

Irreversible tissue damage (necrosis, apoptosis)

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Irreversible tissue damage

Necrosis

Apoptosis

Not programmed

Genetically programmed

Does not require energy

Energy requirement

Ruptured membrane structures

Intact membrane structures

Accompanied by inflammation reaction

No inflammation around

Two major mechanisms:

- death receptors

- mitochondrial route

The same agent may produce either apoptosis or necrosis, depending on its concentration

Necrosis

Circumscribed death of tissue/organ within a living organism

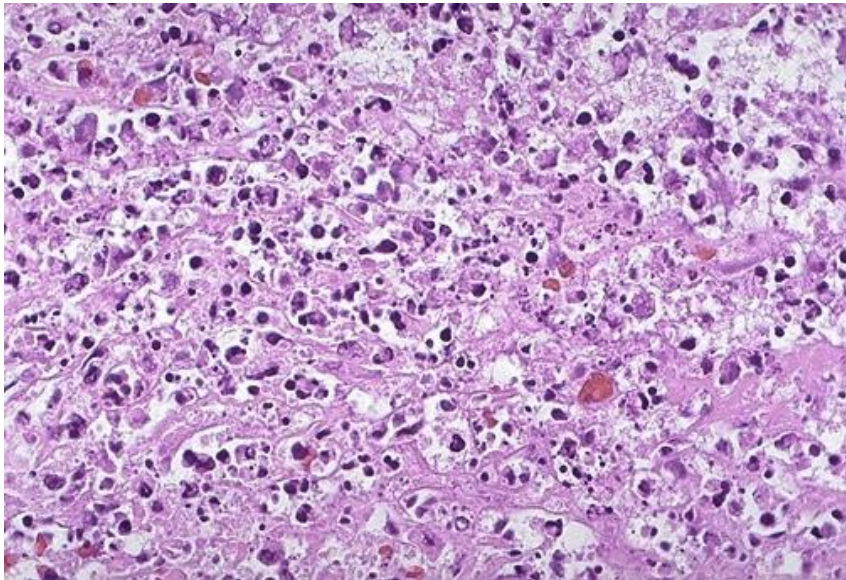
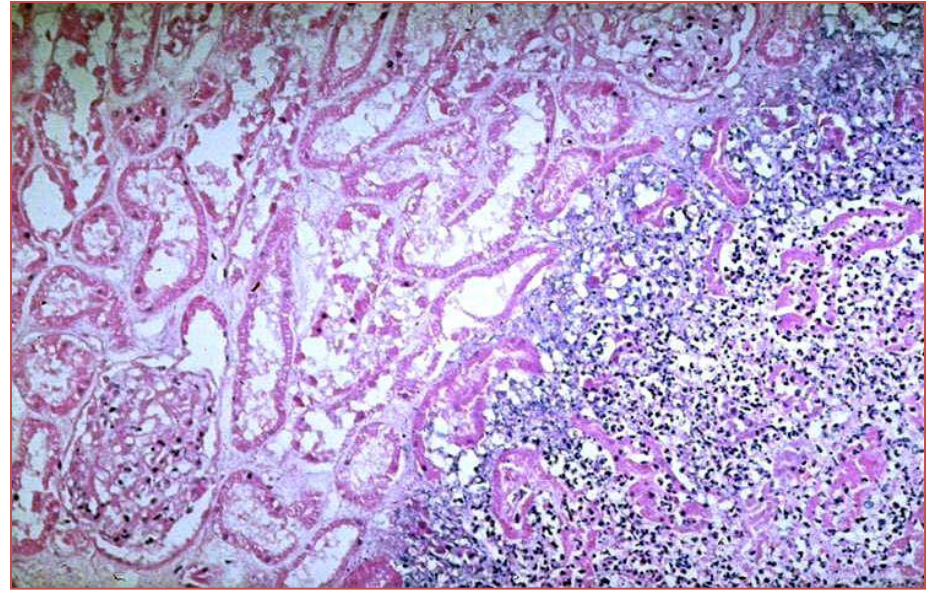
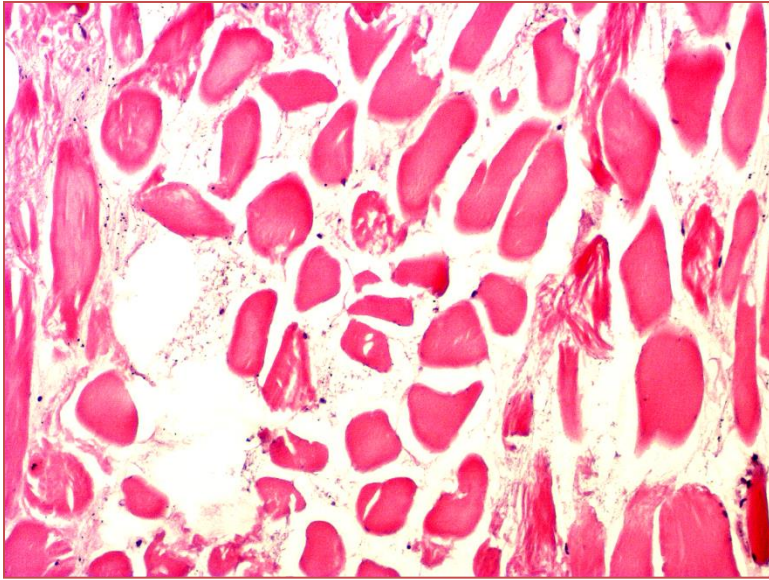
Cause: The strength of the harmful factor exceeds the compensatory capacity of the given tissue

a./ endogeneous causes:

- **vascular causes (obstruction of arteries, veins) – thrombosis, embolia**
- **neural effects (Raynaud-phenomenon, diabetes mellitus)**
- **immunological causes (immune complexes, C3-activation)**
- **mechanical causes (prolonged compression) – decubitus**

b./ exogeneous causes:

- **chemicals (cytostatic drugs)**
- **irradiation**
- **electricity**
- **freezing**
- **biological agents**
- **toxins**



karyopyknosis

karyorrhexis

karyolysis

demarcation zone

Necrosis

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graph TD; Necrosis --> Coagulative; Necrosis --> Colliquative; FatNecrosis[Fat necrosis] --> enzymatic; FatNecrosis --> traumatic;
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Coagulative

- **Infarct**
 - anemic (heart, liver, spleen, kidney...)
 - hemorrhagic (lung, small bowel, testicle)
 - gangrene (dry – wet)
- **Caseation (cheesy necrosis) – tbc**
- **Crust formation (large bowel)**
- **Fibrinoid necrosis (vessel walls, stomach)**
- **Waxy necrosis of Zenker**
- **In the center of neoplasms**

Colliquative (liquefactive)

primary:

emollition (brain)

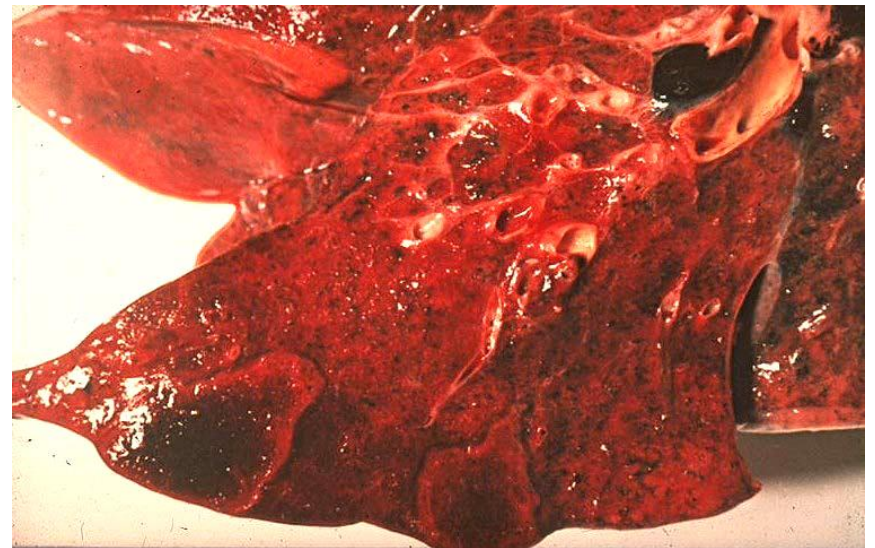
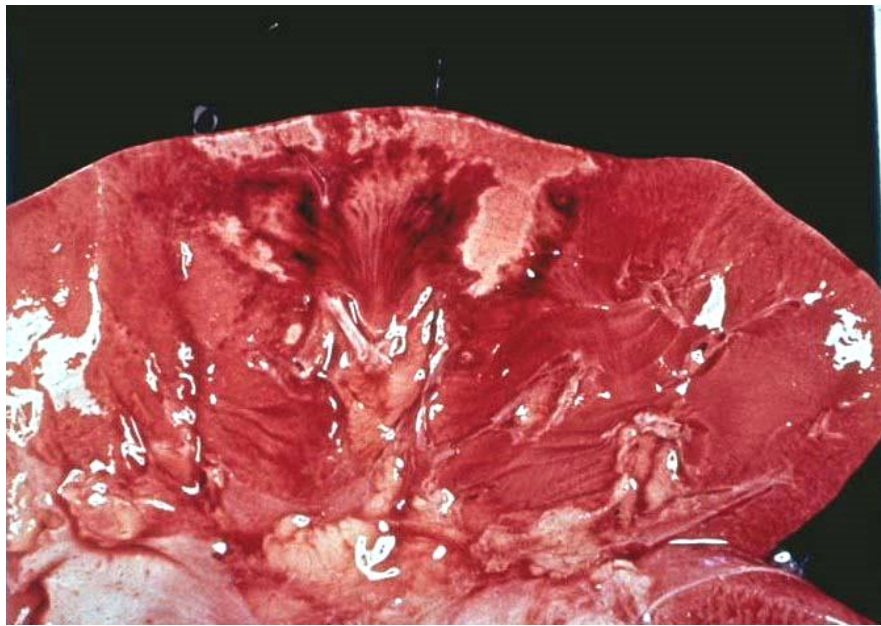
secondary:

myomalacia

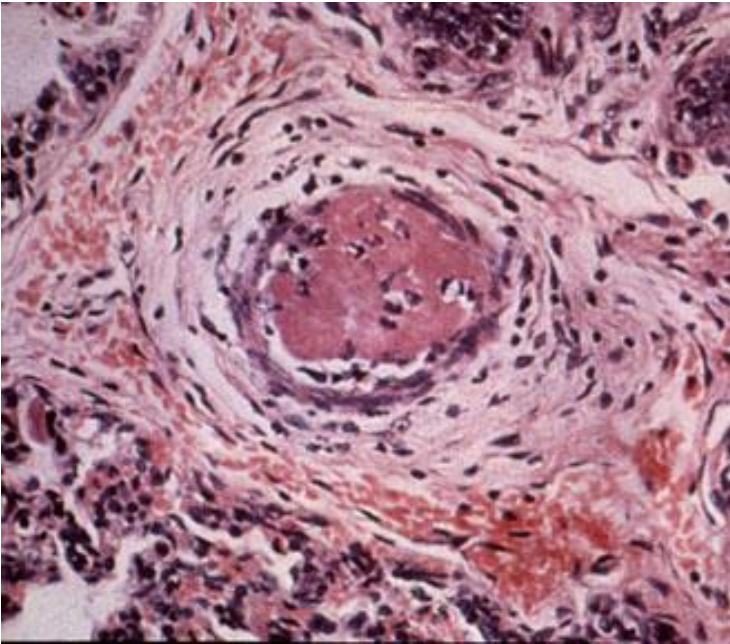
Fat necrosis

enzymatic

traumatic



Lung, hemorrhagic infarction

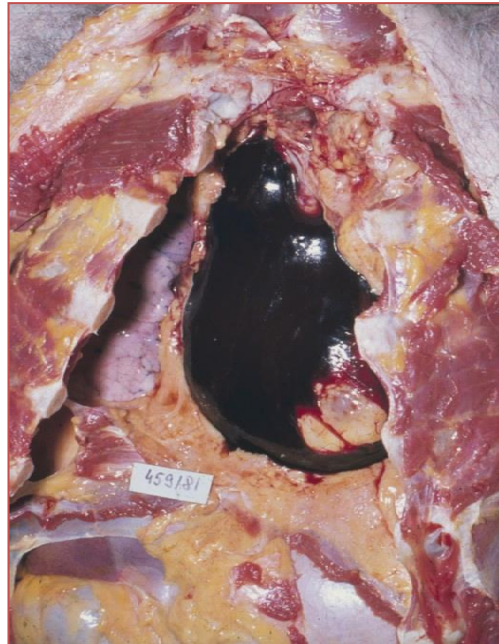
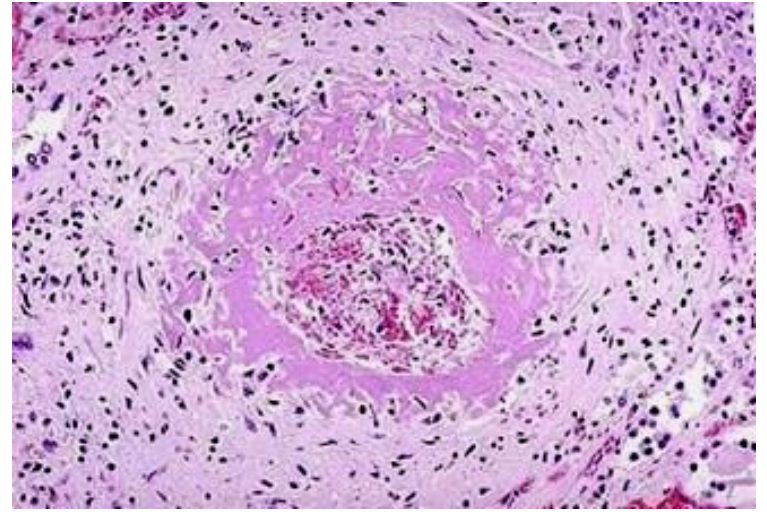


Thromboembolia in the 1st/2nd branches of pulmonary arteries

Sources:

- deep veins of the leg
- femoral, iliac veins
- periprostatic veins
- parametric veins
- renal veins
- hepatic veins
- right atrium, right auricle
- jugular veins
- subclavian veins
- dural sinuses



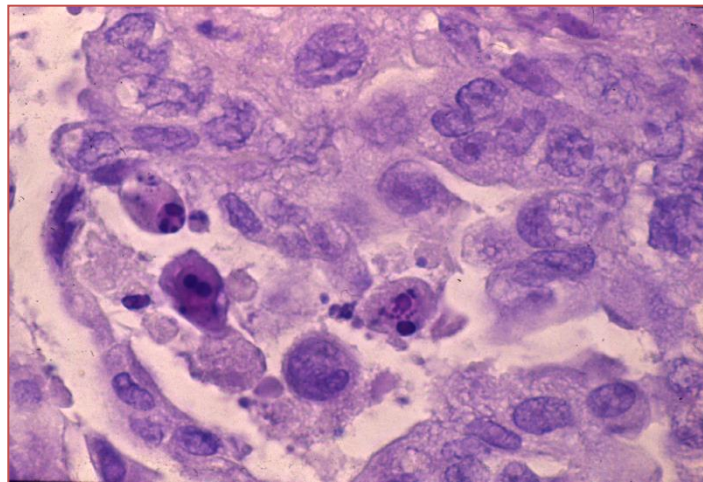


Apoptosis

Physiologic role:

- disappearance of buccopharyngeal membrane
- thymic involution
- disappearance of primitive kidney
- lumen formation in the bowel → atresia
- disappearance of the membrane between fingers → syndactylia

APOPTOSIS INDUCTION IS AN IMPORTANT THERAPEUTIC GOAL IN CASES OF MALIGNANT TUMORS



Necrosis and apoptosis are sometimes biologically negative, sometimes very useful