Tikrit University
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Healing and Repair

Subject name: Pathology

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Overview

Repair, sometimes called healing, refers to the restoration of tissue architecture and function after an injury. (By convention, the term *repair* is often used for parenchymal and connective tissues and *healing* for surface epithelia, but these distinctions are not based on biology and we use the terms interchangeably). Critical to the survival of an organism is the ability to repair the damage caused by toxic insults and inflammation. Hence, the inflammatory response to microbes and injured tissues not only serves to eliminate these dangers but also sets into motion the process of repair.

Repair of damaged tissues occurs by two types of reactions: regeneration by proliferation of residual (uninjured cells) and maturation of tissue stem cells, and the deposition of connective tissue to form a scar

Regeneration :

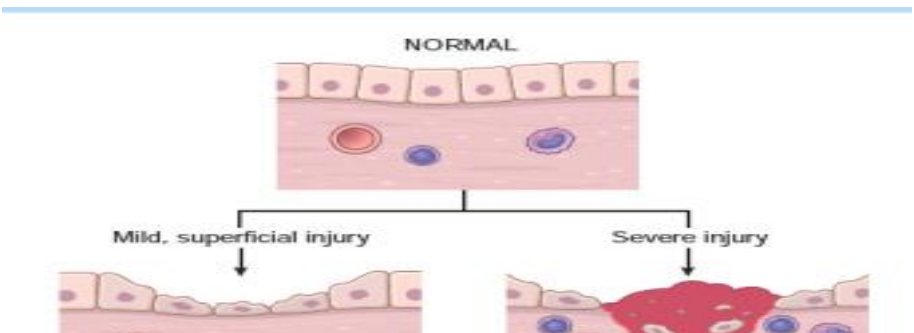
Some tissues are able to replace the damaged components and essentially return to a normal state; this process is called regeneration

Complete reinstitution of damage component of the affected tissue i.e. tissue return to a normal state, the most specialized tissue such as neurons of central nervous system and myocardium not regenerated, whereas, liver, connective tissue surface epithelium of skin regenerate easily. Physiological regeneration that occurs in RBCS and skin surface epithelial.

1- Regeneration, which is the replacement of injured tissue with cells of the same type.

2-Replacement by connective tissue

Most injuries are repaired by a combination of these processes. Obviously, it is most advantageous for repairs to occur by regeneration because this will restore the organ to normal functioning capabilities. Repair by regeneration is governed largely by several factors including the regenerative capacity of the cells involved and the severity of the injury.



Regeneration

Based on their regenerative capabilities, the cells of the body are divided into three groups: labile cells, stable cells, and permanent cells.

A. Labile cells. proliferate normally throughout life replacing cells that are continually being destroyed (continuously and rapidly replaced.(

Examples: Surface epithelium of skin, G.I. tract, G.U tract, hematopoietic cells.

B. Stable cells. These are continuously but slowly replaced. Their proliferation can be markedly accelerated during regeneration (stimulated to divide rapidly in response to various stimuli.(

Examples: Hepatocytes, renal tubular epithelial cells, endothelium, smooth muscle and mesenchymal cells such as fibroblasts, smooth muscle cells, osteoblasts, and chondroblasts.

C. Permanent cells: Although portions of these cells may be restored (e.g. neuron), the cells themselves are not replaced. Regeneration does not occur.

Examples: Skeletal and cardiac muscle, CNS neurons.

***Repair :** Restoration of tissue structure and function after injury this occur by regeneration and\or healing which proliferation of various cells and close intercellular spaces by matrix.

Repair of damaged tissues occurs by two types of reactions: regeneration by proliferation of residual (uninjured) cells and maturation of tissue stem cells, and the deposition of connective tissue to form a scar

The body attempts to heal damage induced by local injury very early in the process of inflammation.

Healing : a reparative process in which laying down connective tissue

(fibrous tissue) that result in scar tissue formation this occur when:

1- Injured area are incapable for complete regeneration (wound is much wide).

2- The supporting structures are severely damaged .

*Healing of cutaneous wound can occur by first intention and second intention.

In which healing of a clean uninfected surgical wound focal disruption of epithelial basement membrane continuity and death of few cells (epithelia) and fibroblasts . Epithelial regeneration predominates over fibrosis from edges ,a small scar is formed and mild wound contraction ,such type of wound healing united within 2 weeks and dense scar tissue laid down within 1 month

General considerations

Repair of injuries is intimately associated with the inflammatory response. The healing process begins early in the inflammatory process and results in repair of the injury by replacement of dead or damaged cells with healthy cells. The body uses two distinct processes to effect repairs:

1-Repair by connective tissue replacement:

This type of repair predominates when injuries occur in tissues formed largely of permanent cells or when the injury results in extensive damage to stromal framework and supporting connective tissues. In these situations, the injured tissue is replaced by fibroblastic cells, usually in the form of granulation tissue, which eventually results in the formation of a scar.

2-Granulation tissue:

Early in the inflammatory process, fibroblasts and vascular endothelial cells start to proliferate. Sometimes this begins as early as 24 hours after injury. By 3 to 5 days, a specialized type of tissue appears that is known as granulation tissue. This specialized tissue is composed of proliferating fibroblasts and newly formed blood vessels. The process resulting in the development of these newly formed blood vessels is called angiogenesis or neovascularization. This process is important in healing and is also involved in the progressive growth of parenchymatous tumors. It occurs in four basic steps:

- enzymatic degradation of the basement membrane of the parent vessel,
- migration of endothelial cells toward the angiogenic stimulus,
- proliferation of endothelial cells,

 maturation of endothelial cells and organization into capillary tubes.

These newly formed vessels have leaky inter-endothelial junctions, thus granulation tissue tends to be edematous.

Granulation tissue will generally have considerable numbers of macrophages. Initially, their main purpose is to eliminate injuring agents, macrophages also remove extracellular debris and ultimately they participate in "blanching" of the wound, a process by which the excess granulation tissue is removed. In addition, granulation tissue may have varying numbers of neutrophils, lymphocytes, and eosinophils.

C**onnective tissue deposition (scar formation).**

If the injured tissues are incapable of complete restitution, or if the supporting structures of the tissue are severely damaged, repair occurs by the laying down of connective fibrous) tissue, a process that may result in scar formation. Although the fibrous scar is not normal, it provides enough structural stability that the injured tissue is usually able to function. The term fibrosis is most often used to describe the extensive deposition of collagen that occurs in the lungs, liver, kidney, and other organs as a consequence of chronic inflammation, or in the myocardium after extensive ischemic necrosis (infarction). If fibrosis develops in a tissue space occupied by an inflammatory exudate, it is called organization (as in organizing pneumonia affecting the lung)

1-First intention healing (Primary Union)

In which healing of a clean uninfected surgical wound focal disruption of epithelial basement membrane continuity and death of few cells (epithelia) and fibroblasts. Epithelial regeneration predominates over fibrosis from edges ,a small scar is formed and mild wound contraction ,such type of wound healing united within 2 weeks and dense scar tissue laid down within 1 month.

Healing stages

1- Stages of wound healing by First Intention:

1- Fibrin clotted blood fill narrow wound incision.

2- Within 24 hrs. neutrophils migrate to word the fibrin clot .

3- Within 24-48 hrs. epithelial migration from edges along the dermis

4- By day 3 neutrophils replaced by macrophages and granulation tissue invade the incision space granulation tissue composed of new capillaries and proliferated fibroblasts.

5- By 5th day neovascularization reach its peak as granulation tissue fill the incisional space.

6- During 2nd week collagen accumulation, fibrosis proliferation that bridge the incision.

7- Processes of blanching begins accomplished by collagen deposition and regress of vascular channels.

8- By the end of first month the connective tissue scar devoid inflammatory cells, covered by normal epidermis

This type of healing occurs when there is no contamination of the wound and the edges of the wound are approximated, thus closing the wound. The best example of this situation is the surgical incision where contamination of the wound is minimized and the wound is closed by suturing.

2-Second intention healing (Secondary Union)

This occur when wound edges are widely separated, the gab can not bridged directly. Here is extensive loss of epithelia, sever wound contamination and sub epithelial tissue damage so healing occur by granulation tissue from the bottom to the surface of wound. the larger defect is greater mass of scar tissue than healing by first intention , such scarring result too much wound contraction, the mode of healing in 2nd intention occur in large wound , abscess, ulcerations , and after infarction

- ✓ **Secondary healing differs from primary by :**

1- Large clot enriched in fibrin and fibronectin form at the surface of wound

2- Inflammation more intense because more tissue defects occurred

3- Much larger amount of granulation tissue result in greater scar formation

4- Associated with wound contraction.

This type of healing occurs when injuries result in more extensive loss of tissues such as with infarction, inflammatory ulceration, and large surface wounds. In these situations, due to the large tissue defect, repair by regeneration is minimal and the defect is filled by granulation tissue. Second intention healing differs from

first intention healing in several ways. First, the greater injury invokes a more intense inflammatory response. Secondly, much more granulation tissue is formed. And thirdly, wounds that are repaired by second intention healing undergo a phenomenon known as "wound contraction" whereby specialized granulation tissue fibroblasts called myofibroblasts contract and dramatically reduce the size of the wound.

Factors affecting wound healing

A- local:

1- Wound sepsis .

2- Poor blood supply.

3- Wound tension.

4- Foreign bodies.

5- Previous irradiation .

6- Poor technique.

B-systemic :

1- Nutritional deficiencies.

2- Systemic diseases , D.M.

3- Therapeutic agents.

4- Age.