بسم الله الرحمن الرحيم
WOUND Healing

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OBJECTIVES

- Definition & phases of wound healing.
- Factors affecting wound healing.
- Types of wound healing.
- Classification & types of wounds.
- Management of open wounds.
- Complications of wound healing.
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- **Definition & phases** of wound healing.
- **Factors** affecting wound healing.
- **Types** of wound healing.
- **Classification** & types of wounds.
- **Management** of open wounds.
- **Complications** of wound healing.
WOUNDS

“A cut or break in the continuity of any tissue, caused by injury or operation”

(Baillière’s 23rd Ed)
Wound healing

- All wounds **heal** following a specific sequence of phases which may overlap.

- These phases are:
  - Inflammatory phase
  - Proliferative phase
  - Remodelling or maturation phase
Haemostasis & inflammation phase

- Day 0 – 5
- Starts at the moment of injury – the clotting cascade is initiated
- Platelets aggregate, release cytokines & growth factors that stimulate:
  1. **Chemotaxis** of macrophages which help phagocytosis & wound debridement
  2. **Activation** of fibroblasts & endothelial cells.
The inflammatory phase is characterised by heat, swelling, redness, pain and loss of function at the wound site.

This phase is short lived in the absence of infection or contamination.
Proliferation phase

Characterized by proliferation of:

- **Fibroblasts**: Derived from surrounding tissues and secrete collagen fibers.
- **Endothelial cells**: Derived from intact venules and form new capillary buds which together with fibroblasts form the granulation tissue.
- **Epithelial cells**: Derived from wound edges and migrate to close the epithelial defect.
Maturation and remodeling phase

Deposition of collagen in the wound:

- Collagen III 1st then over the next weeks it decreases while collagen I increases.

- Collagen fibers become thicker, arranged along lines of stress and increase the tensile strength of the wound.

- Remodeling continues for about 1 year.

- Wound never attains its full original tensile strength.
Wound contraction

- Helps to diminish the size of the wound.
- Starts immediately and continues for the next 2-3 weeks.
- Special myofibroblasts.
Phases of wound healing
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Factors affecting wound healing

- General factors
- Local factors
Factors affecting wound healing

General factors

- **Age:** Slow in elderly due to decreased protein turnover.
- **Debilitating diseases:** as ureamia, jaundice, cirrhosis, diabetes and malignancy.
- **Irradiation:** inhibit wound contraction and granulation tissue formation. Prior irradiation causes ischemia due to end arteritis obliterans.
Factors affecting wound healing

General factors

- **Nutrition:**
  - **Proteins:** essential for synthesis of collagen & ground substance.
  - **Vit. C:** essential for maturation of protocollagen.
  - **Vit. A:** essential for epithelialization.
  - **Calcium, Zinc, Copper and Manganese.**

- **Drug intake:**
  - **Steroids:** inhibit the inflammatory response and the formation of fibroblasts.
  - **Antimitotic drugs:** impair wound healing.
Factors affecting wound healing

Local factors

- **Vascularity:** good blood supply in face & scalp helps rapid healing while poor blood supply below knee causes delayed healing: (time of suture removal).

- **Immobilization:** wounds over joints or weight bearing areas.

- **Tension:** sutures under tension, haematoma & infection increase wound tension causing ischemia & delayed healing.
Factors affecting wound healing

Local factors

- **Infection:** bacteria compete with fibroblasts for oxygen and nutrition & secrete collagenolytic enzymes that destroy collagen.

- **Foreign bodies and necrotic tissue:** impair wound healing.

- **Adhesion to a bony surface:** prevents wound contraction as over the shin of the tibia & chronic venous ulcers.

- **Impaired venous drainage:** impairs wound healing as in post phlebotic limb.
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Types of wound healing

- **Primary intension:**
  - clean wounds immediately closed by sutures or clips.
  - Minimal scar
Types of wound healing

- **Secondary intension:**
  - Edges not approximated or gaping due to haematoma or infection.
  - Filling with granulation tissue & ugly scar.
Types of wound healing

- Tertiary intension:
  - Contaminated wounds may be left open for about 5 days.
  - If there are no signs of infection delayed primary sutures can be done.
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Classifying wounds

Wounds may be classified according to the number of skin layers involved:

- **Superficial**
  - Involves only the epidermis
- **Partial Thickness**
  - Involves the epidermis and the dermis
- **Full Thickness**
  - Involves the epidermis, dermis, fat, fascia and exposes bone
Environment

- **Household:** generally “clean”, but not “sterile”
- **Outdoor:** contaminated in varying degrees (the barn, industrial machinery)
- **Bites:** highly contaminated (human, animal)
Types of wounds

Closed wounds:
- Contusions
- Haematoma
- Abrasions

Open wounds:
- Incised wounds
- Lacerated wounds
- Penetrating wounds
- Missile wounds
- Bites
Contusion

- Blow with blunt object.
- Extravasation of blood from injured capillaries.
- Painful & swollen.
- Bluish, brownish then green.
Haematoma

- Excessive bleeding.
- 1st cystic then clot within hours and later liquefies.
- TTT: Aspirated if small otherwise evacuated by surgical incision.
Haematoma

Subungual haematoma:

- < 40 % nail area, nail bed injury is unlikely, make drainage hole in nail with a needle.
- > 40 % nail area, requires nail extraction & surgical repair.
- distal phalanx fr. might be present
Abrasions

- Scraping of the superficial layers of the skin due to friction with a hard rough surface.
- Very painful due to exposure of sensitive nerve endings.
- TTT: Cleaning with antiseptic & non adherent dressing.
Incised wounds

- Sharp cutting instruments as razors, glass pieces or knives.
- Longer than deep, edges are clean cut & usually extensive hge.
- Tendons & nerves are liable to be cut.
Incised wounds
Lacerated wounds

- Severe violence with blunt objects, (RTA or falling from height).
- Irregular in shape, severely traumatized, devascularized & contaminated.
Lacerated wounds

Degloving injury

- Lacerated wound are Commonly accompanied by degloving injury of skin & s.c. tissue from deep fascia.
- Skin devascularization become apparent in few days.
Penetrating wounds

- Penetration by a pointed object as a knife.
- More deep than long, so may injure deep important structures that can be missed.
- Small external opening & poor drainage encouraging infection.
Penetrating wounds

Foreign bodies

- Inert – (glass, metal), may leave unremoved if necessary
- Organic – (wood), must be removed
Missile wounds

- Shock waves spread out of the missile tract and cause extensive local tissue damage.
- In high velocity injuries there is widespread tissue damage and injury to blood vessels & nerves in areas away from the missile tract.
Bites

- Either animal or human bites
- Lacerated wounds with involvement of bones, joints, tendons, vessels, nerves.
- Puncture wounds (difficult to irrigate and decontaminate) with high risk of infection.
- Closure: Dog bites in scalp, face, trunk, proximal extremities may be closed if superficial while Human bites “never” to be closed primarily (delay 48 –72hr.)
Bites
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Management of open wounds

- Follow the priorities of multiply injured patient. (A, B, C, D, E)
- Inquire about time & cause of injury.
- Prophylaxis against tetanus.
- Prophylactic antibiotics.
Management of open wounds

- **Bleeding:** control by direct local compression (clean dressing & tight bandage). No tourniquet except as a temporary measure.
- **Suspected fracture:** splint & arrange for X-ray
- **Thorough cleaning** of the wound: saline irrigation & removal of foreign bodies then antiseptics as povidine iodine.
- **Inspection:** of all structures within the wound and dealing with them:
Management of open wounds

- **Arteries & veins** either large (repaired) or small (ligated).
- **Nerves or tendons** (repaired).
- **Muscles** are repaired by mattress sutures if cleanly incised, while ischaemic or necrotic muscles should be completely excised (dark red or gray in colour, does not contract if pinched and does not bleed if incised).
- **Bones** : no internal fixation if there is possibility of infection, better external fixation.
- **Deep fascia** should be left open in contaminated wounds or extensive tissue destruction.
Management of open wounds

- **Skin:**
  - Necrotic areas of skin or subcutaneous fat should be excised.
  - Primary closure of clean incised wounds
  - Delayed primary closure after few days in lacerated contaminated wounds.
  - Skin graft or flap if there is skin deficiency.
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Complications of wound healing

- **Wound dehiscence**: due to general or local factors. Dehiscence of abdominal wound is called burst abdomen.
- **Wound infection**
Complications of wound healing

- **Stretching** of the scar.
Complications of wound healing

- **Contracture:** Shortening of the scar tissue.
Complications of wound healing

- Alopecia
Complications of wound healing

- Hypertrophic scar:
  raised above the surface but it remains within the confines of the wound.
Complications of wound healing

- **Keloid formation:**
  - Over activity of the healing process & excessive scar tissue.
  - Raised above the surface and extends beyond the confines of the wound.
  - More in blacks, familial tendency & certain areas as ear lobule, shoulder & parasternal areas.