Burns

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كيف نتعامل مع حالة Emergency ؟؟!!

Basic life support (BLS) A B C D E F

(A) Airway by Inhalational burn

closed ↓ Tracheostomy

Cricothyrotomy

upper airway ↓ edema

airway ... patient ... sign of Inhalation injury

① Burned facial hair
② pitting edema
③ Burn mucosal membran lips
④ ash
⑤ Hoarness of voice
⑥ stridor

Endotracheal tube

Closed airway < finding his breath < ... < ... < قاعد عادي يتكلم

(B) Breathing

flam burn → ① CO (High affinty to Hb)

shift O_2 saturation to left

pulsoxymeter → O_2 staturation

2 cyandis

cynosis → don't

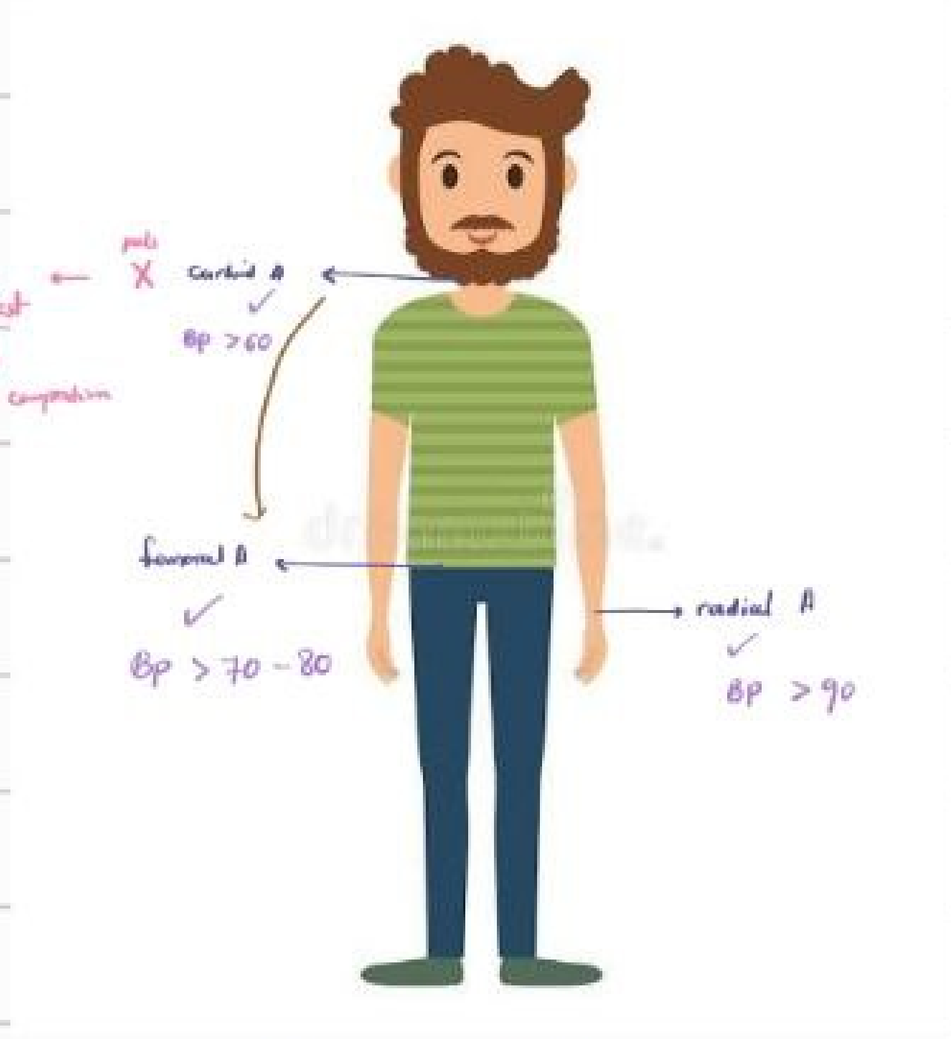
no chest expantion

air way open

Tretemnt 100% O_2 by intubation

normal O_2 breathing 22%

(C) Circulation



Bp = systolic Bp

all carotid, femoral, radial } not in schock

carotid ✓ ✓
femoral ✓ X } in schock
radial X ✓

ما هو سبب shock !!؟

مساحة سطح الجروحة ← Inflamatory reaction (يطلع cytokines) تأثر على الجسم خاصة capillary ← capillary leak

يصير فيه (ارتشاح) من capillary (second space) إلى Interstitial (Third space)

(fluied) السائل ما وصلت الكريا وكلت بـ vessle

↓

↓↓↓ preload

↓

↑↑ HR ↑↑ SV

↓

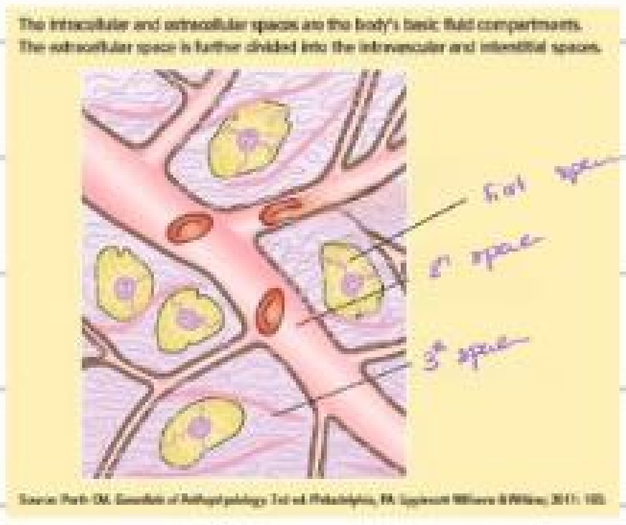
↑↑ V.C

↓

Heart < Brain < kidny < gut < skin

يصير منه V.C تعبّ شيء د يطلع وصول الدم الـ

(طعم معني) سيركل على الجلد وهو طعروق



⊕

Heart شغل واصلة دم د يضخ الوقت قاعد يواجه resistance د يه (HAP) الي يواجه عالي

⊕

السوائل المتجمعة د interstitial بتضغط على (veins) تعبر Third space حسبما ي (peritoneal cavity)

↓

pressuer on vena cava

↓

↓↓↓ preload

↓

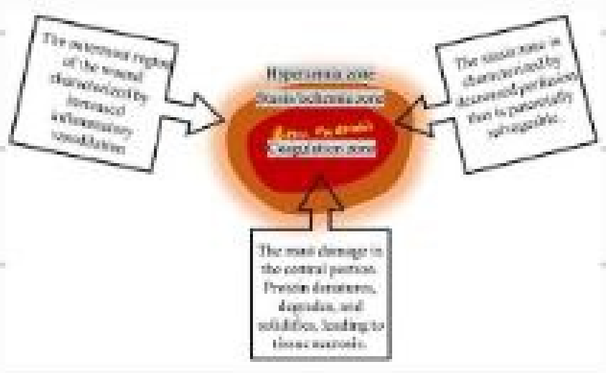
هذه Circle فيدخل بـ

Hart shock (cardiogenic shock)

كيف بدي اعالج الحالة ؟!!

الاستكة ← fluied بطلع من capillary فاتح حرم وبدو fluid سوبر Cell

Jackson Zone خلال 48 h (Zone stasis) ← (Zone of necrosis) دورت علاج



2th dgree ← 3th dgree shift brun

(كيف اعالج)

Early excision

Early Excision

↓

resuscitate 24 h

systemic inflammatory response

ebb phase flow phase

ebb phase من اول 24 h حل بالموج الطبيعي

بنشط macrophages

(uridre stress) الموجين ← graft فاشل اكثر

Excision اذا بدك تعمل

بدك بديل يغطي skin ← دائم

يبقى مدة اسبوع ← يكون الجسم طالع من recovery

فيه تفاعيل هورمونية بسلبية (19)

ايش اللي بدي اعطيه؟؟

fluied يعطي

عشان احافظ ع حجم الfluid بالـ hyperemia stasis

عشان ما اعمل shock

صدام الخلية لما capillary leak ما تعطي colloid ليش بيطلعش من capillary بيظل جوا

Intravascular ← fluid يسحب oncotic pressur يزيد من

colloid first line globally not use

↓

stress plus ← ① Intracellular من يسحب يكون عالي يعمل oncotic pressur بجاب

② Increase load on heart

(HES colloid) ← interstitial nephraitis

(Albumins) ← molar mass 66.5 k Da

بعطية بعد 24 ساعة

First 24 h give patient crystalloid (lactate ringer)

① isotonic

② concentration تركيز الكترولايت
K⁺ Na⁺ Cl⁻

③ lactate — acid
alkali يكون
(Acidosis) حمض في حالة Burn

lactate → liver → alkalin

parkland Formula = 4 X wight X TBSA (17) هيتم دراسته بالتفصيل بعدين

Burns patient → catabolic

need Nitrogen + protein

Ecalory formula ~~X~~ مش مهم

(D) Disability GCS trauma Burn مش كتير بتعمل بـ

الا اذا كان فاقد الوعي ...

(E) Exposure بدك تتأكد المريض تحمله مساعدة الطبي

* fast ultrasound → Intraabdominal tract

BASIC PRINCIPLES

■ Burn management can be broken down to the **5R** principles to guide the most suitable therapy for each individual patient:

• **R**esuscitation: The modified Brooke formula is now preferred by most burn centers (over the Parkland formula) to minimize over-resuscitation after burn injury. The **time of injury**, not the time of presentation, is used to figure the infusion rate

• **R**esurfacing: Involves tangential excision of partial-thickness burns and suprafascial excision of full-thickness burns followed by coverage with temporary dressings, biologic matrices, xenograft, allograft, autograft, or vascularized tissues

• **R**econstruction: Involves restoration of form and function and can be divided into acute, intermediate, and late reconstruction

• **R**ehabilitation: Involves early mobilization, splinting, scar management, sensory re-education, strengthening, and conditioning

• **R**ecovery: True recovery involves the return of self-esteem and self-worth, coupled with the confidence to move toward independence, enabling patients to return to school, work, and social functions

DEMOGRAPHICS

INCIDENCE IN THE US

■ 486,000 burn injuries receive medical treatment per year

• 3,275 deaths per year

■ High-risk groups: Pediatric, geriatric, military personnel, and disabled populations

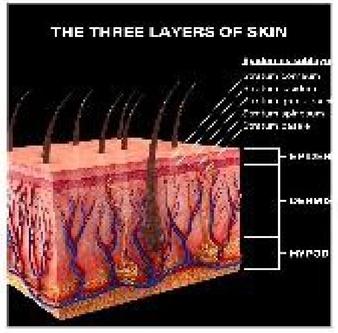
PROGNOSIS

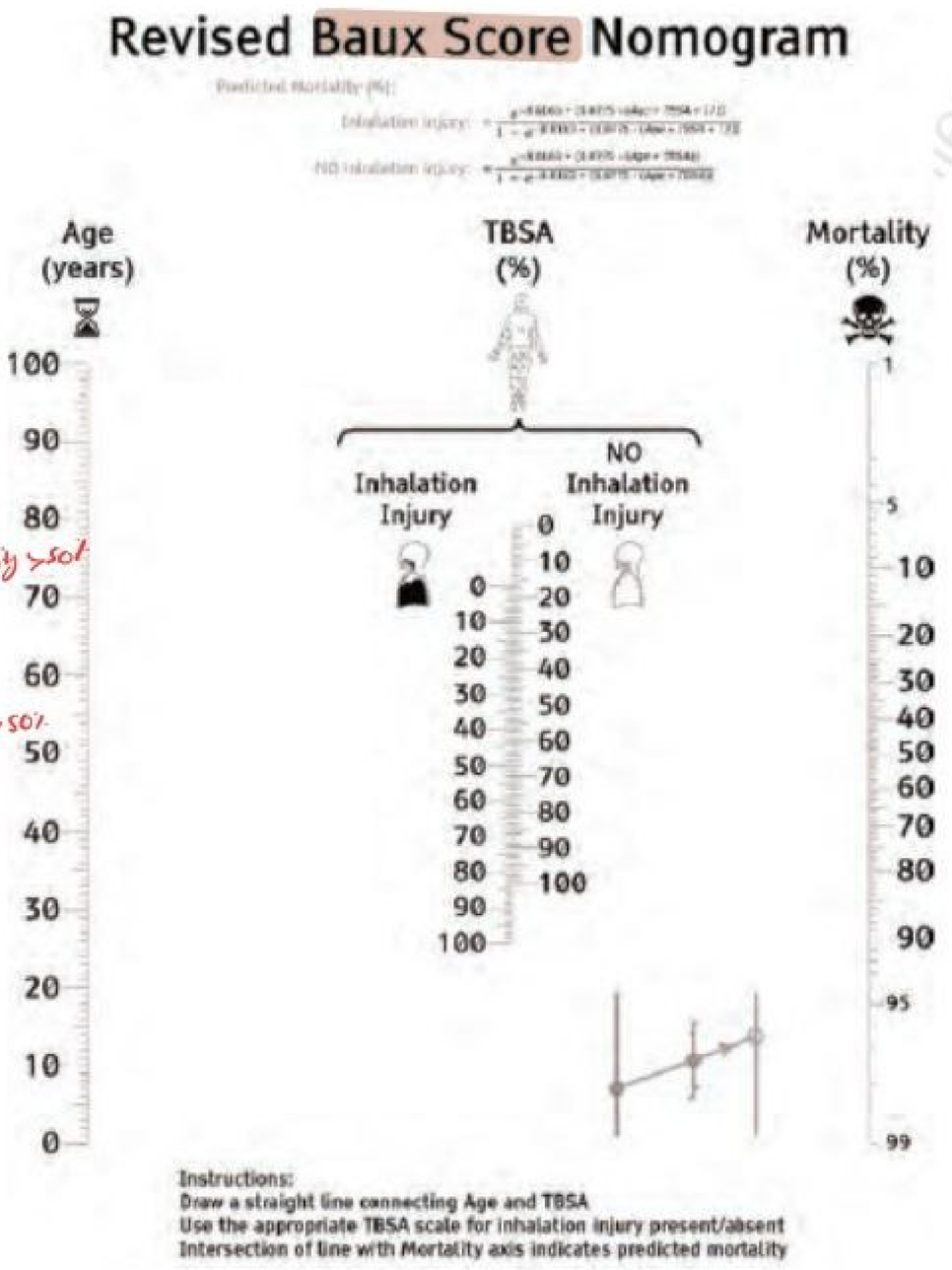
■ Major predictor of mortality: Age, total body surf ace area (TBSA), inhalation injury

• **Baux score: 50% mortality if age + %TBSA = 110 (Baux score)**

• **However, if there is associated inhalation injury, then 50% mortality associated with age + %TBSA = 100 (revised Baux score)**

■ Nomogram for the revised Baux score for mortality following burns





"Rule of 9s" for adults: To calculate TBSA, assign the following percentages per area burned :

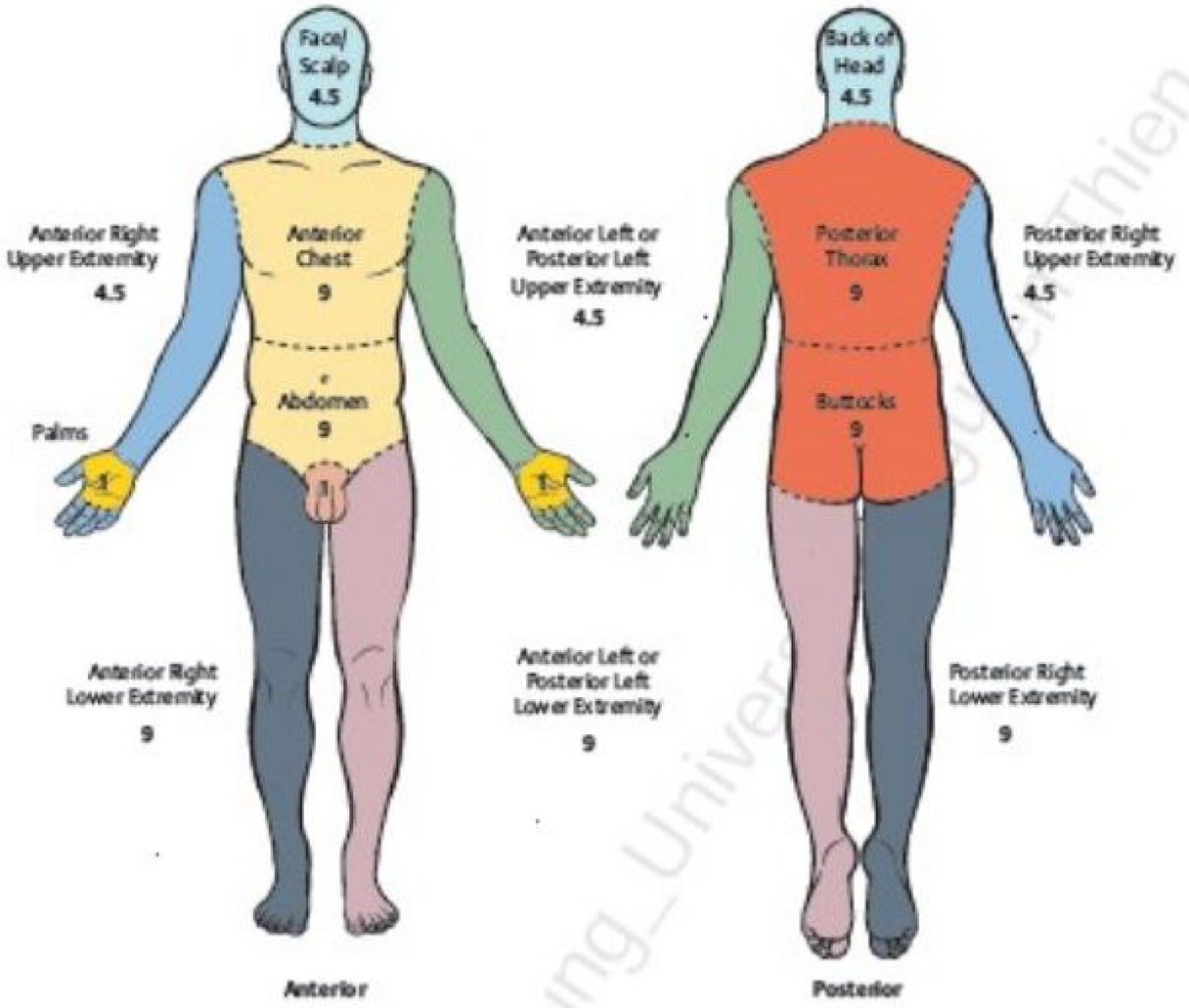
- Head and neck, 9%
- Anterior torso, 18%

Posterior torso, 18%

- Each upper extremity, 9%
- Each lower extremity, 18%
- Genitals, 1%
- Palm (without digits) represents a unit of 1% TBSA

يد الريض

In children



PATHOPHYSIOLOGY

BURN WOUNDS CLASSIFIED BASED ON DEPTH OF PENETRATION

3 one

■ Depth depends on: Mechanism, temperature, duration of contact, thickness of the

dermis, and blood supply

■ Progression of TBSA and depth depends on such patient factors as diabetes,

smoking, previous XRT, autoimmune disease, pre-existing hepatic or renal

dysfunction, use of vasopressors, hypothermia, difficult resuscitation, and

development of infection

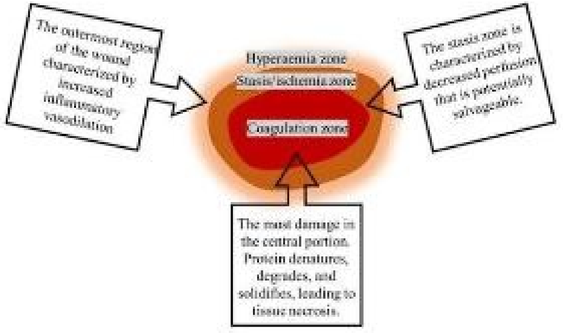


Table 21.1 *Burn Tissue Histology*

	Zone	Clinical Finding	Treatment
1	Zone of coagulation (necrosis)	Nonviable necrotic tissue in center of the burn wound	Excision and grafting
2	Zone of stasis (edema)	Surrounds zone of coagulation, initially viable	Aggressive resuscitation to improve perfusion and prevent transformation to necrosis
3	Zone of hyperemia (inflammation)	Outermost zone, viable	Aggressive resuscitation

(Data from Herndon DN, ed. Total Burn Care, 3rd ed. London: WB Saunders, 2007; and Kaga RJ, Peck MD, Ahrenholz DH, et al. Surgical management of the burn wound and use of skin substitutes. American Burn Association White Paper. Chicago: American Burn Association, 2009.)

Dgree of the burn

■ First degree (superficial burns)

sun bairn

- Epidermis only
- Skin erythema, painful

tretemnt → skin clear

- Blanches with pressure
- No blistering
- Symptoms subside over 3–4 days, the dead epidermis sloughs and is replaced by regenerating keratinocytes at about day 4 → because strtum besals

■ Second degree (partial-thickness burns)

- **Superficial:** Papillary dermis **sparing skin appendages**
  - ▶ Painful more than deep (Nerve end in reticular dermis)
  - ▶ Blanches with pressure
  - ▶ Blistering may be delayed for 12–24 hours after burn more than deep
  - ▶ With appropriate wound care, most superficial partial-thickness burns will heal within 2 weeks without risk of hypertrophic scarring good heal by regeneration
- **Deep:** Reticular dermis involving **loss of skin appendages** because skin appendages (hair follicles, sweat glands)
  - ▶ Decreased sensation
  - ▶ Capillary refill slow or not at all
  - ▶ Blistering

Note : Dermis < papillary / Reticular

▶ Generally, takes longer than 3 weeks to heal, hypertrophic scarring common, usually treated with excision and grafting

collagen by fibroblast

- **Indeterminate**: Mixed-depth partial-thickness burns

▶ Evaluated with serial clinical assessments over several days post injury to determine healing potential

▶ May use laser Doppler imaging

■ Third degree (full-thickness burns)

- Entire dermis and adnexal structures → SC, fat, fascia, Muscle
- Blistering absent
- **Insensate**, charred, leathery consistency → all skin burn
- Color varies with mechanism of burn brown
- If there is no intervention, it will demarcate and separate over days to weeks.

However, this delays healing and risks infection

- **Circumferential** third-degree burns of extremities may lead to **compartment syndrome** if muscles become edematous; likewise circumferential chest wall burns may inhibit expansion and breathing

CRITERIA FOR TRANSFER TO A BURN CENTER

■ Burn Center Transfer Criteria has been established by the American Burn Association (ABA) to provide safety and proper care for the burn patients

INDICATIONS/PATIENT SELECTION

■ Partial-thickness burns >10% of TBSA

■ Third-degree burns

■ Burns involving face, hands, feet, genitalia, perineum, or major joints

■ Chemical burns

■ Electrical burns

■ Any burn with concomitant trauma in which burn poses greatest risk to patient

■ Inhalation injury

■ Preexisting medical disorders that could affect mortality

■ Hospitals without qualified personnel or equipment for care of burned children

■ Patients who will require special social, emotional, or rehabilitative intervention

TIP: The criteria for transfer to a burn center are frequently asked on examinations, including boards.

PREOPERATIVE DIAGNOSIS AND TREATMENT

FACIAL BURNS

■ Airway evaluation

• Extensive edema formation (blood supply and loose connective tissue): Head

elevation

■ Full-thickness burns should be excised and grafted **within 7–10 days post injury** to

promote early wound closure and minimize scar contracture deformities

■ Eye examination and fluorescein staining for corneal injury before extensive

edema

■ Ophthalmology consult

INHALATION INJURY

■ **Clinical significance**

• Increased mortality

• Airway closure secondary to oropharyngeal edema

• Increased resuscitation fluid requirements

• Impaired pulmonary gas exchange

• Pneumonia

• Risk of systemic inflammatory response syndrome and multiorgan failure

▶ Chronic pulmonary dysfunction

▶ Laryngeal edema

■ **Supraglottic injury (thermal/chemical):** Hoarseness, pharyngeal erythema, and edema → obstruction upper airway

■ **Infraglottic injury (chemical):** Mental status changes because of hypoxia

■ Carboxyhemoglobin (≥10% in CO poisoning)

■ Chest radiographic examination (typically normal initially)

■ Bronchoscopy may assist in determining severity

■ Cyanide toxicity

▶ Hydrogen cyanide (HCN), the gaseous form of cyanide, is generated by the combustion of nitrogen and carbon containing substances, such as wool, silk, cotton, and paper

▶ Cytotoxicity is due to its reversible inhibition of cytochrome c oxidase, suppressing cellular respiration and causing tissue anoxia and metabolic acidosis

▶ Elevated HCN concentrations are directly related to the probability of death as it causes severe central nervous system (CNS), respiratory, and cardiovascular dysfunction

▶ Toxicity occurs at a level of 0.1 µg/mL, and at 1.0 µg/mL, death is likely

▶ Consider using Cyanokit: Hydroxocobalamin 5–10 g intravenous injection for adults or 70 mg/kg for children

♦ If clinical suspicion of cyanide poisoning is high, Cyanokit should be administered immediately

■ **Treatment**: Goal is to maintain oxygenation while facilitating adequate ventilation

• Strategies include use of 100% oxygen to disassociate CO from hemoglobin (Hgb), prevention of barotrauma with low tidal volumes, permissive hypercapnia, high frequency percussive ventilation, and extracorporeal membranous oxygenation (ECMO)

COMPARTMENT SYNDROME

■ May occur in burn or unburned limbs due to massive fluid resuscitation

■ High voltage electrical injury

■ Crush injury

■ Occult fracture

■ Delay in escharotomy (ischemic–reperfusion syndrome)

■ **Clinically:**

• Pain on passive stretch

• Tense compartments on palpation

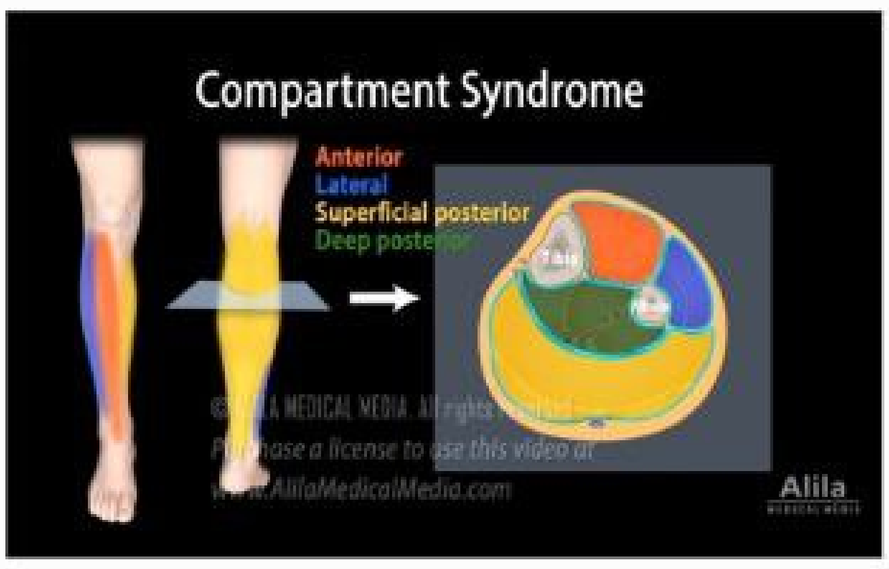
• Paresthesia

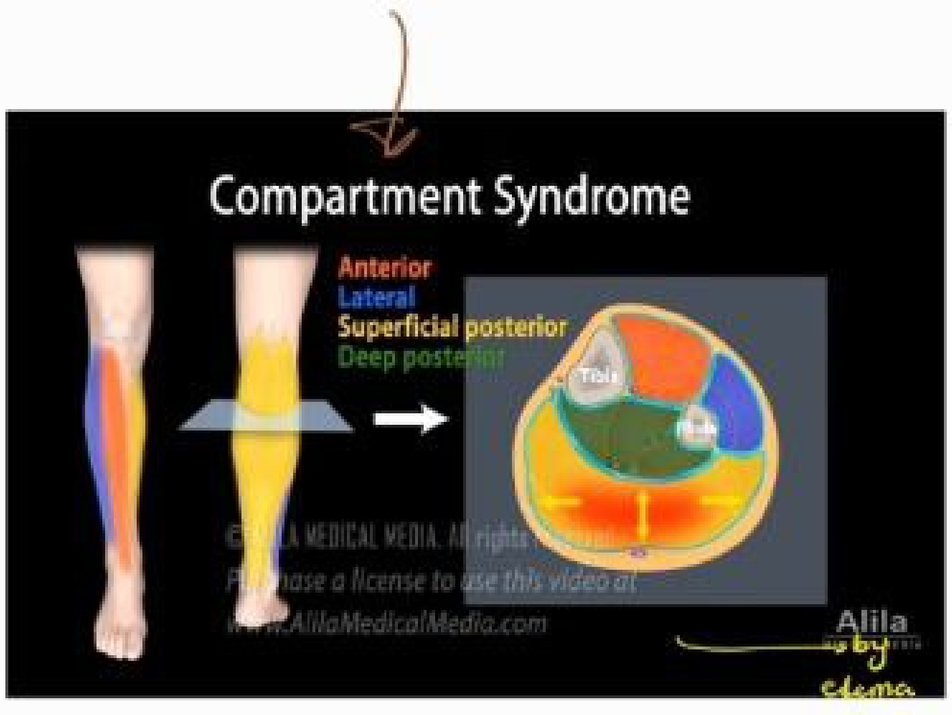
• Doppler flowmeter

• **Compartment pressures > 30 mm Hg is indication for escharotomy or fasciotomy**

However, decision to operate is usually made based on clinical factors

CAUTION: Compartment syndrome may also occur when pressures are < 30 mm Hg, in the presence of a fracture or with significant crush injury.


Compartment Syndrome
Anterior
Lateral
Superficial posterior
Deep posterior
Alila


Compartment Syndrome
Anterior
Lateral
Superficial posterior
Deep posterior
Alila


Fasciotomy
Compartment Syndrome
Two Long Incision is Made
The Fascia is Incised
Deep Posterior Compartment is Incised
Visit our website to search for reasonable Fasciotomy for leg Surgery package.
Check Surgery Price Now
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7039970399
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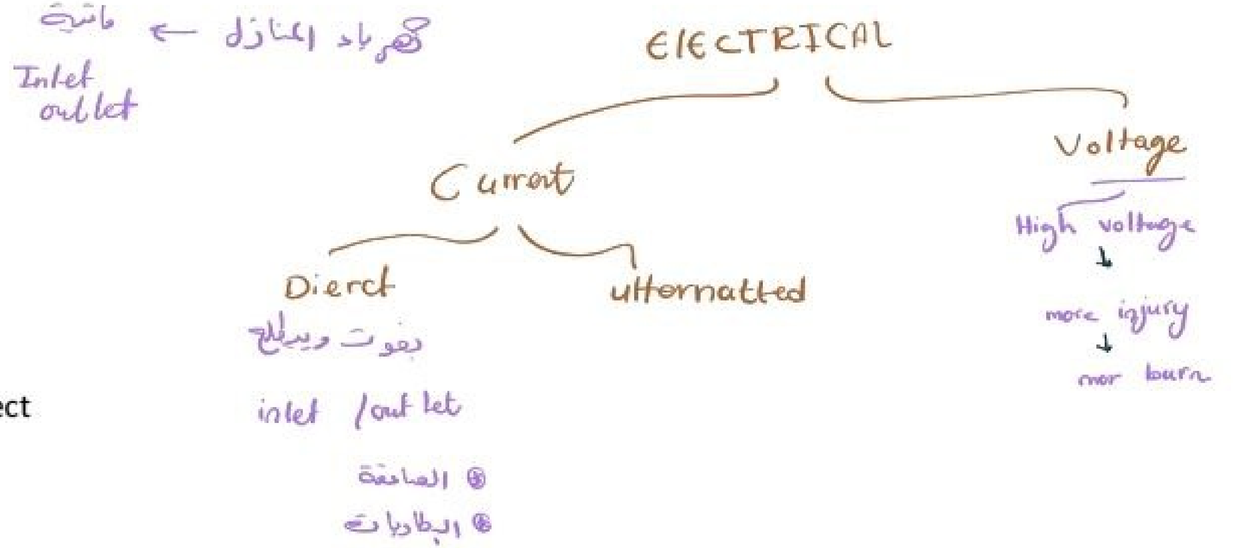
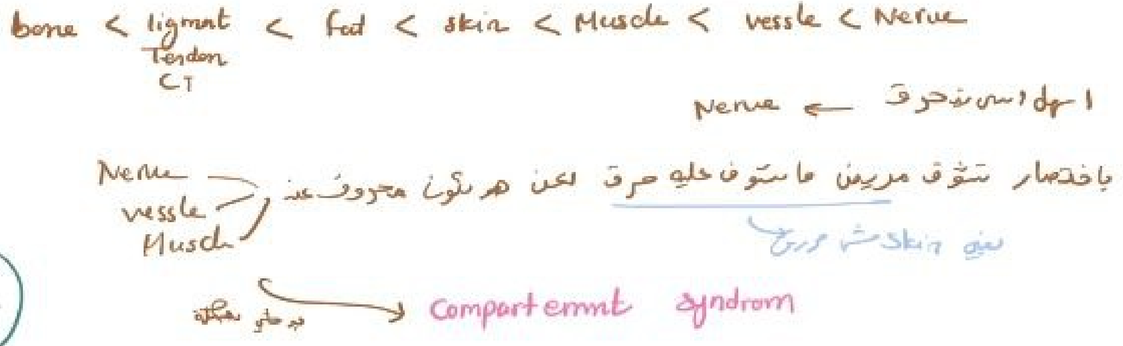
ELECTRICAL INJURIES

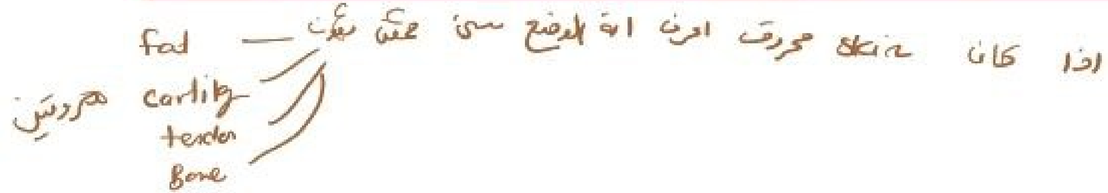
- Approximately 5% of burn admissions
- Can produce significant morbidity despite relatively small burn sizes
- **Three types: Current, arcing, and flash**
  - True electrical injury by current flow
  - Arc injury from the electrical arc as it passes from the source to an object
  - Flame injury from ignition of clothing or surroundings
- Most sequelae from high-voltage injury (>1000 volts)
- Find contact points
- Electrocardiogram (EKG) and troponins
- Continuous cardiac monitoring, for at least 24 hours (1)
  - Arrhythmias common
- Renal function panel including creatine kinase above 1000 IU
- Tea-colored urine indicates myoglobinuria
  - Maintain urine output at **75–100 mL/hour** to minimize myoglobin precipitation.

Bicarbonate or mannitol may be needed

- Risk of compartment syndrome in involved extremity







CHEMICAL BURNS

① Concentration
② Duration

■ **Alkali:** Penetrates deeply because of liquefactive necrosis and protein denaturation

• Commonly found in oven cleaners, drain cleaners, fertilizers, and heavy industrial cleansers

• Copious water irrigation for at least 15–20 minutes

• Avoid neutralization with weak acids, which causes an exothermic reaction

■ **Acids:** Coagulative necrosis and protein precipitation limit the depth of tissue damage

• Copious water irrigation for at least 15–20 minutes

■ **Hydrofluoric acid:** Fluoride ion binds calcium causing **severe systemic hypocalcemia** and tissue necrosis leading to death

• Treat topically with calcium gel, intradermal calcium gluconate, or intra arterial calcium gluconate based on severity

• Cardiac monitoring

■ **Phenol:** Coagulative necrosis can cause systemic derangement (e.g., liver, kidney)

• Irrigate and treat with polyethylene glycol or ethyl alcohol

■ **Phosphorus:** Stain particles with 0.5% copper sulfate or detect with UV light and surgically remove

• Can cause hypocalcemia, hyperphosphatemia, and cardiac arrhythmias

■ **Anhydrous ammonia:** Exposure causes blistering of the skin and injury to the lungs if the fumes are inhaled

• Copious irrigation with water

TIP: These chemical injuries and their treatments are frequently on written board exams.

RESUSCITATION: PARKLAND *VERSUS* MODIFIED BROOKE FORMULA

■ Burn shock with systemic response typically occurs with >20% TBSA (>15% in pediatric and geriatric patients) and may be exacerbated by hypovolemia (from alcohol or hyperglycemia-induced diuresis) or cardiogenic failure

■ Burn shock requires resuscitation; otherwise, maintenance fluids may be adequate

in pediatric

■ Colloids and pressors are indicated if crystalloid resuscitation is inadequate

■ Both Parkland and modified Brooke formulas recommend **crystalloids** during the first 24 hours

• Administration of **colloids** (5% albumin) is normally reserved for the second 24 hours, but is often used earlier for oliguria when calculated crystalloid requirements are met

• **Parkland Formula: *4 mL* × Weight (kg) × % TBSA burned**

• **Modified Brooke Formula: *2 mL* × Weight (kg) × % TBSA burned**

• **Half of the total amount in lactated Ringer's solution given over the first 8 hours *from the time of injury* and the second half over the next 16 hours,** with rate adjusted based on hourly urine output (UO; target UO is 0.5 mL/kg per hour)

• Additional fluid is typically required in concurrent trauma, electrical injury, inhalation injury

glucose الشكل

• Maintenance fluid with D5W ½ NS in addition to resuscitation fluid is required in infants and children → no enough glycogen stored in liver

stress phase → glycogenolysis في → Starvation عشان يصير

Table 21.2 *Burn Shock Requires Resuscitation*

Common Burn Resuscitation Formulas		
Formula	**First 24 hours post burn**	**Next 24 hours post burn**
Evans Formula	NS: 1 mL/kg/% TBSA burn Colloid: 1 mL/kg/% TBSA burn D5W: 2000 mL	NS: 0.5 mL/kg/% TBSA burn Colloid: 0.5 mL/kg/% TBSA burn D5W: 2000 mL
Brooke Formula	NS: 1.5 mL/kg/% TBSA burn Colloid: 0.5 mL/kg/% TBSA burn D5W: 2000 mL	NS: 0.5 mL/kg/% TBSA burn Colloid: 0.25 mL/kg/% TBSA burn D5W: 2000 mL
Modified Brooke Formula	LR: 2 mL/kg/% TBSA burn Colloid: None	LR: None Colloid: 0.3–0.5 mL/kg/% TBSA burn
Parkland Formula	LR: 4 mL/kg/% TBSA burn Colloid: None	LR: None Colloid: 5% albumin Given at 0.3–1 mL/kg/% TBSA burn/16 per hour

LR, lactated ringer's; NS, normal saline; TBSA, total body surface area.

TIP: Adequate volume resuscitation is paramount because this can preserve the zone of stasis (edema) and prevent further tissue loss

① Maintenance :- فيه اثنت حالة لازم نعطيه سوائل بالوريد حاجتك اليومية بدون ② ongoing loss :- مرتاعه بجسم اثنت بتعطيه fluid

② Deficit :- الاشي اللي خسرانه (Burn)

OPERATIVE TREATMENT

ACUTE-PHASE BURN RECONSTRUCTION

■ Excision

• Fascial excision results in less blood loss than tangential excision but creates a more severe deformity

• The decision on how much to excise during a single setting is determined by the patient's comorbid conditions, blood availability, and the ability to cover the wound

■ Wound coverage

■ Eyelid and oral commissure contractures surgically treated in the acute burn period to prevent exposure keratitis and irreversible damage to dentition

■ Aggressive occupational therapy including splinting

TIP: Plan for surgical blood loss of 0.5 mL/cm2 (area of burn excision; Total size of burn wound excision that can safely be performed at each operative setting ranges from 10 to 20% TBSA but depends on depth of excision, blood available for intraoperative transfusion, and critical care resources available in the postoperative setting

Table 21.3 *Options for Burn Wound Coverage*

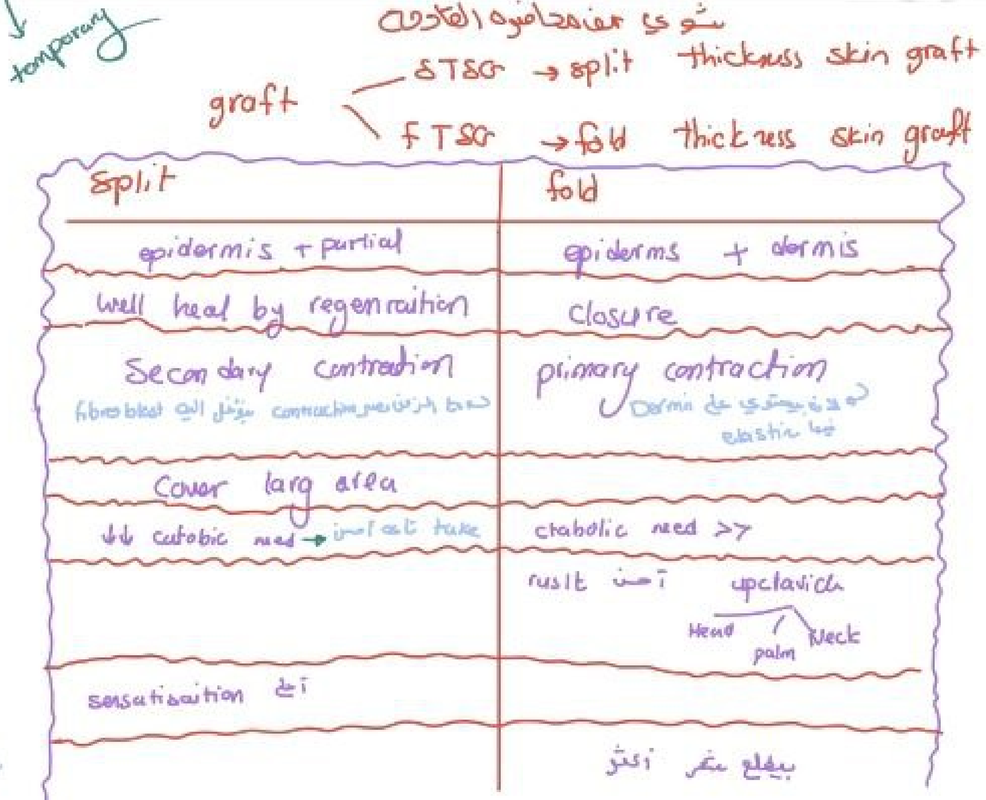
Temporary	Characteristics	Uses
Allograft (Homograft) جثث	Cadaveric split-thickness skin graft	Benchmark for temporary coverage Lasts 3–4 weeks, until rejection by host
Xenograft (Heterograft) حيوانات	Typically porcine skin graft	Application on equivocal superficial vs. deep dermal burn may obviate the need for excision and autografting
Biobrane (Smith & Nephew, Largo, FL) بيولوجي ممتز	Nylon fabric coated with porcine dermal collagen with silicone membrane	Promotes fibrovascular ingrowth; not widely used
TransCyte (Smith & Nephew)	Biobrane and cultured human neonate fibroblasts	Not widely used, though used as an adjunct at some burn programs

temporary

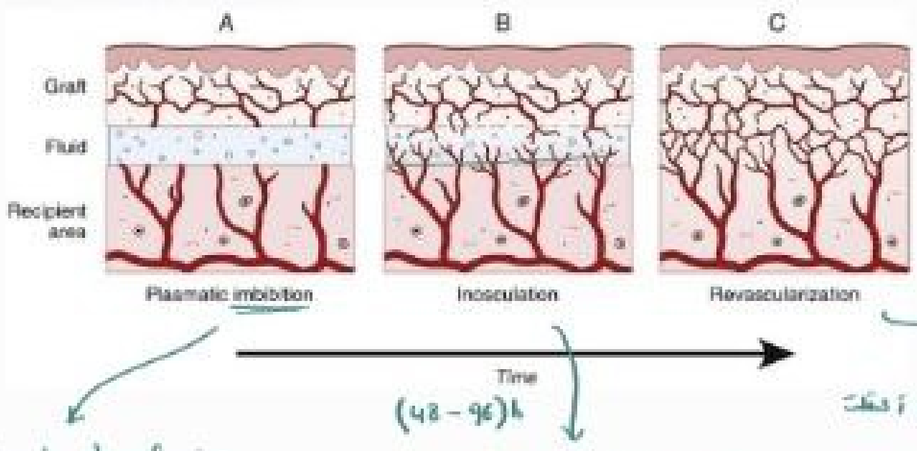
graft

Permanent		
Autograft	Epidermis and partial (STSG) versus entire (FTSG) thickness of dermis	Adheres by imbibition, inosculation, and capillary ingrowth over 5 days
STSG ↓ split	✓ Secondary contraction > primary contraction ✓ May be meshed to cover larger area	More reliable graft take versus FTSG Donor site heals in approximately 10 days to 2 weeks depending on thickness of graft
FTSG ↓ fold	✓ Primary contraction (elastic fibers) > secondary contraction ✓ Decreased scar formation	Less reliable graft take versus STSG Donor site closed primarily Typically used for face and hand wound coverage
Integra allo blast (Integra LifeSciences, Plainsboro, NJ)	A dermal regenerative template constructed with bovine collagen and shark chondroitin-6-sulfate with a silicone surface layer	Forms neodermis in 10 days to 3 weeks, then can be covered with thin STSG, which is predominantly epidermis (<0.008 inch), in a second operation Used if insufficient autograft or for the treatment of scar contractures
AlloDerm (LifeCell, Branchburg, NJ)	Acellular human dermal matrix Reduces scarring	Replaces dermis and can be covered with thin STSG, which is predominantly epidermis (<0.008 inch), in one operation Inspect on day 7, when autograft should look white and yellow
Cultured epithelial autograft (CEA; Epicel)	Sample of patient's skin is cultured in lab to produce epithelial cells, which are then attached to petrolatum gauze	Fragile wound coverage given absence of dermal layer When applied over AlloDerm, successful take increases by 40%

FTSG, Full-thickness skin graft; *STSG*, split-thickness skin graft.
(Data from Herndon DN, ed. Total Burn Care, 3rd ed. London: WB Saunders, 2007; and Kaga RJ, Peck MD, Ahrenholz DH, et al. Surgical management of the burn wound and use of skin substitutes. American Burn Association White Paper. Chicago: American Burn Association, 2009.)



كيف ج graft تثبت ؟!



Simple transfusion
24 h
bed → graft
Interstitial spaces

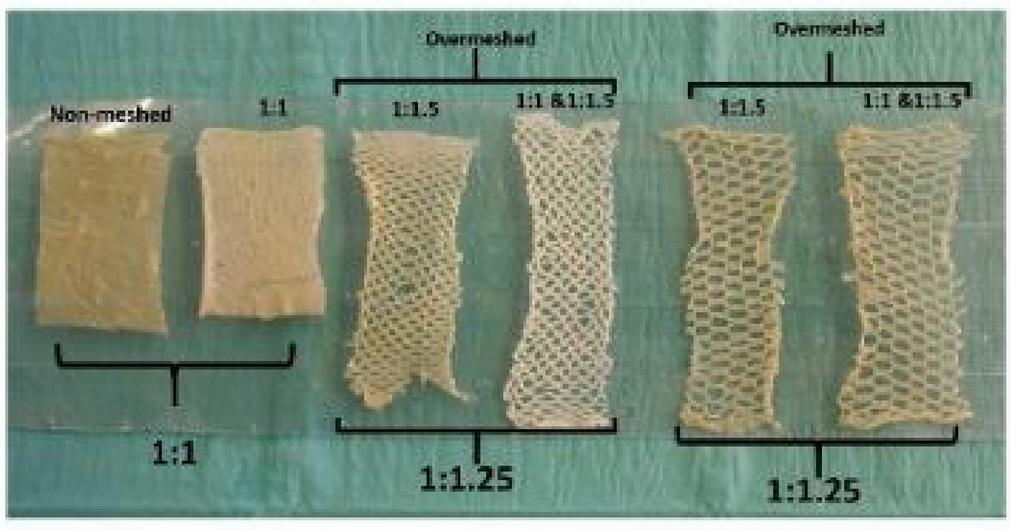
bed
graft

graft → per

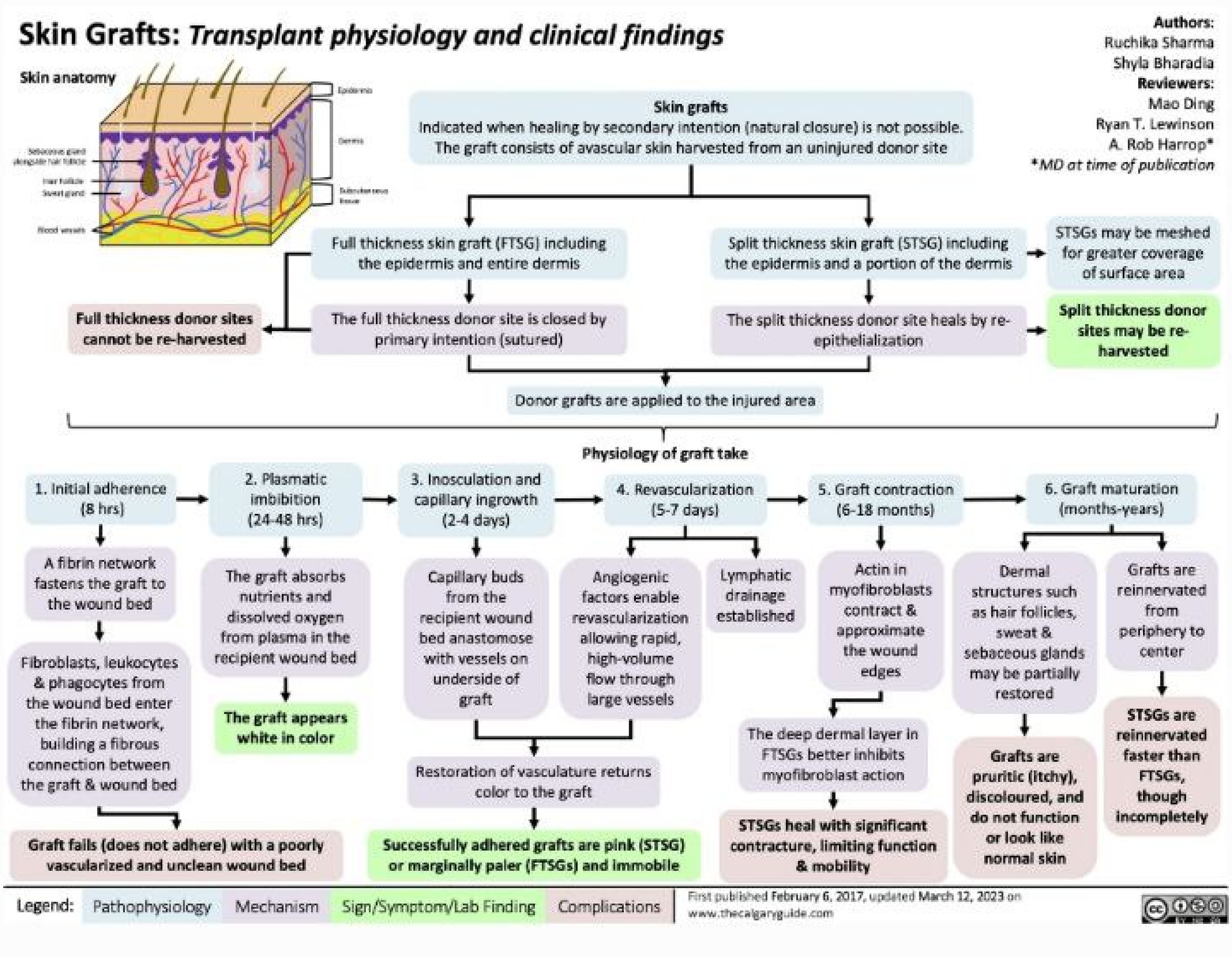
per of graft

(angiogenesis)

graft ← { color, adherent, Temperature } ← graft



Excision



Excision

ضغة أكتر من عادية

1. Chemical
   (seliver
2. Biological
   ↳ maggot therapy الديدان
3. Mechanical thyrapy
   - Water شفط
   - Tangertail

Tangertail
- advantage ← ما شلت اشي غير الجروح
- Disadvantage ← blood loss أكتر

fasica Excision
- advantage ← no blood loss
- disadvantage ← شلت كل جلد
  جلد ذكي متحة

no use 3th degree
elderly

(*) really bad graft بس لاذا بدك

✓ 3th degree
✓ Elderly

(*) مبنوع Infected burn على graft
مانرسم نعمل tissue culture وليس swab culture

(*) اسواد بكتريا ب culture ← group a beta hemolytic streptococci
↳ عشان هيك اي culture بيكون على power of 5
streptococci لا ← power of 4

(*) اسواد بكتريا ب sepsis ← gram Negtive psudomonas

لازم يكونوا عارفين Antibiotic الا اذا sepsis

19 جدول سلايد Intgera موضوع

Excision لحلنا لكن اكو بعض شي جاهز نأخذ منه autograft

allo blust الـ ما نستخدمها Integra

Integra ← collagen + silikon

بعد اسبوعين اتوقع انه collagen يلتحم على الـ collagen

مشي زمنا بتلنا كل حبه elderly من خلال facia excision منزيد مساحة سطح الجلد

نبدل ما كان يدي (flap) ← من مكان ثاني من نفس الشخص وهو اوسع وصورة اصبح يدي graft ← صبع بدون اظفر وصورة

فبعد اسبوعين بنشيل طبقة sillikon

اذا كانا سعل sillikon بيمزع وتاينه ونفس حراره الجلد

* Infected burn blood loss الاكثر

INTERMEDIATE-PHASE BURN RECONSTRUCTION

■ Hypertrophic burn scars mature over months to years. In this period, the goal is favorable scar maturation

• **Depth of initial injury** and **wound tension** determine final scar appearance

• Techniques to relieve tension include Z-plasty, releases with grafting, laser treatment, intralesional and laser assisted steroid delivery (used sparingly), and fat grafting

• Aggressive occupational therapy including splinting

Table 21.4 *Calculation of Expected Blood Loss*

Calculation of Expected Blood Loss	
Surgical Procedure	**Predicted Blood Loss**
<24 hours since burn injury	0.45 mL/cm² burn area
1–3 days since burn injury	0.65 mL/cm² burn area
2–16 days since burn injury	0.75 mL/cm² burn area
>16 days since burn injury	0.5–0.75 mL/cm² burn area
Infected wounds	1–1.25 mL/cm² burn area

LATE-PHASE BURN RECONSTRUCTION

■ Mature burn scars blend into surrounding normal tissue as they become more pliable, less hypertrophic, and less hyperemic

■ Goals of therapy after scar maturation are definitive treatment of remaining functional and aesthetic deformity. Postoperative therapy is critical to outcome in some regions

■ Scars that remain hypertrophic and hyperemic are typically under persistent tension and may be treated with release and laser treatment

■ Each body region presents unique problems that may be best approached at various levels of the reconstructive ladder

• **Head and neck:** Eyebrows, eyelids, ears, nose, perioral, and scalp reconstruction should be based on an overall strategy and a clear understanding of the fundamental problems. Tissue expanders are helpful

• **Extremities:** Larger joints of the extremity are important for hand and foot positioning. Assess the entire extremity during operative planning to maximize functional restoration

• **Breasts:** Release with grafting, flaps, tissue expansion, and implant exchange. Obtain symmetry in unilateral burn injury because a burned breast may not become ptotic over time

MC death in Burn → Sepsis ← أسبابه تصير عنده

POSTOPERATIVE TREATMENT

- Systemic antibiotics for suspected infections
- Culture guided: Sputum, blood, tissue, urine
- Topical antimicrobials not systemic AB
- Nutrition

• Burns involving more than 20% of the TBSA represent a massive metabolic injury

• Malnutrition results in delayed wound healing, organ failure, and compromised

immune system

• Enteral nutritional (EN) feeding is preferred to total parenteral nutrition (TPN) because it stimulates enteric blood flow, maintains barrier function by preserving tight-junction integrity, and induces production and release of mucosal immunoglobulin and critical endogenous growth factor

• **Curreri formula** is used to calculate caloric needs:

▶ Age, 16–59 years = 25 kcal/kg/day + 40 kcal/%TBSA/day

▶ Age, > 60 years = 20 kcal/kg/day + 65 kcal/%TBSA/day

• Dedicate 1.5–2 g/kg/day and 2.5–4 g/kg/day of protein in burned adults and burned children, respectively, with additional glutamine supplementation, providing a calorie/nitrogen ratio of 100:1

Table 21.5 *Commonly Prescribed Topical Antimicrobials for Burn Wounds*

Drug	Target Organism	Properties and Side Effects
Silver sulfadiazine (Silvadene)	Broad spectrum with gram-positive and gram-negative coverage	① Transient leucopenia ② Penetrates eschar poorly ③ many form silver sulfadiazine – silver nitrate ④ black dis coloration
Mafenide acetate (Sulfamylon)	Gram-positive	Potent carbonic anhydrase inhibitor ② Hyperchloremic metabolic acidosis Compensatory hyperventilation Penetrates deeply
0.5% silver nitrate solution	Staphylococcus species and gram-negative aerobes (Pseudomonas)	Hyponatremia Hypokalemia
Sodium hypochlorite	Broad spectrum	At 0.025% is bactericidal without inhibiting fibroblasts or keratinocytes
Nystatin	Fungus	Powder easily mixed with other antimicrobials

Sulfat reaction ← can't cross cartilage

2th degree + AB

① pain full → sedation (analgesic)

3th degree → cross eschar, cross cartlige

Blood test weekly

3th degree XX

Dressing

nanocrystalline silver

Dressing

Hydro fiber → جرح بيطلع سوائل

Hydrocolloid → جرح ناشف

Dressing → silicone

COMPLICATIONS

■ Care related

• **Hospital acquired infections:** *Most common cause of death in burn patients*

▶ Hospital associated pneumonia and ventilator associated pneumonia

▶ Central line associated blood stream infections

▶ Catheter associated urinary tract infections

▶ Skin and soft tissue infections

• **Sepsis** (new definition—Sepsis-3 based on Sequential Organ Failure Assessment [SOFA]

▶ Biomarkers predictor of sepsis include C-reactive protein (CRP), procalcitonin (PCT), and cytokines including IL-6, IL-10, and IL-120

■ **Shock:** Inadequate end-organ perfusion, based on inability to meet the metabolic demands of the tissue

■ **Gastrointestinal complications:** Ileus, stress gastritis, gastroduodenal perforation, bowel perforation from ischemia, abdominal compartment syndrome, *Clostridium difficile* infection, pancreatitis, acalculous cholecystitis PPI

■ **Renal failure:** Acute tubular necrosis (ATN) from hypoperfusion, nephrotoxicity from antibiotics such as aminoglycosides and vancomycin

Table 21.6 *Sequential Organ Failure Assessment (SOFA), quick SOFA (qSOFA) score*

Sepsis-3 Consensus definition for sepsis and septic shock (suspected or documented infection and qSOFA ≥2 and/or SOFA ≥ 2)	
qSOFA score	1) Altered mental status (Glasgow Coma Scale <13) 2) Systolic blood pressure ≤ 100 mm Hg 3) Respiratory rate ≥ 22 breaths/min
SOFA variables	1) PaO_2/F_iO_2 ratio 2) Glasgow Coma Scale 3) Mean arterial pressure 4) Vasopressor requirement 5) Serum creatinine or urine output 6) Bilirubin 7) Platelet count
Septic shock predictors (sepsis and both predictors)	1) Vasopressors required to maintain mean arterial pressure (MAP) >65 mm HG 2) Lactate >2 mmol/L (after adequate fluid resuscitation)

TIP: Signs of sepsis:

1. Hyperventilation
2. Fever or hypothermia
3. Hyperglycemia
4. Obtundation
5. Ileus
6. Hypotension and oliguria

■ **Hospital acquired pressure injuries:**

• Device related: Endotracheal tube, nasogastric tube, splint, dressing

• Sacral, trochanteric, ischial, calcaneal, malleolar, occipital

■ **Surgical**

• Graft loss

• Burn scar contracture

• Delayed healing with chronic wounds

■ **Heterotopic ossification:** Pathologic formation of ectopic osseous lesions causing severe pain, nonhealing wounds, and restricted range of motion

• Can result from severe trauma, burns, musculoskeletal injury, spinal cord injury (SCI), traumatic brain injury (TBI), and genetic mutation in bone morphogenetic signaling protein

• Nonsteroidal anti-inflammatory drugs (NSAIDs), bisphosphonates, and radiation therapy have been used as preventive prophylaxis

■ **Wound breakdown**

■ **Hypertrophic scar formation** with chronic neuropathic pain, manifested by paresthesias, dysesthesias, pruritis

Burn children (6-13) y
affect thier growth

(Stre Zone) لازم تأخذوا

joint

لما تتحرك
hetro topic dislocation
بعض NSAID اذا ما زبط عملية جراحية

KEY SAFETY MEASURES

■ Pneumonia

• Obtain sputum cultures and start broad spectrum antibiotics for recurrent fevers post excision. Aggressive pulmonary toilet

• Early tracheostomy for severe inhalation injury to promote ventilation wean and easy suctioning

■ Sepsis

• Hour-1 Bundle

▶ Excise all deep burns, serial re-evaluations of indeterminate burns, may use laser Doppler imaging to help determine depth

▶ Clinical suspicion for necrotizing soft tissue infections (NSTI); need radical Debridement

Box 21-1 *Surviving Sepsis Campaign, Hour-1 Bundle*

Hour-1 Bundle: Initial Resuscitation for Sepsis and Septic Shock (Begin Immediately

1. Measure lactate level[x]
2. Obtain blood cultures before administering antibiotics
3. Administer broad-spectrum antibiotics
4. Begin rapid administration of 30 mL/kg crystalloid for hypotension or lactate ≥4 mmol/L
5. Apply vasopressors if hypotensive during or after fluid resuscitation to maintain a mean arterial pressure ≥ 65 mm Hg

[x]Remeasure lactate if initial lactate elevated (>2 mmol/L)

(Data from Society of Critical Care Medicine)

■ Bleeding

• Intraoperative bleeding—calculate expected blood loss

• Transfusion ratio 1:1:1 (packed red cells/fresh frozen plasma/platelets)

• Check labs including prothrombin time, partial thromboplastin time, bleeding time

• Viscoelastic tests, such as thromboelastography (TEG) and rotation thromboelastometry (ROTEM), are efficient, fast, and sensitive at detecting early coagulation abnormalities and help guide blood product therapy

• Rule out disseminated intravascular coagulation (DIC), check D-Dimer and fibrinogen levels

■ Venous thromboembolism (VTE)

• Overall incidence in the burn population is low (0.61%), including deep venous thrombosis (DVT, 0.48%) and pulmonary embolism (PE, 0.18%)

• Routine chemoprophylaxis with unfractionated heparin or low molecular weight heparin

• Complex DVT/PE treatment depends on the cause (spontaneous versus induced)

KEY POINTS

☑ Decreased sensation occurs with deep second-degree and deeper burns.

☑ Know the criteria for admission for burn injuries—they are frequently asked on tests.

☑ The traditional Parkland formula is still used to calculate initial resuscitation for the first 24 hours after burn injury. The time of injury, not the time of presentation, is used to figure the rate.

☑ Silver sulfadiazine can cause leukopenia.

☑ Mafenide acetate can cause metabolic acidosis secondary to its inhibition of carbonic anhydrase.

☑ Silver nitrate can cause hyponatremia.

THANK YOU