Inflammation II

Outcomes of inflammation with clinical examples

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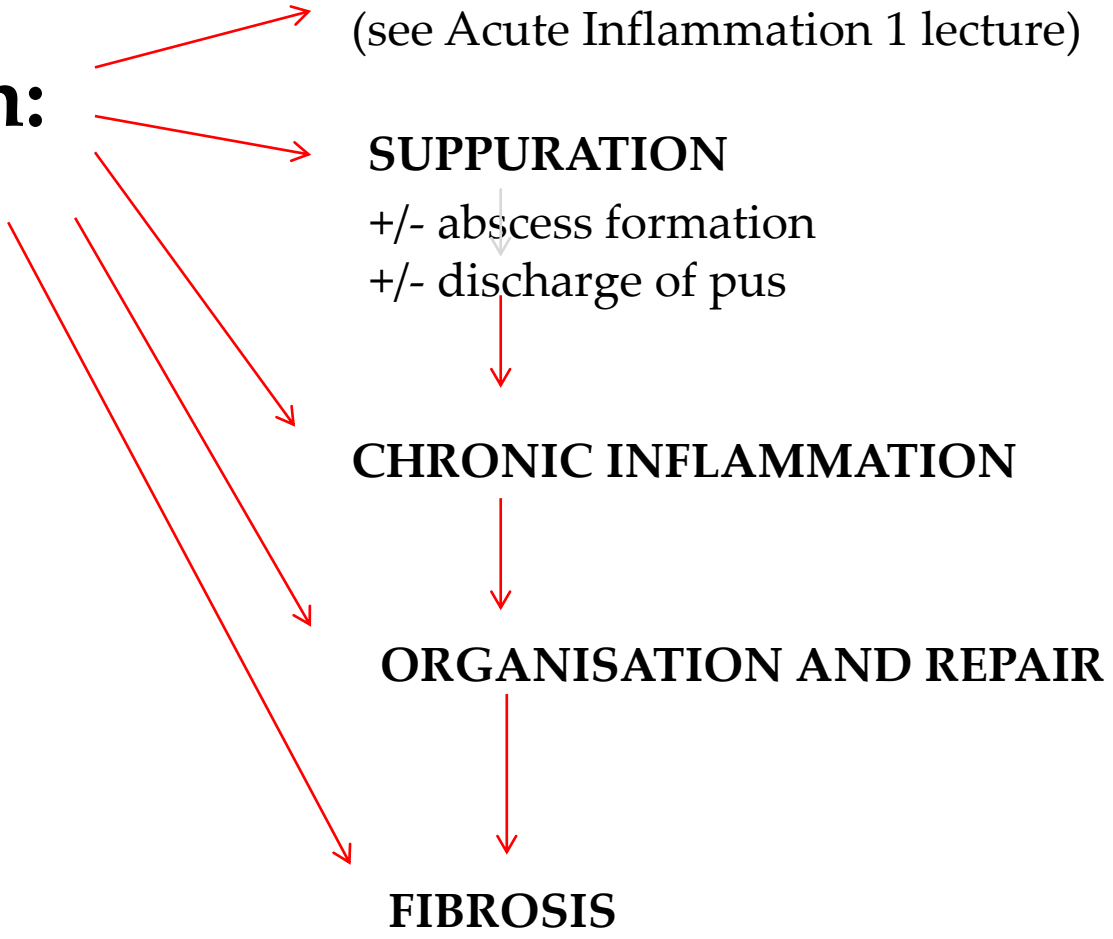
Acute Inflammation: Sequelae



SUPPURATION

Definitions

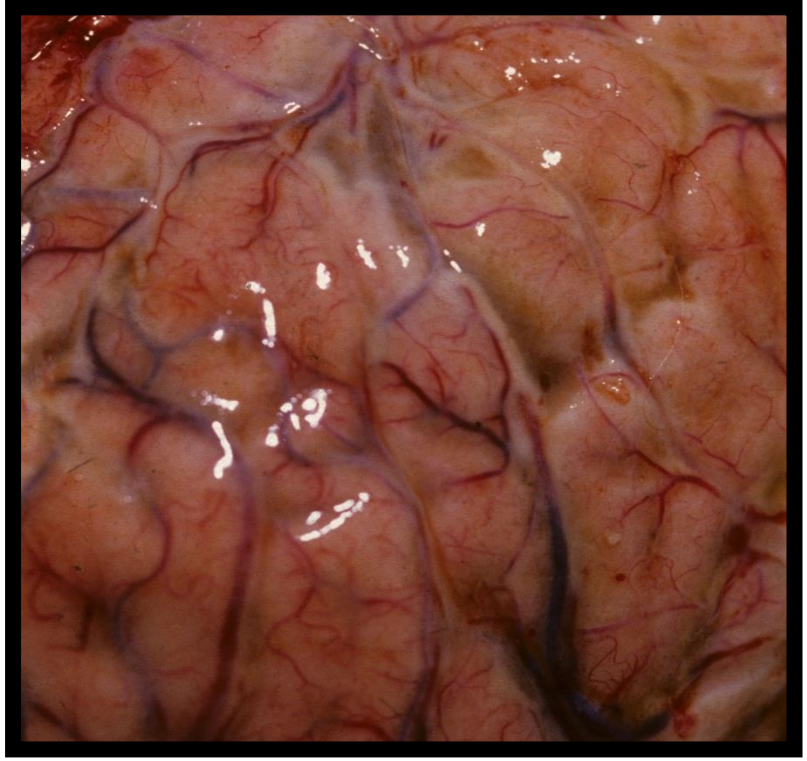
Suppuration: the formation of pus.

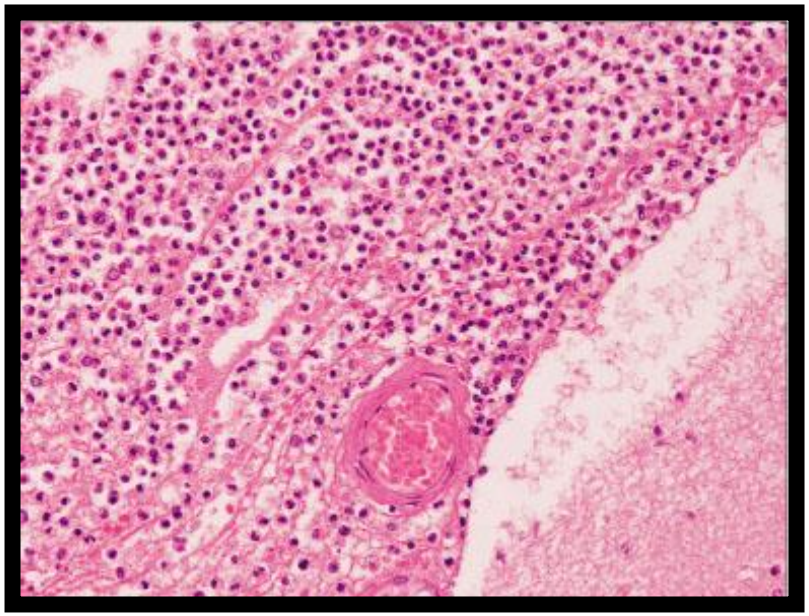
Pus: an accumulation of dead and living neutrophils, dead and living bacteria (when inflammation caused by **pyogenic bacteria**), protein (especially fibrin) and other particulate matter (eg cell fragments etc)

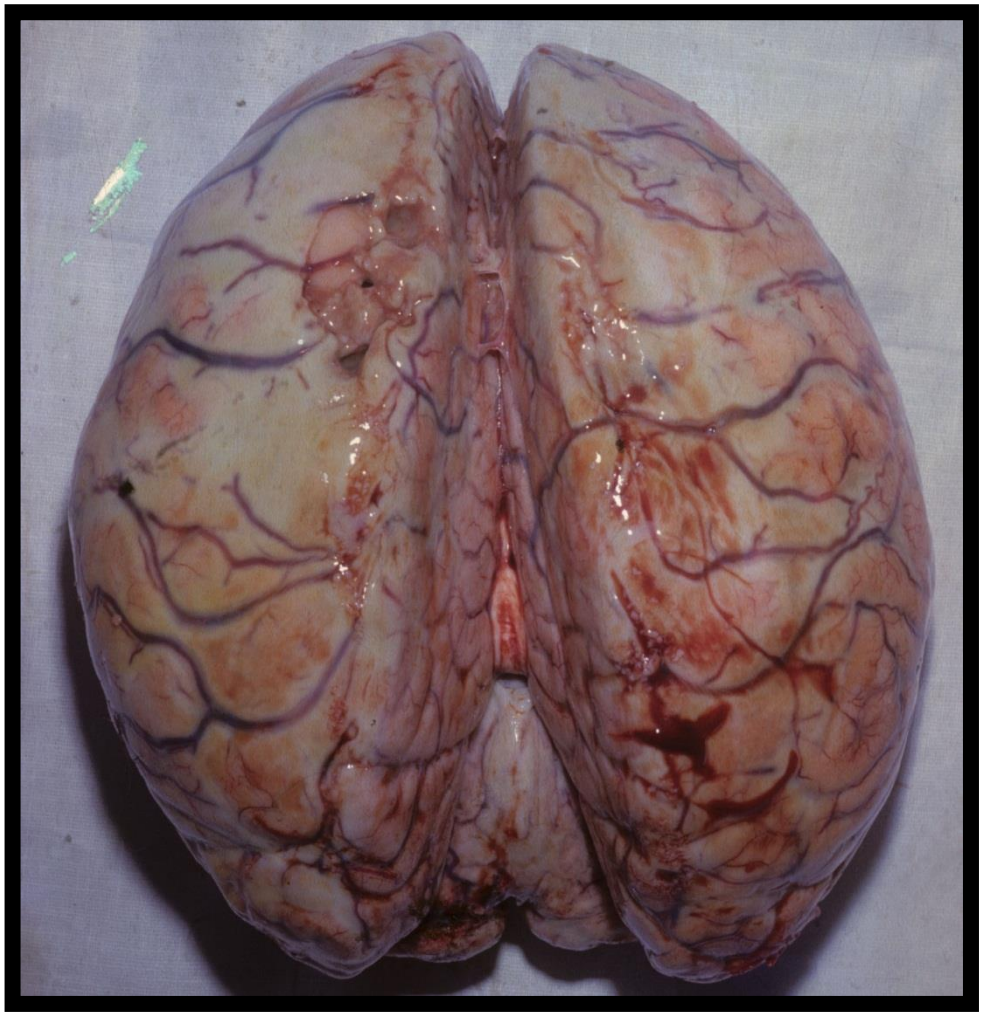
Abcess: a pus-filled cavity

Empyema: an accumulation of pus in a naturally occurring body cavity

*This type of exudate if referred to as **'suppurative'** or **'purulent'***







Suppurative meningitis

Note creamy yellow exudate around vessels in subarachnoid space

Micro: Exudate predominantly neutrophils, fibrin, bacteria

Evolution of an abscess

Starts as an acute **inflammatory exudate with many neutrophils.**
Proteins (mainly fibrin), bacteria and polymorphs aggregate to form a mass

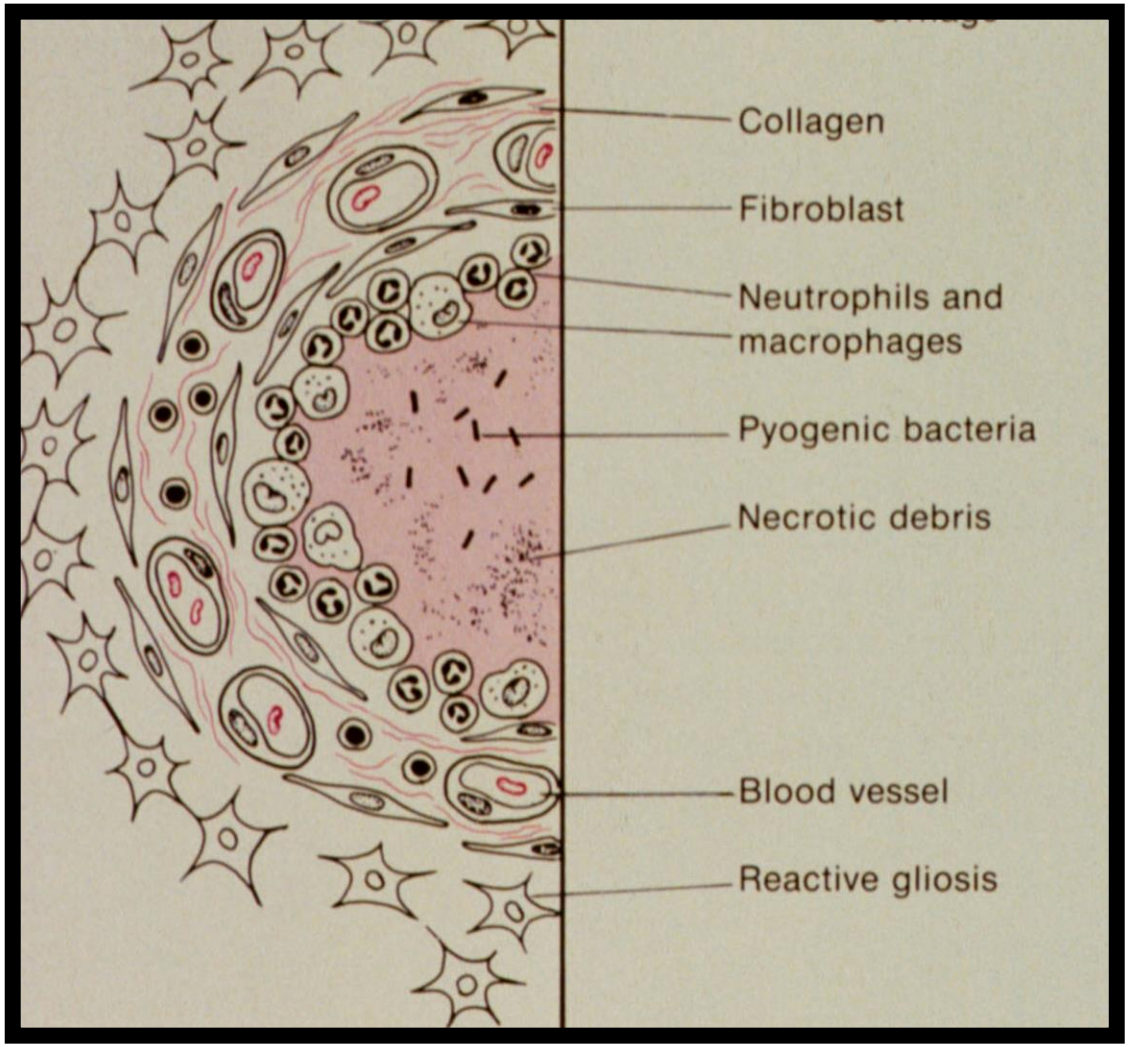
Tissue death (necrosis) ensues

New capillaries and fibroblasts develop at edge of accumulated material = '**granulation tissue'** (process of **organisation**)

Fibroblasts start to lay down scar tissue (collagen)

Pus resorbed (if small amount) or can burst onto ('point') to external surface (**sinus**)or adjacent body cavity (**fistula**) and be discharged in this way

Collagen deposition proceeds to formation of mature scar



Brain abscess

Pus filled cavity with peripheral organisation

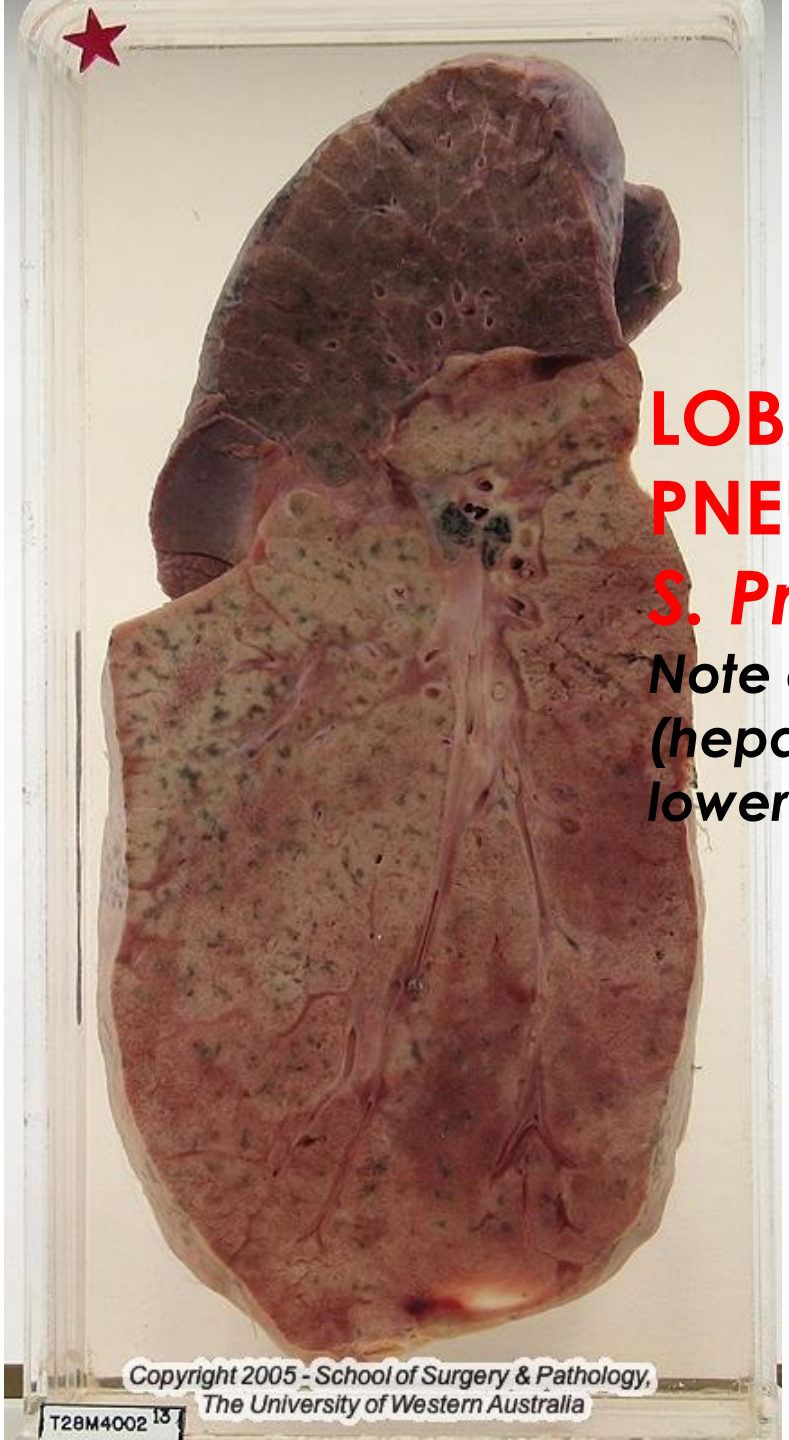
Wall of abscess

Note: suppurative exudate and surrounding organisation

EXAMPLES of ACUTE INFLAMMATORY REACTION IN THE LUNG caused by PYOGENIC BACTERIA

(Bacterial Pneumonia)

- **Lobar pneumonia**
- **Bronchopneumonia**

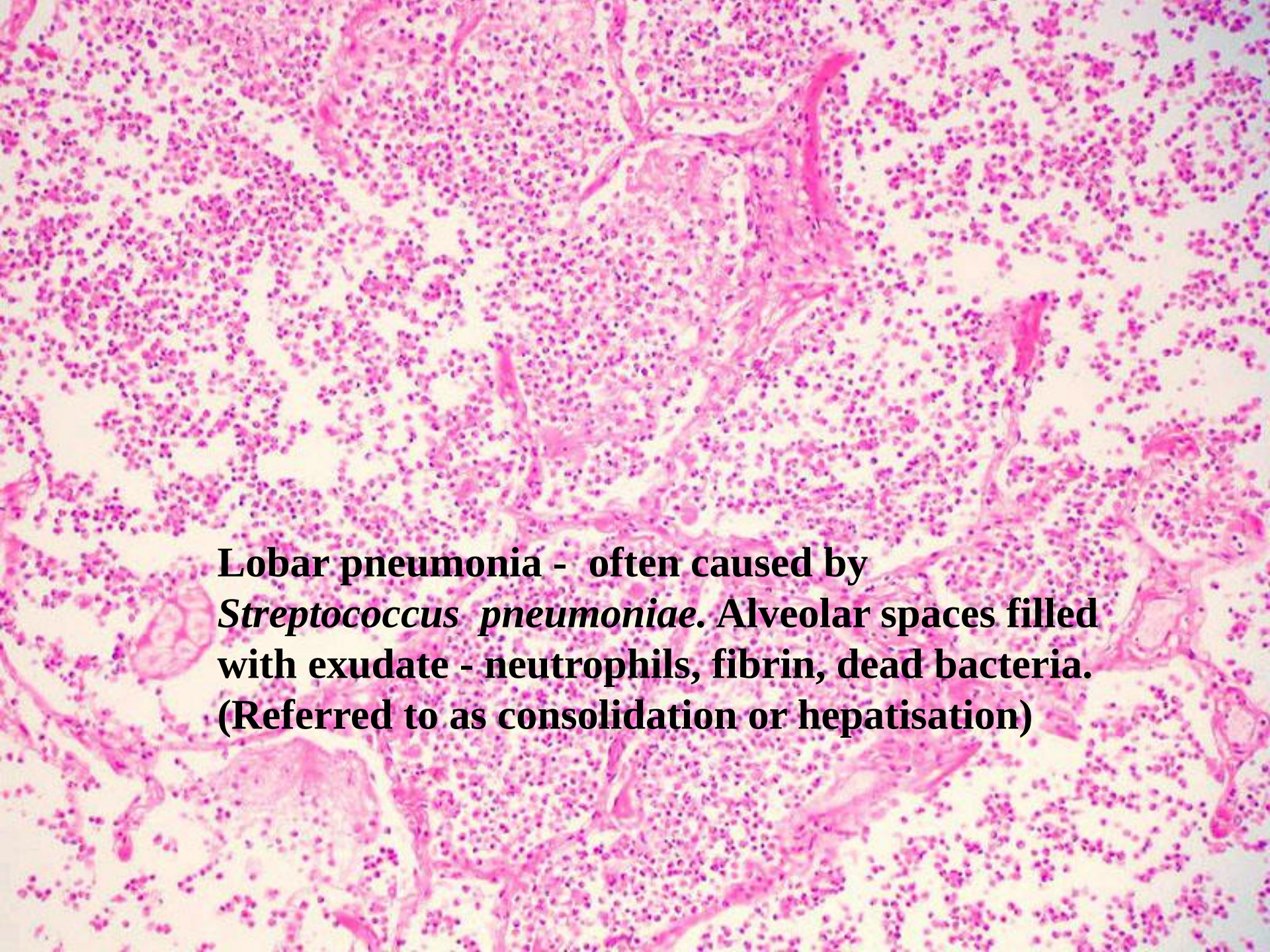


LOBAR PNEUMONIA

S. Pneumoniae

Note consolidation (hepatisation) of lower lobe


Consolidation of entire lobe
METRIC 1
2
3



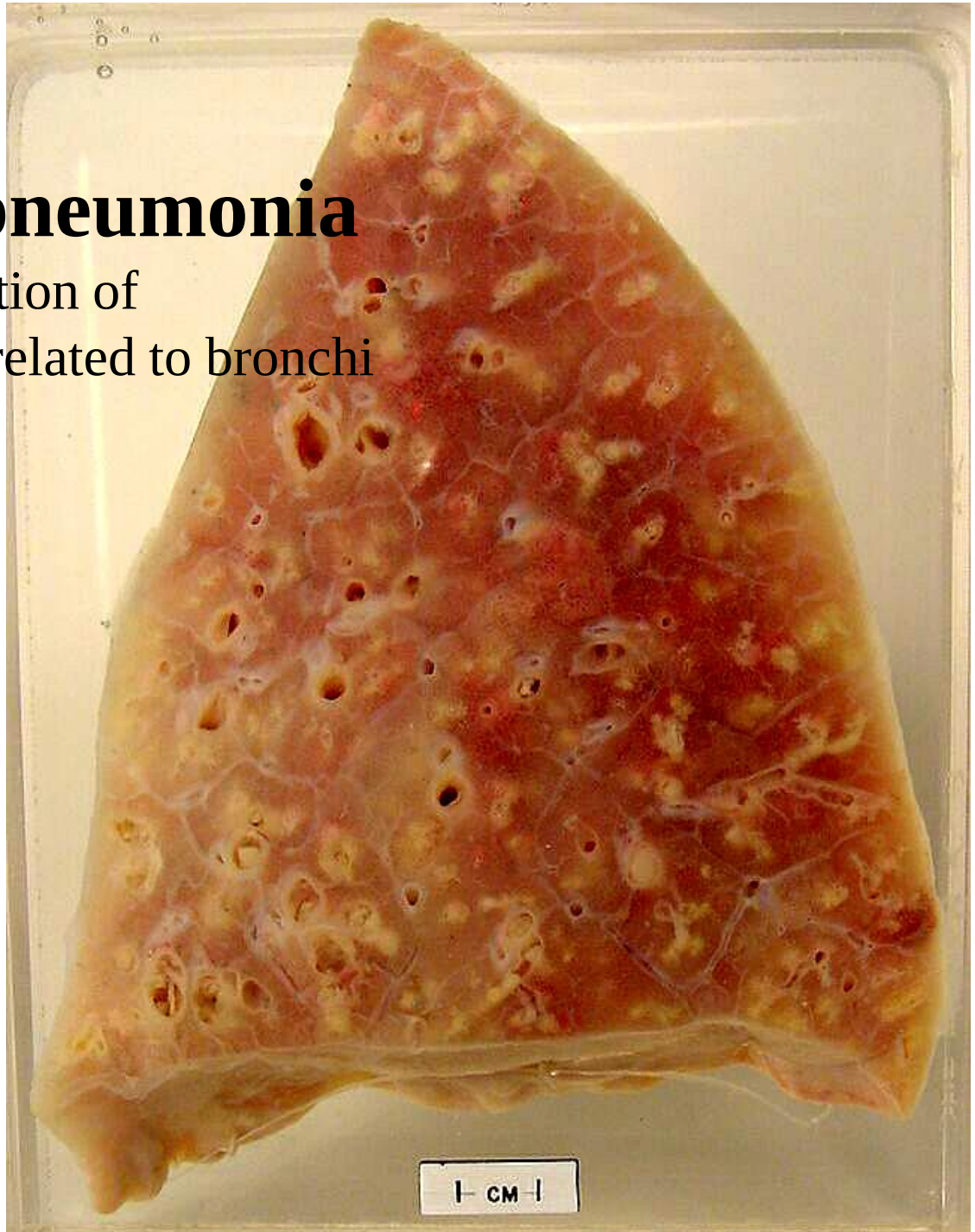
Lobar pneumonia - often caused by *Streptococcus pneumoniae.* Alveolar spaces filled with exudate - neutrophils, fibrin, dead bacteria. (Referred to as consolidation or hepatisation)

Outcomes of pneumonia

- Resolution
- Abscess formation
- Empyema
- Fibrosis and scarring
- Septicaemia
- Death

Bronchopneumonia

Patchy distribution of consolidation, related to bronchi



Abscess formation complicating pneumonia

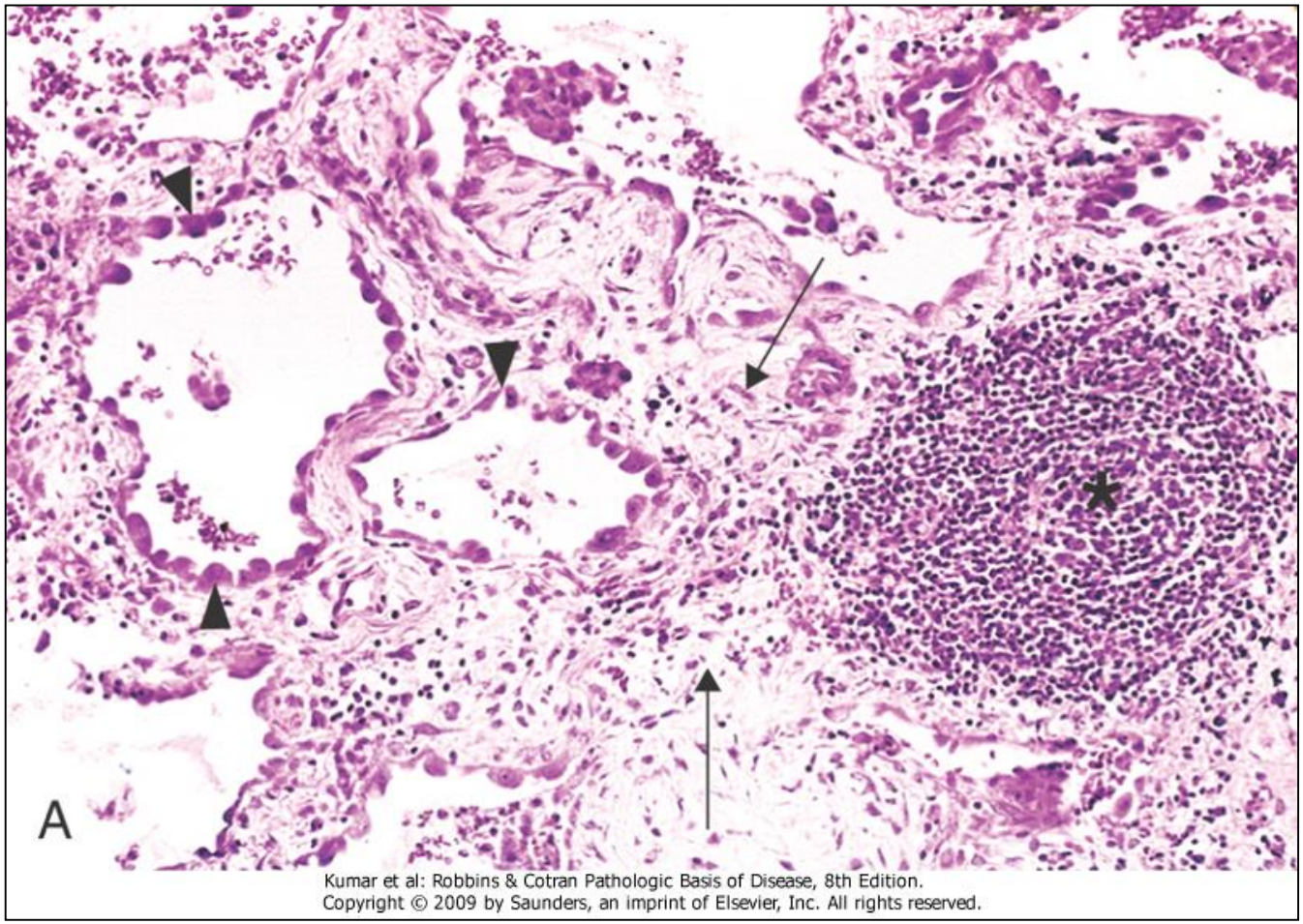
https://healthed.hms.uwa.edu.au/pelc/search.php

CHRONIC INFLAMMATION

Description:

- Inflammation enduring longer than acute inflammation
- May be primary but often results from acute inflammation when causative agent cannot be removed
- Polymorphs (neutrophils) largely replaced by lymphocytes, plasma cells (and macrophages)
- Macrophages often fuse to form giant cells
- Often proliferation of vascular endothelium and fibroblasts

  esp at periphery (= **organisation**)
- Fibrosis



Lung – chronic inflammation
Note lymphocytic aggregate (*), interstitial fibrosis (long arrows), Type 2 pneumocytes (blunt arrows)

Example of chronic inflammatory reaction

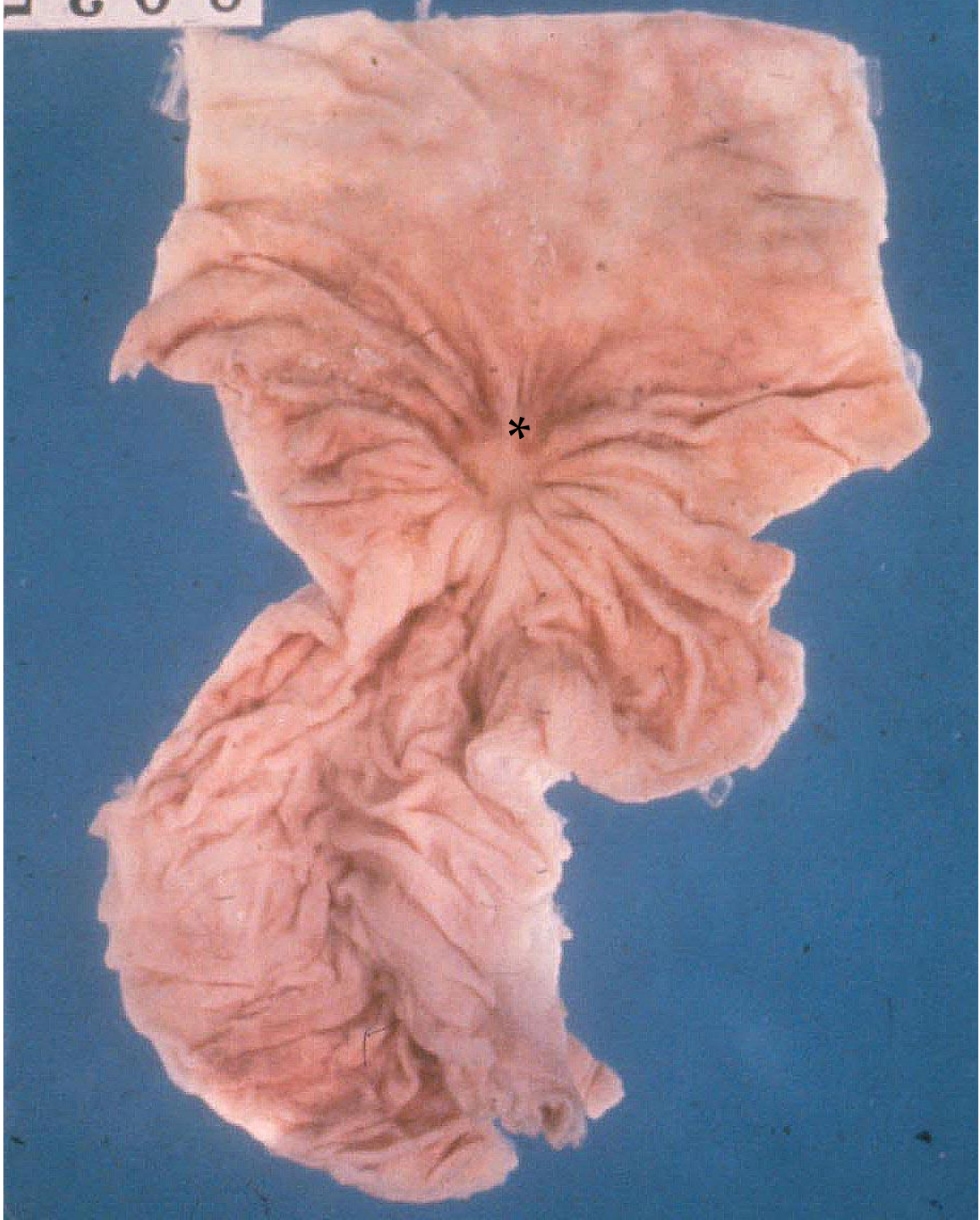
CHRONIC PEPTIC ULCER

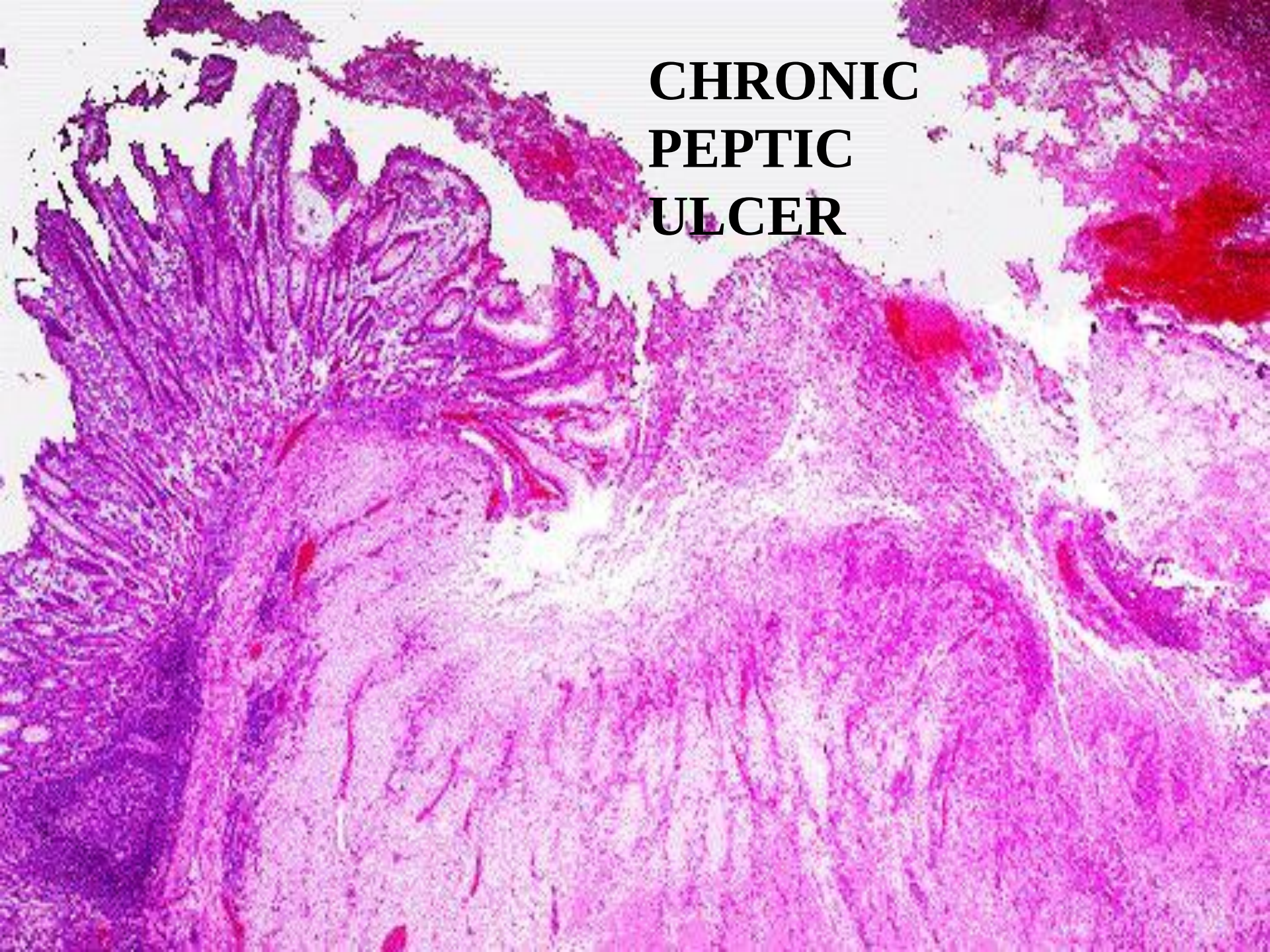
Chronic ulcer occurring in an area of acid pepsin digestion

Commonly stomach duodenum oesophagus

Often associated with *Helicobacter pylori* infection

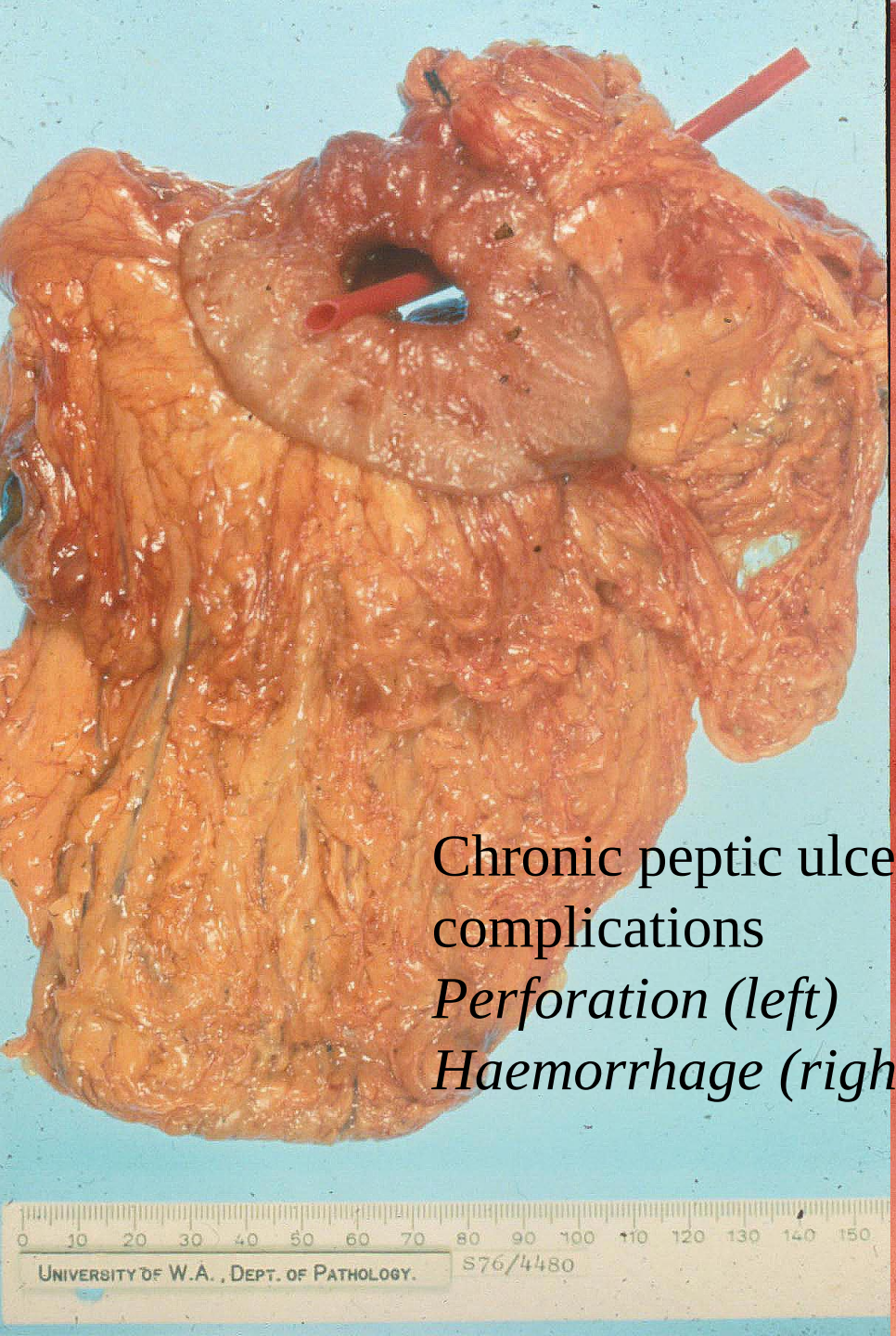
Chronic peptic ulcer of stomach (*)




CHRONIC
PEPTIC
ULCER

OUTCOMES OF CHRONIC PEPTIC ULCER

- Resolution - rare without appropriate therapy
- Haemorrhage
- Fibrosis (± stenosis)
- Perforation
- Penetration (± fistula formation)
- Malignant transformation very rare



Chronic peptic ulcer complications

Perforation (left)

Haemorrhage (right)

Example of chronic inflammatory disease

Tuberculosis

Mycobacterium tuberculosis

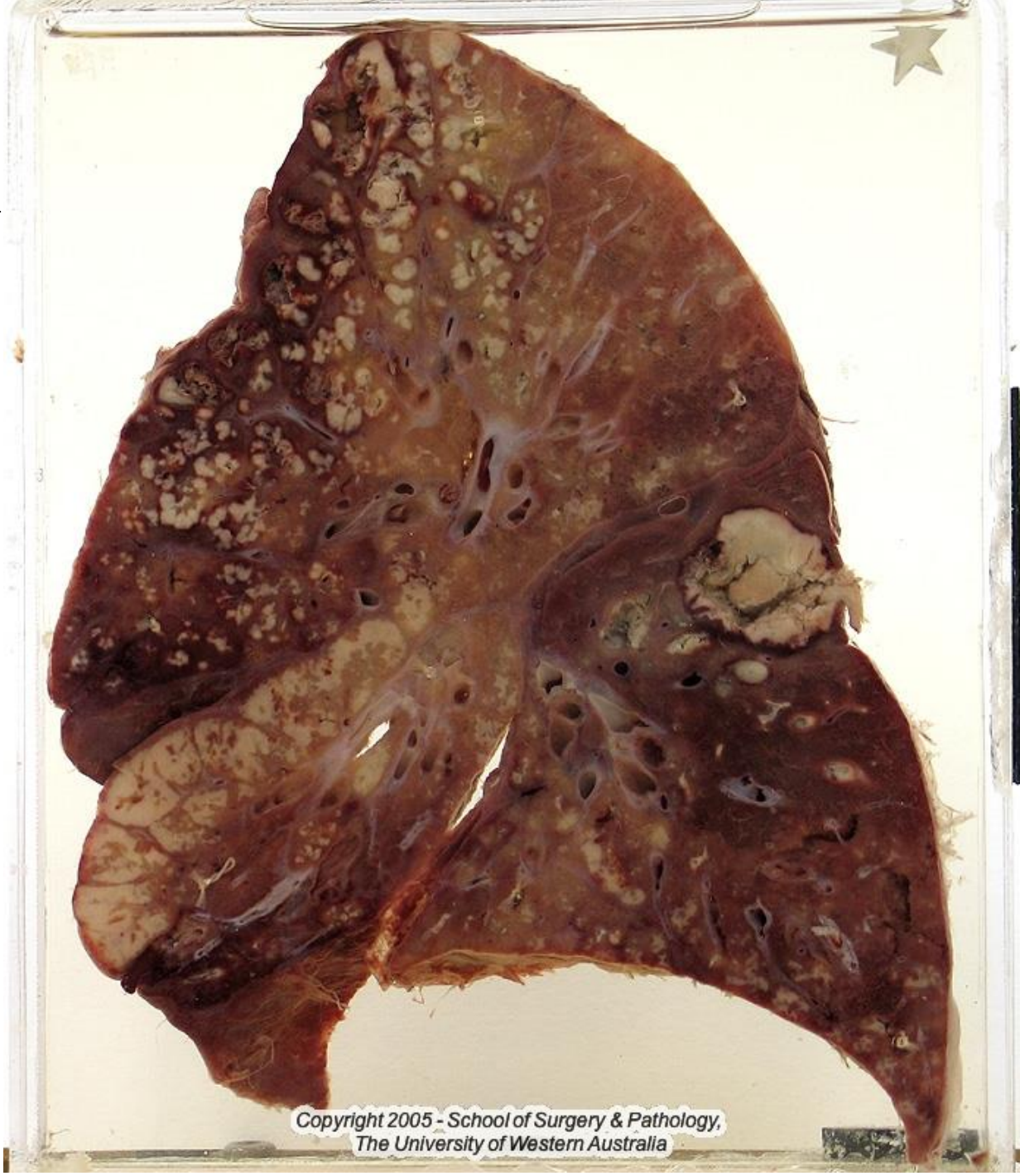
Tuberculosis

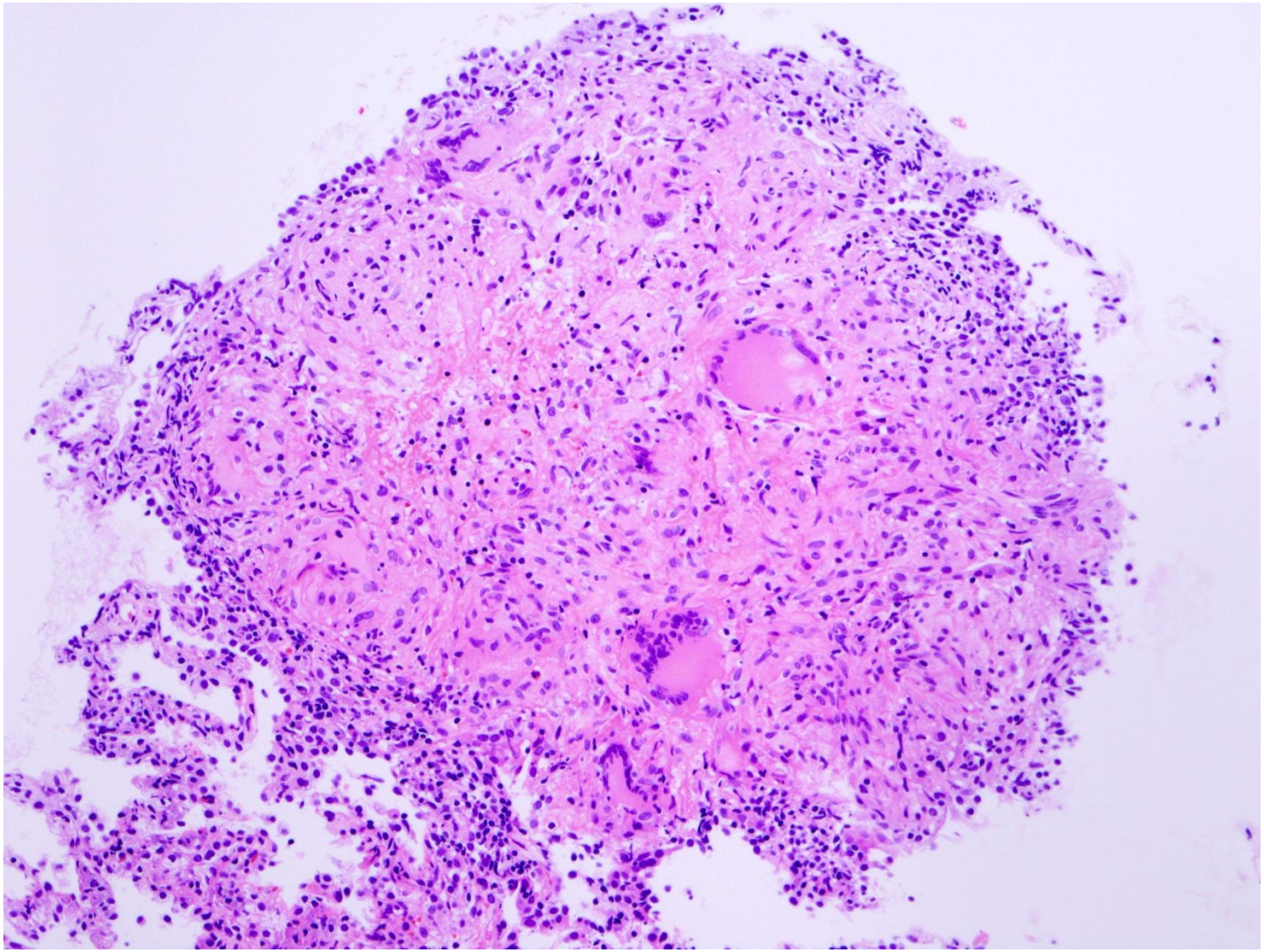
Tuberculous meningitis - above

Tuberculosis of spine (Pott's disease) - right

Tuberculosis
Often associated with
'caseous' necrosis

LUNG
Caseous tuberculosis and tuberculous bronchopneumonia





Tuberculosis:

Often associated with ***granulomatous inflammation***

Note epithelioid macrophages and giant cells

Outcomes of inflammation

Healing and repair

Healing

Resolution

- Removal of exudate
- Regeneration of tissue if possible
- Complete return to normal

Repair

- Occurs when resolution impossible
(severe, ongoing damage , or tissue cannot regenerate)
- Involves formation of granulation tissue (**organisation**)
- Maturation of granulation tissue to scar tissue (fibrosis)

Organisation

Definition

- The growth of new capillaries and fibroblasts into the damaged tissue together with migration of macrophages. Macrophages remove debris, fibroblasts lay down collagen.
- **New capillaries and fibroblasts = 'granulation tissue'** which matures to form fibrous tissue (collagen).
- Often occurs when exudation or damage is excessive and cannot be removed
- Is the process involved in **repair** (healing) of tissue (when resolution is not possible)

Example of healing

Healing of a skin wound

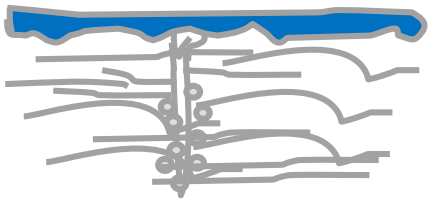
Healing of a skin wound

Healing by primary intention

- Occurs in clean incised wounds with apposed edges (eg surgical wounds)
- Results in minimal scarring
- Occurs in shorter time (mainly healed in a week or two – stitches can be removed)
- Strengthening, devascularisation continues longer

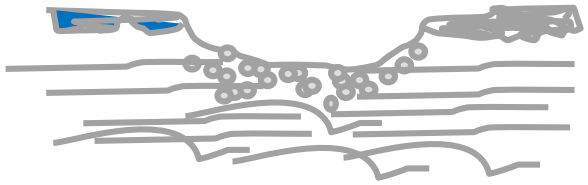
Healing by secondary intention

- Occurs in open wounds (loss of tissue, necrosis or infection)
- Often results in significant scarring (fibrosis)
- Process may continue for months or years



Healing by primary intention

Immediate: small cavity fills with blood and fibrin
2-3 hours: minor inflammation
2-3 days: macrophage, fibroblast activity, new vessel formation (ie minimal granulation tissue)
10-14 days: re-epithelialisation complete, weak fibrous union
Weeks: good fibrous union continues strengthening for **months to years**.
Devascularisation. Minimal scarring

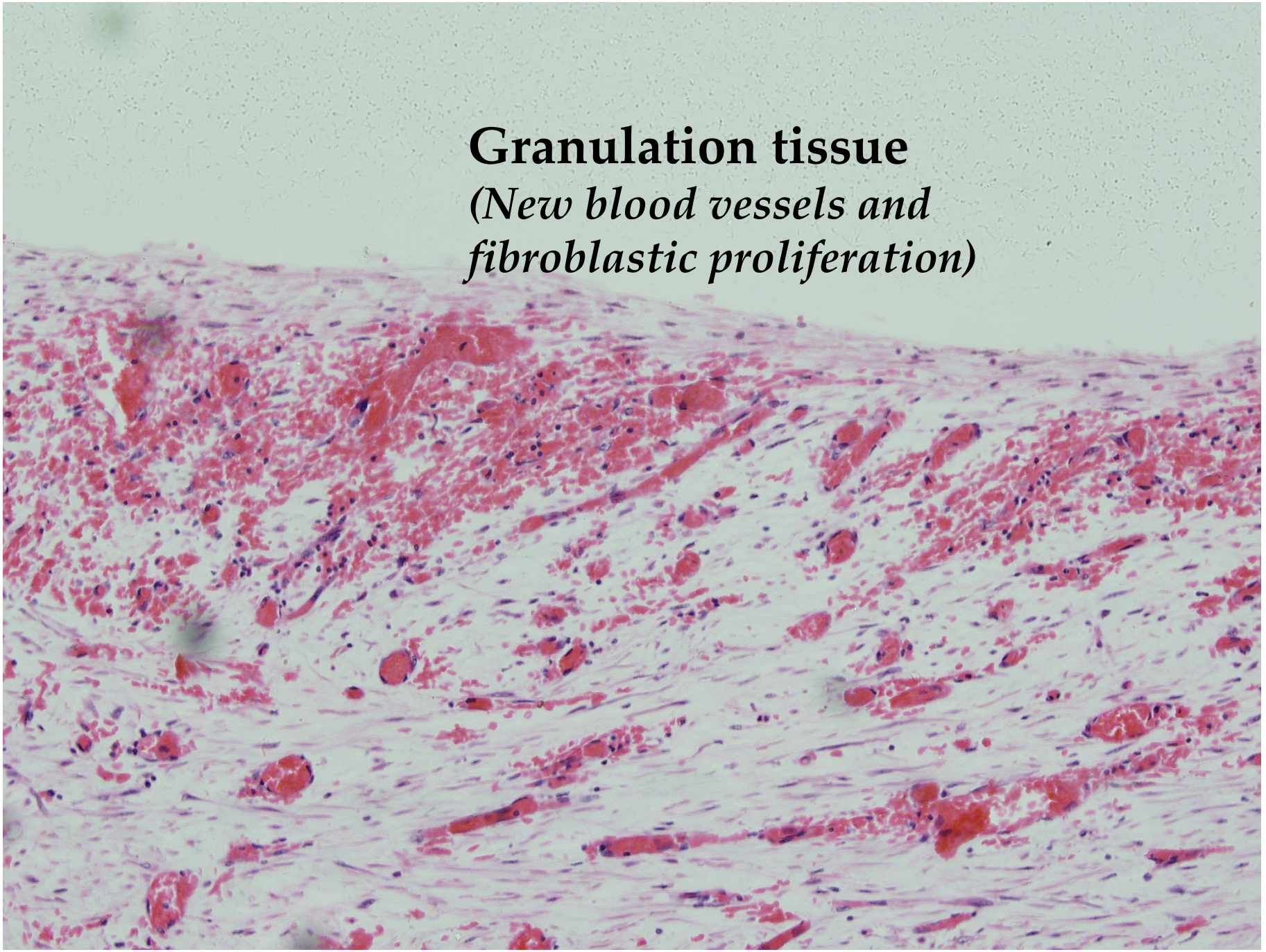


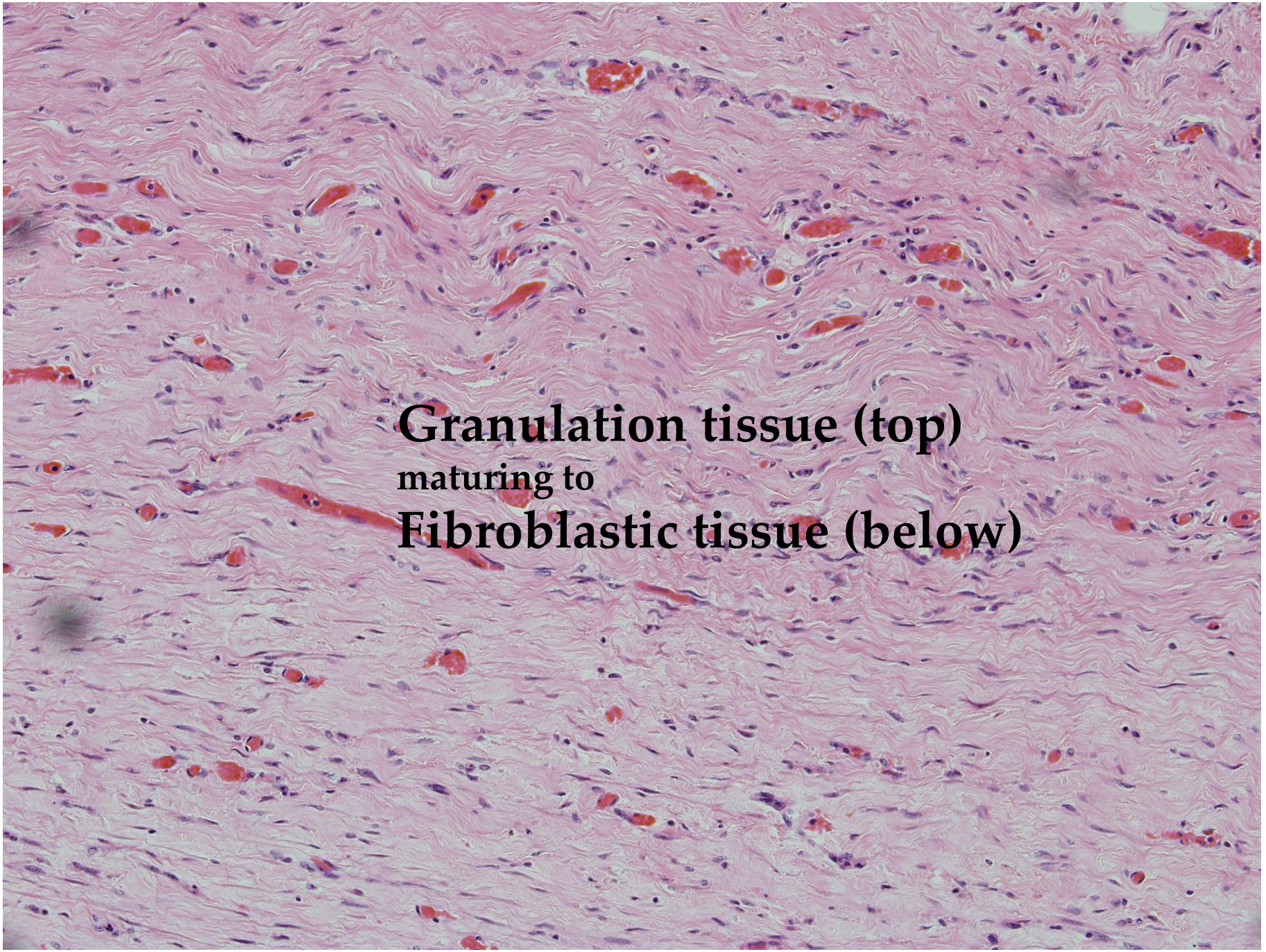
Healing by secondary intention

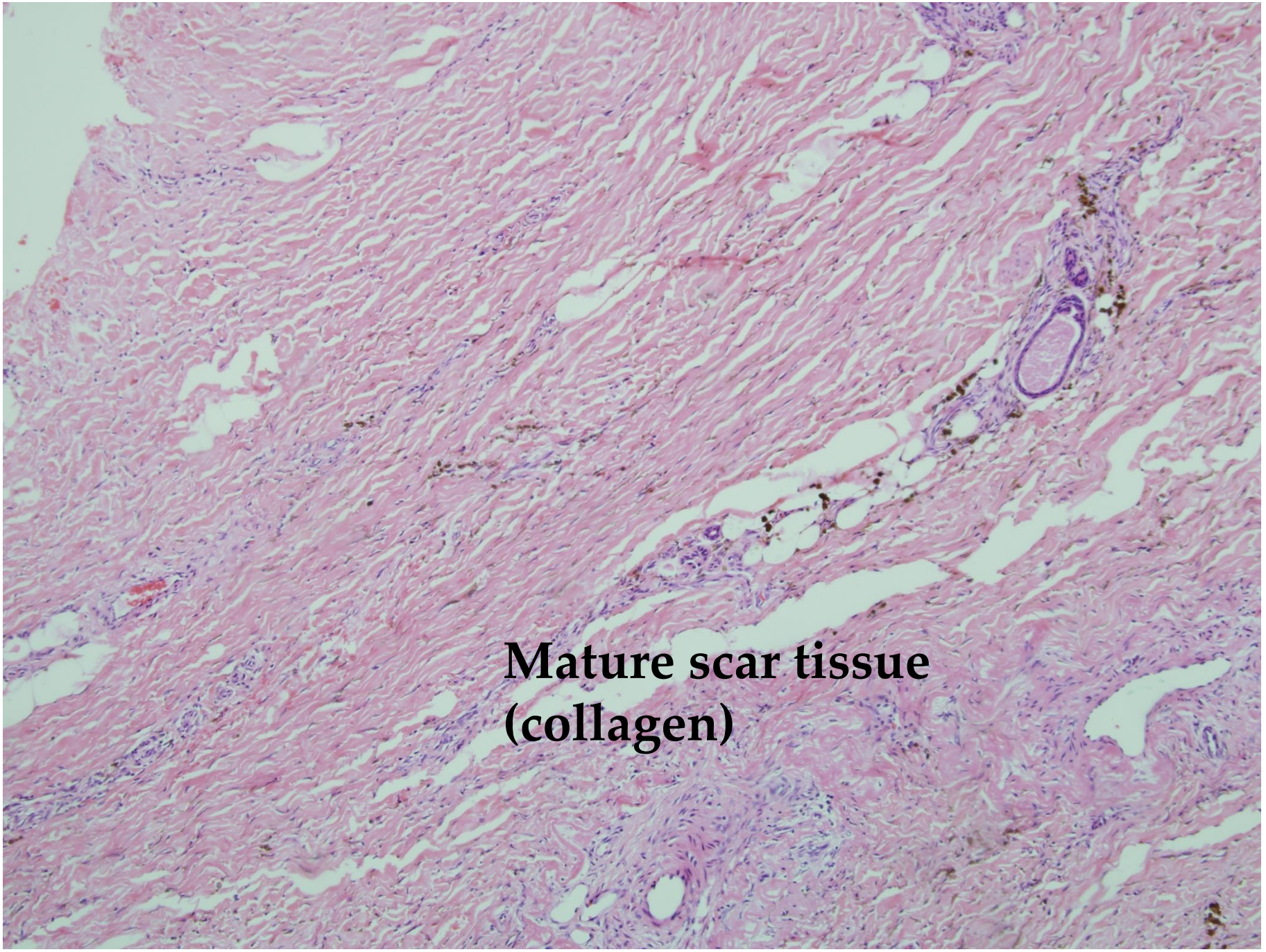
Immediate: large cavity fills with blood and fibrin. Acute inflammation begins.
Days: epithelium begins to regenerate to cover lesion. Overlying exudate = **scab**.
Contraction of wound
New capillary loops form, bring macrophages, neutrophils (prominent granulation tissue). Fibroblasts proliferate
Weeks-months: epithelium restored, collagen bundles thickened. Often extensive scarring

Granulation tissue

(New blood vessels and fibroblastic proliferation)




Granulation tissue (top)
maturing to
Fibroblastic tissue (below)


Mature scar tissue
(collagen)

FIBROSIS

End result of organisation in wound healing and chronic inflammation

The process:

- Fibrocytes stimulated by polypeptides from surrounding damaged cells
- Become active fibroblasts. Commence protein synthesis
- Secretion of ground substance including fibrinonectins
- Secretion of procollagen
- Condensation to fine reticulin fibres
- Further condensation to mature collagen fibres
- Binding and weaving to form scar tissue
- Fibroblasts revert to fibrocytes

Factors adversely affecting wound healing

Local

Poor blood supply

Infection

Excessive movement or irritation

Foreign material

General

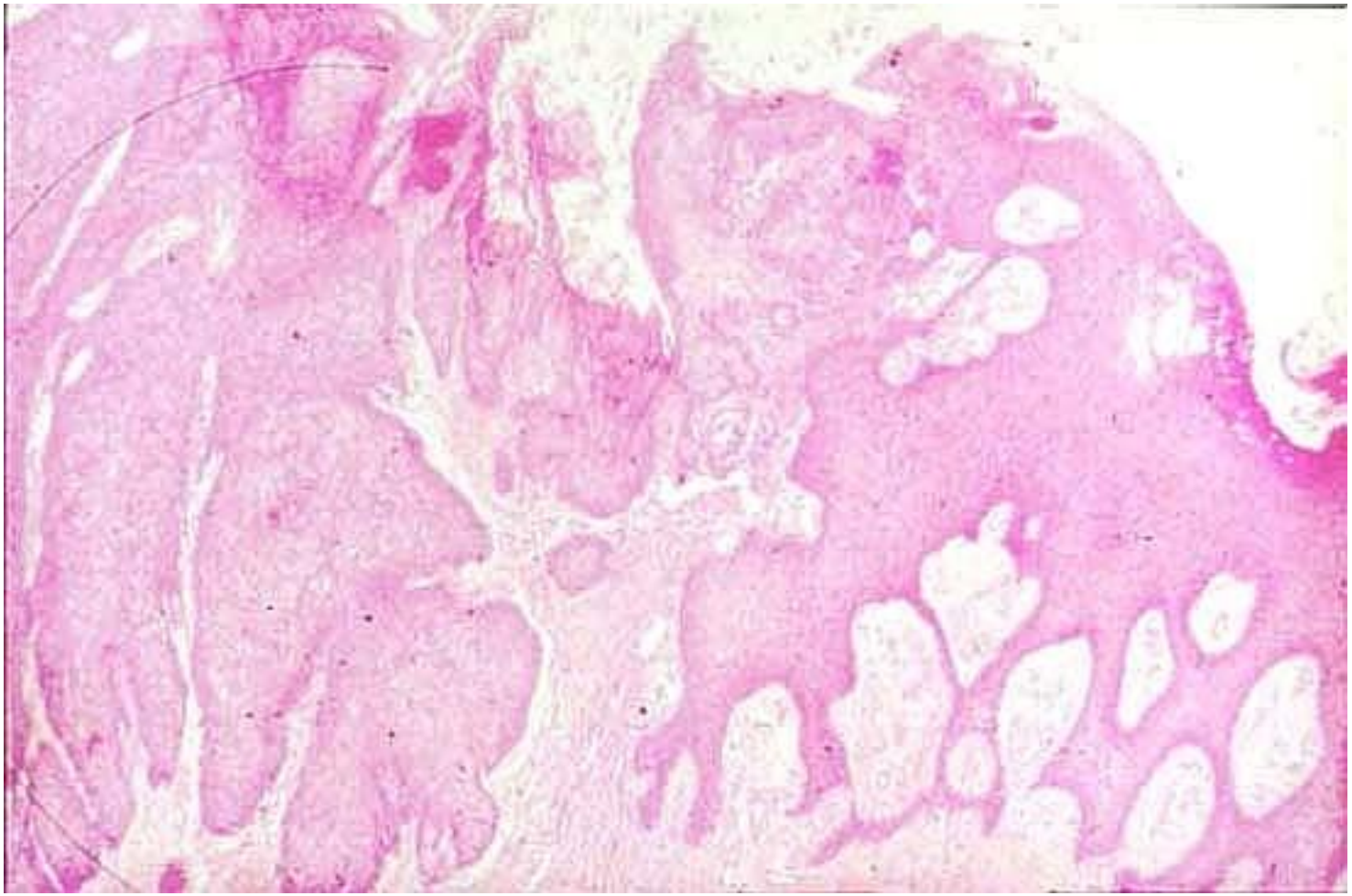
Deficiency of Vitamin C, essential amino acids, zinc

Excess adrenal corticosteroids

Intercurrent debilitating chronic disease

COMPLICATIONS OF WOUND HEALING

- Infection
- Failure to heal
- Breakdown of wound
- Scarring/Stricture
- Keloid formation
- Pseudoepitheliomatous hyperplasia
- Malignancy



Excessive epithelial proliferation (pseudoepitheliomatous hyperplasia)

Complication of wound healing: excess collagen formation (keloid)