Foley catheter to monitor urine output
- **Dressings**, essential to protect from contamination and for promotion of healing
  Types:
  - Evaporative dressings: eg: paraffin, gauze
  - Semi occlusive and occlusive: eg: hydrogel, hydrocolloid
- **Topical antibiotics**, like Silver Sulfadiazine (Flamazine) and Povidone Iodine (Betadine) (Not advised in the first 48 hours as they can make the determination of the depth more difficult).
- special Cases
  - preexisting Renal disease or Impaired renal function → diuretics.
  - Only in positive blood culture and septicemia → Systemic antibiotics.
  - Proton pump inhibitors (PPI) eg: Omeprazole → prophylaxis for curling's ulcer.
  -

1. Most cases will use antibiotics due to different types of burns involved in the same place.
2. **Topical antibiotic has 2 types :**

- Cream-based: not oil based, used for minor wounds, increases the hydration to the wound (keep moist) , example : flamazine and silver (commonly used)
- Ointment :oil-based, used for a longer duration (broad spectrum), makes an artificial surface for the wound so it locks it and provides a good environment , example: fusidic acid

Burn

Types of burns according to the causative agent:

1 Thermal burns:

- Caused by heat , **e.g.** scalding by hot water .
- **Heat is classified into 2 types:** 1-Dry heat e.g. oven heat 2-Moist heat e.g. Hot coffee/kitchen oil.
- Extent and depth of the injury is proportional to intensity and duration of heat applied. For that: the first thing to do is to remove clothes if something hot was spilled on it, otherwise the burn will go deeper and deeper.
- **Thermal response:**

Edema

- Inflammatory phase.
- Hand edema produces joint fibrosis and contractures.
- Edema may indirectly reduce blood flow by fluid accumulation (will compress blood vessels).
- When we give IV fluids we worry about (third-spacing) which might lead to edema eventually.
- If someone get burned in joint areas ex;hand or leg. Make sure to extent it to its maximum (each part has its own level) because if not , joint will get edema and gonna be so difficult to open it later (compartment syndrome).

Ischemia

Systemic factors:

- Hypovolemia from evaporation and increased capillary permeability.
- Fluid resuscitation if there is fluid loss , or 2nd degree burn (in 1st degree blood vessels are intact > no inflammation > no exudate) is required for significant burns.

★**Parkland formula:**
LR volume= 4cc x kg x %burn
(It's extremely important to understand parkland formula
Example:
If a burn is estimated to cover 10% Body surface of a child weighing 7kg the amount of fluid need to be replaced is equals to
4 x 10 x 7 = 280mL).

Local factors:

- Unyielding eschar/compartment.
- Ischemia leads to loss of injured/viable tissue.

Infection [1]

- Multiple factors contribute to development of the infection:
  - Systemic factors: impaired immune response.
  - Local factors: as bacterial counts increase, invasion of bacteria into the dermis occurs.
- Infection can convert burns from a partial to a full thickness injury (because infections cause further reduction in blood supply).
- Prior to antibiotic use, Streptococcus species was most common organism. Still seen with burn cellulitis (nowadays Staph are more common than Strept)
- Pseudomonas species is most common cause of systemic sepsis. (It is a gram negative that could be acquired for the hospital) so use **silver based antibiotic.**

1-Infection happens due to loss of outer layer of the skin.In case of infection suspicion, the amount of bacteria that determines that the wound is infected is bacteria > 10^5 at the wound sight.

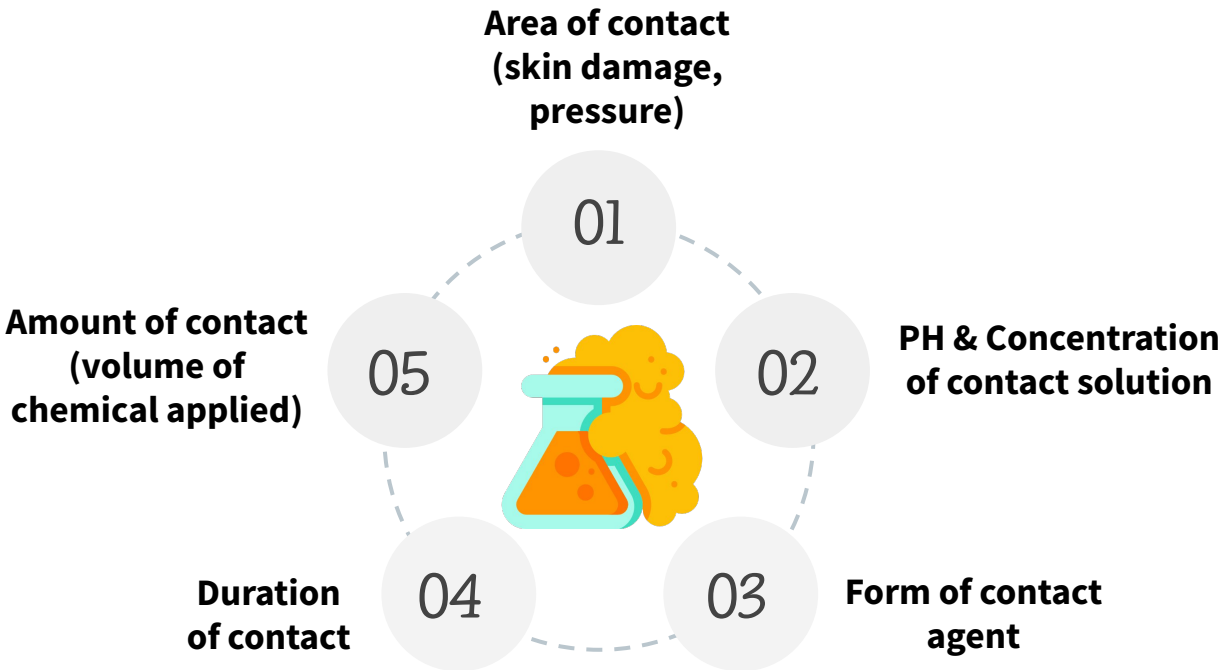
- Burn wound sepsis is the number one cause of morbidity in burns (common complication).

Burn

Types of burns according to the causative agent:

2 Chemical burns

- Chemical burns don't simply end with removing the burning agent like thermal burns; because chemical agents react with the body's tissue and the injury extends deeper.
- Acid → The most common cause of chemical burns, they cause fast tissue necrosis (Acids burns are most commonly seen in those working in Gas stations or Chemical laboratories). One of the worst types is sewer plugs (sulfuric acid drain cleaner)
- Base → The most dangerous cause of chemical burns.
- Acids and bases keep burning even after removal till neutralization of the acid or base happens (some of them have antidotes).
- Acute vs chronic
- Short acting vs long acting
- Superficial vs deep
- Factors which worsen the burn:



"We don't usually ask about these tables." :)

Acids		Bases	Pathophysiology:
Batteries: Sulfuric acid/lithium	Acetic acid	Ammonia Tile cleaners: Ammonium chloride	**Bases:** • Proton acceptor (OH^-). • Higher pH is stronger on logarithmic scale. • Liquefaction necrosis. • Protein denaturation. • Lipid saponification (exothermic = heat producing). • Eschar can't form and base penetrates deeper than acid (continuous action). **Acids:** • Proton donor (H^+). • Lower pH is stronger on logarithmic scale. • Necrosis by protein denaturation. • Forms eschar which limits penetration.
Rust removers: Hydrofluoric acid [2]/chromic acid	Trichloroacetic acid	Drain cleaners: Sodium hypochlorite (lye), Sodium hydroxide	
Pool cleaner: Hydrochloric acid	Chloroacetic acid	Potassium hydroxide	
Phosphoric acid	Chemical peels: Phenol (Carbolic acid)	Cement: Calcium hydroxide/oxide (lye), Alkali. Calcium hypochlorite	
Nitric acid	Cresols	SIlicates, Phosphates, Lithium hydride	
Formic acid	Toilet bowl cleaners/cement removers: Muriatic acid	Petroleum solvents: organics. Air bag deployment: Alkali. Bleaches/household cleaners: oxidizers.	

Special categories	
Oxidants	• Bleaches, peroxides, chromates, manganates • Neutralize with milk/egg white/starch before water irrigation
Reduction reactions	• Binds free electrons and thus denatures proteins. • Neutralize first with soda lime, soap,magnesium before water irrigation
Corrosives	• White phosphorus (military), metals, aqueous ammonia, phenol. • Remove particles, copper sulfate solution
Desiccants	• Sulfuric acid, muriatic acid • Dehydrates tissue • Exothermic: heat producing • Neutralize with lime water, soap,magnesium.
Vesicants	• Chemical warfare (phosgene, mustard, etc) • Blisters, edema, ischemic necrosis • Special antidotes • Chemotherapy agents
Protoplasmic proteins	• Hydrofluoric acid, acetic acid, tungstic acid, tannic acid. • Forms salts and bind proteins/calcium or ions.

Hydrofluoric acid	• After initial lavage for 30 minutes to treat the H^+ ion, treat fluoride ion.
	• 10% Calcium gluconate gel topically:
	  ○ May need to remove nails to get contact.
	  ○ May combine with 50% DMSO (dimethyl sulphoxide).
	• Consider injection (not with digits).
	• Consider intra-arterial injection.

1-History should give you a hint about the type of burn which is important because they are managed differently (eg. Gas station explosion, chemistry lab fire, household chemical cleaners acids/bases…etc).

2-Causes Hypocalcemia

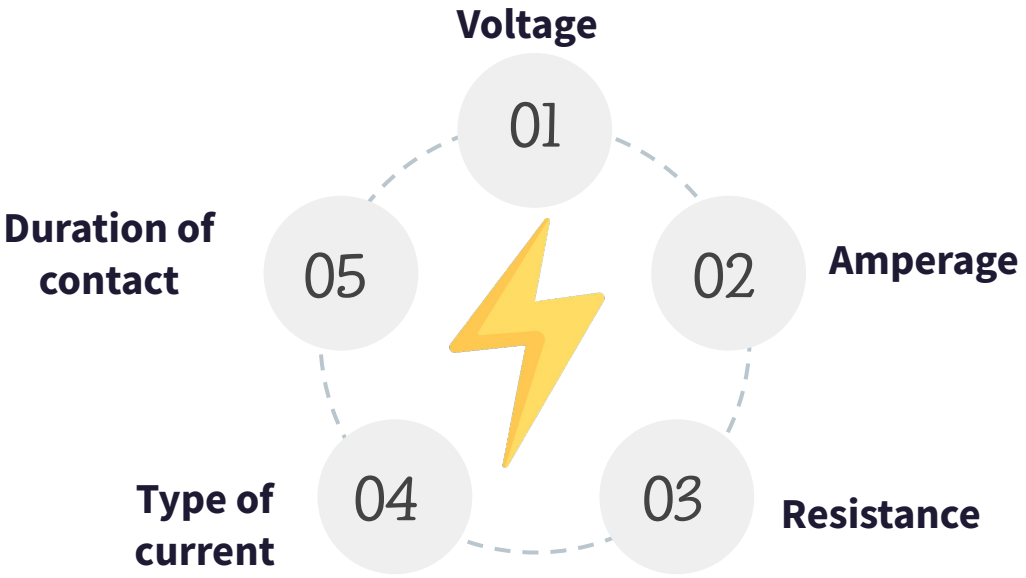
• If you don't know the type of the chemical agent just dilute it with water to minimize its effect "The solution of pollution is dilution"

Burn

Types of burns according to the causative agent:

3 Electrical burns: e.g Electricity station burns , or in airport generators.

- Pathophysiology
  - Current burns can be described as burning from inside out from deeper organs till it arrives to skin, patients who experience electric shock may have no external injuries.
  - History of electrical shock (voltage, current type and source of electricity) should give you a hint if there's any muscle(lead to renal failure later) or bone damage and doesn't exclude electrical injury as a differential
  - Severity of an electrical injury depends upon:

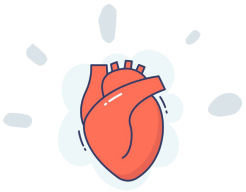


- Tissue resistance:
  - Bone > Fat > Tendon > Skin > Muscle > Vessel > Nerve
- Path of current:
  - Low voltage follows least resistance (The worst type).
  - High voltage direct flow.

Burn

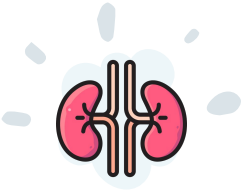
3 Electrical burns cont.:

- Systemic injury: if a current entered from one hand and exits from the other it means that it went through the heart and can cause arrhythmia so the initial management should be cardiac monitoring.



Cardiac arrhythmias [1]

sepsis



Renal failure

Due to muscle necrosis and failure of hydration

PNS injury

01 Evaluation

- Extent of necrosis is hard to asses
- Red, swollen extremity
- Entry and exit wound
- Skeletal injury possible secondary to a fall or being thrown
- Compartment syndrome [2]
  - Low threshold for fasciotomy

Treatment 02

- Fasciotomy [3]:
  - Within 4-6h
  - Nerve decompression as needed
- Debridement of devitalized tissue
- Second look procedure
  - 48-72h
  - Expect additional necrosis from vascular thrombosis
- Definitive treatment:
  - Amputation and/or flap coverage

1. Common worries in high voltage electrical burns (e.g. metro stations and electrical companies)include arrhythmia,muscle injury (compartment syndrome), rhabdomyolysis, internal edema and renal failure .
2. Compartment syndrome results from the combination of increased interstitial tissue pressure (tissue pressure exceeds the perfusion pressure) and the noncompliant nature of the fascia and osseous structures that make up a fascial compartment resulting in edema(causes an increase in capillary and venous pressure leading to muscle necrosis) and swelling of the deep compartments (muscles or bones). Compartment syndrome is associated with electrical burns.
3. **Fasciotomy** has the same principle as **Escharotomy** but much deeper. A fasciotomy consists of one or more fascial incisions and remains the only effective way to treat acute compartment syndrome.

Inhalation injuries:

- Common in house fires and caused by inhalation of smoke from burning objects eg:plastic.
- Usually fatal.
- Carbon monoxide displaces oxygen and binds to hemoglobin forming (Carboxyhemoglobin)
- The patient can be saved if he was put on 100% O2 for 75 min or for 4-6 hours in a room with clean air.
- Cyanide inhalation is also common and can be fatal
- Damage to lung parenchyma due to inhalation of chemicals or heated smoke can happen.

Complications of burn:

01 > 02 > 03

Early consequences

- Hypovolemic shock.
- Electrolytes imbalance (hyponatremia followed by hypernatremia, and hyperkalemia followed by hypokalemia).
- Sepsis.
- Hemolysis .
- Hypothermia.

Short Term consequences

- Nutritional depletion and weight loss
- Respiratory failure and ARDS
- Renal failure (due to hypovolemia)
- Venous thrombosis
- Curling's ulcer (acute duodenal ulcer) and erosive gastritis (due to ischemia of the Gut from water loss)

Long term consequences

- Permanent disfigurement
- Prolonged hospitalization
- Psychological disturbance
- Impaired mental and physical function

Summary

Recall

Q1:How do superficial burns present?
Painful, dry, red areas that do not form blisters (think of sunburn)

Q2:How do partial-thickness burns present?
Painful, hypersensitive, swollen, mottled areas with blisters and open weeping surfaces

Q3:How do full-thickness burns present?
Painless, insensate, swollen, dry, mottled white, and charred areas; often described as dried leather

Q4:Define STSG
Split-Thickness Skin Graft

Q5:What is an autograft STSG?
STSG from the patient's own skin

Q6:What is an allograft STSG?
STSG from a cadaver (temporary coverage)

Q7:What prophylaxis should a Burn patient receive?
Tetanus

Q8:What principles guide the initial assessment and resuscitation of the burn patient?
ABCDEs, then urine output; check for eschar and compartment syndromes

Q9:What are the signs of smoke inhalation?
Smoke and soot in sputum/mouth/nose, nasal/facial hair burns, throat/mouth erythema, history of loss of consciousness/explosion/fire in small enclosed area, dyspnea, low O2 saturation, confusion, headache, coma

Q10:What diagnostic imaging is used for smoke inhalation?
Bronchoscopy

Q11:What lab value assesses smoke inhalation?
Carboxyhemoglobin level (carboxyhemoglobin level >60% is associated with a 50% mortality); treat with 100% O2 and time

Q12:How should the airway be managed in the burn patient with an inhalational injury?
With a low threshold for intubation; oropharyngeal swelling may occlude the airway so that intubation is impossible; 100% oxygen should be administered immediately and continued until significant carboxyhemoglobin is ruled out

Q13:What burns qualify for the Parkland formula?
≥20% TBSA partial- and full-thickness burns only

Q14:What is the Brooke formula for burn resuscitation?
Replace 2 cc for the 4 cc in the Parkland formula

Q15:What is the rule of 10's?
For determining hourly IVF rate: TBSA × 10 (patients 40 to 80 kg)

Q16:How is the crystalloid given?
Through two large-bore peripheral venous catheters

Q17:Can you place an IV or central line through burned skin?
YES

Q18:Why is glucose-containing IVF contraindicated in burn patients in the first 24 hours postburn?
Patient's serum glucose will be elevated on its own because of the stress response

Q19:What fluid is used after the first 24 hours postburn?
Colloid; use D5W and 5% albumin at 0.5 cc/kg/% burn surface area

Q20:Why should D5W IV be administered after 24 hours postburn?
Because of the massive sodium load in the first 24 hours of LR infusion and because of the massive evaporation of H2O from the burn injury, the patient will need free water; after 24 hours, the capillaries begin to work and then the patient can usually benefit from albumin and D5W

Summary

Recall

Q21:What is the minimal urine output for burn patients?
Adults 30 cc; children 1 to 2 cc/kg/hr

Q22:Why do most severely burned patients require nasogastric decompression?
Patients with >20% TBSA burns usually develop a paralytic ileus → vomiting→ aspiration risk → pneumonia

Q23:What stress prophylaxis must be given to the burn patient?
PPI to prevent burn stress ulcer (Curling's ulcer)

Q24:What are the signs of burn wound infection?
Increased WBC with left shift, discoloration of burn eschar (most common sign), green pigment, necrotic skin lesion in unburned skin, edema, ecchymosis tissue below eschar, partial-thickness burns that turn into full-thickness burns,hypotension

Q25:Why are systemic IV antibiotics contraindicated in fresh burns?
Bacteria live in the eschar, which is avascular (the systemic antibiotic will not be delivered to the eschar); thus, apply topical antimicrobial agents

Q26:Circumferential, full-thickness burns to the extremities are at risk for what complication?
Distal neurovascular impairment

Q27:How is it treated?
Escharotomy: full-thickness longitudinal incision through the eschar with scalpel or electrocautery

Q28:How is carbon monoxide inhalation overdose treated?
100% O2 (± hyperbaric O2)

Q29:Which electrolyte must be closely followed acutely after a burn?
Na+ (sodium)

Q30:What is the name of the gastric/duodenal ulcer associated with burn injury?
Curling's ulcer (Think: CURLING iron burn = CURLING's burn ulcer)

Q31:What is the "rule of the palm"?
Surface area of the patient's palm is ≈1% of the TBSA used for estimating size of small burns

Q32:What is the "rule of nines"?
In an adult, the total body surface area that is burned can be estimated by the following:Each upper limb = 9%/ Each lower limb = 18% / Anterior and posterior trunk = 18% each / Head and neck = 9% / Perineum and genitalia = 1%

Classification of Burns:

	Superficial 1st degree	Superficial partial thickness 2nd degree	Deep partial thickness 2nd degree	Full thickness 3rd degree	Full thickness 4rd degree
Zone involved	Epidermis	Epidermis and upper dermis	Epidermis and most of dermis	Epidermis and total dermis including epidermal appendages and subdermal fat	Extends to underlying structure ; muscle, fascia, bone
Description	Painful + Edema + erythema	Painful +Pink **blister**	-	Dry, inelastic, waxy appearing scar	-
Management	Mild analgesics Daily cleansing +/- topical antibiotic	Daily dressing Heal within 2 wks	Debridement	Debridement and meshed split thickness skin grafting	Amputation or flap coverage with salvage procedure

439's Quiz

Q1: In which of the following Structure of the skin the Healing process happen?

A. Epidermis
B. Dermis
C. Subcutaneous tissue

Q2: A 28-year-old man is brought to the emergency room after sustaining burns during a fire in his apartment, he wasn't able to move away from the fire and when he came to ER he has skin layers, and injury to bone and joint. Which of the following is the most appropriate degree for this case ?

A. First degree
B. Second degree
C. Third degree
D. Fourth degree

Q3: In previous case (Q2) what is the most appropriate treatment?

A. Skin grafts ONLY.
B. Amputation.
C. Flap coverage with salvage procedures.
D. Both B & C are Treatment options.

Q4: Which of the following is surgical management of Burns?

A. Skin grafting
B. Tetanus prophylaxis
C. Analgesia
D. Dressing

Q5: A 27 year old was admitted to the ER after suffering a temporal burn. If a burn is estimated to cover 10% Body surface and his weighing 70kg . What is the amount of fluid need to be replaced?

A. 2300 mL
B. 2500 mL
C. 2800 mL
D. 3000 mL

Q6: Which of the following tissue more resistance to electrical burns?

A. Nerve
B. Bone
C. Tendon
D. Skin

Answers

Q1	B	Q4	A
Q2	D	Q5	C
Q3	D	Q6	B

Extra Questions

438's Quiz

Q1: A 30 year old chef 75 kg was admitted to the ER after suffering a burn from boiling water that fell over his entire anterior Arms and anterior forearms. The doctor wants to administer fluids for him in order to avoid hypovolemic shock. Calculate the volume of fluid needed.

A. 2700 mL Crystalloid
B. 1200 mL Crystalloid
C. 2700 mL Colloid
D. 1200 mL Colloid

Q2: A 44 year old blacksmith suffered a Burn injury to his leg at work. He was rushed into the ER. His leg showed severe necrosis and loss of sensation over the burned area which covers the entire circumference of the leg. What is the appropriate management in this case

A. Skin Grafting
B. Apply Dressings and support with fluids
C. Escharotomy with cauterization
D. Systemic Antibiotics

Q3: After a huge fire in one of the houses, a survived teenager was admitted to the ER unconscious. His blood pressure was 90/55 And his heart rate 120 While his RR was 28. Which of the following should be done to save the patient

A. Fluid therapy
B. Nutritional support
C. Clear airway and put him on 100% O2 mask
D. Careful monitoring

Q4 which of the following is a prophylaxis that is given to a Burn patient

A. VZIG
B. Penicillin
C. Rubella specific IgG
D. TIG

Q5 most common kind of burns between children under 2 years old ?

A. Scald burns
B. Flame (Thermal) burns
C. Electrical burns
D. Chemical burn

Q6 A 25-year-old man is brought to the emergency room after sustaining burns during a fire in his apartment. He has blistering and erythema of his face, left upper extremity, and chest. He also has circumferential frank charring of his right upper extremity with decreased capillary refill. He is agitated, hypotensive, and tachycardic. Which of the following is the most appropriate initial management of his wounds ?

A. Topical antibiotics should be applied to the burn wounds.
B. Excision of facial and hand burns.
C. Escharotomy of the right upper extremity.
D. Excision of all third-degree burns.
E. Split-thickness skin grafts over the areas of third-degree burns.

Answers

Q1	A	Q4	D
Q2	C	Q5	A
Q3	C	Q6	C

Good Luck!

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Feedback