

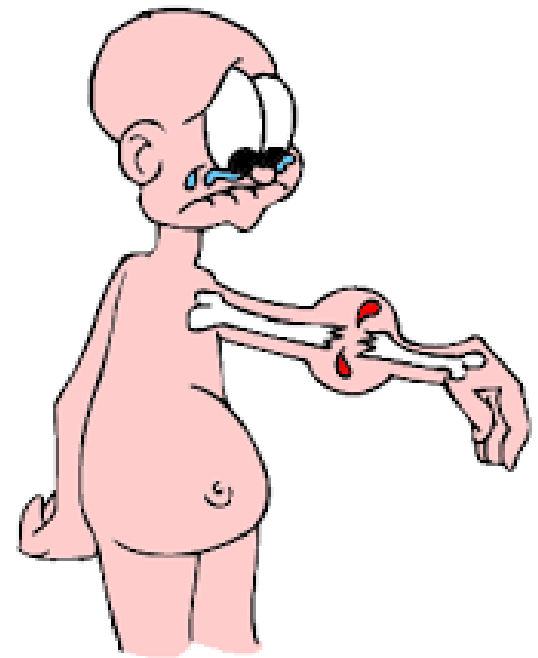


Healing II

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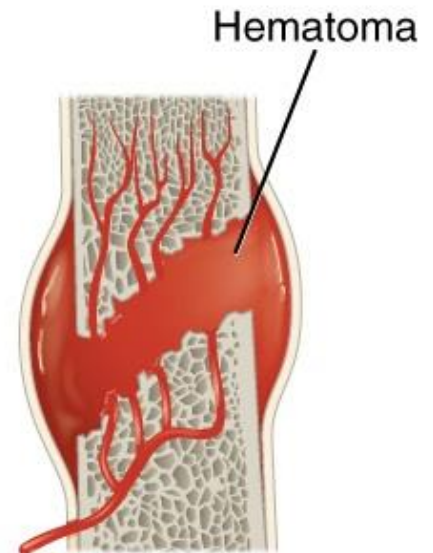
Bone

- Procallus formation
- Osseous callus formation
- Remodelling



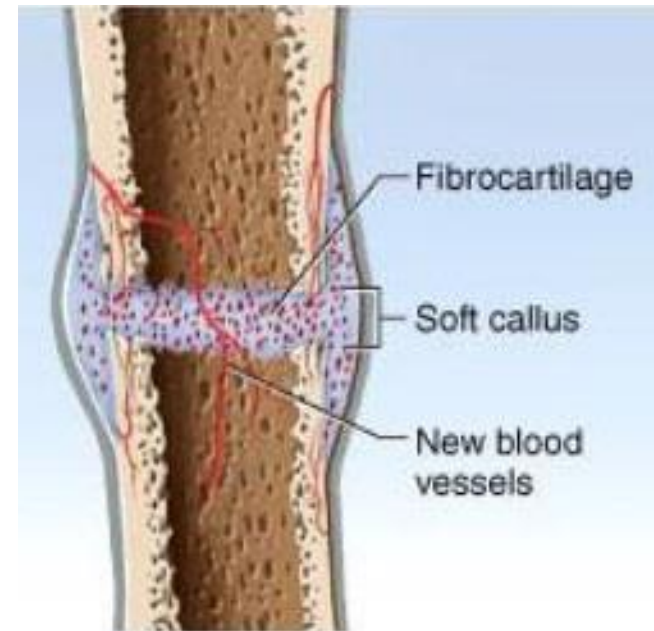
Procallus formation

- Haematoma
 - Clotted blood forms a fibrin mesh
 - Seal off the fracture site
 - Creates a framework for infla cells, FB, new capillaries
- Local inflammatory response due to tissue damage
 - Polymorphs
 - Macrophages
 - clears fibrin, cells, inflammatory exudate
 - Remove dead bone fragments



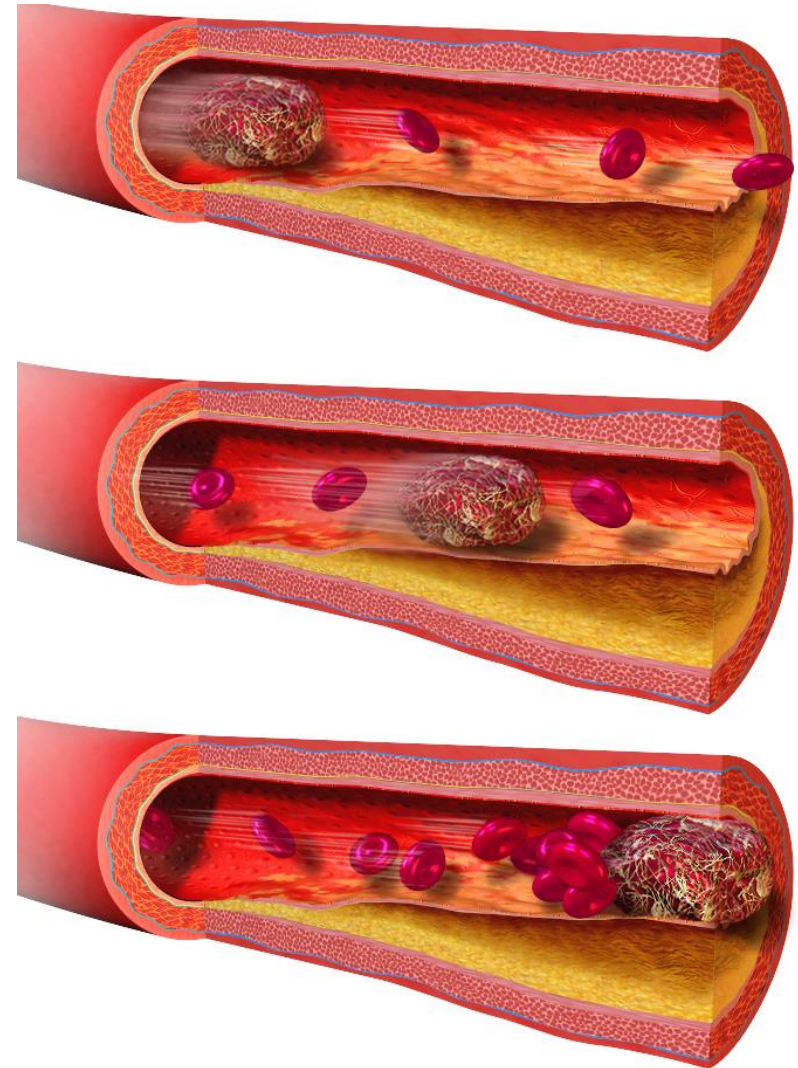
Procallus formation cont.

- Ingrowth of granulation tissue formation
 - New vessel formation
 - Proliferation of mesenchymal cells
- Fusiform uncalcified mass forms a soft tissue callus (procallus)
 - Provides some anchorage between 2 ends of the bones
 - No structural rigidity for weight bearing



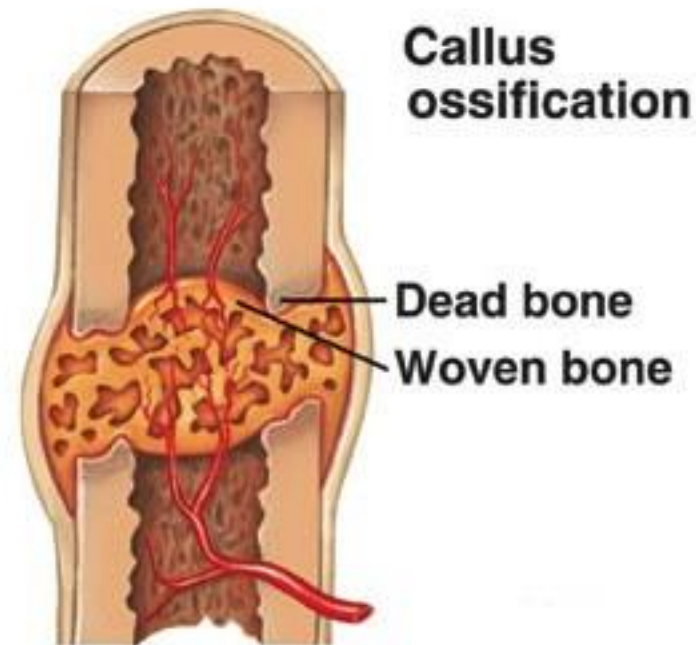
Emboli

- Fatty marrow undergo necrosis
- Globules of fat are released
- Fat globules may enter disrupted vascular spaces
- Can become emboli



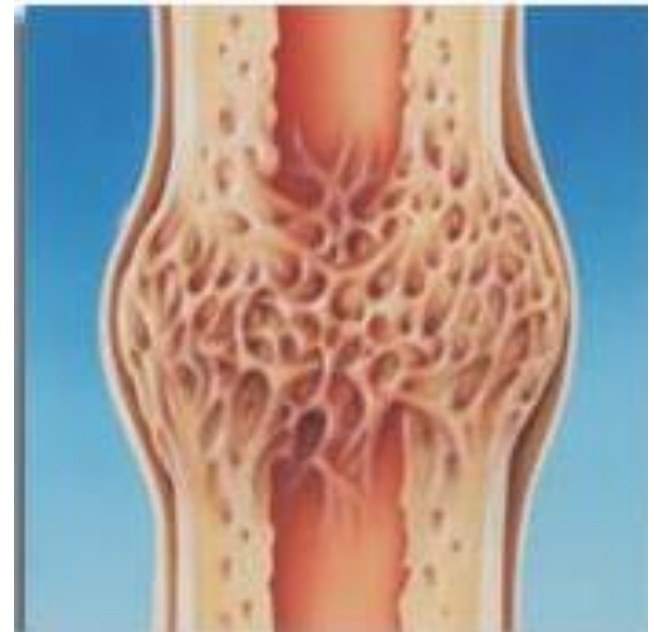
Osseous callus formation

- Periosteal cells → osteoblasts
- Osteoblasts form
 - collagen fibres
 - Ground substance in which they are embedded
- Osteoid (formed during maturation of GT)
- Osteoid undergo calcification → woven bone



Osseous callus formation cont.

- Periosteal cells → chondroblasts which form hyaline cartilage → new cartilage undergoes endochondral ossification
- Fusiform in shape and act as a scaffold.
- Final adult lamellar bone can be built on this.



Osseous callus formation cont.

- Woven bone cleared by osteoclasts
- Osteoblasts lay down osteoid which calcifies to form bone.
- It's collagen fibres are arranged in orderly lamellar fashion.
- Lamellar bone is formed.



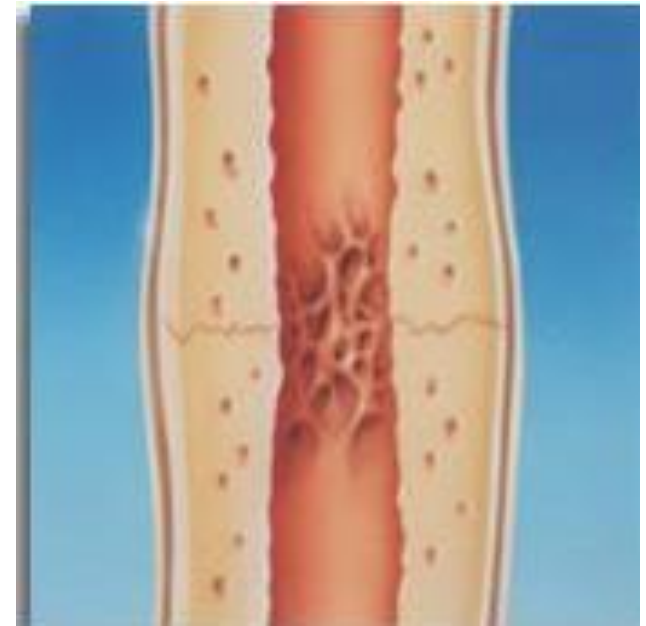
Remodelling

- Callus formation occur in excess.
- Excess fibrous tissue, cartilage, bone
- Callus matures, when subjected to weight bearing forces, portions that are not physically stressed are reabsorbed.
- Callus is reduced in size.
- Medullary cavity is restored.



Remodelling cont.

- Osteoclasts clear the excess bone
- Osteoblasts lay down bone
- External callus - Cleared away
- Intermediate callus is converted to compact bone containing Haversian systems (cortex).
- Internal callus is hollowed out to form bone marrow.



Abnormalities of Fracture healing

- Fibrous union
- Non union
- Delayed union

Fibrous union

- Heal by forming fibrous tissue rather than new bone.
- If the the fracture site is not immobilised, Cells behave as fibroblasts→bone ends become united by simple scar tissue.
- If movement is excessive→cells may differentiate into synovial cells and forms a false joint (pseudoarthrosis)

Pseudoarthrosis



Non union

- A complete lack of union between the two ends.
- Commonly results from interposition of soft parts (muscle, fascia).

Delayed union

- A certain amount of time is required before bone healing
- May vary according to age, bone involved, level of the fracture, and associated soft tissue injury.
- Delayed union is present when this period of time has elapsed.

Delayed union cont.

- The fact that a bone is delayed in its union does not mean that it will become a nonunion.
- Nonunion is one end result of a delayed union.
- Causes;
 - inadequate reduction
 - inadequate immobilization
 - loss of blood supply
 - infection

Pathological fracture

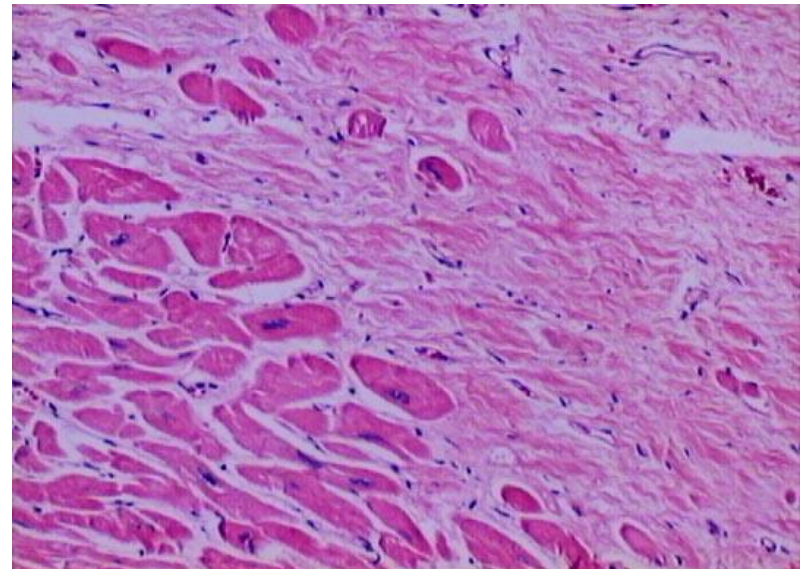
- Fractures occurring in diseased bones following minimal strain.
- Any lesion that weakens the bones is liable to cause fractures.
- Causes
 - Osteoporosis
 - Secondary metastasis

Muscle



Muscle healing

- All 3 types have limited capacity to regenerate.
- Damage to the myocardium which results in necrosis is permanent, as cardiac muscle cells do not divide.
- This means that damaged muscle cells are not replaced.
- Healing is by the formation of granulation tissue and fibrosis (i.e. fibrous scar tissue).

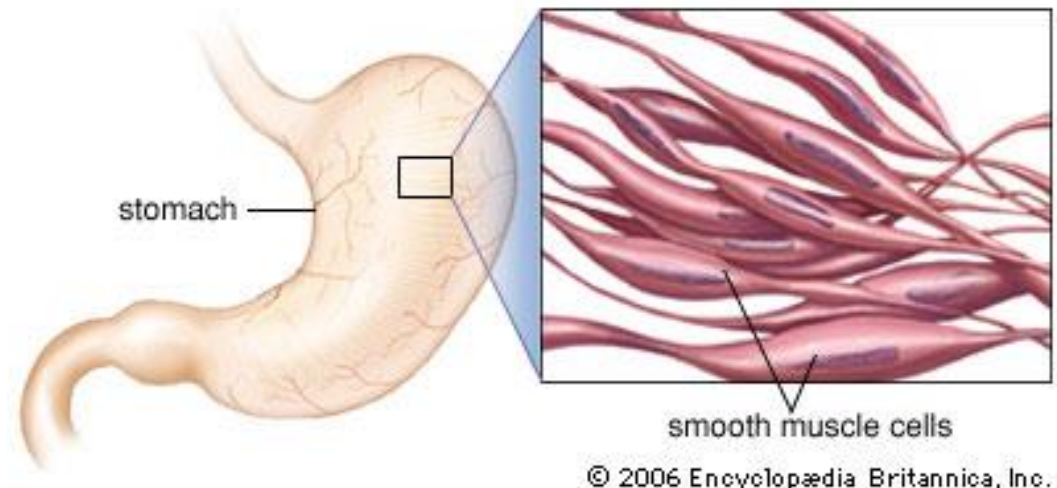


Skeletal muscles

- Cut ends of muscle fibres retract but are held together by stromal connective tissue.
 - Injured site is filled with inflammatory cells, fibrinous material.
 - Macrophages clear the damaged fibres.
- Intact muscle sheath → Properly oriented muscle fibres are formed
- Damaged muscle sheath → Fibrous scar

Smooth muscles

- Large lesions → permanent scar
 - Eg. Healed chronic peptic ulcer
- But SM have potential for regeneration.
- It is thought that they are differentiated from pericytes which are scattered along certain small vessels.



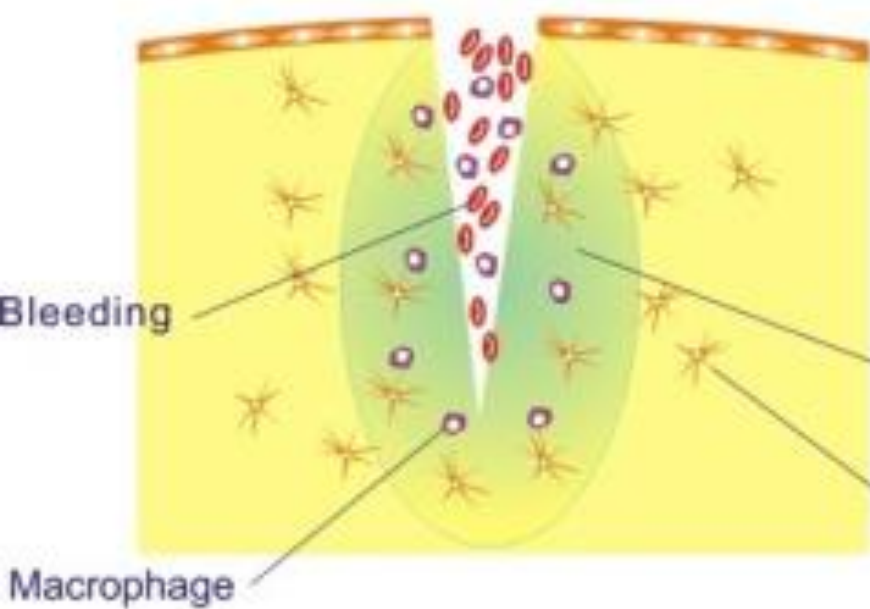
Brain healing

- No neuronal regeneration, Only glial cells proliferate.
- Repair begins after injury as astrocytes outside the lesion are activated.
- Astrocytes proliferate and undergo hypertrophy.
- This glial response is called gliosis.

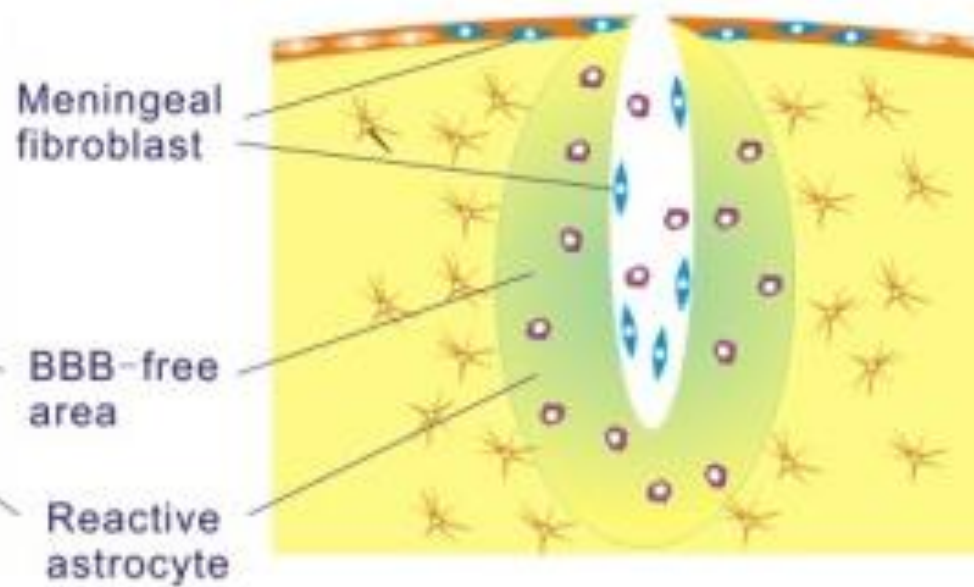
Brain healing cont.

- In the most extreme form, the proliferation associated with gliosis leads to the formation of a glial scar.
- Glial scar creates a wall around the injury sealing off the injury.
- This is made up of a multilayered sheet of activated astrocytes.

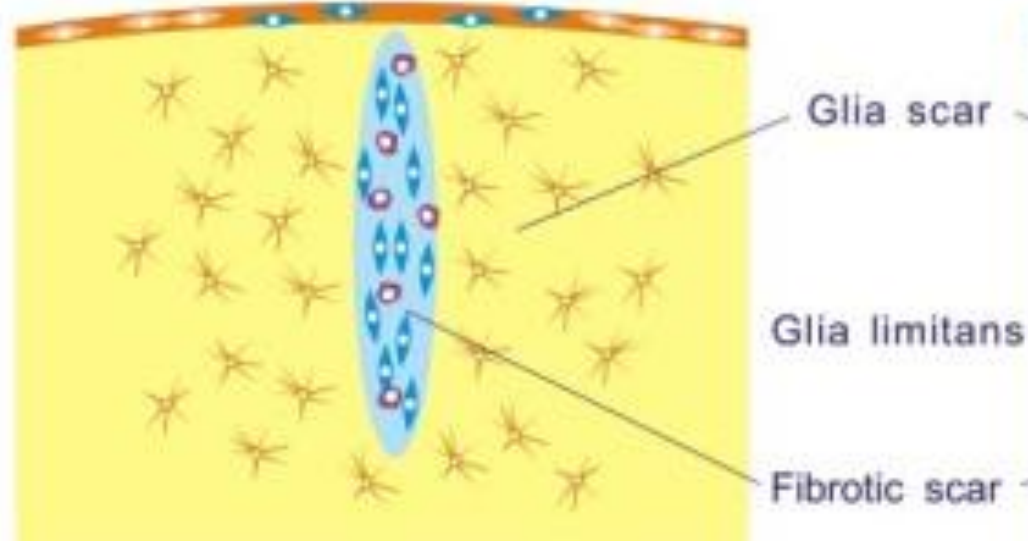
a 1 day after



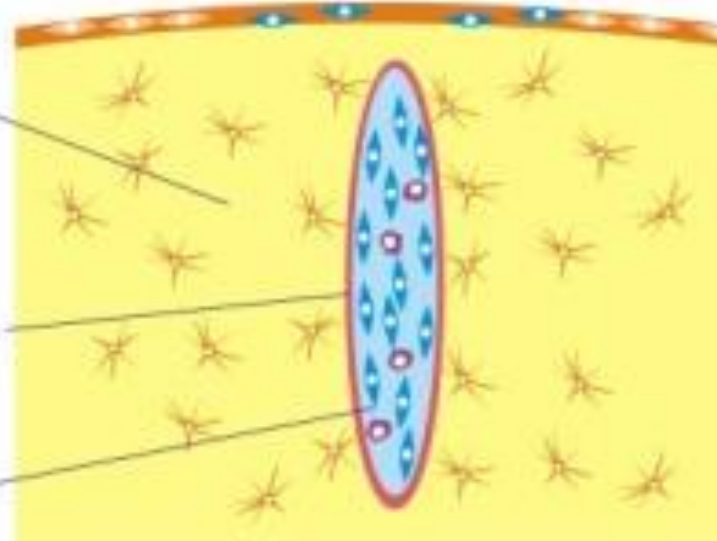
b 3 days after



c 7 days after



d 14 days after



Brain healing cont.

- Gliosis protects healthy cells from injury and assist in healing.
- Contents of damaged neurons /inflammatory constituents do not harm healthy cells.

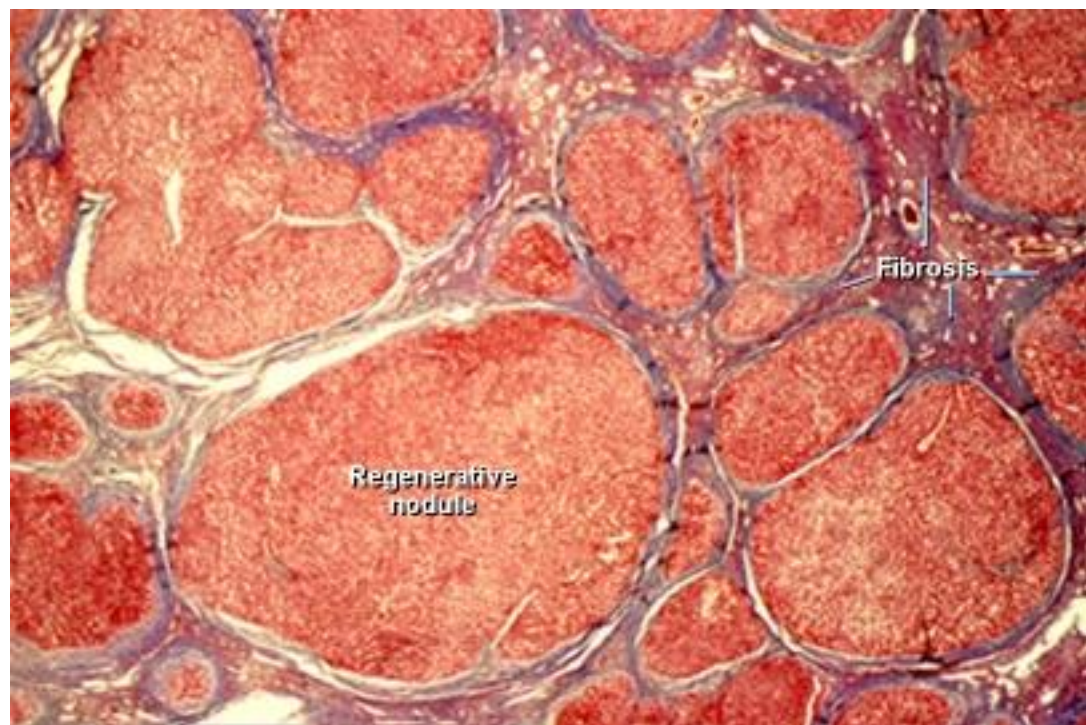
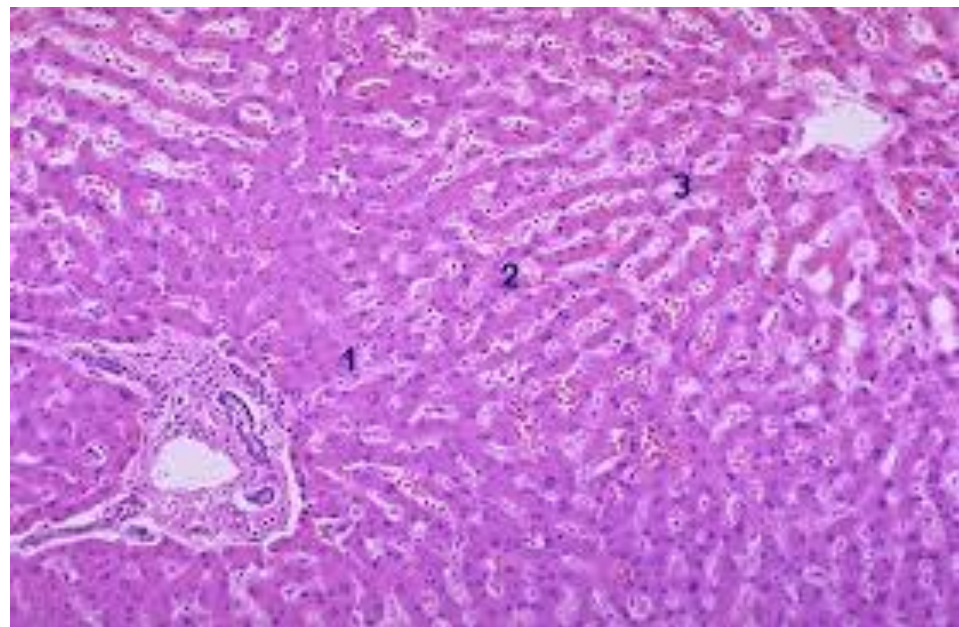
Liver



- Liver is able to regenerate very well.
- Regeneration of cells seen in any type of necrosis, provided the patient survives.
- Acute hepatic injury caused by viral hepatitis or toxin exposure, can regenerate completely restoring full form and function.

Liver cont.

- Chronic insults such as ongoing exposure to alcohol or hepatitis C virus
- Connective tissue network is severely damaged
- May result in the formation of collagen based scars and the development of cirrhosis → loss of function → Liver failure



Kidneys

- Renal tubular epithelium has good powers of regeneration.
- But whole nephrons do not.
- This means that mild damage to the kidneys will heal completely.
 - Eg. Acute tubular necrosis due to toxins → BM not damaged → complete return to normal.
- Eligible for haemodialysis due to full recovery is expected

Kidneys cont.

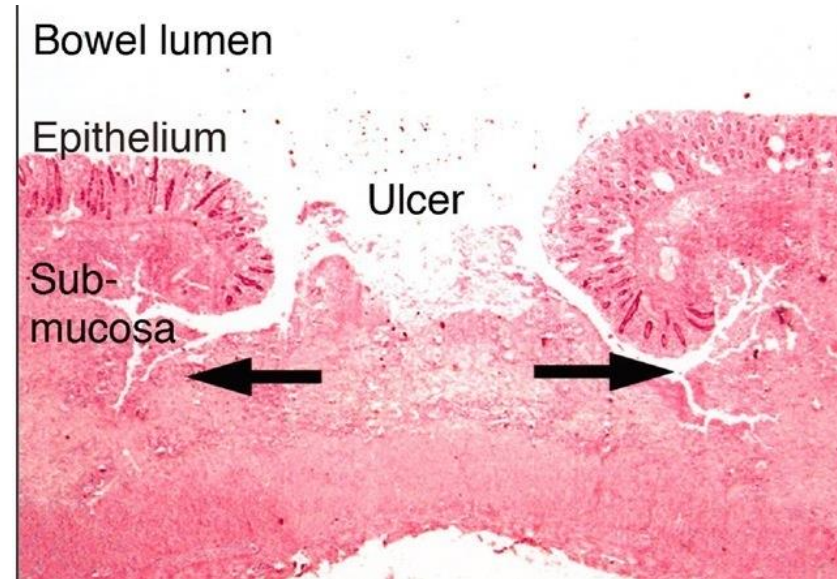
- But more extensive injuries will result in scar formation.
- Regeneration is poor when
 - BM is disrupted
 - Damage to complete nephron
- The glomeruli do not regenerate after injury. Once destroyed, it cannot be replaced.
- Glomerular damage → scarring

Kidneys cont.

- Unilateral nephrectomy → remaining kidney enlarge in size → no new nephrons are formed → increase in cell size and number in the nephrons

Mucosal ulceration

- Defect covered by blood
- Inflammation
- Macrophage remove debris
- Granulation tissue formed
- Mucosa spread from the margin to the base of the ulcer
- Muscle replaced by scar tissue
- May lead to stenosis and obstruction



Lungs

- Damage to the alveoli may occur as a result of infection, inhalation of irritants or shock.
- As long as the basement membranes of the alveoli remain intact there can be complete healing.
- More severe damage can lead to areas of pulmonary fibrosis.

Thank You