



Pathology

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Repair and Healing

Ninth Lecture

Healing by Second Intention (Secondary Union)

Secondary union differs from primary union by the followings :

1. Infected, contaminated and large wound with large tissue loss, large defect, and edges are widely separated that have wide gaps between wound margins → large blood clot or large scab is formed at surface.
2. Healing is slower and requires more time to close the wound.
3. Acute inflammation is more intense.
4. Larger defects require a larger or greater volume of granulation tissue to fill in the gap or defect → results in more scarring tissue and **Large Hypertrophic Scar** or **Keloid Scar** formation.
5. Fibrosis predominates over Epithelial (Epidermal) Regeneration.
6. **Wound Contraction or Contracture**: in large skin defect, there is **Reduction in size** of wound surface by **5% to 10%** from its original size caused by contraction of **Myofibroblasts** leads to limitation of joint movement or hand claw deformities.

Contracture → Deformity in the extremities with limitation of joint movement which cannot fully extend (E.g. **Hand claw deformity**).

❖ **Examples of healing by secondary union are :**

- Infarction.
- Large wounds, burns, ulcers and abscesses.

Skin graft in wound healing

A large wound in which Re-epithelialization or Epithelial (Epidermal) Regeneration is delayed or impossible can be covered by skin graft.

Wound strength

- Sutured wound has **70%** of normal skin strength **because of the suture**.
- By end of First week → wound strength is about **10%** of normal skin strength when the suture is removed.
- By end of 3rd month → wound strength is about **70-80 %** of normal skin strength and persists as such for life.

Complications of Wound Healing

1. Infections.
2. Wound Dehiscence or Ulceration.
3. Implantation Dermoid cyst.
4. Keloid Scar and Hypertrophic Scar Formation
5. Painful Scar and Weak Scar (**Incisional hernia**).
6. Pigmented Scar.
7. Wound Contracture
8. Cicatrization.
9. Neoplastic Changes such as **Squamous Cell Carcinoma or Basal Cell Carcinoma of Skin** which is called Marjolin Ulcer
10. Exuberant (Excessive) Granulation Tissue Formation.

Keloid :

It is a raised ugly- looking hypertrophic scarring tissue. It is a **Dermal mass** of excessive uncontrolled haphazard collagen fibers deposition and has **genetic predisposition**, commonly occurs in negro (black) females , sometime even without any injury or trauma or minor injury. Keloid grows larger and extends beyond the original wound borders without subsequent regression and is difficult to treat.

Factors affecting wound Healing

Local Factors

Causes of delayed wound Healing :

1. **Infection** : is the **single most important** cause of delay in healing .
2. **Poor Blood Supply** : local venous obstruction, atherosclerosis and diabetes mellitus will delay wound healing. E.g. Pretibial skin wound heals much slower than wound in the face.
3. **Mechanical Factors**: Increased local pressure, torsion, excessive movement → wound to pull apart (**Wound Dehiscence**).
4. **Radiation Therapy** → Inhibit cell proliferation.
(Radiotherapy for malignant tumors is delayed until the surgical wound has been completely healed).
5. **Foreign Body** in the wound.
6. **Adhesion** to bony surface.
7. **Neoplastic Changes** (Malignant Tumors : such as Squamous Cell Carcinoma or Basal Cell Carcinoma of the skin).
8. **Type and Extent** of tissue injury, **Location** of injury, and the **Character** of the tissue in which the injury occurs are also important.

Systemic Factors

1. Protein – Calorie Malnutrition.
2. Vit-C and Zink deficiency → Inhibit Collagen Synthesis
Zink deficiency occurs in **Severe Burns** and **Intestinal Fistula**.
3. Diabetes Mellitus (DM).
4. Corticosteroid Treatment → Inhibit Fibrosis.
5. Renal Failure.
6. Hematological diseases – Leukemia and Neutropenia.
7. Tumor Cachexia.
8. Age of Patient.

Mechanisms of wound healing (Summary)

1. Acute Inflammation.
2. Regeneration of Epithelial Cells (Epidermis).
3. Formation of New Blood Vessels (Angiogenesis).
4. Migration and Proliferation of Fibroblasts.
5. Deposition of ECM and Collagen Synthesis.
6. Maturation and Scar Remodeling by Collagenases and Gelatinases which cause Collagen Degradation.

All these complicated processes of wound healing are controlled by a variety of mechanisms which involve :

1. Chemical mediators.

2. Growth factors : Examples

- Epidermal Growth Factor (EGF)
- Platelet- Derived Growth Factor (PDGF)
- Transforming Growth Factor- α (TGF- α)
- Fibroblast Growth Factor (FGF) and others.

3. Growth inhibitors :

- Transforming Growth Factor- β (TGF- β)
- Tumor Suppressor Genes
- Contact Inhibition.

4. Extra-cellular Matrix (ECM).

THANK YOU