BURNS

Prepared by
PhD ZULFIYYA ISMAYILOVA

***Burns* are the damages to tissues caused by their exposure to thermal, chemical, electrical, or radiation energy.**

A) Causes

1. Thermal: dry heat, hot metal, glass or other objects, steam, flame, hot liquids (scalds)

2. Chemical: strong acids, alkalis. Alkaline burns tend to be more severe causing more penetration deeper into the skin by liquefying the skin (colliquation necrosis).

3. Electrical: high voltage burns (more than 1000 volts), low voltage burns (less than 1000 volts)

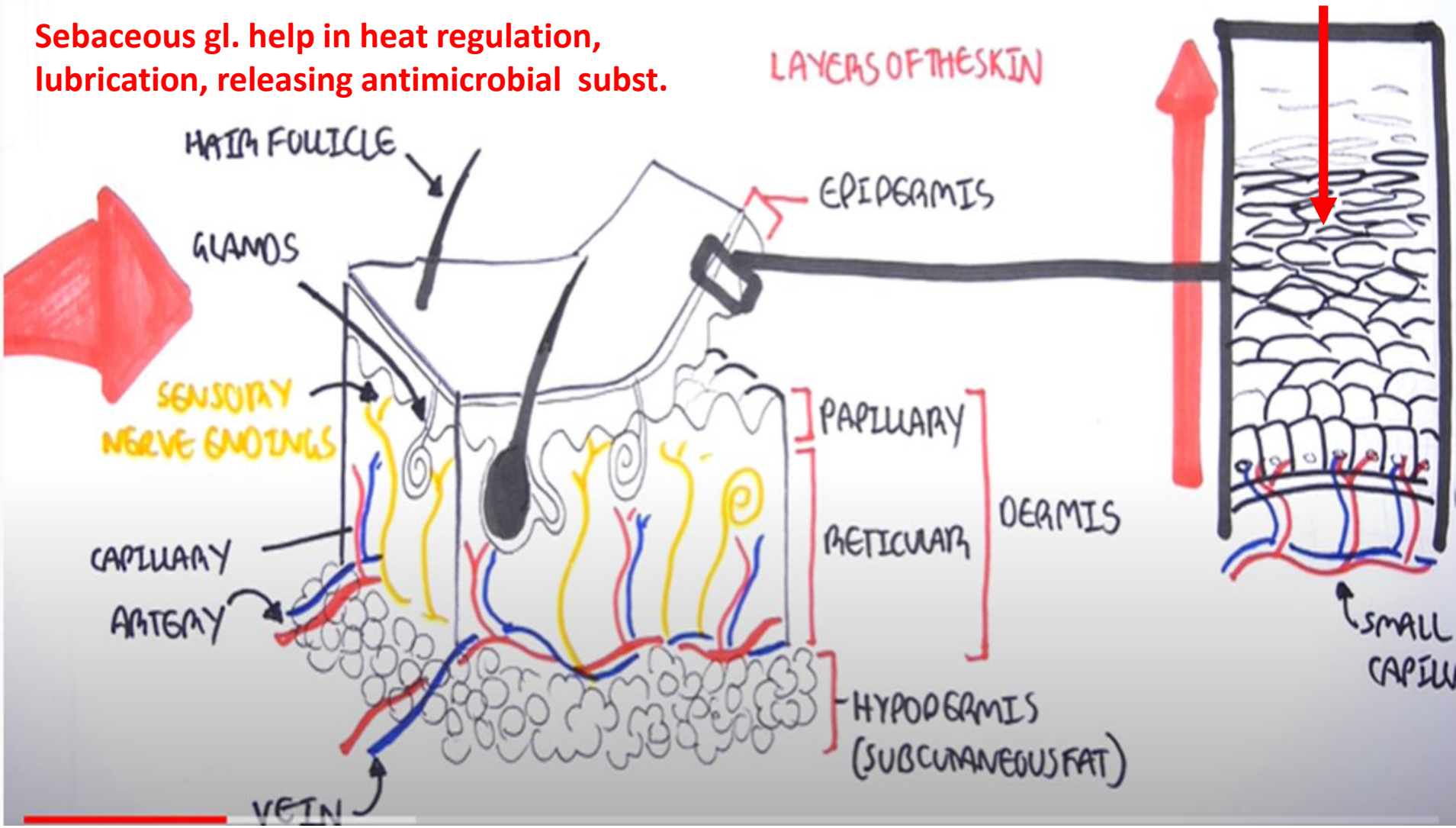
4. Radiation.

Flame and scald burns are the leading cause of burns.

NORMAL SKIN ANATOMY

As cells divide and move up they have less and less blood supply until they die

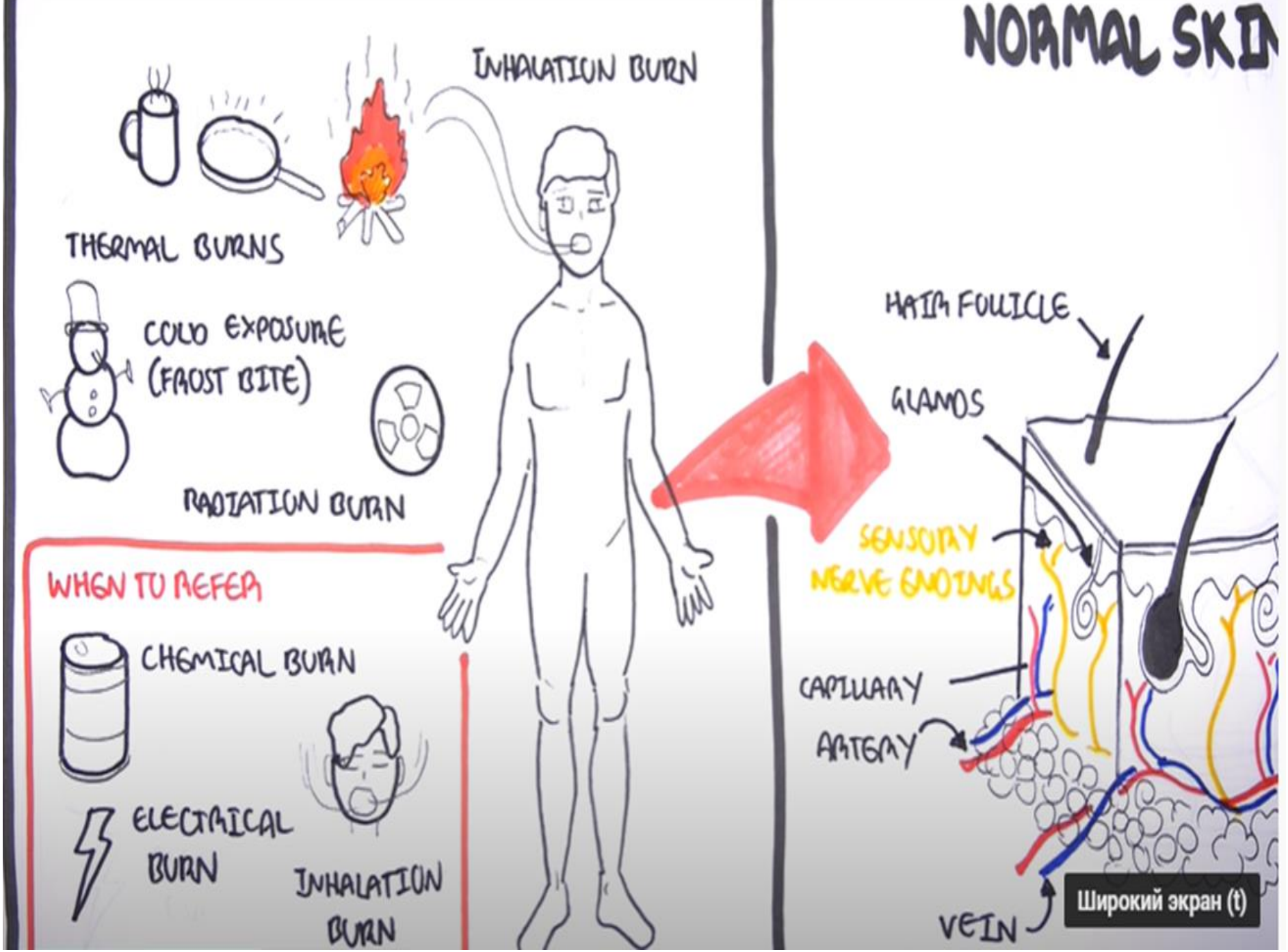
Sebaceous gl. help in heat regulation, lubrication, releasing antimicrobial subst.



Depth of damage

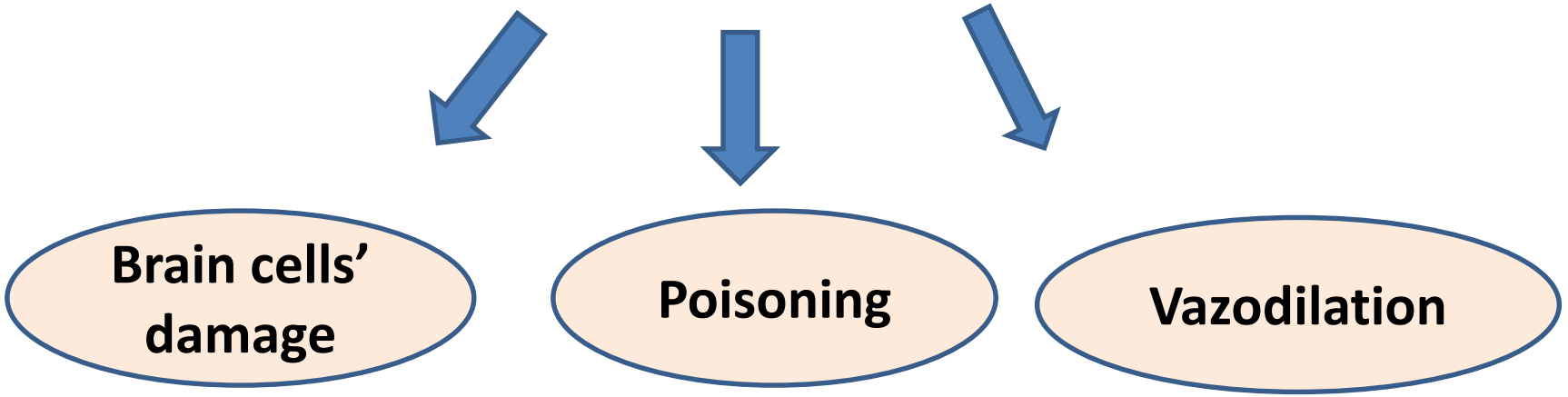
- **Degree 1** ⟹ epidermis.
- **Degree 2** ⟹ epithelium up to the **basal layer.**
- **Degree 3** ⟹ dermis.
- 3a - epithelial necrosis with partial involvement of the basal layer; hair follicles, sweat and sebaceous glands are intact.
- 3b - complete necrosis of the dermis, basal layer and part of the subcutaneous layer.
- **Degree 4** ⟹ complete necrosis of the skin and underlying tissues.

- **Depth of the burn is directly proportional to the temperature and duration of exposure time (**how high temperature is and how long it stays in contact with the skin).


INHALATION BURN
THERMAL BURNS
COLD EXPOSURE (FROST BITE)
RADIATION BURN
WHEN TO REFER
CHEMICAL BURN
ELECTRICAL BURN
INHALATION BURN
NORMAL SKIN
HAIR FOLLICLE
GLANDS
SENSORY NERVE ENDINGS
CAPILLARY
ARTERY
VEIN
Широкий экран (t)

INHALATION BURN (IB)

- IB can compromise airway and cause significant lung injury.
- IB occurs if patients have been burned in a confined space.
- Hb → carboxy Hb.



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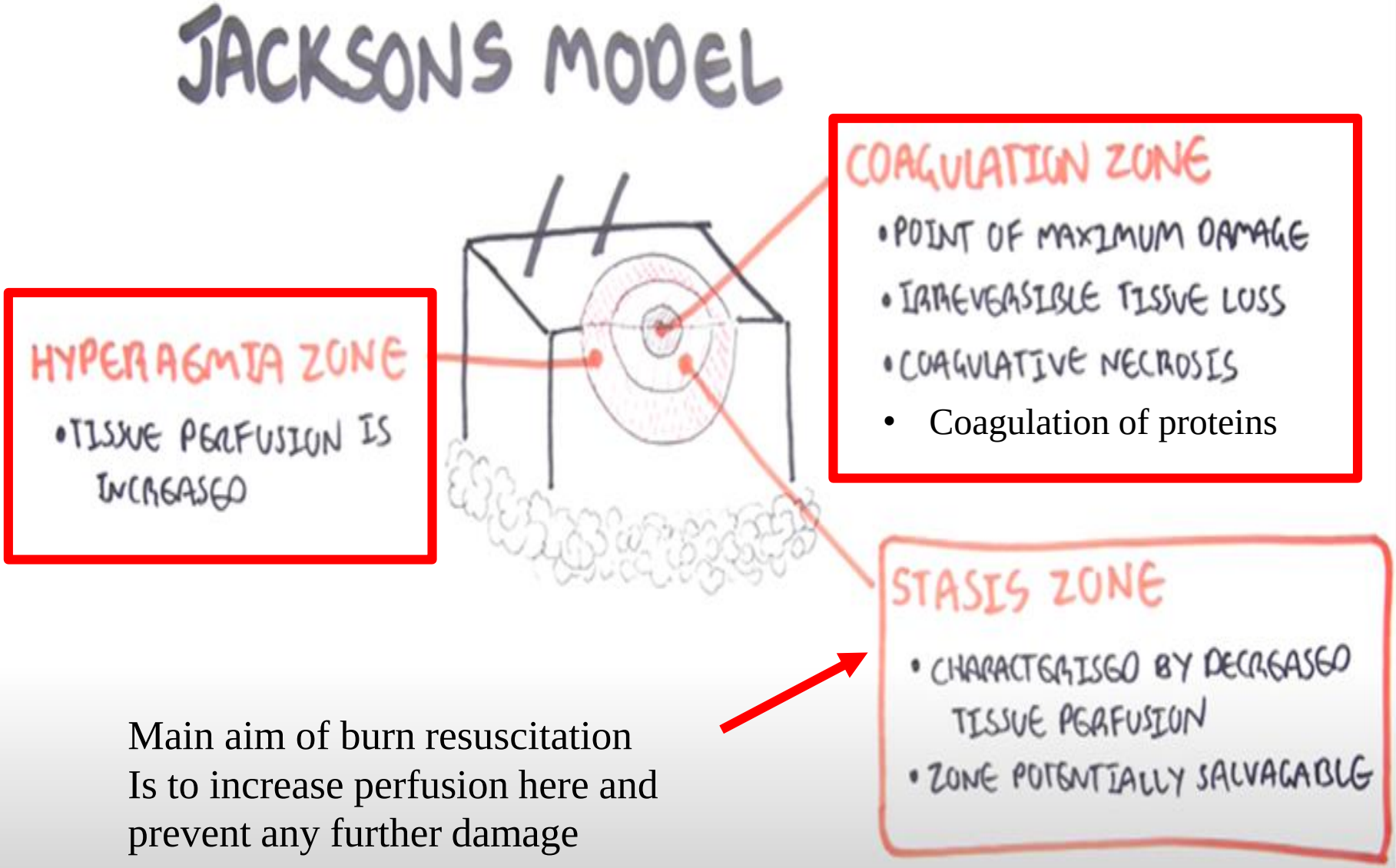
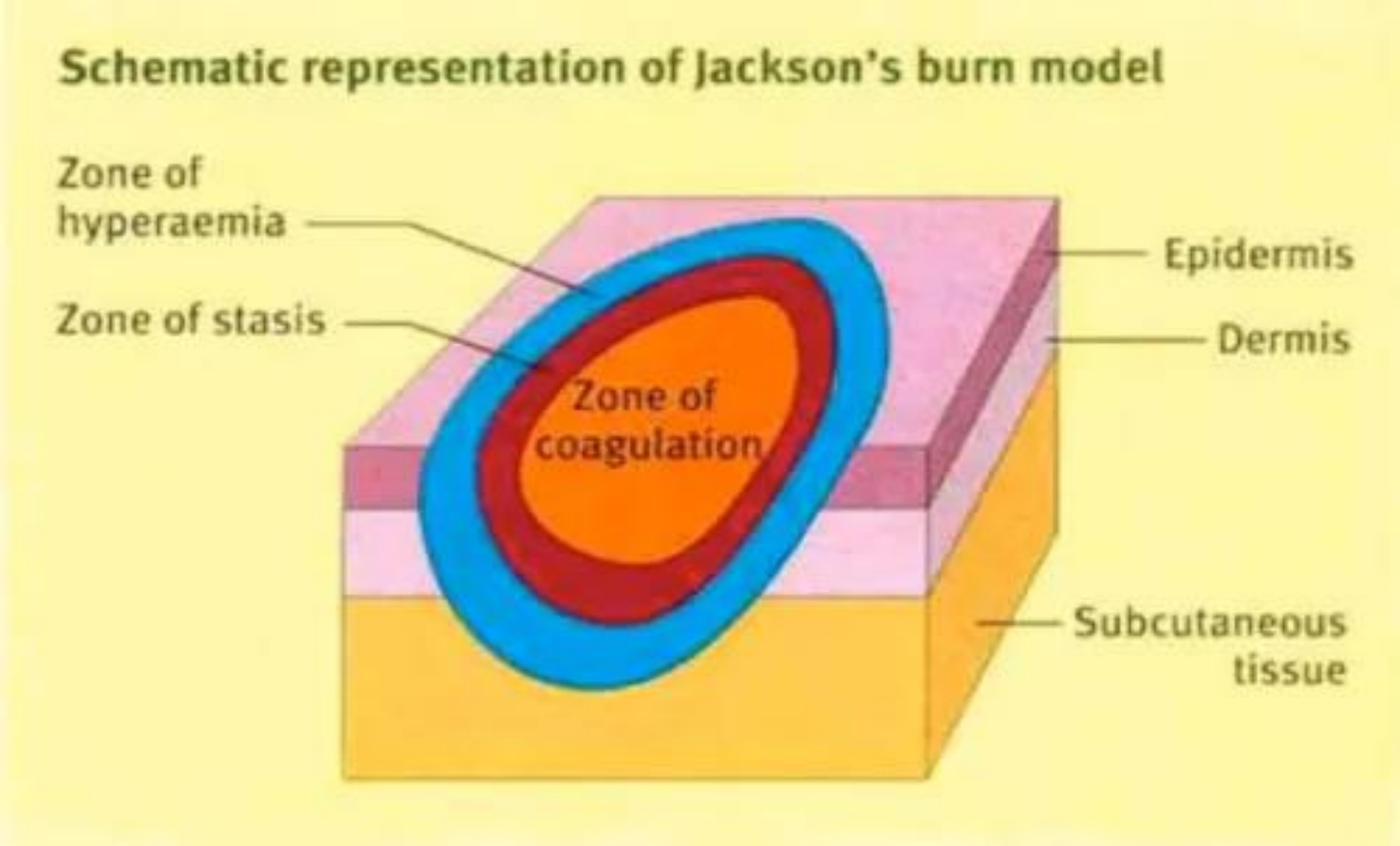
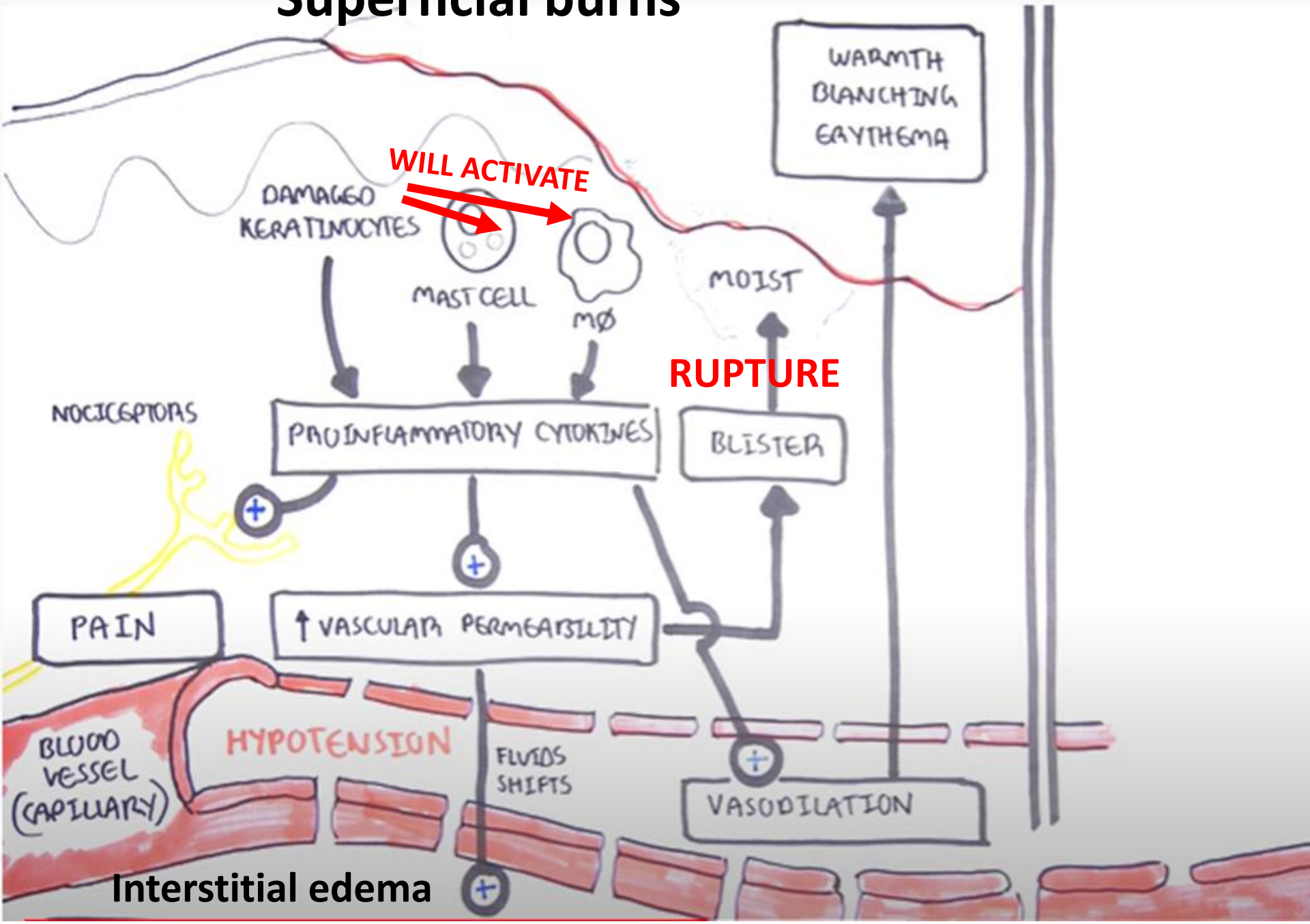


Main aim of burn resuscitation
Is to increase perfusion here and prevent any further damage

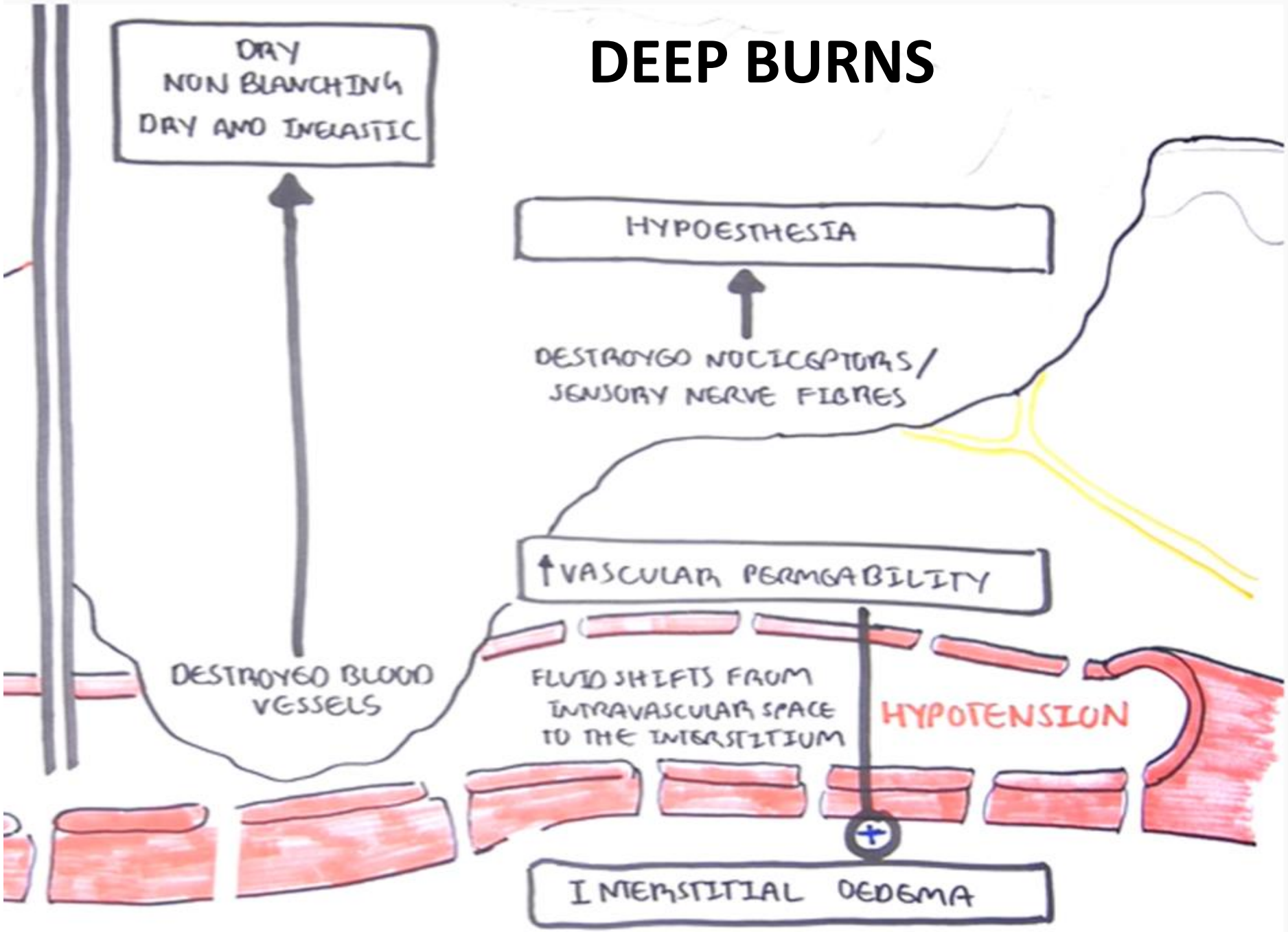
The ischemic zone may progress to full necrosis unless the ischemia is reversed

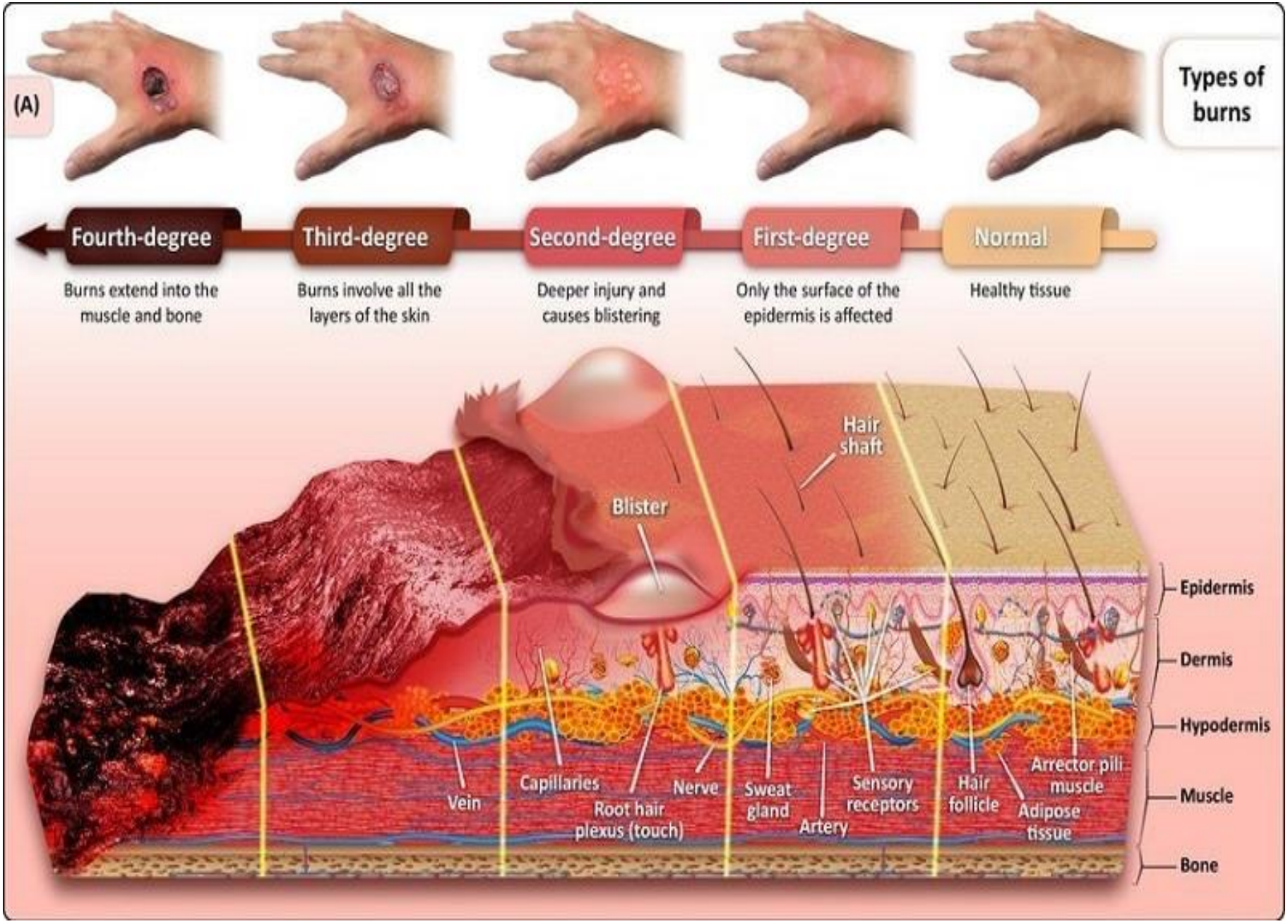


Superficial burns

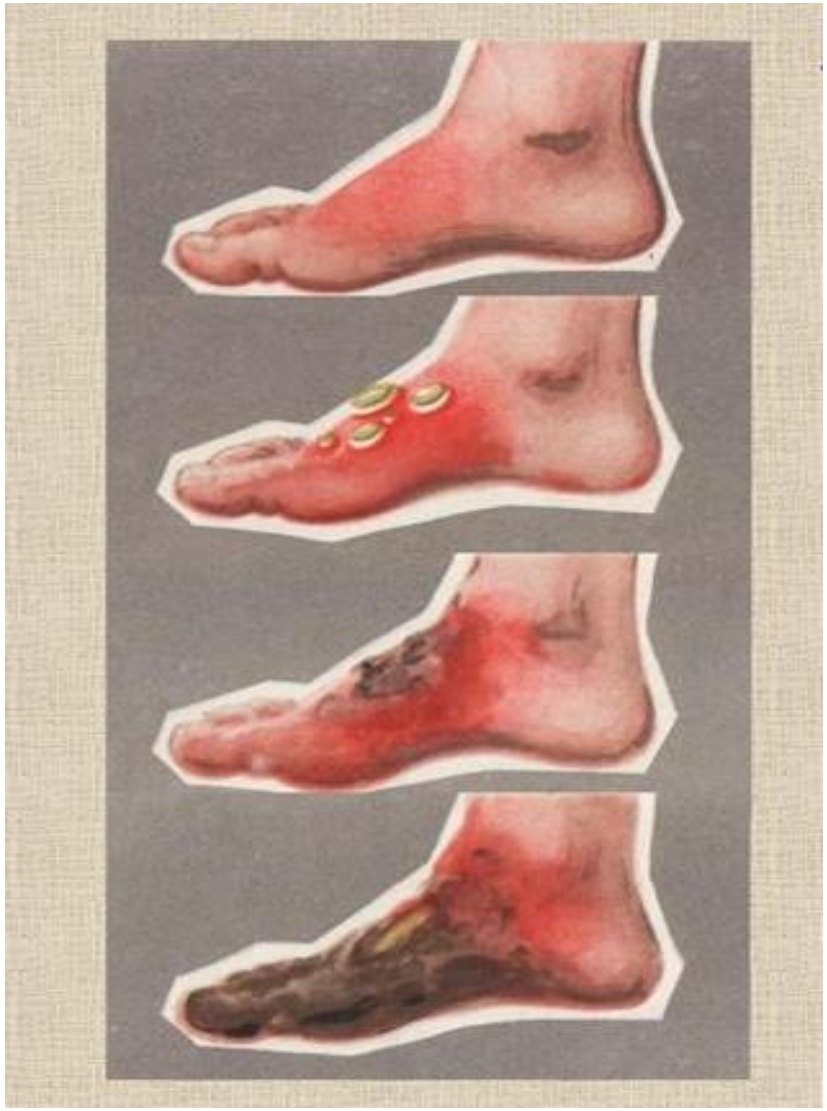


DEEP BURNS


DRY
NON BLANCHING
DRY AND INELASTIC
HYPOESTHESIA
DESTROYED NOCICEPTORS/
SENSORY NERVE FIBRES
↑VASCULAR PERMEABILITY
DESTROYED BLOOD
VESSELS
FLUID SHIFTS FROM
INTRAVASCULAR SPACE
TO THE INTERSTITIUM
HYPOTENSION
+
INTERSTITIAL OEDEMA


(A)
Types of burns
Fourth-degree
Third-degree
Second-degree
First-degree
Normal
Burns extend into the muscle and bone
Burns involve all the layers of the skin
Deeper injury and causes blistering
Only the surface of the epidermis is affected
Healthy tissue
Hair shaft
Blister
Epidermis
Dermis
Hypodermis
Muscle
Bone
Vein
Capillaries
Root hair plexus (touch)
Nerve
Sweat gland
Artery
Sensory receptors
Hair follicle
Arrector pili muscle
Adipose tissue

Burn degrees



1. Hyperemia, edema, pain

2. Blisters with serous fluid

3. Skin necrosis, brown eschar formation

4. Necrosis and charring of all tissues

BURNS

2 DAYS

2.5 DAYS

3 DAYS

4 DAYS

1 WEEK

10 DAYS

3 degree thermal burn

BURNS

Burns- Classification and Treatment.mp4

The severity of burns depends on the area and depth of damage.

1. The «rule of nine». According to this rule, the TBSA is divided into areas that are multiples of 9%:

- head and neck - 9%,
- upper limb - 9%;
- anterior part of the trunk - 18%,
- the back - 18%,
- lower limb - 18% (thigh - 9%, leg and foot - 9%),
- the external genitals - 1%.

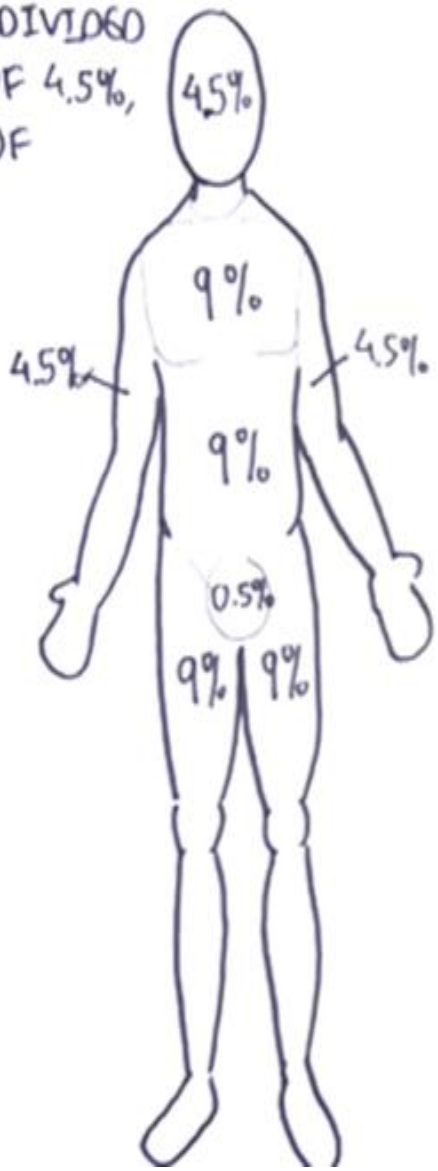
2. *The «rule of palm»*

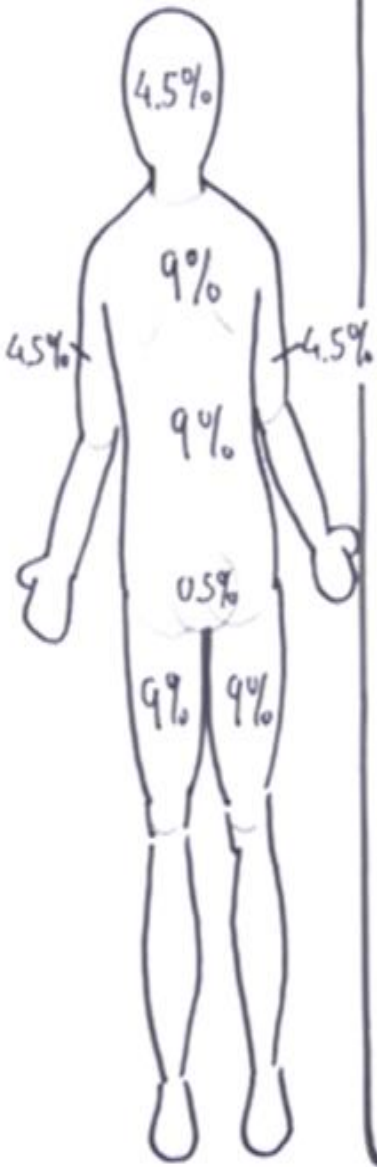
- **The size of an adult palm is about 1% of the body surface area.** The palmar surface of the patient's hand, including the fingers, represents ~ 1% of the patient's body surface.
- Palmar method is useful in **small and scattered (diffuse) burns.**

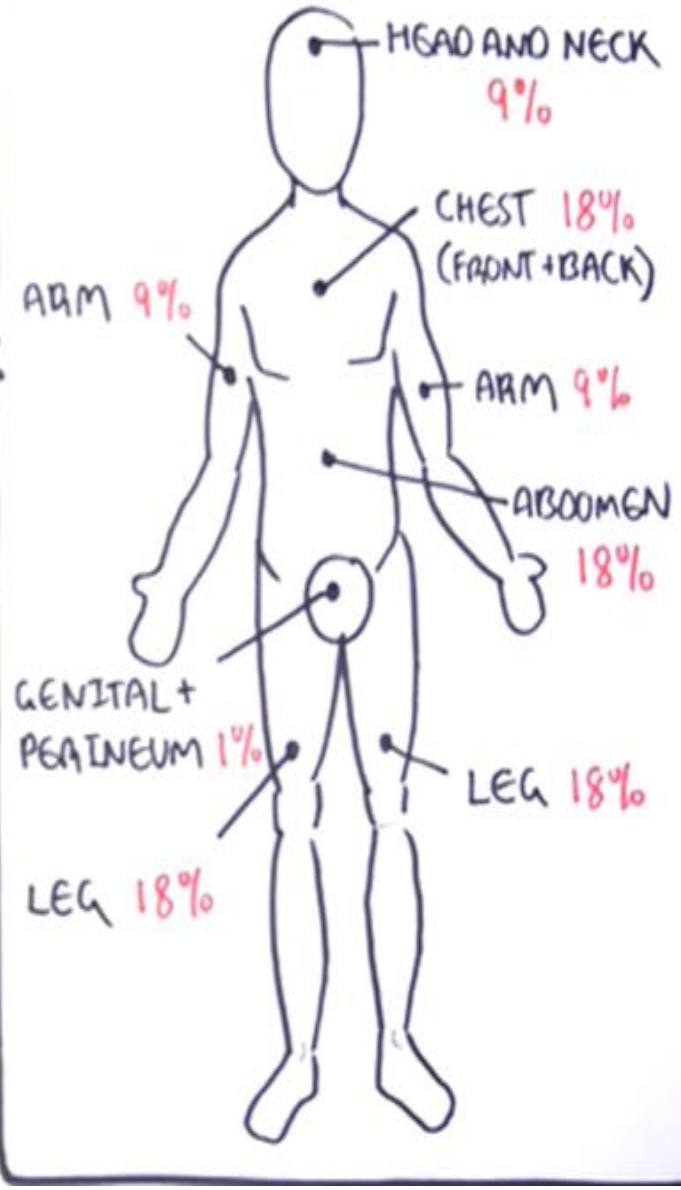
CLASSIFICATION - SIZE OF BURN - RULE OF NINES

- GREAT RAPID ASSESSMENT
- THE BODY IS DIVIDED INTO AREAS OF 4.5%, 9% OR 18% OF

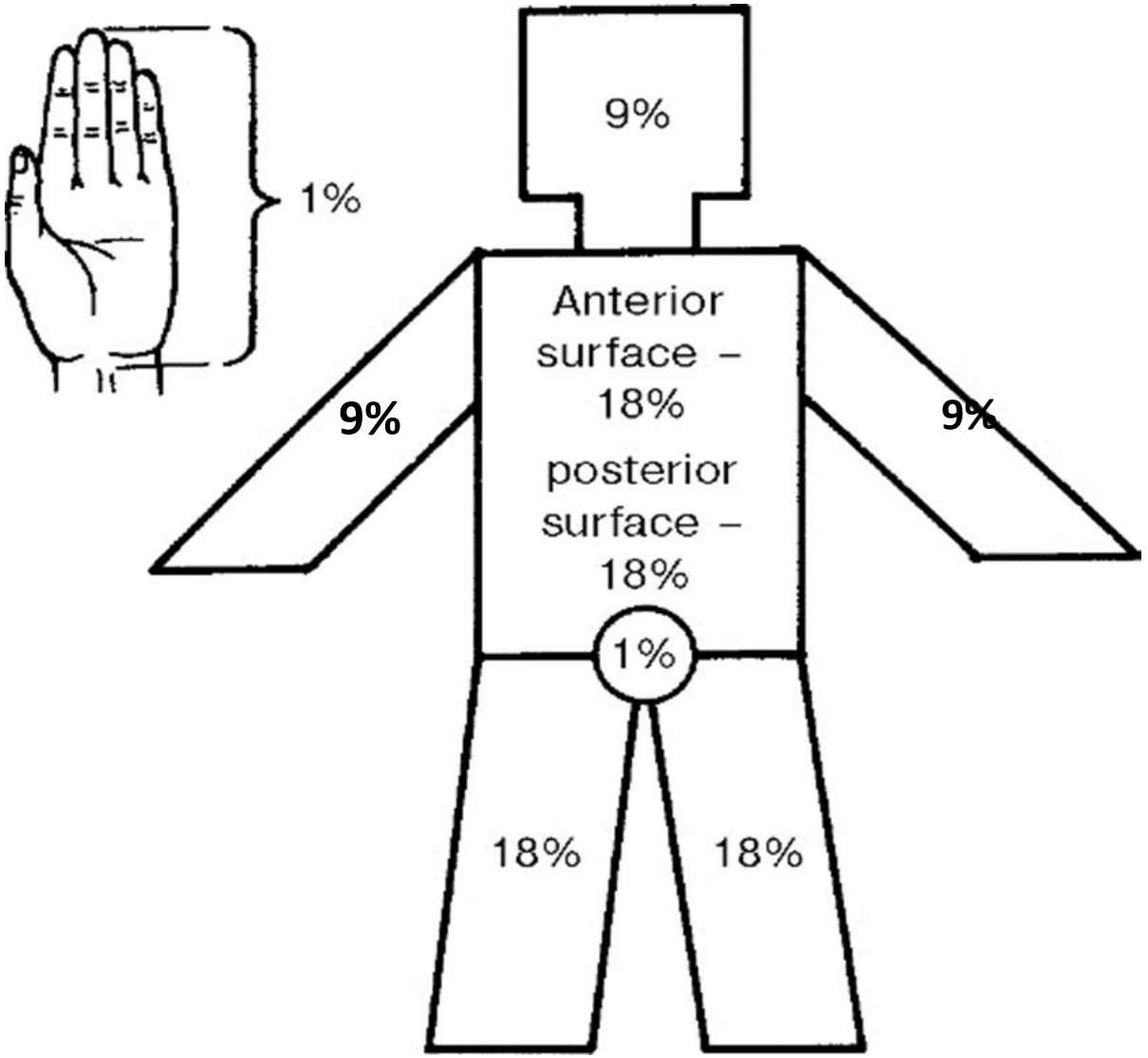
TOTAL
BODY
SURFACE
AREA







THE ASSESSMENT OF BURN AREA (WALLACE'S RULE OF NINE)



PALMAR METHOD - SIZE OF BURN

PALM AND FINGER OF THE PERSON :

1% TBSA

BURN 1%

USEFUL FOR SMALL AND SCATTERED BURNS

PERSON'S PALM

- **Assessment of the depth of burns.** The classification of burns into superficial and deep is primarily based on the skin's capability of regenerating through epithelization in superficial burns .

- The evaluation of skin sensation is used. In *superficial* burns, pain sensation at the affected areas is intact, while in deep burns it is lost.

- In ***deep burns*** of a limb, unaffected areas below the affected ones become edematous.
- The method of infrared thermography
- The depth of burns can be established on **days 7-14** following the injury.

Evaluation of severity of burns. In adults, the rule of 100 can be used (age in years + general burns area in %:

total score shows prognosis

- **up to 60 - good prognosis;**
- **61-80 - relatively good prognosis;**
- **81 - 100 - doubtful prognosis; above 100 - poor prognosis).**

- ***Frank's index*** is more specific and involves determination of both the area and depth of damage.
- **1% = 1 ⟹ SB 1% = 3 ⟹ DB**
- **Thus, if 1% of a superficial burn equals one point, 1% deep burn equals three points.**
- The total sum ⟹ Frank's index.
- good ⟹ below 30, relatively good - 31-60 sites, doubtful ⟹ 61-90
- poor ⟹ above 90 sites.

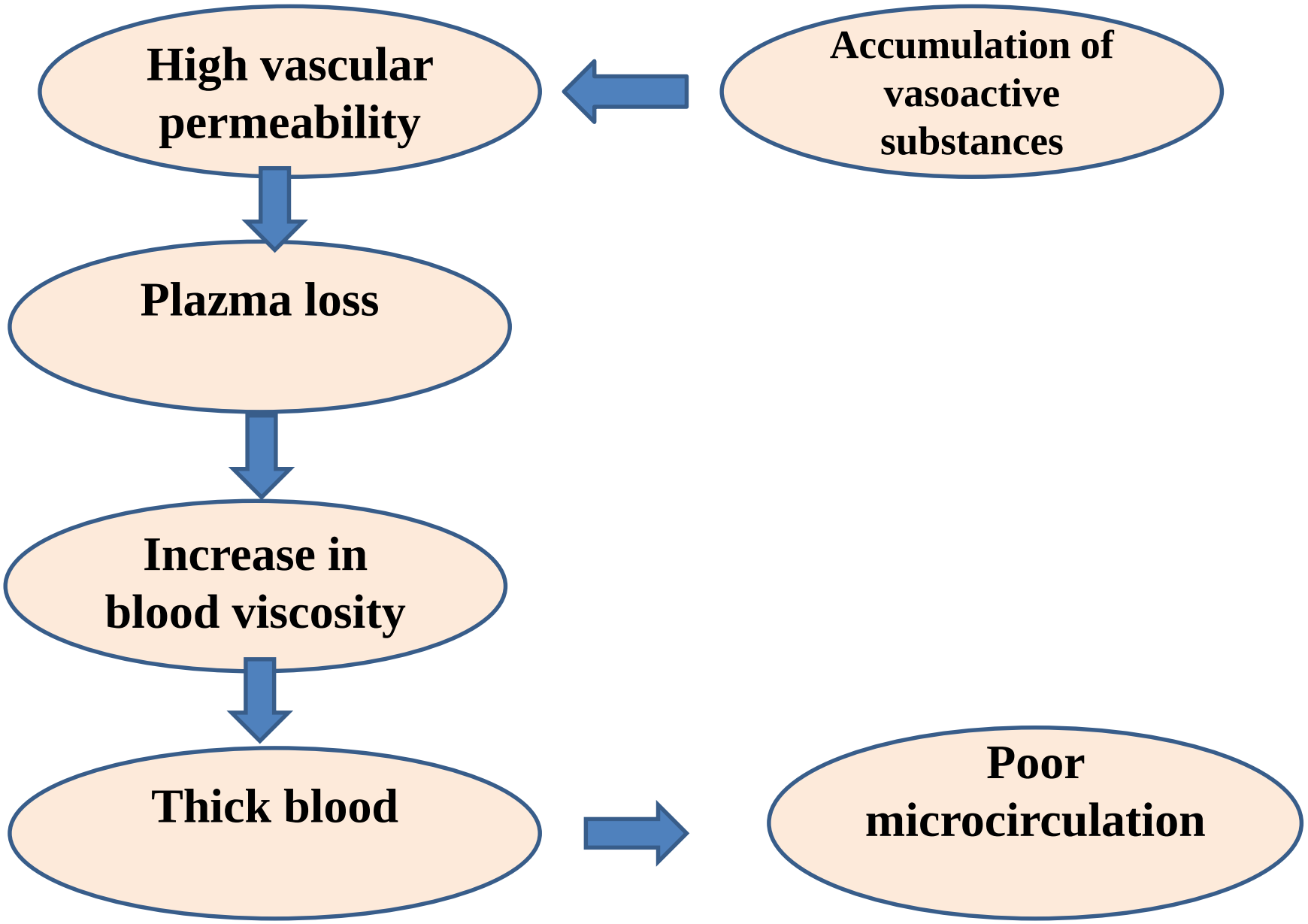
BURN DISEASE

- Superficial burns (degrees 2-3a) area is above 15%
- Deep burns area is more than 10% of body surface.

1. Burn shock;
2. Acute burn toxemia;
3. Septicaemia;
4. Recovery.

Burn shock.

- The manifestations of burn shock, which may last **2-72 hours,** depend on its duration and severity of circulatory defects.


High vascular permeability
Accumulation of vasoactive substances
Plazma loss
Increase in blood viscosity
Thick blood
Poor microcirculation

Acute burn toxemia.

During this period toxic products enter the blood stream, this situation leads to severe intoxication.

Burn toxemia manifests by:

- ✓ fever,
- ✓ tachycardia,
- ✓ dullness of heart sounds,
- ✓ anemia, hypo- and dysproteinemia,
- ✓ impairment hepatic and renal functions.

Acute burn toxemia continues **for 7-8 days.**

Septicemia.

- Septicemia starts **on 10-th day**
- Common causative agents → *Pseudomonas, Staphylococcus, and Proteus spp, E. coli*
- signs of general deterioration, which in severe cases may present as weight loss
- skin dryness and pallor
- pronounced muscular atrophy,
- bed sores and contractures of joints.

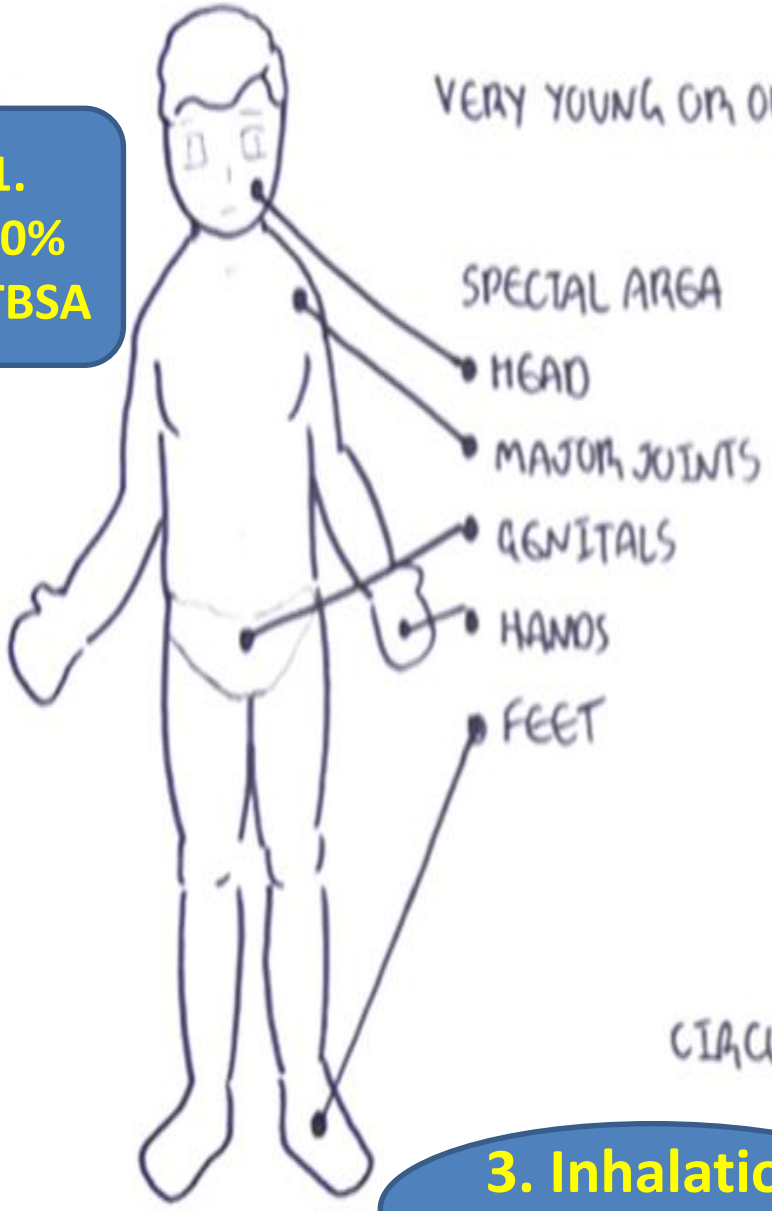
- The separation of the necrotic eschar starts on **days 7-10,**
- the period is characterized by proliferation of microbes and development of septic conditions (pneumonia, bed sores, pyelonephritis and sepsis).
- Complete skin regeneration is indicative of the end of the septicemic period.

Recovery

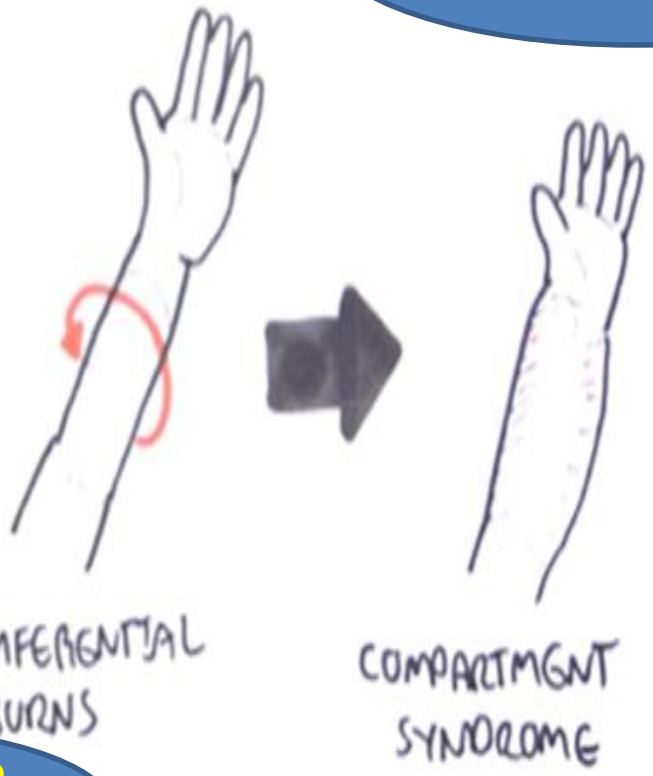
- Recovery is characterized by restoration of bodily functions, which have been affected previously, i.e. during the earlier three periods of the disease.
- As the functional organ changes (for ex. those of the heart, liver, kidneys) can persist for as long as 2-4 years after the trauma, the patients with a history of burn disease should be followed up regularly.

WHEN TO REFER BURNS TO BURN UNIT

1. >10% of TBSA



2. FULL THICKNESS BURNS



3. Inhalation burns

- First-degree burns are usually treated with home care.
- soaking the wound in cool water
- taking analgesics for pain relief
- applying combined ointments with anesthetic (lidocaine)
- Never apply cotton balls to a burn because the small fibers can stick to the injury and increase the risk of infection. Also, avoid home remedies like butter and eggs as these are not proven to be effective.

- in more serious cases ***First aid*** should aim at terminating the burning process and cooling the burnt area.
- Remove constricting clothing, jewelry. Cooling is achieved with cold water, ice packs (?).
- Be carefully! Cooling may cause hypothermia, especially in children, and may worsen shock.
- Cover the patient with warm, clean and dry linens, prevent hypothermia!

Airway

- The airway above the glottis is very susceptible to obstruction because of exposure to heat. The clinical presentation of inhalation injury may be subtle and often does not appear in the first 24 hours.
- **Clinical indications of inhalation injury include:**
  - Face and neck burns, Carbon deposits and acute inflammatory changes in the oropharynx.
  - Singeing of the eyebrows and around the nose.
  - Carbon particles seen in sputum; Hoarseness.
  - Explosion, with burns to head and torso.

- Diagnosis of CO poisoning is made primarily from a history of exposure.
- Patients with CO levels of less than 20% usually have no physical symptoms.
- Higher CO levels may result in headache and nausea, confusion, coma and death.
- CO dissociates very slowly but this is increased by breathing high-flow oxygen via a non-rebreathing mask.

Pain management

- Analgesics and non-steroidal inflammatory drugs,
- in case of extensive burns - phentanyl and droperidol,
- inhalation of nitrous oxide in combination with oxygen.
- Apart from **analgesics, neuroleptics** and **antihistamines** prior to transportation
- After the pain has subsided → aseptic non-adhesive dressing. During this period, topical treatment should be avoided.
- assess the need for tetanus prophylaxis.

- Apply aseptic dressing
- Keep the patient warm (warm tea and mineral water)
- If the patient is going to be transported for a long distance, start IV therapy, oxygen therapy and general anesthesia (nitrous oxide), and cardiovascular agents.

- **Resuscitation** of the patient in the state of shock should be started at the stage of first aid, before admittance to hospital and continued in hospital.

Baseline determination for the major burn patient:

- **Blood:** FBC, type and cross match, carboxyhemoglobin, serum glucose, electrolytes, and pregnancy test in all females of childbearing age. Arterial blood gases.
- **CXR.**
- **Cardiac monitoring:**
- **Circulation:** severely burned patients may have hypovolemic shock
- Monitoring hourly, daily urinary outputs (indwelling urinary catheter should be inserted).

Intravenous access and fluid replacement

- Any adult with burns affecting more than 15% of the TBSA (where superficial burns are disregarded) or a child with more than 10% of the TBSA burned requires fluid replacement.
- Put large-calibre intravenous line, start IV therapy
- Replacement fluids required in the first 24 hours from the time of injury aim **to maintain a good urine output - 0.5-1 ml/kg in adults, 1-2 ml/kg in children.**

- **Adults:**

- For partial-thickness and full-thickness burns, or those with associated inhalation injury, use 4 ml of Hartmann's solution/kg body weight/% total body surface area (superficial burns are discounted here).
- Half of this calculated volume is given in the first 8 hours and the other half is given over the following 16 hours.

1. in the antishock ward

- analgesics (fentanyl + droperidol), antihistamines.
- Transfusion of plasma solutions (native and dry plasma, albumin, protein), whole blood, solutions that improve circulation, detoxication solutions, saline solutions (10% glucose, acesol, disol, trisol, lactosol).
- Improving cardiac function by giving digitalis derivatives.
- Improving microcirculation with euphyllin, intravenous droperidol and 0,25% novocain).

- Restoration of renal function (mannitol, lasix in mild cases, intravenous infusion of 20% sorbitol solution in severe cases).
- The most plasma is usually lost within the first 8 to 12 hours and continues for about 2 days. In extensive burns, plasma loss can reach at least 6-8 l/day, the daily loss of protein being at least 70-80 g.
- Injection of hydrocortisone (125-250 mg) or prednisolone (60-90 mg) after circulating blood volume has been restored.

There are several methods to calculate the fluid requirement, the principles of which can be as follows:

1. The volume of fluid given should not exceed 10% of the patient's body weight.

2. Within the first 8 hours after injury 1/2 or 2/3 of the daily amount of fluid required should be given.

3. On days 2 and 3, the amount of fluid given should not exceed 5% of the body weight.

Of practical importance is the **Brock's formula:** [2 ml × body weight × the surface area burnt (unless the burn is of degree 1) + 2000 ml of 5% glucose solution.

The effectiveness of treatment is assessed based on clinical features, hemoglobin and hematocrit values; of great importance are the central venous pressure values and those of hourly diuresis.

- ***Local treatment.*** The two topical (closed and open) methods are used for burns. First, primary wound toileting is done.
- The skin around the burnt areas is cleansed with swabs soaked in 0,25% ammonium, 3-4% boric acid, warm soapy water, with subsequent application of alcohol.
- Pieces of clothing, foreign bodies, peeling epidermis are removed from the wound; large blisters are opened to drain their contents, minor ones being left alone.

- Fibrin deposits are usually left intact since it is under these where regeneration takes place.
- Excessively dirty burnt areas are cleansed with 3% hydrogen peroxide. Sterile gauze or tissues are used to dry the burnt surface.
- As a rule, the primary wound toileting is done after 1-2 ml of promedol or omnopon have been injected subcutaneously.

The *closed* method (bandaging or covering with dressing material) is the most commonly used and has a number of advantages as follows:

- isolation of the wound;
- provision of optimum conditions for the application of topical agents;
- the possibility of active movement of patients with extensive burns during transportation.

Its pitfalls are the following:

- labor intensiveness;
- the expenditure (spending) of large amounts of dressing material;
- painful change of dressing.

- The ***open method*** is void of these disadvantages. In addition, it promotes formation of the thick eschar on the burnt surface.
- It is difficult, however, to implement this method when dealing with patients with deep and wide areas of burns as it requires the use of special equipment (e.g. chambers, cage with electric lamps).
- Moreover, there is always a high risk of wound infection.

The open method is indicated for

- **facial,**
- **genital or**
- **perineal burns.**

The open method requires the use of ointments containing antibiotics (5 and 10% synthomycin emulsions) and antiseptics (0,5% furacilin, 10% sulphacyl) three to four times a day. Suppurated wounds should be dressed. If granulation is found in the areas of deep burns treated with the open method, the closed method should be added.

- Surgical treatment involves several operations:
  - **early necrectomy,**
  - **autodermoplasty,**
  - **limb amputation and**
  - **reconstructive operations.**
- Circular burns of chest and limbs have to be treated by necrectomy. The operation helps reduce the pressure exerted on the underlying tissues. If possible, necrectomy should be performed in the first three days after trauma when shock has resolved.

Indications for early necrectomy are as follows:

1. Deep burns involving 10-20% of the body surface.
2. Burns involving fingers; in such cases it is necessary to prevent excessive scar (webbed fingers) that can affect digital functions.
3. In elderly burn patients, to prevent wound infection and to facilitate early mobilisation.

- **Autodermaplasty** is the only method applied for deep burns (degrees 3b and 4).
- For this operation split thickness skin flaps (dermatome plastic), full thickness flaps on vascular peduncles, as well as migrating (Filatov's) stalks are used. The operation can be performed either under local or general anesthesia.
- To cover the burnt surface in deep burns cultured autofibroblasts or fetal fibroblasts can be used.

The using of cloned allofibroblasts in combination with autodermoplasty

C H E M I C A L B U R N S

- These are caused by concentrated solutions of acids and alkali (base), which leads to necrosis of the skin and mucosal membranes that may extend to deeper lays.
- Acids cause
  - *dry,* or coagulation, *necrosis,* while alkali cause
  - *wet,* or colliquative, *necrosis.*
- The common culprits are sulphuric, hydrochloric acid, and sodium hydroxide.
- Chemical burns are most commonly localised.

Examination of the patient reveals burnt areas with clear borders.

Strips of bands can be seen leading from the damaged areas, which form as a result of the trickling of the acid or base, or separate areas of necrotic spots are encountered when the chemical substance was sprinkled.

- Acids cause tissue dehydration, eschars form that are located deeper than the intact skin.
- When the burn is caused by sulphuric acid, the eschar formed is grey, dark brown or black, nitric acid - yellow, hydrochloric - greyish yellow, acetic - greenish.
- Wet necrosis caused by alkali burns appears as a thick jelly mass of grey color. The necrotic skin is on the same level with the intact skin or occasionally a bit swollen up.
- Chemical burns of the first and second degrees are considered ***superficial***, third and fourth degree burns are regarded as ***deep*** burns.

- In first degree burns patients complain of pains, and burning sensation.
- Examination of the burnt area reveals an outlined area of hyperemia with minimal swelling of the skin, which is more pronounced in alkaline burns.
- All types of sensory functions are intact, pain sensation is exaggerated.

THE CHEMICAL BURNS

THE CHEMICAL BURNS AFTER GETTING A HOLIDAY HENNA TATTOO

In second-degree burns dry (in acid burns) or jelly-like/soapy (in alkaline burns) superficial skin eschars are found. The eschar is very thin and easily creased.

In deep (third and fourth degree) chemical burns, thick firm skin eschar is found, which cannot be creased. The eschar is immobile and appears as wet necrosis in alkaline burns and dry necrosis in acid burns. All types of sensation are lost. It is not possible to differentiate between third and fourth degree chemical burn at the first examination.

In third degree of burns, all skin layers are necrotised, in the fourth degree, necrosis develops as deep as to the bone.

It is only at the third - fourth week after injury when the eschar begins to separate and the depth of damage can be established:

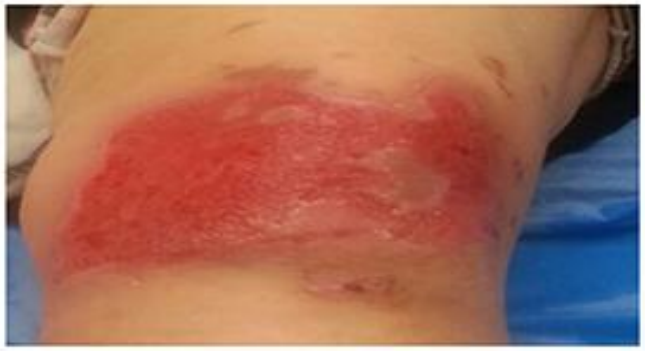
- if only necrotised skin peels off then it is a third degree burn,
- in case deeper lying tissues separate, it is a fourth degree burn.

The examples of the acid burns










Alkaline burn with cement

- ***First aid*** → remove of the chemical agent from the skin as early as possible
- wash the area under running water for 10-15 min,
- in fluoric acid burns wash for 2-3 hours.
- Washing should be continued until the smell of the chemical disappears or until the color of the litmus paper placed on the area has changed.

- In burns caused by lime, washing is not allowed because the resulting chemical reaction produces more heat to lead to thermal burns in addition.
- Remove lime mechanically. After the chemical agent has been removed, apply sterile dressing and transporte the patient to the hospital.

Electrical burns

High-voltage electric current can cause electrical burns at the entry and exit sites of the current.

HV EB are always deep, and the underlying tissues are damaged more than the skin itself.

All the tissues on the way of the current get necrotic, the major vessels get thrombosed in addition.

- On the sites of entry and exit of the current «current signs» form. «Current signs» are circular, oval, with normally a diameter of 2-3 cm wounds.
- «Current signs» consist of grey or dark brown colored eschars with depressed centers and edema of the adjacent tissue. Skin sensitivity is decreased. The «figures» of lightning consist of dark greyish brown tree like forms.

High tension electric current injury

SYMPTOMS:

- CONFUSION,
- DIFFICULTY IN BREATHING,
- HEART RHYTM PROBLEMS,
- MUSCLE PAIN, CONTRACTIONS,
- SEIZURES,
- LOSS OF CONSCIOUSNESS
- CARDIAC ARREST.

Electrical burns

High voltage electrical burn

A - Decompression fasciotomy
B - Lower eyelid ectropion

- **First aid** to the person with electric shock → remove the patient from the current
- Resuscitation measures, if necessary,
- Cover the places of burns with sterile dressing.
- Remember! that touching the patient's body can also lead to injury of the one trying to help.
- Turn off the electricity connection.
- Apply CPR.
- All persons after rescue from an electric shock must be sent to the hospital.

THANKS FOR ATTENTION