

Burns

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- **A burn is defined as a dissolution in tissue continuity as a result of thermal damage, in which there is coagulative necrosis of tissues.**

Etiology

- (1) Dry heat**
- (2) Flame**
- (3) Scald**
- (4) Electric contact**
- (5) Thermoelectric**
- (6) Chemical**
- (7) Friction**
- (8) Ionizing radiation**
- (9) Frostbite**

Body's Response to Burns

- **Emergent Phase (Stage 1)**
 - Pain response
 - Catecholamine release
 - Tachycardia, Tachypnea, Mild Hypertension, Mild Anxiety
- **Fluid Shift Phase (Stage 2)**
 - Length 18-24 hours
 - Begins after Emergent Phase
 - Reaches peak in 6-8 hours
 - Damaged cells initiate inflammatory response
 - Increased blood flow to cells
 - Shift of fluid from intravascular to extravascular space
 - MASSIVE EDEMA
 - “Leaky Capillaries

Body's Response to Burns

- **Hypermetabolic Phase (Stage 3)**
 - Last for days to weeks
 - Large increase in the body's need for nutrients as it repairs itself
- **Resolution Phase (Stage 4)**
 - Scar formation
 - General rehabilitation and progression to normal function

Clinical features

- Burn **shock**.
- Intense **pain** in 2nd degree burn.
- Burnt **wound**, depending on the duration, degree & type of thermal injury.

Management of a patient with burns

Immediate Care & Resuscitation

Prehospital care

- ***In burns & scalds***
 - **Remove** the patient from source of heat & **extinguish** the flame.
 - A standard **ABC** check followed by a rapid **secondary** survey.
 - Apply cold, **clean water soaks** to affected areas & renew these every 3 minutes.
- ***In electrical burns***
 - **Switch** off the electrical supply.
 - If victim is unconscious Ô **Exclude** the presence of **cardiac arrest**, & if necessary, apply cardio-pulmonary resuscitation.
- ***In chemical burns***
 - **Irrigate** affected area with copious amounts of clean water except in phenol burns.
 - In phenol burns Ô Irrigate with **polyethylene glycol**.
- **Note: Ensure rescuer safety, esp. in house fires & in electrical & chemical injuries.**

Transportation

Burn patients must be transported with great care.

- A secure **IV line** is required for major cases.
- Burns should be **covered** with clean sheets & patient wrapped in warm blankets or foil.
- Anyone involved in a fire in an enclosed space should receive **oxygen**, esp. if there is an altered consciousness level.
- **Elevate** Ô
 - Sitting a patient up with a burned airway may save life.
 - Elevation of burned limbs will reduce swelling & discomfort.

Hospital Care

- Possibility of **additional injury** must be sought & treated appropriately.
- Assess **severity** of burn injury;
 - **Percentage** of total body surface area burnt.
 - **Depth** of burn.
 - Presence of **inhalation** injury.

Priorities in the management of a major burn

- A.** Airway control
- B.** Breathing & ventilation
- C.** Circulation
 - **Burn assessment**
- D.** Disability (neurological status)
- E.** Exposure with environmental control
- F.** Fluid resuscitation

Airway



- In cases of **burned airway**, **secure the airway** with an endotracheal tube until the swelling has subsided, which is usually after about 48 hours.
 - Delay can make intubation very difficult due to swelling.
- Perform an emergency **cricothyroidotomy** if intubation is delayed.
 - Time from burn to airway occlusion is usually between **4 & 24 hours**.

Breathing

- ***Recognition of the potentially burned airway***
 - A history of being **trapped** in the presence of smoke or hot gases.
 - Burns on the **palate or nasal mucosa**, or loss of all of the **nasal hairs**.
 - Deep burns around the **mouth & neck**.
 - Progressive increase in **respiratory effort & rate**, rising pulse, anxiety & confusion.
 - Decreasing **oxygen saturation**, & patchy consolidation on **chest x-ray**.

Breathing

- **Treatment**

- **Physiotherapy, nebulizers & warm humidified oxygen;**
 - patient's progress should be monitored using respiratory rate, & blood gas measurements.
- If condition deteriorates, **continuous or intermittent positive pressure** may be used with a mask or T piece, & in the severest cases, intubation & management in an intensive care unit will be needed.
- Any mechanical block to breathing from the eschar of a full thickness burn on the chest wall requires **escharotomy**.

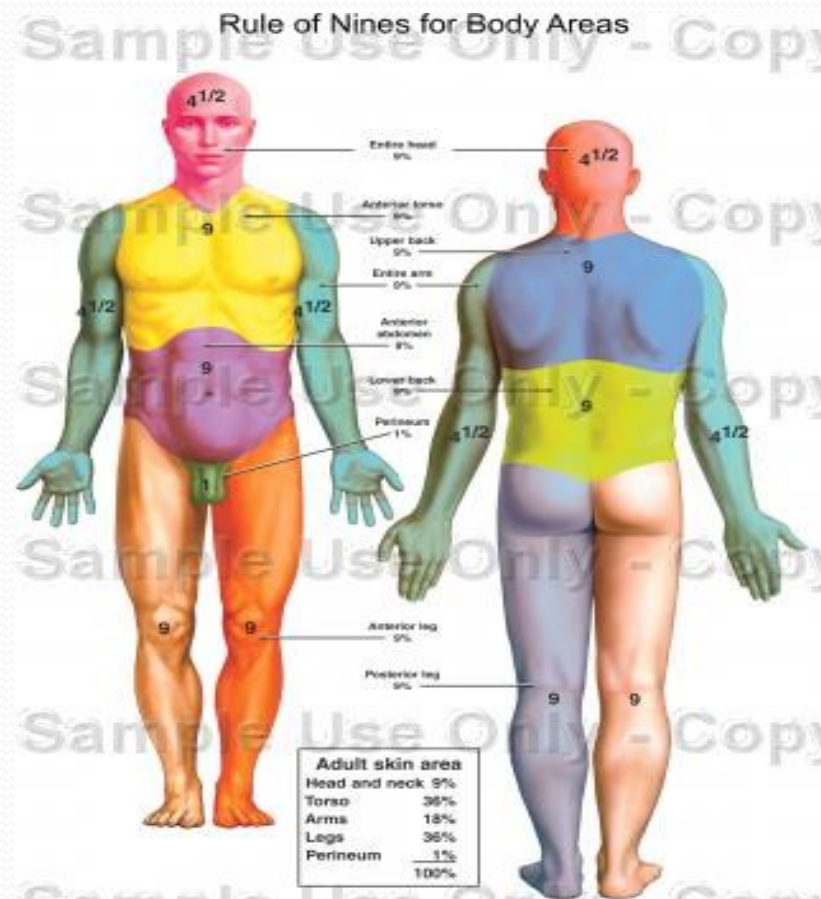
Assessment Of Burns Injury

Extent of total body surface area (TBSA) burnt

- This is necessary because burn patients require IV resuscitation if their injury exceeds **10%** body surface area in children or **15%** in adults.
- **Methods of assessment**
 - **Patient's whole hand is 1% TBSA**, & is a useful guide in small burns.
 - **Lund & Browder chart** is useful in larger burns.
 - **Wallace's Rule of Nines** is adequate for a first approximation only.

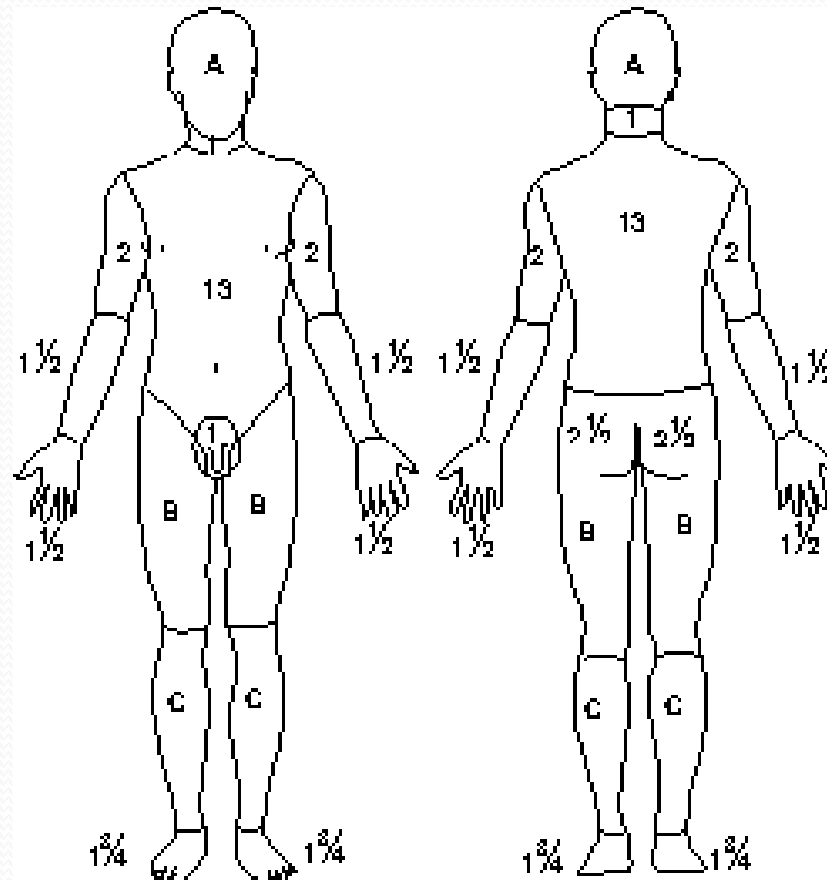
• Wallace's Rule of Nines

- Head & neck $\hat{=}$ 9%.
- Anterior aspect of trunk (chest + abdomen) $\hat{=}$ 18% (9% x 2).
- Posterior aspect of trunk $\hat{=}$ 18% (9% x 2).
- Upper limbs (right & left) $\hat{=}$ 18% (9% x 2).
- Right lower limb (front & back) $\hat{=}$ 18% (9% x 2).
- Left lower limb (front & back) $\hat{=}$ 18% (9% x 2).
- Perineum $\hat{=}$ 1%.



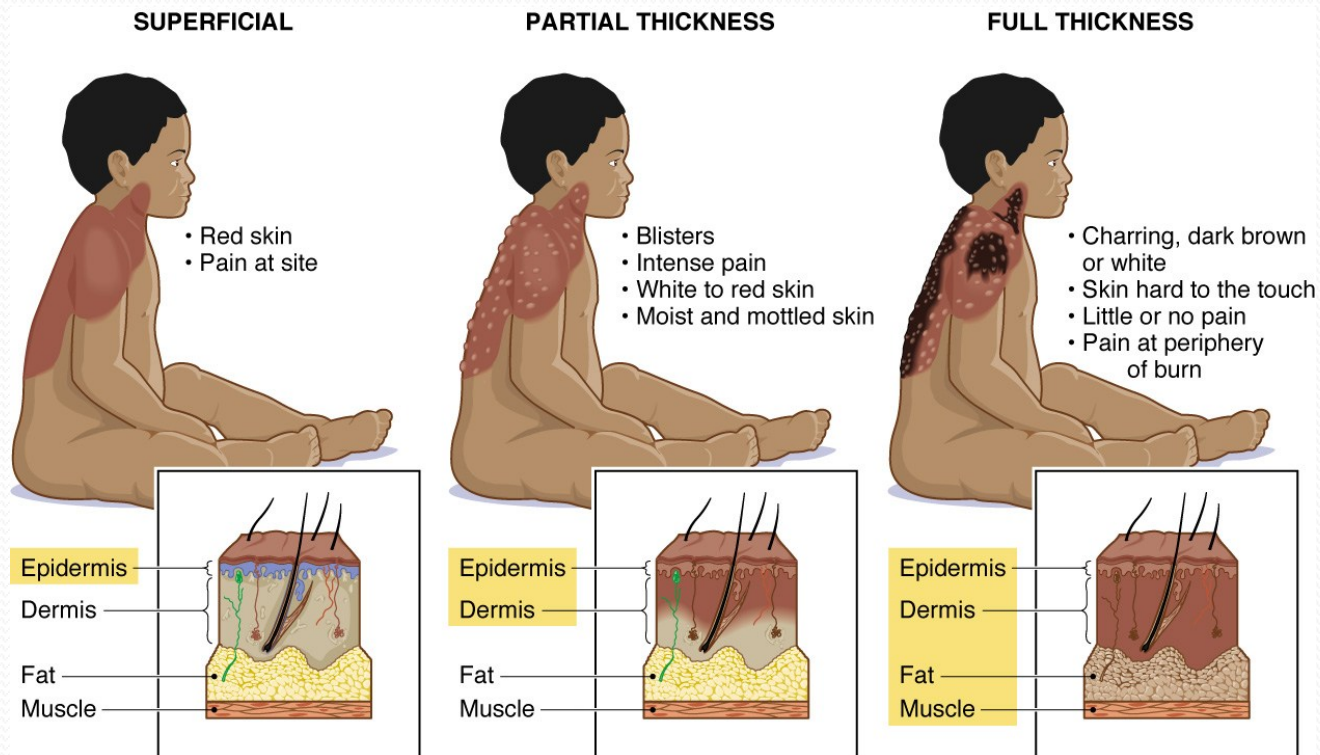
Lund & Browder Chart

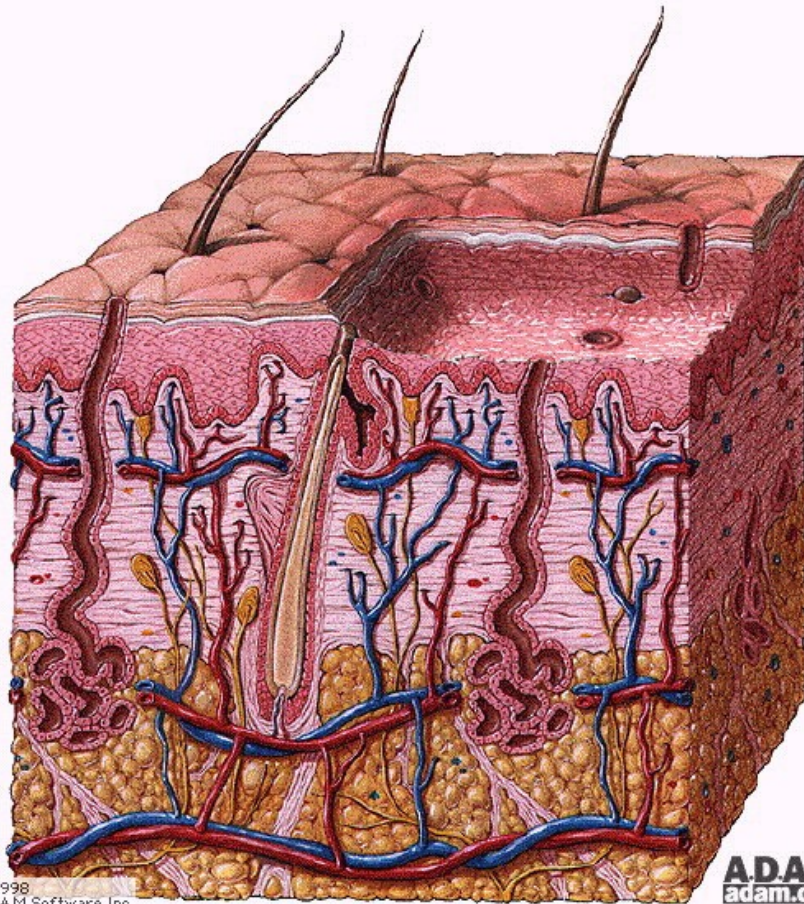
	<i>Relative % of area affected by growth</i>					
<i>Age in years</i>	<i>0</i>	<i>1</i>	<i>5</i>	<i>10</i>	<i>15</i>	<i>Adult</i>
<i>A Head</i>	9	8	6	5	4	3
<i>B Thigh</i>	2	3	4	4	4	4
<i>C Leg</i>	2	2	3	3	3	3



Depth of Burn

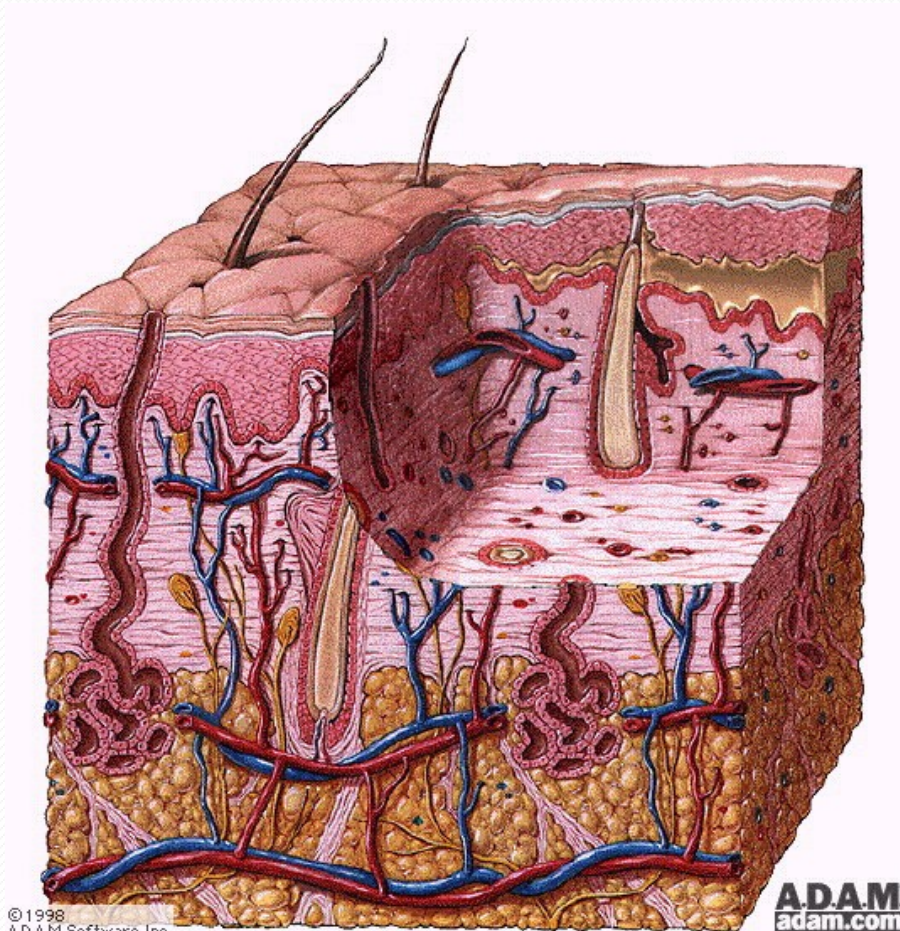
- Superficial Burn
- Partial Thickness Burn
- Full Thickness Burn





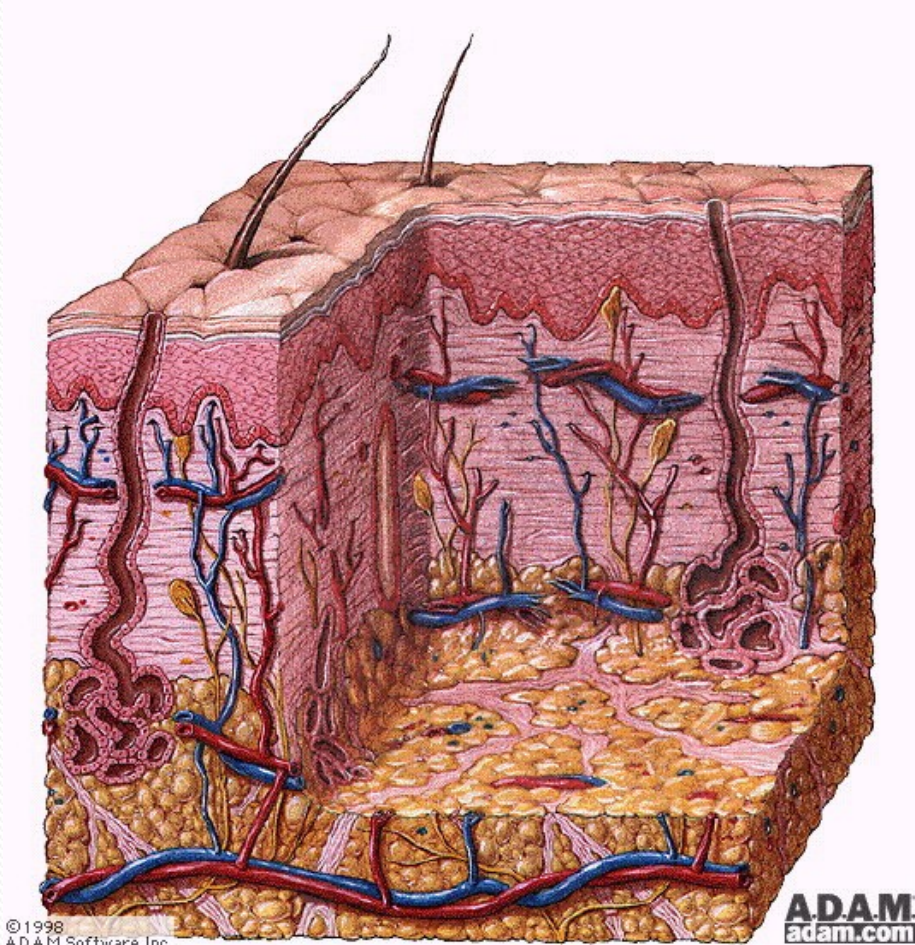
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- Superficial Burn:
1st Degree Burn
 - Signs & Symptoms
 - Reddened skin
 - Pain at burn site
 - Involves only epidermis



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- Partial-Thickness Burn:
2nd Degree Burn
 - Signs & Symptoms
 - Intense pain
 - White to red skin
 - Blisters
 - Involves epidermis & dermis

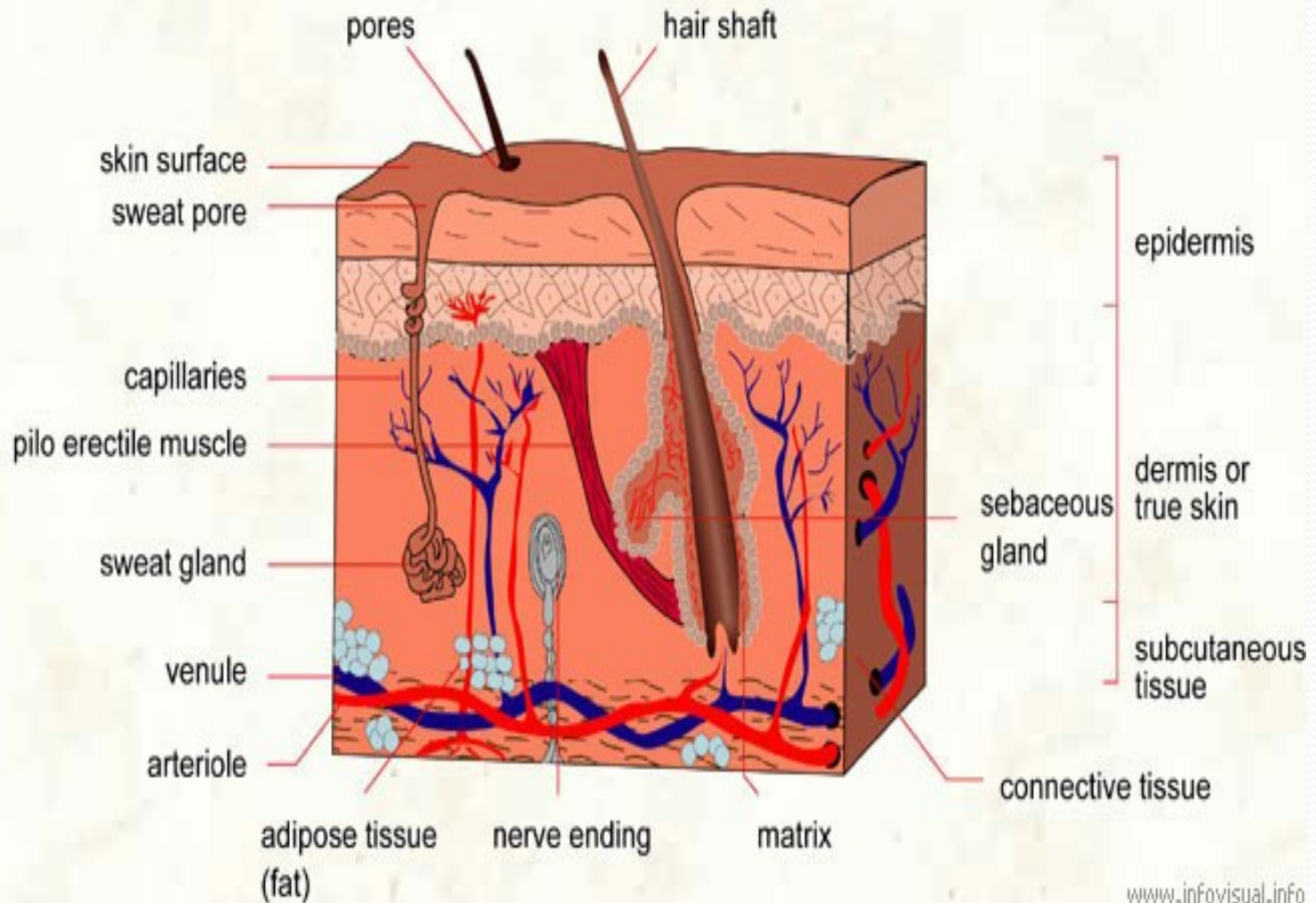


- Full-Thickness Burn: 3rd Degree Burn
 - Signs & Symptoms
 - Dry, leathery skin (white, dark brown, or charred)
 - Loss of sensation (little pain)
 - All dermal layers/tissue may be involved

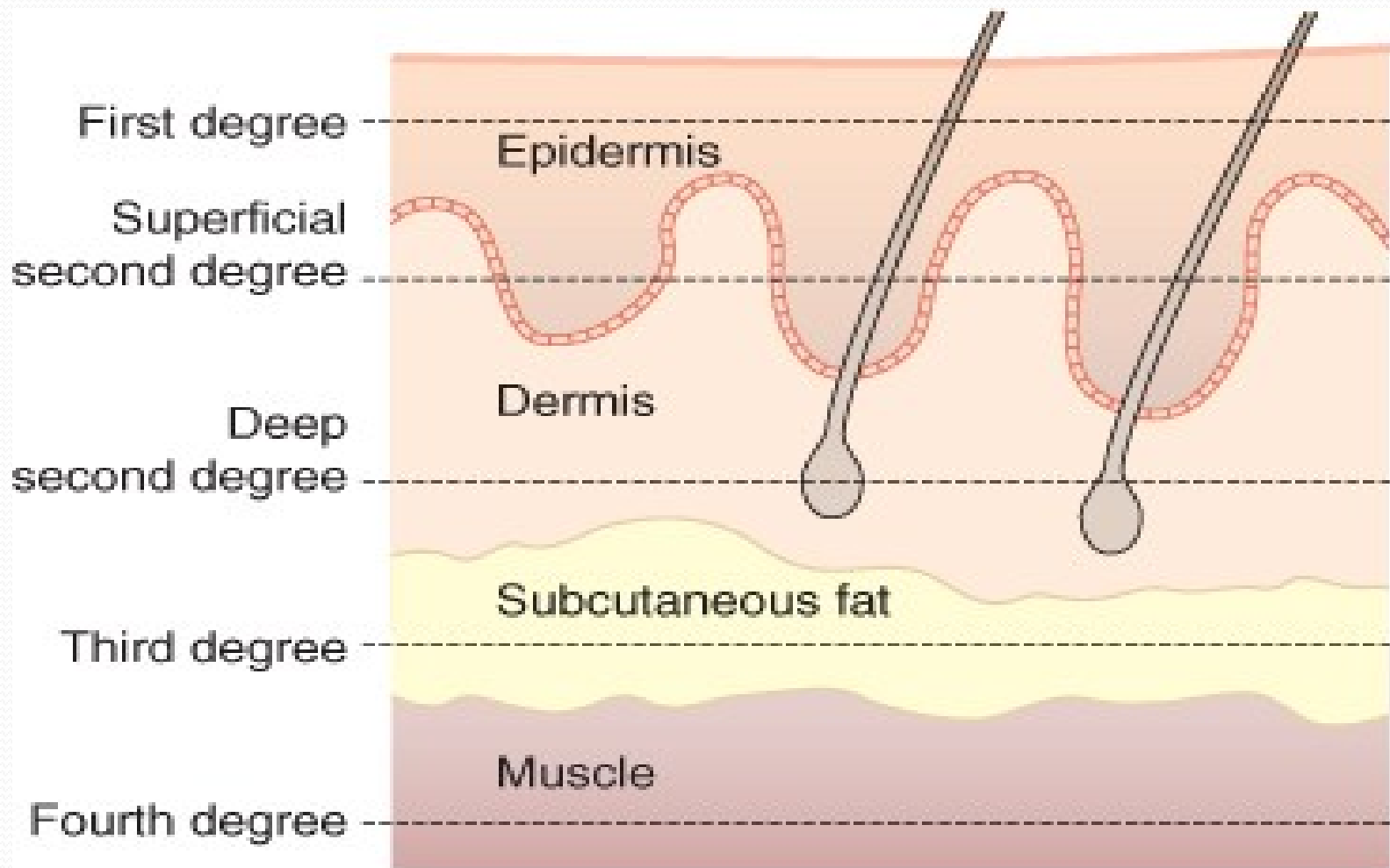
Depth of burns

- History is important which includes temperature, time & burning material.
- **Superficial partial thickness burns**
 - Injury is upto the **papillary dermis**, with blistering &/or loss of epidermis.
 - Underlying dermis is pink & **moist**.
 - Capillary return is clearly visible when **blanched**, & **pinprick** sensation is normal.
 - It **heal without residual scarring in 2 weeks**.
- **Deep partial thickness burns**
 - Injury is upto the deeper parts of the **reticular dermis**, with loss of epidermis.
 - Exposed dermis is **not as moist** as that in a superficial burn.
 - Color does **not blanch** with pressure, & the sensation is reduced.
 - It take **3 or more weeks to heal without surgery** & usually lead to hypertrophic scarring..
- **Full-thickness burns**
 - These have a dry, charred, waxen, or leathery appearance, & may be white or greyish in color.
 - Thrombosed vessels may be evident.
 - Burn surface is **pain free**, & is anesthetic to a pinprick or to touch.

CROSS SECTION OF SKIN



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- A superficial partial-thickness scald **24 hours** after injury. The dermis is pink and blanches to pressure.
- At **2 weeks**, the wound is healed but lacks pigment.
- At **3 months**, the pigment is returning.



- A deep dermal burn undergoing tangential shaving.
 - The dead dermis is removed layer by layer until healthy bleeding is seen.
 - The burn is pale because it was dressed with silver sulphadiazine cream, but no blanching was visible under this layer.
 - The patient was unable to differentiate between pressure from the sharp and blunt ends of a needle.
- A thin, split-thickness graft harvested from the thigh.
- The thin graft is placed in the dermal remnants.

Criteria for acute admission to burns unit

- Suspected airway or **inhalational** injury
- Any burn likely to require **fluid** resuscitation
- Any burn likely to require **surgery**
- Significant burns 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 of the **extremes of age**
- Any burn with potentially serious sequelae including high tension electrical burns & concentrated hydrofluoric acid burns

Circulatory Support & Fluid Resuscitation

Type of fluid

- 1. Ringer's lactate or Hartman's solution.**
- 2. Human albumin solution or fresh-frozen plasma.**
- 3. Hypertonic saline.**

Note: If oral fluids are to be used, salt must be added

Volume of fluid

- Volume of fluid to be given in first 24 hours is calculated by **Parkland formula**;
 - Volume in ml = **Total percentage body surface area x weight in Kg x 4**
 - Half of this volume is given in the first 8 hours, & the second half is given in the subsequent 16 hours.
- **In children, maintenance fluid** (dextrose saline) must also be given, as follows;
 - **100** ml per kg for 24 hours for the first 10 kg
 - **50** ml per kg for the next 10 kg
 - **20** ml per kg for each kg over 20 kg body weight

Monitoring of resuscitation

- Examination of patient's **general clinical state**:
 - Pulse rate
 - Blood pressure
 - Temperature
 - Jugular venous pressure
 - Skin perfusion & Color & temperature
- **Urine output** should be between **0.5 & 1.0** ml per kg per hour;
 - If the urine output falls, the infusion rate should be increased by 50%.
 - If the urine output is inadequate & patient is showing signs of hypoperfusion then a bolus of 10 ml per kg body weight should be given.
 - Urine output in excess of 2 ml kg body weight per hour should signal a decrease in the rate of infusion.
- **Acid base balance.**
- **Hematocrit measurement.**

A 13 year old boy, 22 kg, suffers 35% burns involving both upper limbs & anterior aspect of trunk.

What is the fluid requirement in first 8 hours?

- A. $3080 + 3080 = 6160$ ml
- B. $3080 + 1540 = 4620$ ml
- C. $1540 + 1540 = 3080$ ml
- D. $1540 + 770 = 2310$ ml
- E. $770 + 770 = 1540$ ml

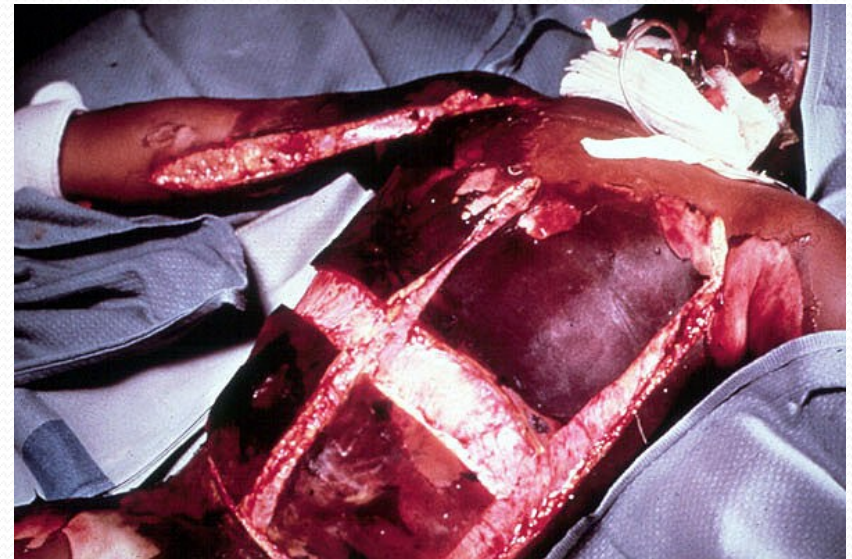
$$22 \times 35 \times 4 = 3080 / 2 = 1540$$
$$1000 + 500 + 40 = 1540 / 2 = 770$$

Answer: D

Any question?

Burn Wound Care

- **Cold water compresses** to relieve pain of partial thickness burns.
- **Remove** any adherent clothing, dirt or foreign material by gentle rinsing with warm sterile water.
- **Escharotomy**
 - Circumferential full thickness burns to the limbs & chest require emergency incision;
 - whole length of full thickness burn is incised in the mid axial line (avoiding major nerves).
- **Special measures:**
 - In **hand** burns Ô Burnt hands should be enclosed in polythene bags, elevated & actively exercised.
 - In burns of **eyelids** Ô Skin graft.



Burn Wound Care

Burns dressing

- **Full thickness & deep dermal burns need antibacterial dressings to delay colonization prior to surgery;**
 - **1% silver sulphadiazine cream.**
 - **0.5% silver nitrate solution.**
 - **Matenide acetate cream.**
 - **Serum nitrate.**

Burns dressing

- Superficial partial thickness burns will heal almost irrespective of the dressing.
- If the wound is heavily contaminated then clean the wound under GA.
- With more chronic contamination, silver sulphadiazine cream dressing for 2 or 3 days is very effective.
- Simplest method of treating a superficial wound is by exposure. This is often used in hot climates, & for small burns on the face.
- Burns can be covered with a permeable wound dressing such as Mefix, or with vaseline impregnated gauze with or without an antiseptic eg chlorhexidin, or with a fenestrated silicone sheet.
 - Swabs need to be changed after the first 48 hours as they are often soaked; after that they can be left for longer.
- Hydrocolloid dressings (eg duoderm) are useful in mixed depth burns, & they need to be changed every 3-5 days.
- Biological, synthetic (eg biobrane) & natural (eg amniotic membrane) dressings also provide good healing environments & do not need to be changed.

Analgesics

- Superficial burns, respond well to simple **oral** analgesia. Topical cooling is especially soothing.
- Large burns require **continuous** analgesia, beginning with infusions & continuing with oral tablets eg slow release morphine.
- Powerful, short acting analgesia should be given **before dressing changes**.

Energy balance & nutrition

- Burns patients need extra feeding.
- A **nasogastric tube** should be used in all patients with burns over 20% TBSA, & feeding should start **within 6 hours** of the injury to reduce gut mucosal damage.
- Removing the burn & achieving healing stops the catabolic drive.
- **Monitored** by measuring weight & nitrogen balance.

Other Considerations

- **Control of infection**

Burns patients are immunocompromized, & are susceptible to infection from many routes.

- **Sterile precautions** must be rigorous, & swabs should be taken regularly.
- A rise in WBC count, thrombocytosis & increased catabolism are warnings of infection.
- A 5-day course of **penicillin or erythromycin** is required in patients with deep & full thickness burns.
- **Tetanus toxoid** booster should be given in all cases.

- **Prevention of early complications**

- **Acute renal failure** Ô By early & proper restoration of blood volume & maintenance of fluid balance.
- **Curling's ulcers** Ô By prescribing cimetidine or ranitidine.

- **Nursing care**

- Personal hygiene, baths & showers.

- **Physiotherapy**

- **Elevation, splintage & exercise** reduce swelling & improve the final outcome. Physiotherapy needs to be started on day 1.

- **Psychological support**

- Constant encouragement & positive reassurance.

Surgery For Acute Burn Wound

Any deep partial thickness & full thickness burns, except those which are less than about **4 cm²** need surgery.

- **Deep dermal burns** need **tangential shaving & split skin grafting**.
 - Topical adrenaline reduces bleeding, but the anesthetist needs to be ready for significant blood loss.
- **Full thickness burns** require **full thickness excision** of the skin.
 - Wherever possible, a **skin graft** should be applied immediately.
 - With very large burns the use of synthetic dermis or homografts provides temporary stable coverage.

- **Postoperative management**

- Maintenance of fluid balance & hemoglobin level.
- Physiotherapy & splints to maintain range of movement & reducing joint contracture.
- Elevation of appropriate limbs is important.
- Hand must be splinted in a position of function after grafting.

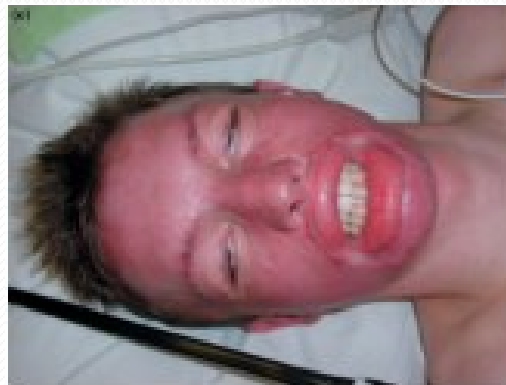
Complications of burns

- *Early*
 - Acute renal failure
 - Curling's ulcers
- *Late*
 - Chronic duodenal ulcer
 - Protein losing enteropathy
 - Chronic renal failure
 - Immune deficiency
 - Marjolin's ulcer
 - Contractures & hypertrophic scars



Delayed Reconstruction & Scar Management

- **Eyelids** must be treated before exposure keratitis arises.
- **Z-plasty** is useful in cases of a single band, & a transposition flap is useful in wider bands of scarring.
- In areas of circumferential or very broad areas of scarring the only treatment is excision & replacement with tissue from either a full **thickness graft** or vascularized **free flap**.
- **Burn alopecia** is best treated with tissue expansion of unburned hair bearing skin.
- Hypertrophy is treated with **pressure garments**; these need to be worn for a period of 6-18 months.
- **Silicone patches** will speed scar maturation, as will intralesional injection of steroid.
- Pharmacological treatment of itch may be required.



- A mixed superficial and deep burn to the face after a petrol explosion. The patient's airway was protected prior to transfer. He has an orogastric tube and feeding has commenced.
- The face dressed with a hydrocolloid dressing. The endotracheal tube is wired to the teeth.
- **Day 6:** the swelling is still present.
- **Six weeks** after injury. With the mouth wide open, the lower eyelids are pulled down, demonstrating the intrinsic and extrinsic shortening of the eyelids.
- **Three months** after injury. The eyelids have been grafted but note the contracture of the lips.
- **Six months** after injury. The patient has had grafts to the upper and lower lips.

Electrical Burns

- Greatest heat occurs at the points of resistance
 - Entrance and Exit wounds
 - Dry skin = Greater resistance
 - Wet Skin = Less resistance
- Longer the contact, the greater the potential of injury
 - Increased damage inside body
- Smaller the point of contact, the more concentrated the energy, the greater the injury

Electrical Burns

- Electrical Current Flow
 - Tissue of Less Resistance
 - Blood vessels
 - Nerve
 - Tissue of Greater Resistance
 - Muscle
 - Bone
- Results in
 - Serious vascular and nervous injury
 - Immobilization of muscles
 - Flash burns

Electrical Burns

- Categories: high voltage (>1000 volts), low voltage, lightning
- **High voltage**: requires trauma evaluation
 - Local injury, deep injury, fractures, blunt injuries
 - Risk of rhabdomyolysis, compartment syndrome, cardiac injury
- **Low voltage**: common in children
 - Local injury
- **Late complications**: cataracts, progressive demyelinating neurologic loss

Chemical Burns

- Chemical destroys tissue
 - Acids
 - Form a thick, insoluble mass where they contact tissue.
 - Coagulation necrosis
 - Limits burn damage
 - Alkalies
 - Destroy cell membrane through liquefaction necrosis
 - Deeper tissue penetration and deeper burns

Chemical Burns

- Empirical treatment
- End the exposure
- ABCDE
- Alkalis generally cause worse damage
- Initial treatment for acid or alkali: irrigation with water
- Dry powder should be brushed off
- Hydrofluoric acid: can cause severe hypoCa

Radiation Injury

- Radiation

- Transmission of energy
 - Nuclear Energy
 - Ultraviolet light
 - Visible Light
 - Heat
 - Sound
 - X-Rays

- Radioactive Substance

- Emits ionizing radiation
- Radionuclide or Radioisotope

Assessment & Management of Electrical, Chemical & Radiation Burns

- **Electrical Injuries**

- **Safety**

- Turn off power
- Energized lines act as whips
- Establish a safety zone

- **Lightning Strikes**

- High voltage, high current, high energy
- Lasts fraction of a second
- No danger of electrical shock to EMS

● Assess patient

- Entrance & Exit wounds
- Remove clothing, jewelry, and leather items
- Treat any visible injuries
 - Thermal burns
- ECG monitoring
 - Bradycardia, Tachycardia, VF or Asystole
 - ACLS Protocols
 - Treat cardiac & respiratory arrest
 - Aggressive airway, ventilation, and circulatory management.
- Consider Fluid bolus for serious burns
 - 20 ml/kg
- Consider Sodium Bicarbonate: 1 mEq/kg
- Consider Mannitol: 10 g

- **Chemical Burns**

- Scene size-up

- Hazardous materials team
 - Establish hot, warm and cold zones
 - Prevent personnel exposure from chemical

- Specific Chemicals

- Phenol
 - Dry Lime
 - Sodium
 - Riot Control Agents

- **Specific Chemicals**

- **Phenol**

- Industrial cleaner
 - Alcohol dissolves Phenol
 - Irrigate with copious amounts of water

- **Dry Lime**

- Strong corrosive that reacts with water
 - Brush off dry substance
 - Irrigate with copious amounts of cool water

- **Sodium**

- Unstable metal
- Reacts vigorously with water
 - Releases
 - Extreme heat
 - Hydrogen gas
 - Ignition
- Decontaminate: Brush off dry chemical
- Cover the wound with oil substance

• Riot Control Agents

- Agents
 - CS, CN (Mace), Oleoresin, Capsicum (OC, pepper spray)
- Irritation of the eyes, mucous membranes, and respiratory tract.
- No permanent damage
- General Signs & Symptoms
 - Coughing, gagging, and vomiting
 - Eye pain, tearing, temporary blindness
- Management
 - Irrigate eyes with normal saline



● **Radiation Burns**

- Notify Hazardous Materials Team
- Establish Safety Zones
 - Hot, Warm, & Cold
- Personnel positioned Upwind and Uphill
- Decontaminate ALL rescuers, equipment and patients

The End!