



Burn Injury & Wound Healing

These are the important notes for this lecture

They are not enough as a studying source, they go along with slides which we worked on.

Good luck =)

Surgery Team

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Burns

Layers of the skin :

1/Epidermis 2/Dermis (appendages) 3/ subcutaneous layer (fat)

Skin appendages example: Sebaceous Glands, Sweat Glands, Hair Follicles, Nails.

We can classify burns according to the cause:

Thermal, **chemical**, **electrical**, **friction** injuries

****A friction burn is usually acquired from a road traffic accident (RTA).**

Extreme cold damage to the skin is called: ***Frost Bite***

Thermal burns:

Fire (flame burn), Hot liquids (scald burn), touching a hot object (contact burn, i.e. an iron),

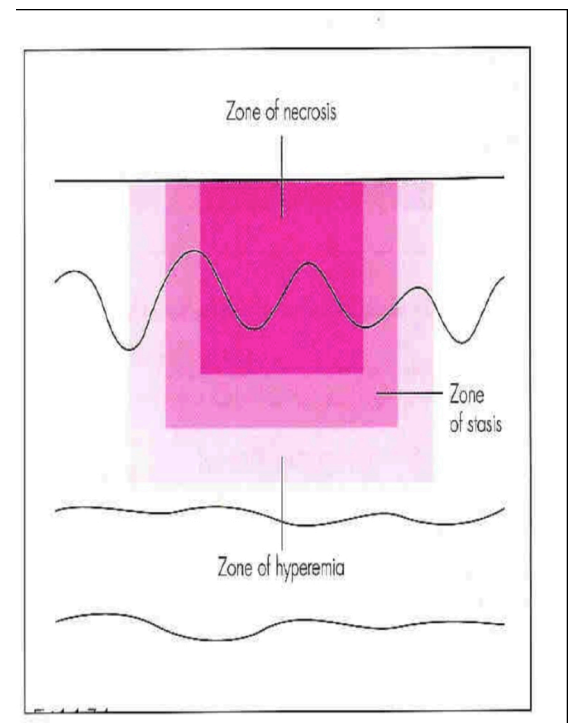
Remember: cellular damage begins at $>45\text{ C}^{\circ}$.

Once an area of the body is burned, there are Three Zones:

1/Central Zone Of Necrosis. → Irreversible

2/Intermediate Zone Of Stasis →the damage is not enough to be irreversible

3/Outer Zone Of Hyperemia →inflammatory response, vasodilatation



A) The Aim of Managing Burns Patients:

Is to prevent the conversion of the *zone of stasis* to *zone of necrosis* and instead shift it to the *zone of hyperemia*.

1-=- Once the burn injury is more than 30% of the body surface area the inflammatory response will be systemic

(SIRS: Systemic Inflammatory Response Syndrome) →

There will be *systemic vasodilatation*, the fluid will shift from the intravascular space to the extra vascular space →

Hypo-perfusion to the vital organs such as the *kidneys*; causing renal failure.

2-=- Also hypo-perfusion to the *intestines* may happen causing Intestinal ischemia → bacteria will shift into the blood stream →

Sepsis

And that's what we call bacterial translocation (un-managed will lead to death).

****burns are serious and could be lethal →**

Inhalation injury, bacterial translocation, sepsis → if unmanaged then quick death!!

*In the past doctors thought that burn patients die from dehydration but now they discovered that the cause of death is sepsis (bacterial translocation).

What to do in the ER:

1/Check the ABC RULE (A= Air way, B= breathing, C= Circulation)

2/Take detailed history! ((Especially if it was a child → it could be abuse)). 3/ IV

access

4/ Blood test

5/ Allergy (mainly to sulfa because *Flamazine* contains it)

6/Quick general exam

7/ Estimate the percentage and depth of the burn.

B) Degree of the burns:

1/ **First Degree (Erythema):** The epidermis is only affected

NO blisters, no scarring, no need for skin grafting, heals after few days. (e.x: sun burn) common in whites

2/**second Degree Burns:** Comparison

	Superficial	Deep
Layers involved	<i>Epidermis</i> and the upper <i>Dermis</i>	<i>Epidermis</i> and most of the <i>Dermis</i> .
Features	Usually no <i>scarring</i> Severe pain! <i>Blanches</i> with pressure <i>Pinkish</i> in color Small <i>blisters</i>	There will be <i>scarring</i> (Unstable scar) Less pain (nerves are damaged) Doesn't <i>blanch</i> with pressure Whitish or <i>cherry red</i> <i>Blisters</i> are bigger → sometimes hemorrhagic
Treatment	flamazine	surgery

**** IMP: BLISTERS ARE ALWAYS IN THE SECOND DEGREE****

**Blanches with pressure* {meaning; when you press it with your finger it will become white and when you remove your finger it goes back into being red and that which indicates the availability of the blood supply to the skin}

***Blisters:**

elevation at the junction of the burn so the dead layer will be raised due to extravasations of fluid.

Why it is important to differentiate between the superficial and the deep 2nd degree burns? Because the treatment will be different.

3/Third degree (full thickness):

All layers of the skin, Whitish or black, PAINLESS, Scarring, thrombosed vessels, no blood flow, feels like leather.

Treatment: Surgery and skin graft

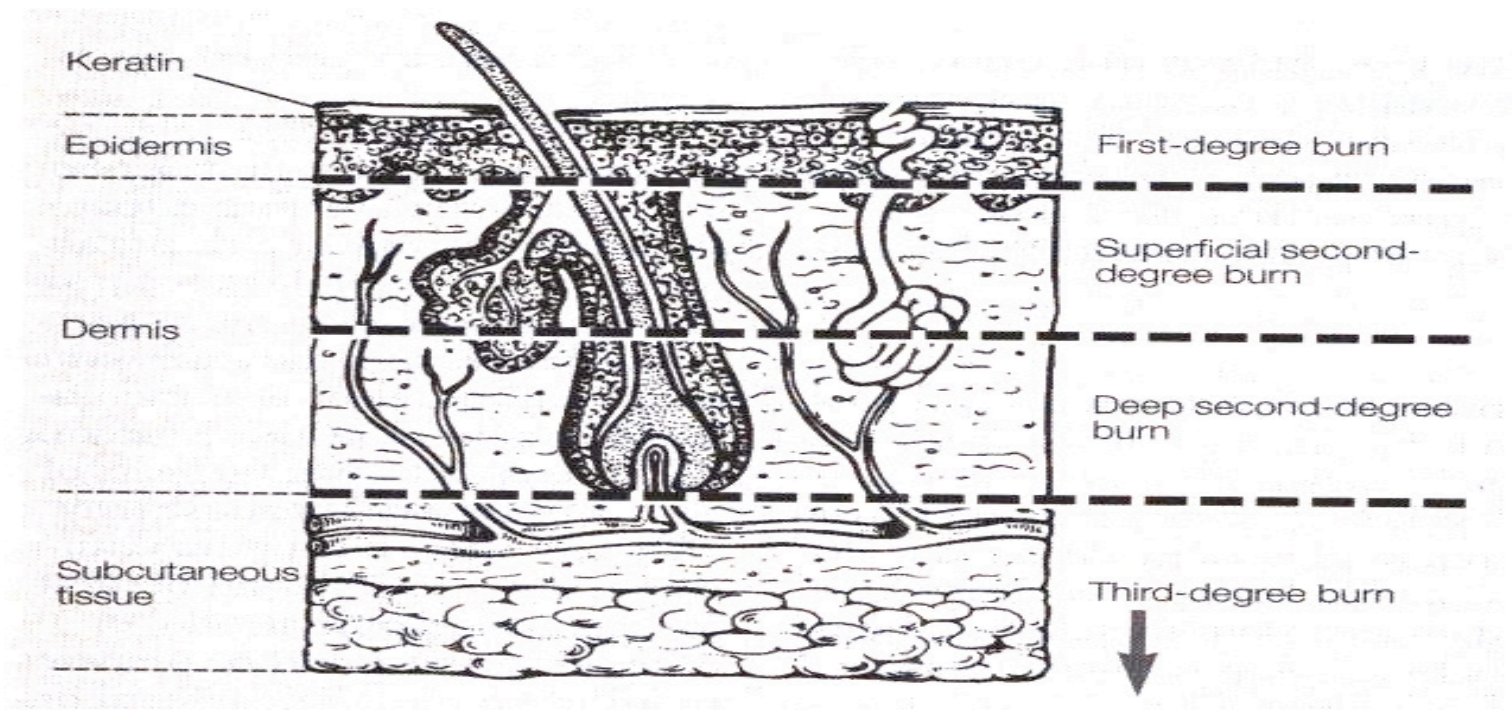
There will be eschar (dead skin of burn)

An Escharotomy may be needed to avoid the pressure caused by compartment syndrome otherwise there will be ischemia of the muscle and nerves (numbness).

***Escharotomy:** cutting eschar to allow the skin to swell and reduce the pressure on the muscles and nerves.

Compartment Syndrome: is the compression of nerves, blood vessels, and muscle inside a closed space (compartment) within the body. This leads to tissue death from lack of oxygenation due to the blood vessels being compressed by the raised pressure within the compartment.

So you must always look for *circumferential burns* around the chest, abdomen, limbs, etc... and perform an **Escharotomy** on it to release the pressure



C) Estimating extent of injury:

How do we calculate the surface area?

By using the rule of nine for normal sized adults (The body is divided into 9 areas) as the following:

Adults:

- All lower limbs 18% (9% front 9% back)
- All upper limbs 9%
- trunk: anterior 18% posterior 18%
- Head and neck 9%

Limitations for this rule (where we can't use it):

- Obese patient because they have larger trunk area so we may underestimate
- Pregnant women
- Pediatrics because they have larger head and neck area and smaller lower limbs

Kids:

- Head & neck: 18%
 - Each Lower Limb: 4%
- Or use lund-browder chart

How can we calculate scattered burns?

The palm of the "patient" is 1% - so use it to measure.

D) Inhalation injury :

It usually occurs if burns took place in closed spaces. It can cause:

- **CO poisoning, dizziness, confusion, nausea and vomiting**

Management: inhalation of 100% O₂.

- **Upper airway obstruction:**

Edema of the upper airways may occur causing obstruction that's why we should immediately intubate the patient before the edema starts and we lose the patient.

- **Chemical injury**

- **Inflammation and systemic reactions**

- **Poisoning:** When the fire affects the furniture, that will produce toxins in the air; once they are inhaled they will affect the lungs directly causing "inflammation pneumonitis" and later pneumonia. Or there will be systemic poisoning due to inhaled fumes like Cyanide

*certain burn victims require reference to the burn unit (slides) After

we checked the ABC steps we give the patient IV fluids How much

IV fluids should we give a burn patient??

PARKLAND formula (crystalloid) >> most common

$4\text{cc} \times (\% \text{ of burn}) \times \text{weight of patient} = \text{total amount of fluid needed in } \mathbf{24 \text{ hrs}}$

******Half the amount calculated is given in first 8 hrs, the other half is to be given in the next 16 hrs (start counting from the time of burn NOT when u see him in ER).

Electrical burns: (4th degree if the current passes through the body)

It is the only type of burn that has an entry and exit point.

However, it *may be minimal on the surface*, but we should check the muscles and bones for any injuries.

Damage mostly affects the *small bones* (feet, hands, and forearms)

Damage is due to resistance which generates heat, that's why it's common in small bones, *Because bones have the highest resistance in the body.*

Divided into:

- 1) Low voltage >>> may cause cardiac arrhythmias.
- 2) High voltage >>> may cause massive tissue damage, respiratory and cardiac arrest.

- ❖ When you want to release the pressure due to compartment syndrome in electrical burns you release the fascia because the damages are internal.
- ❖ Cardiac monitor is a must

Chemical burns: (4th degree if it reaches the fat and muscle)

Types:

- 1- **Acids:** cause coagulation and regular burn necrosis and will stop at that level (limited).
- 2- **Alkaline:** worst" causes liquefaction that may continue for hours after the injury (deeper)

HFI: → worst chemical burn. Why? It has both mechanisms of acid and alkaline.

It burns like an acid because it is an acid and when the fluoride (alkaline) is released it reaches the bone and causes decalcification leading to hypocalcaemia and arrhythmias.

Immediate management:

Wash for at least 30 minutes and brush off the causative agents.

Wound healing

Occurs in 3 phases:

1-**Inflammatory Phase**: ((This phase's aim is to limit the bleeding via *Vasoconstriction*)).

Immediate typically 1-10 days

After the trauma, there is an *initial* extreme *vasoconstriction* then *vasodilatation* occurs.

This phase depends upon **Macrophages**.

TGF-beta released from alpha granules of the platelets is a key component in tissue repair.

1st cell to arrive is the neutrophils

Note: Even when *Neutrophils (PMN)* are absent, the healing will continue

and *Macrophages* are the most essential cells for the healing process as it orchestrates the wound healing. (i.e. It calls other cells to come help, chemotaxis).

2-**Proliferative Phase**: ((This phase's aim is to *close the wound*))

Depends upon **Fibroblasts** to formulate the collagen needed.

Day 5- 3 weeks

Main types of collagen

type 1: for bone, tendon. Skin (primary in wound healing)

type 3: for blood vessels and skin (increased in wound healing) type 2: cartilage

type 4: basement membrane

type 5: all over, especially cornea

The most common type in normal woundless skin: type 1 then type 2 The most common type in wounded (scarred) skin: type 3

When a wound is healing, it goes on at the following sequence: *From day 1 to 2* : type 3

From day 3 to 4 : type 1

After : type 1 takes over again (the body trying to go back to normal)

Angiogenesis happens in this phase

Contents of granulation tissue - **IMP** : capillary ingrowth, collagen, Macrophages, Fibroblasts, Hyaluronic acid (GAG)

2-Remodeling Phase: ((aim to *strengthen the skin*))

3 weeks – 1 year

The most common type of collagen in this phase is: type 3 to type 1

Maximum strength will be 80%, but never back to normal.

Contraction: A minimization for wound's size due to **Myofibroblasts** (with actin contractile filament) causing the skin around the wound to contract - forcing the proliferative phase to take lesser time

When this contraction affects the function of a joint it is called **a Contracture (very important for the exam)**.

Most common site: in Perineum and Trunk, then Head and neck, then Extremities.

Abnormal Healing:

Genetics predispose to abnormal wound healing. Examples:

1- Hypertrophic Scars:

Excessive collagen deposition resulting in a ***raised scar***, within the original wound borders.

Most common in ***darker persons***, but it almost always improves with time.

Doesn't go away with surgery, it will even get worse (when the wound heals it will be hypertrophied).

Tx: steroids, silicone, pressure garments

2- Keloids:

Similar to the hypertrophic scar, but it extends ***way beyond the borders*** of the original wound.

*Autosomal Dominant, Darker Pigment, Often above clavicle but not always

Tx: XRT, steroids, silicone sheeting, pressure, **excise**, often Refractory to Tx & but not preventable.