LECTURE 4

A T R O P H I A - ATROPHY

ATROPHY – change in the size/weight of organ which in the past was of proper size and weight

INVOLUTION –physiological atrophy

SIMPLE ATROPHY (SIMPLEX) – reduction because of the reduction of specific structural elements or an organ or tissue

CONCENTRIC ATROPHY (CONCENTRICA) – concentric reduction of an organ

ECCENTRIC ATROPHY (EXCENTRICA) – reduction of organ weight with an increase in its external dimensions (cystic kidney)

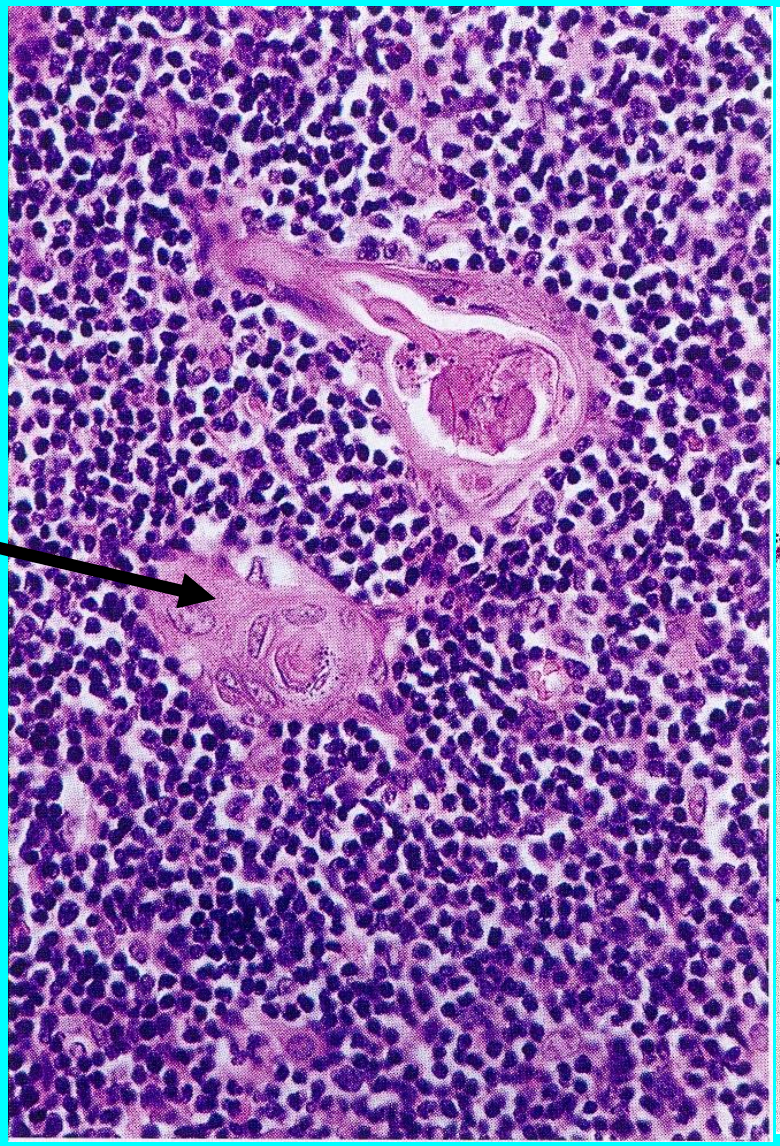
SENILE ATROPHY (SENILIS)

INACTIVITY ATROPHY (EX INACTIVITATE)

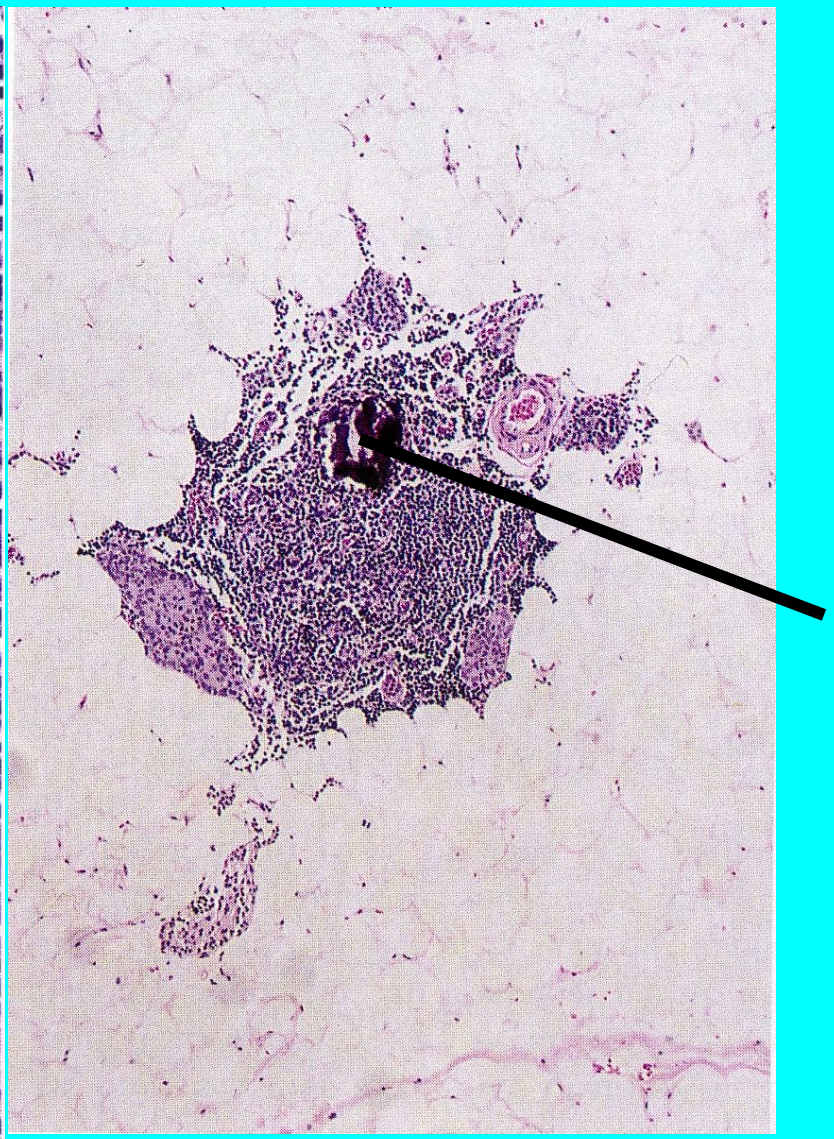
COMPRESSION ATROPHY (E COMPRESSIONE)

HYPERACTIVITY ATROPHY (E HYPERACTIVITATE)

INVOLUTION - INVOLUTION OF THYMUS

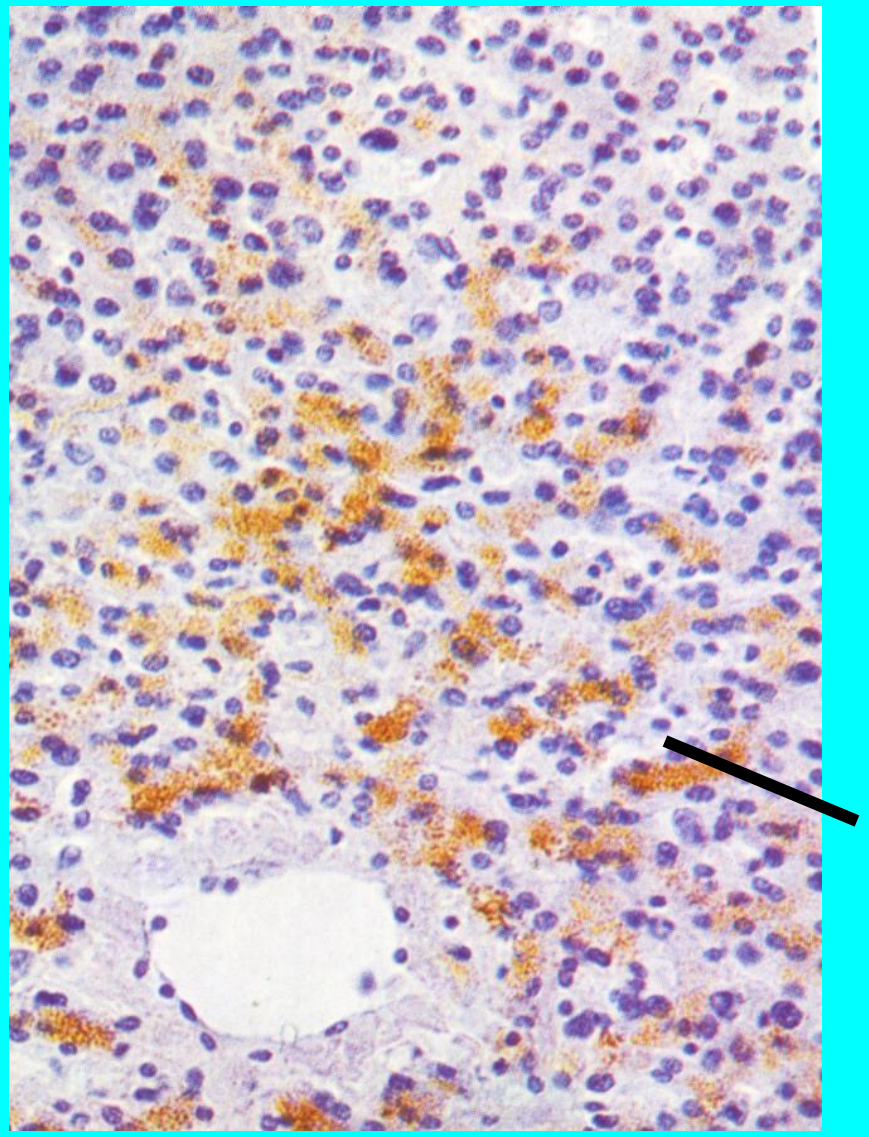


PART OF MEDULLA OF THYMUS WITH HASSALL BODIES



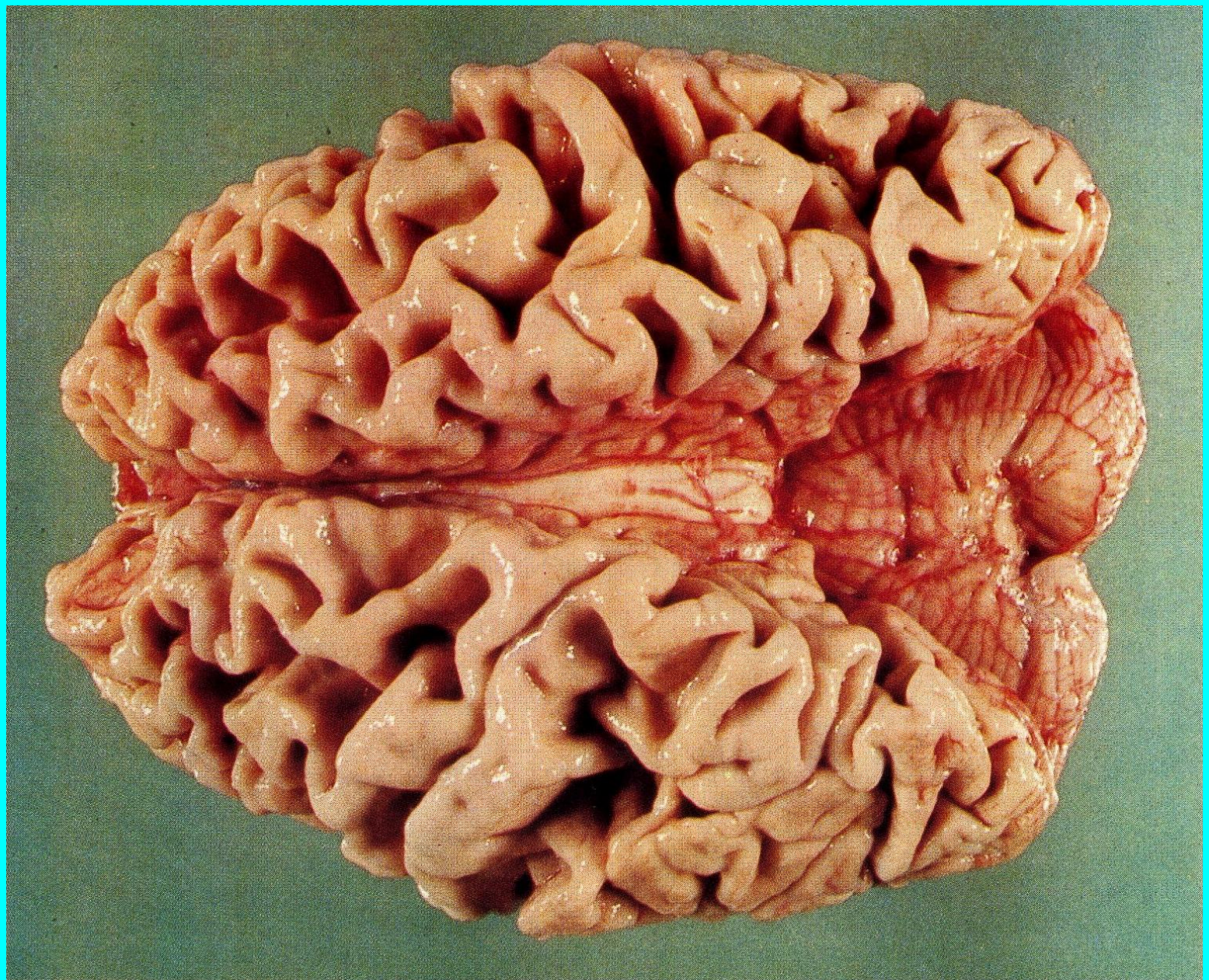
INVOLUTED THYMUS WITH CALCIFICATION OF HASSALL BODIES

SENILE ATROPHY

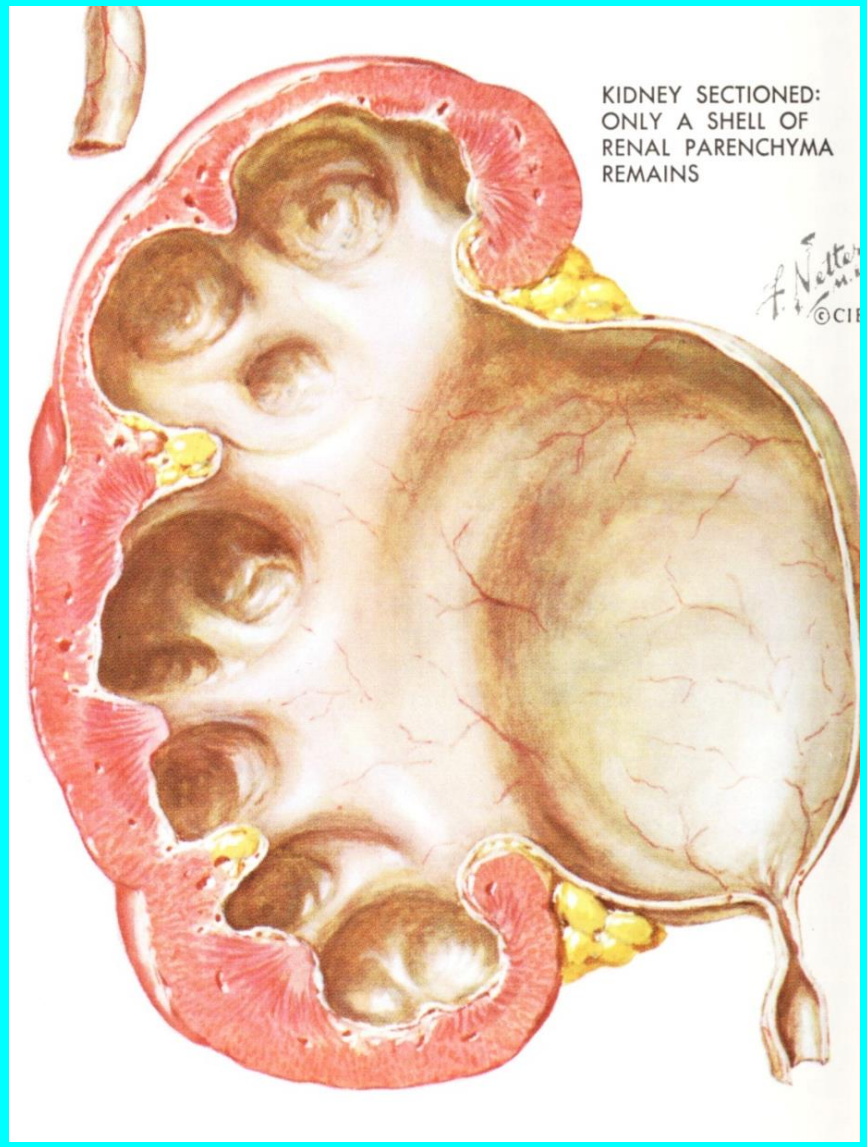


BROWN ATROPHY OF LIVER

SIMPLE ATROPHY - SENILE ATROPHY OF BRAIN



ECCENTRIC ATROPHY



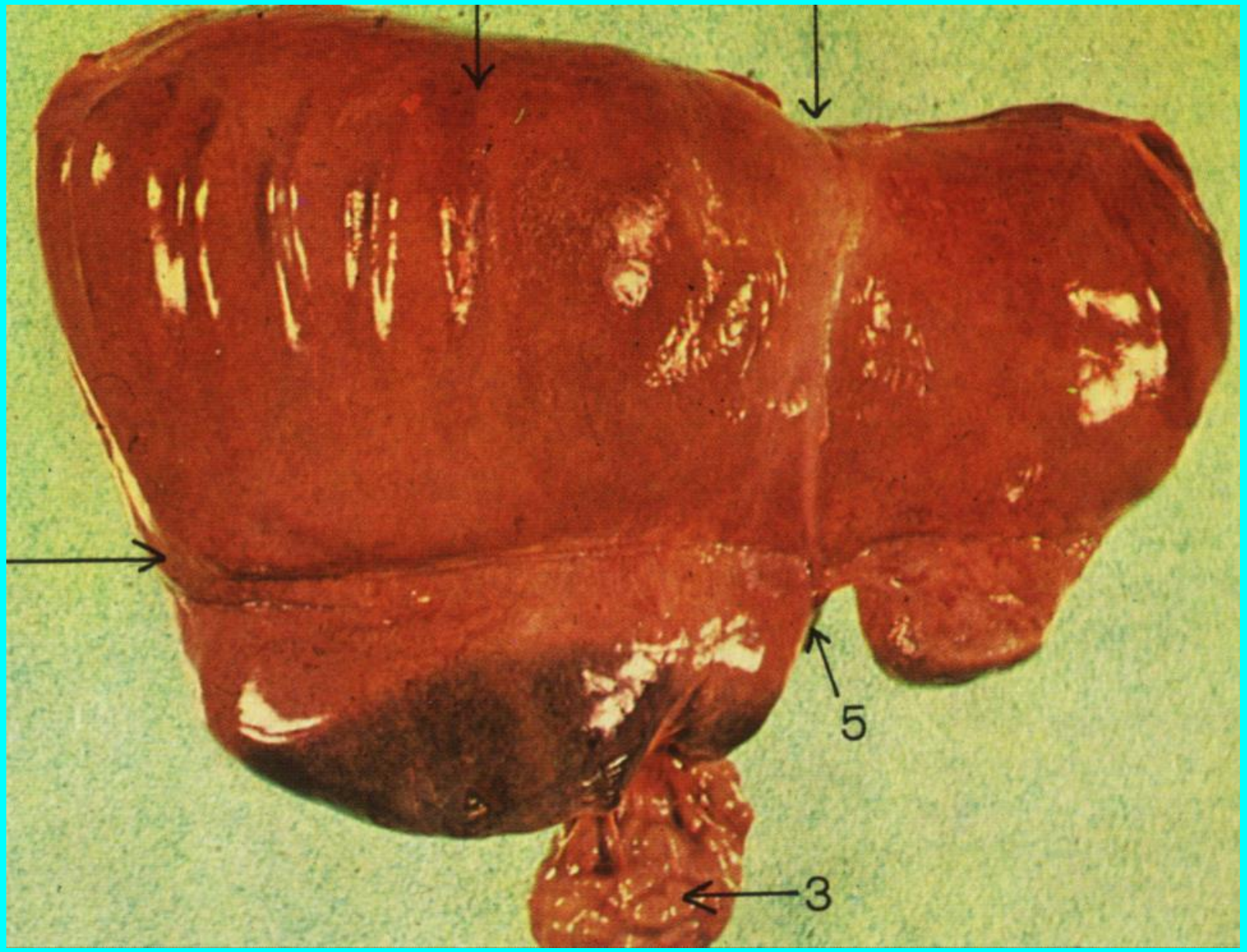
HYDRONEPHROSIS

BULLOUS CHRONIC EMPHYSEMA OF LUNG

The chest cavity is opened at autopsy to reveal numerous large bullae apparent on surface of the lungs in a patient dying with emphysema. Bullae are large dilated airspaces that bulge out from beneath the pleura.

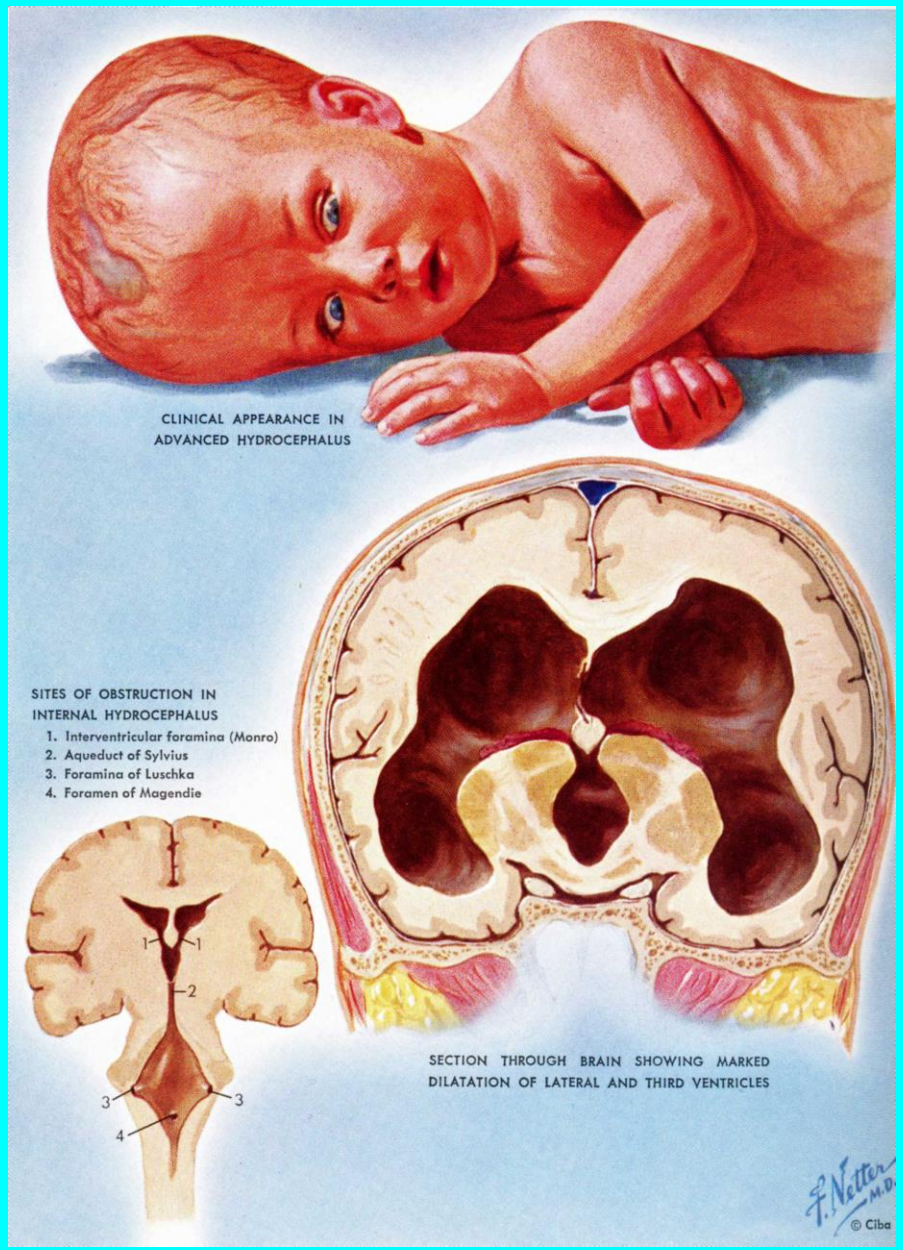
Emphysema is characterized by a loss of lung parenchyma by destruction of alveoli so that there is permanent dilation of airspaces with loss of elastic recoil.

COMPRESSION ATROPHY

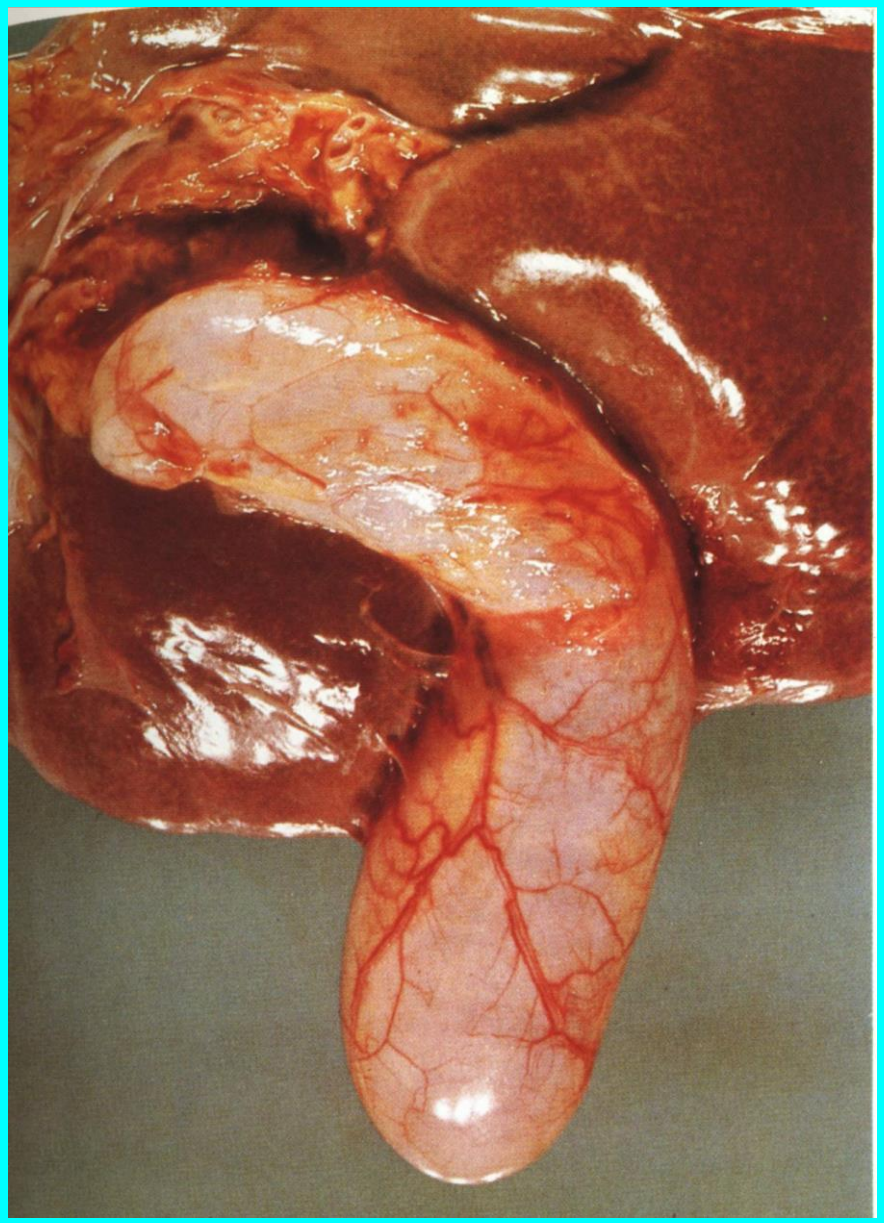


SULCI ON THE DIAPHRAGMATIC SURFACE OF THE LIVER CAUSED BY DIAPHRAGM

COMPRESSION ATROPHY – ECCENTRIC ATROPHY

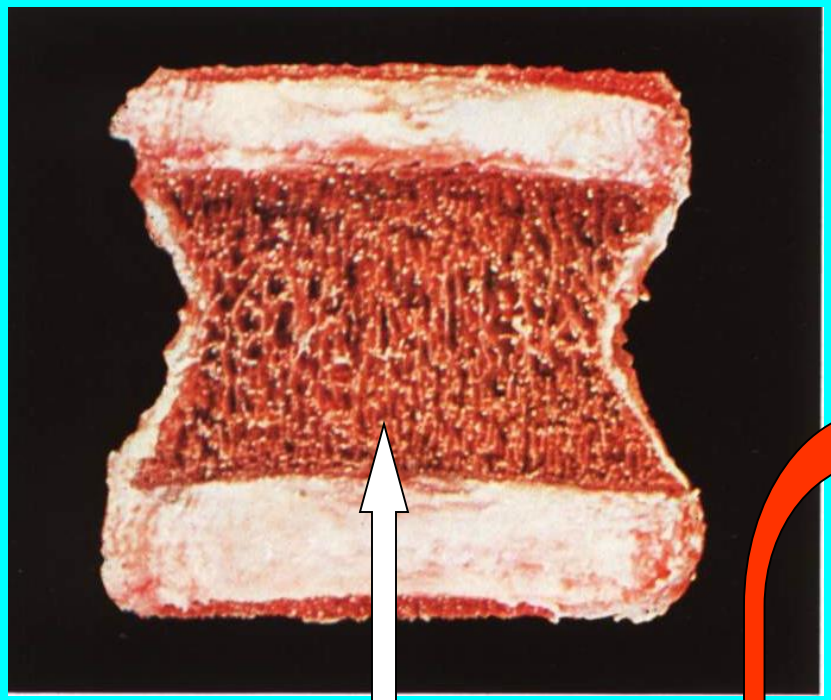


INTERNAL HYDROCEPHALUS



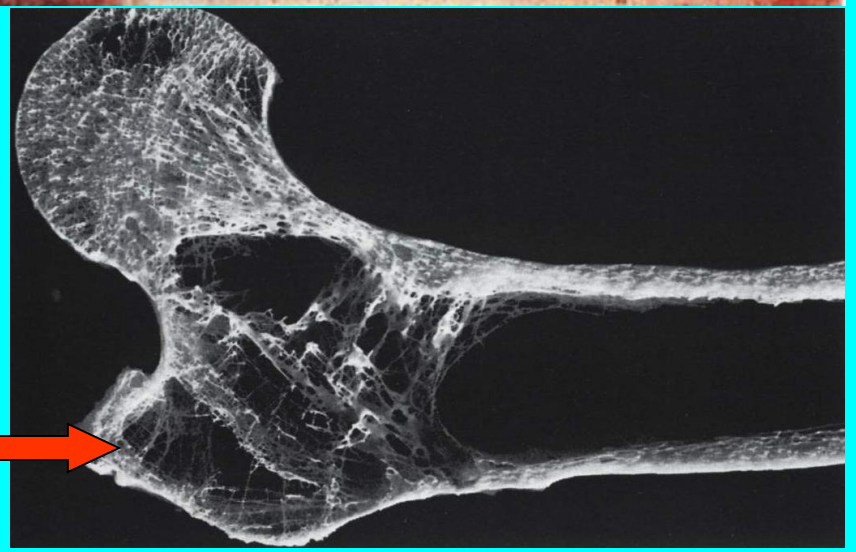
GALL BLADDER HYDROPS

ECCENTRIC ATROPHY
OSTEOPOROSIS



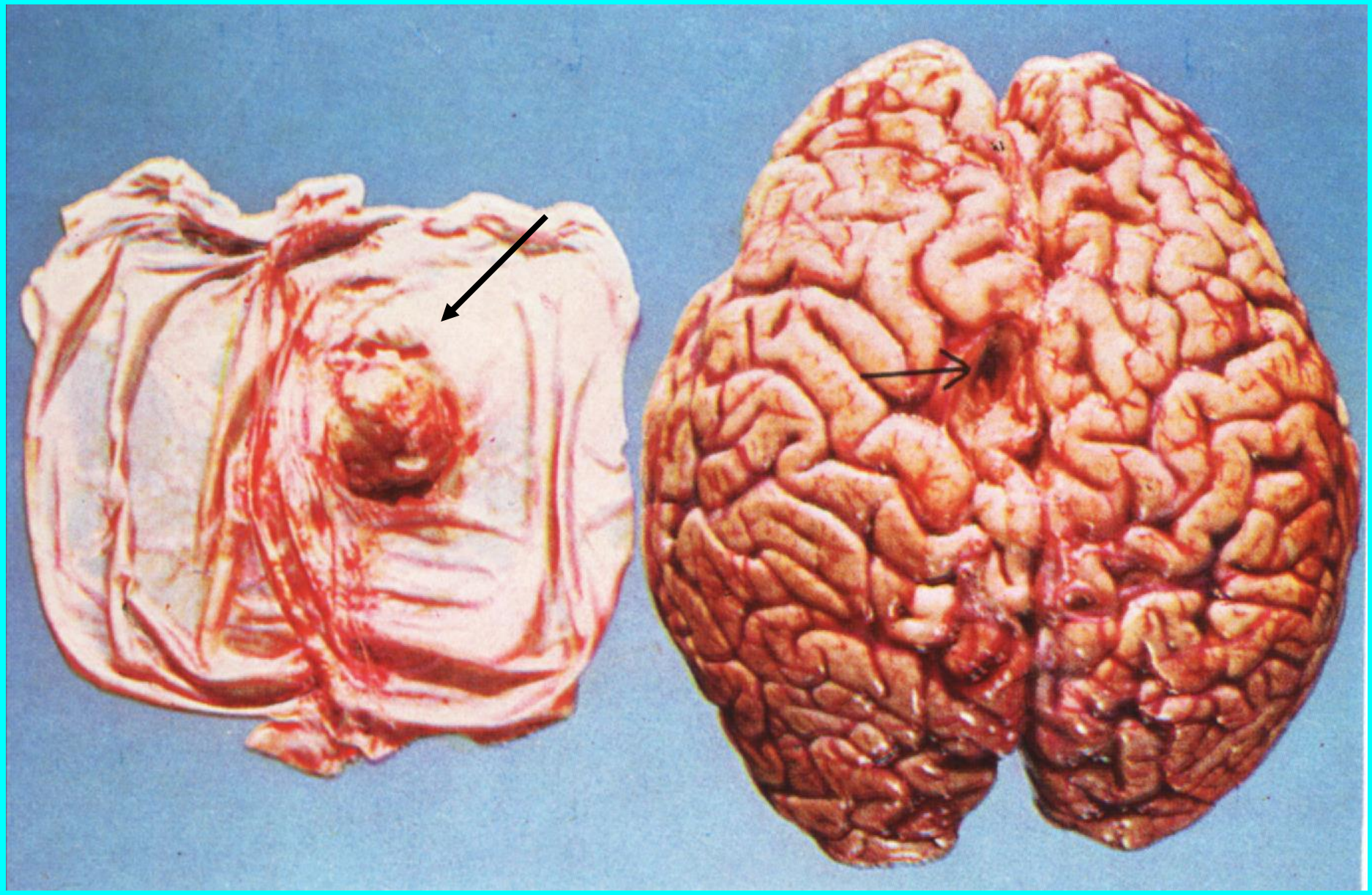
Normal vertebra

vertebra in osteoporosis

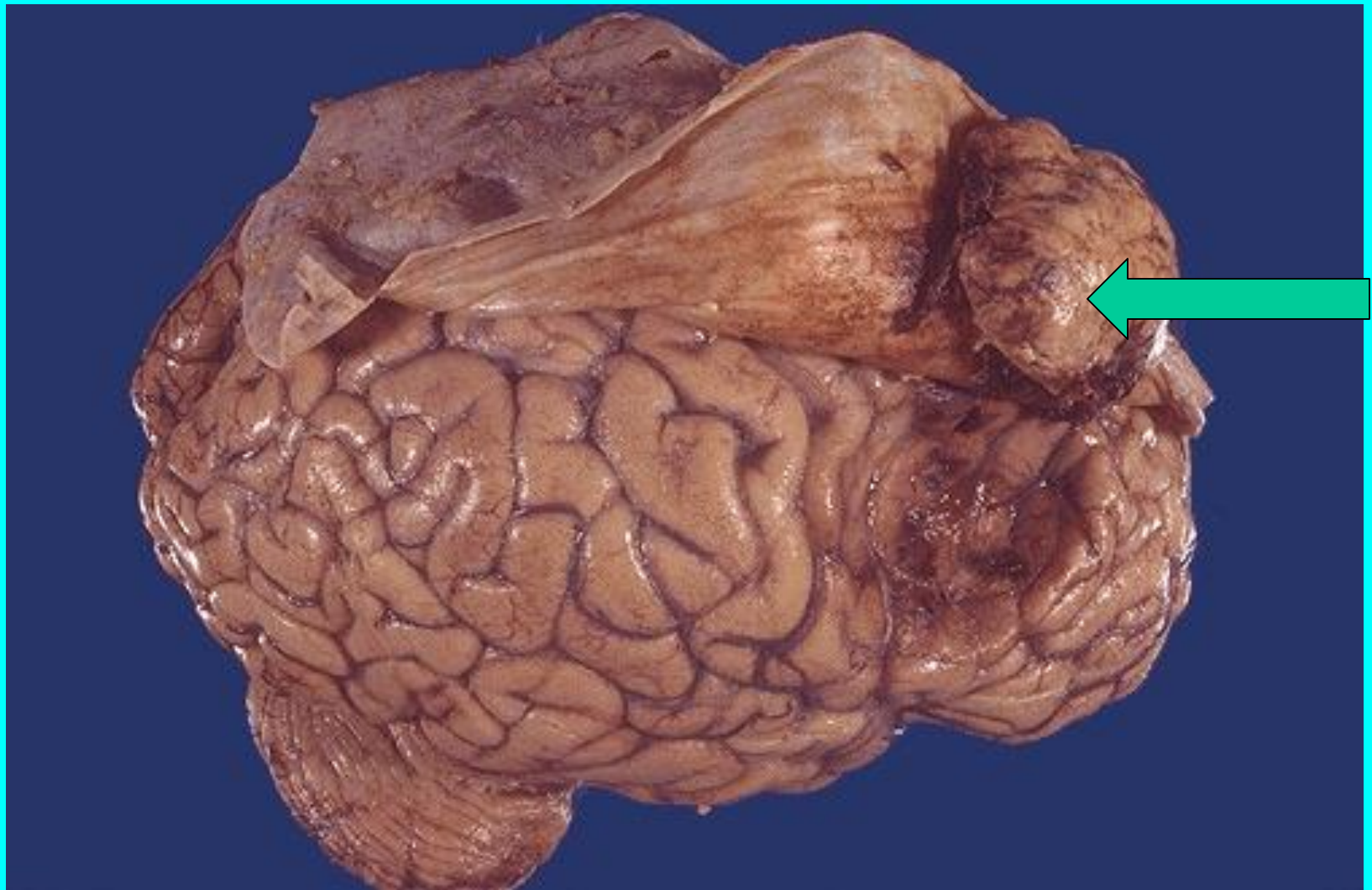


Head and epiphysis of femur in osteoporosis

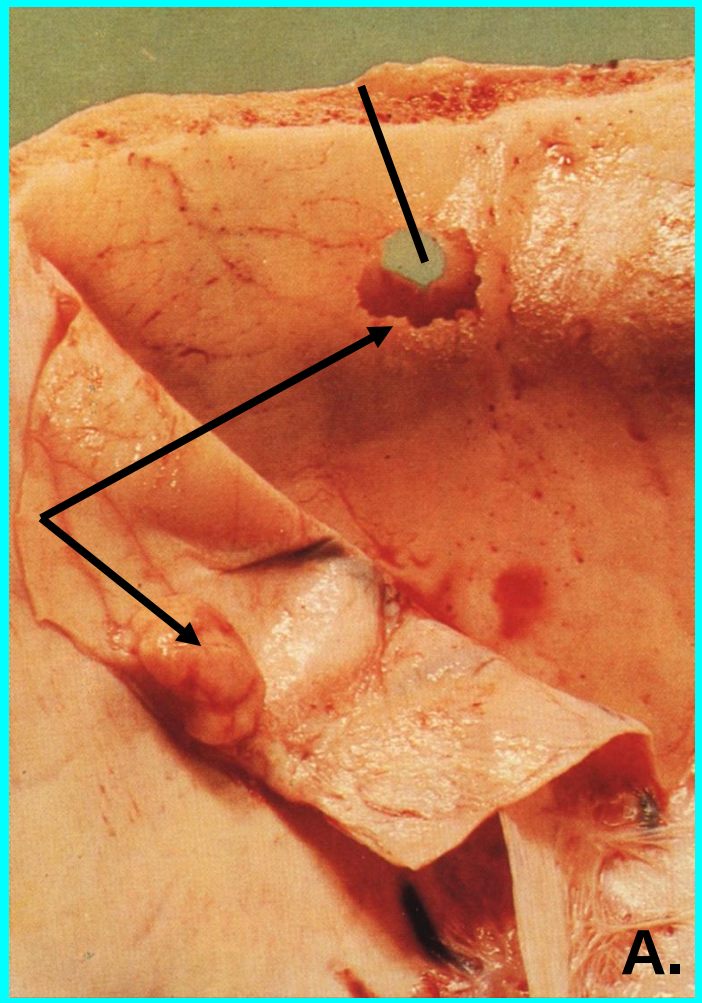
COMPRESSION ATROPHY – meningioma (atrophy of cerebral tissue)

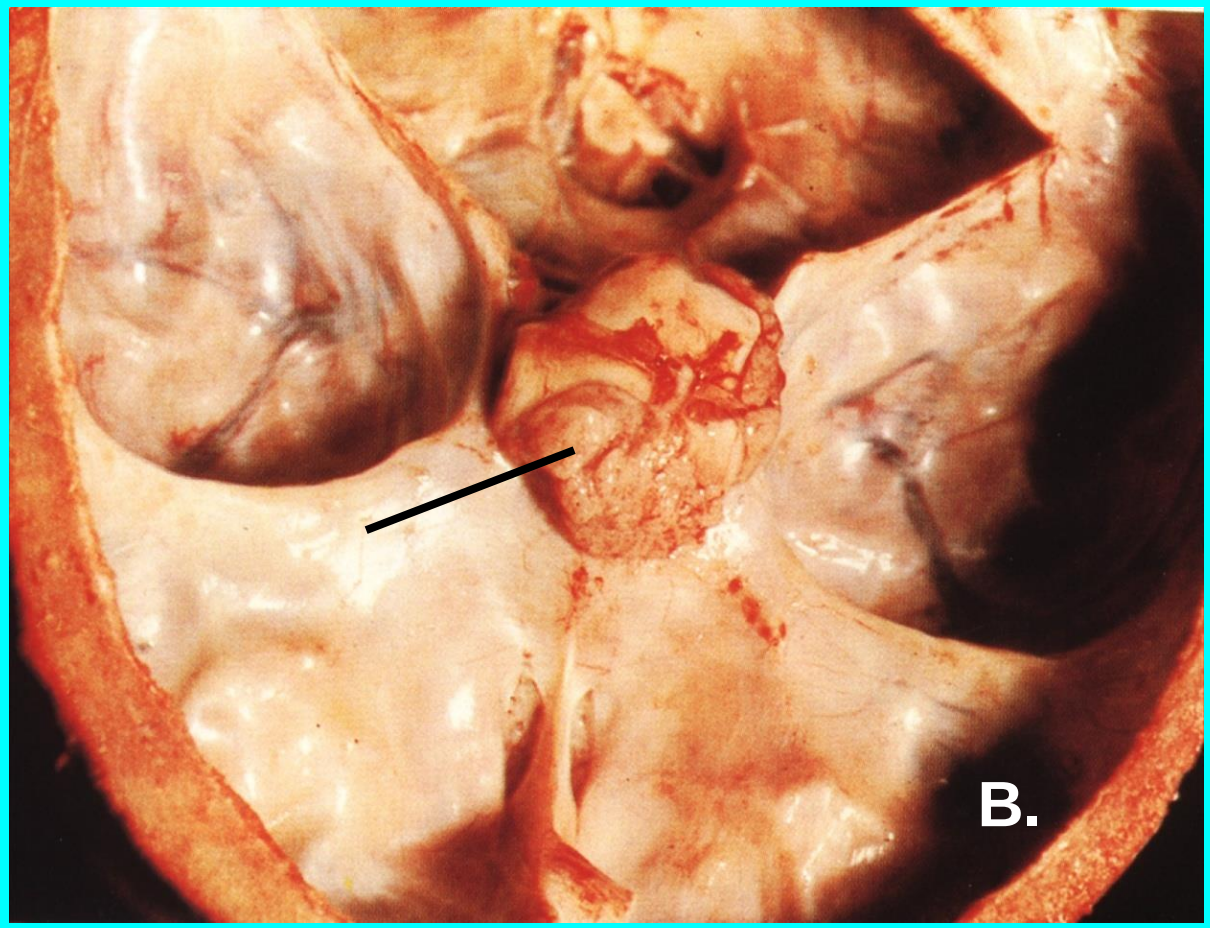


meningioma beneath the dura compresses the underlying cerebral hemisphere; rarely, meningiomas can be more aggressive and invade underlying cerebrum or overlying bone.



COMPRESSION ATROPHY

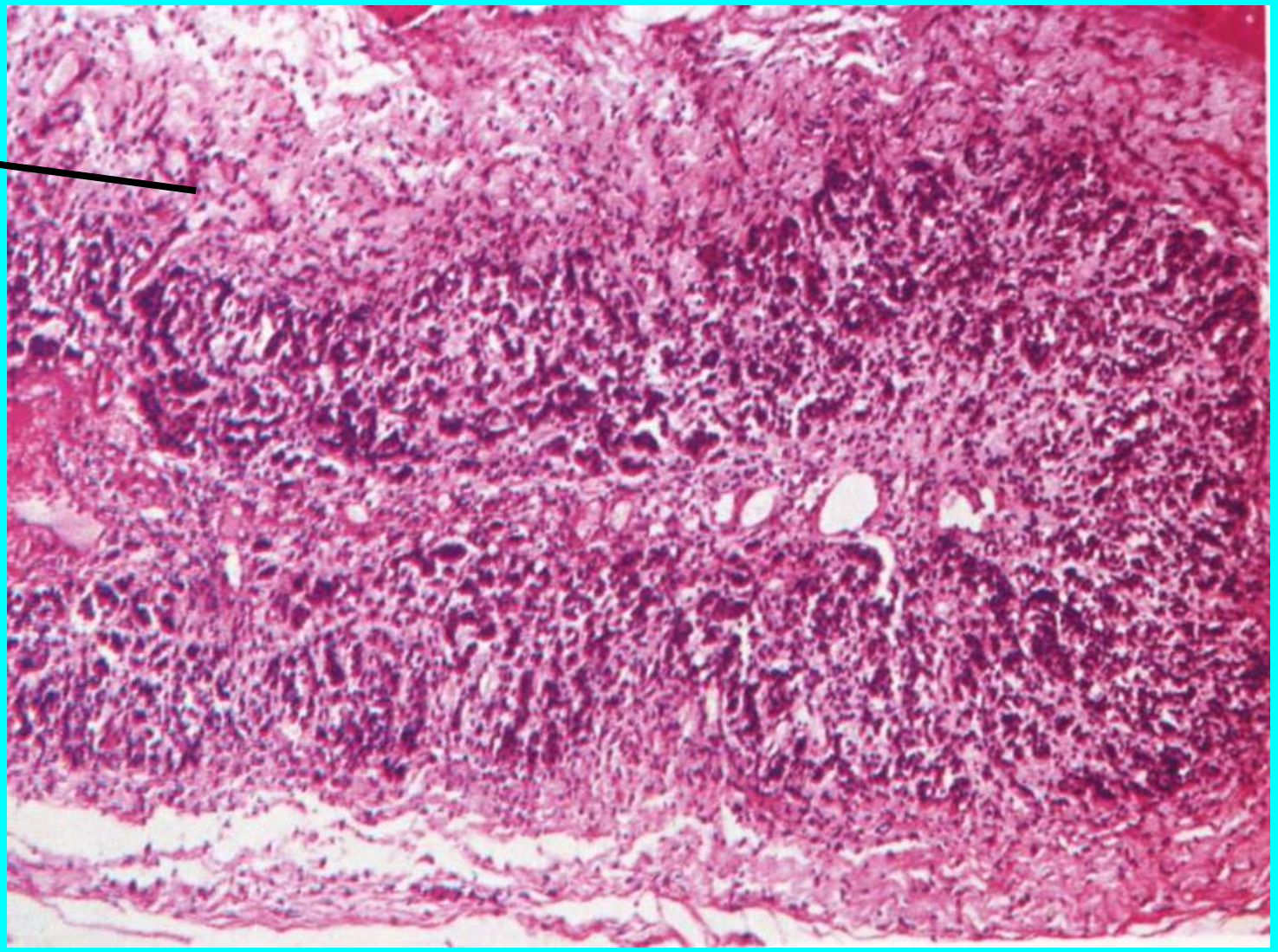




MENINGIOMA A. Complete atrophy of parietal bone. Visible sulci of meningeal arteries. B. Atrophy of sella. Visible digital impressions.

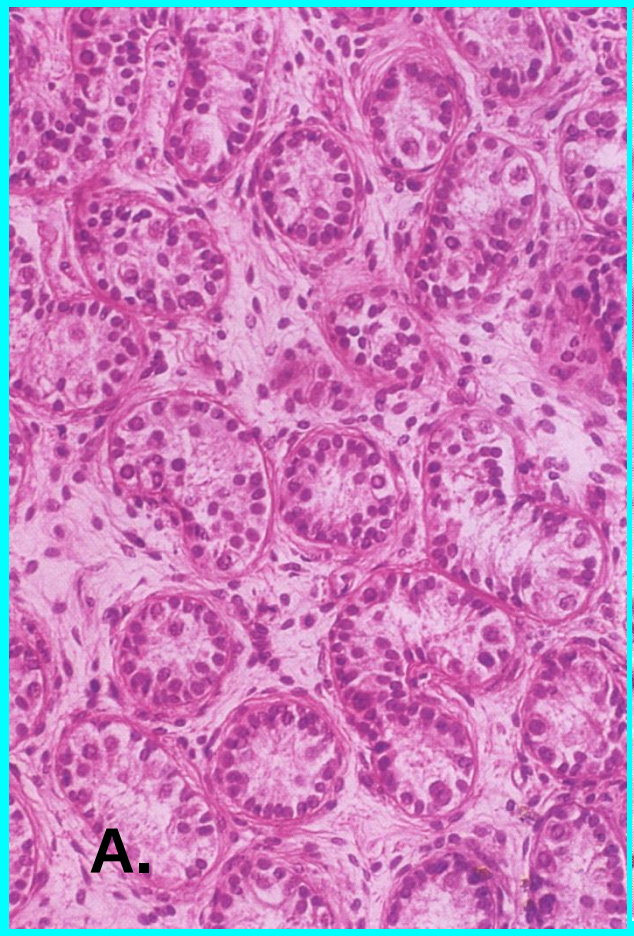
INACTIVITY ATROPHY

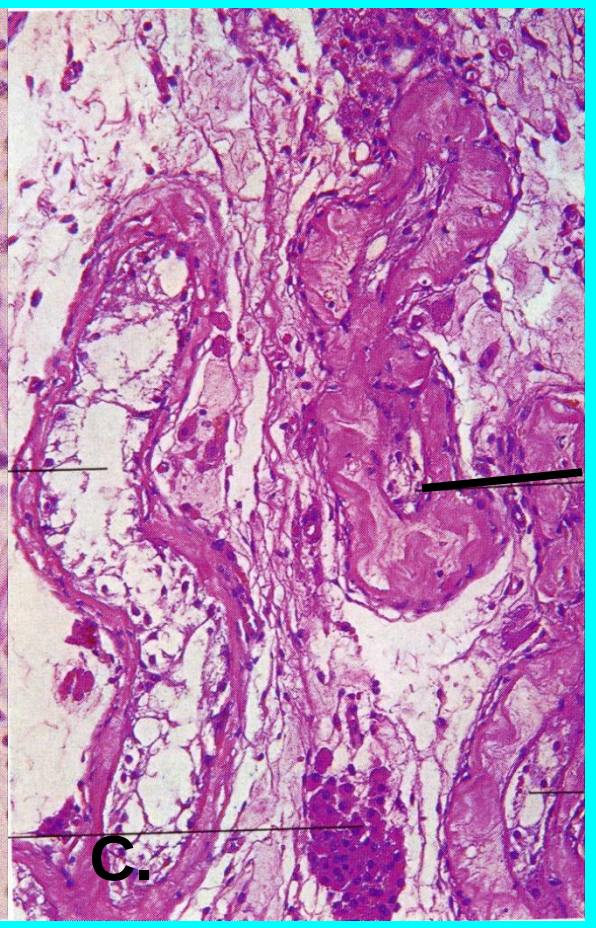
ATROPHY OF ADRENAL CORTEX DURING LONG-TERM STEROID THERAPY



HYPOPLASIA VERSUS ATROPHY

A. HYPOPLASIA OF TESTIS IN 14 Y. OLD BOY WITH CRYPTORCHIDISM. B. NORMAL TESTIS IN 12 YR OLD BOY. C. ATROPHY OF TESTIS IN 30 Y. OLD MAN – AN ALCOHOLIC

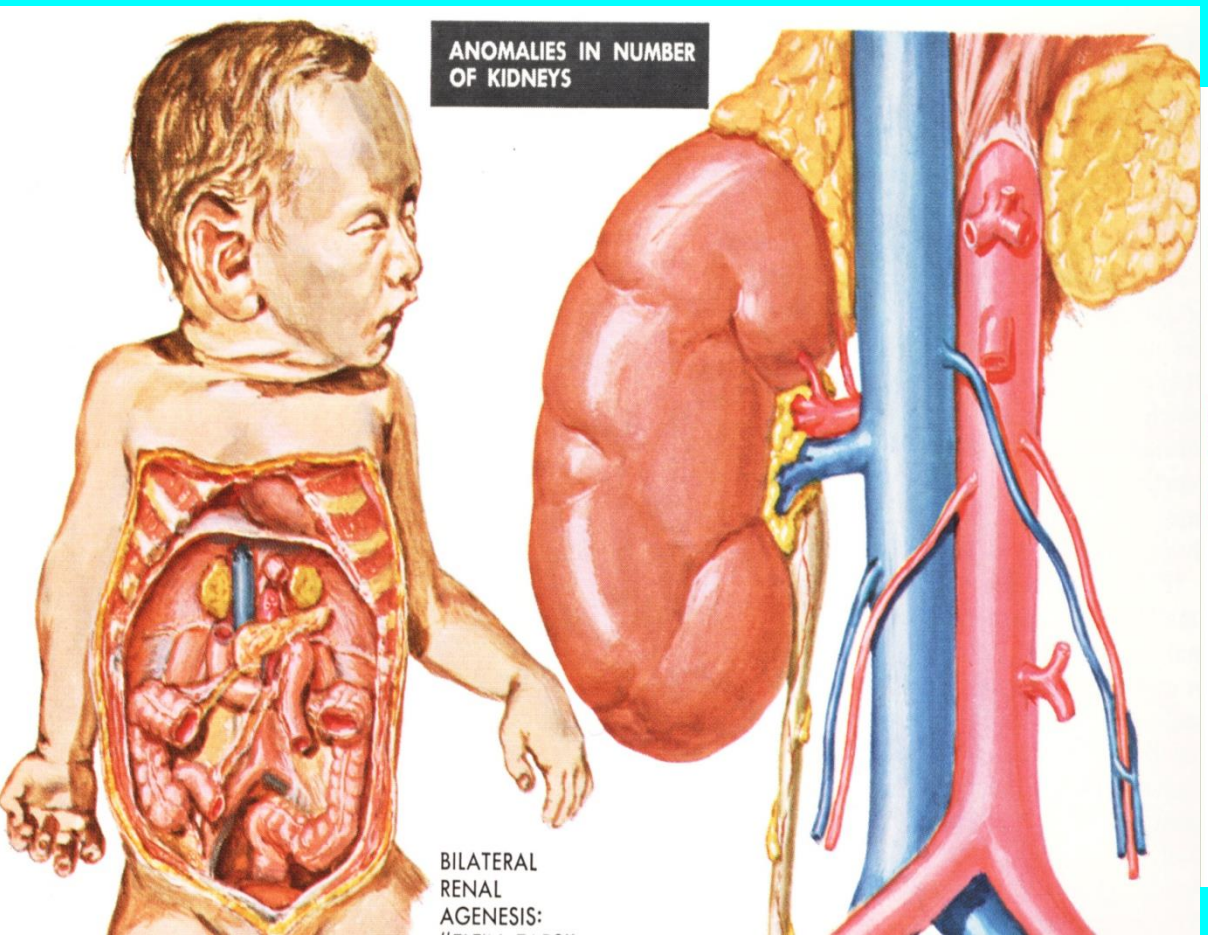


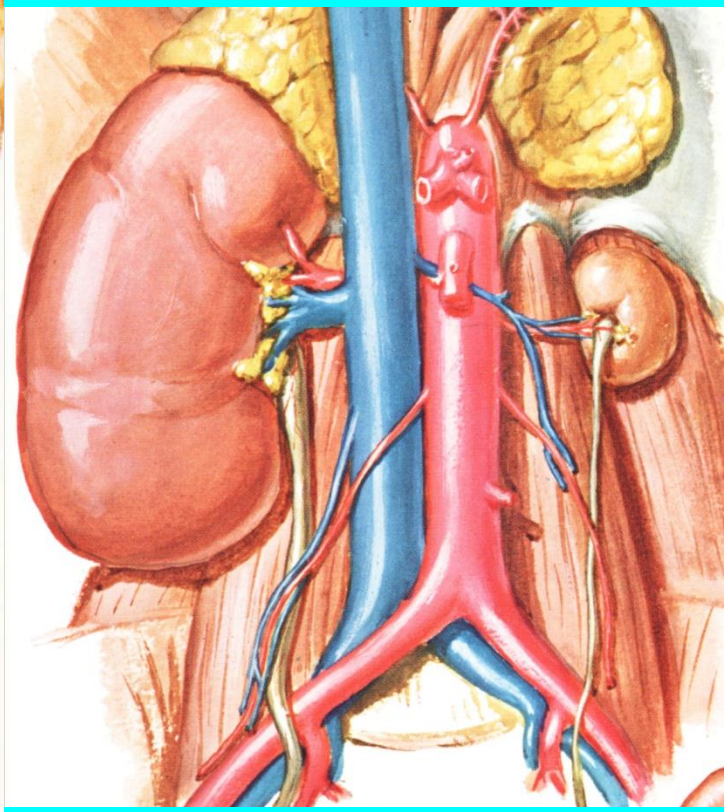


AGENESIS (-SIA) - **lack of primordium**

APLASIA - **primordium present, lack of an organ**

HYPOPLASIA - **organ present but it is not of proper size**





RENAL HYPOPLASIA

Rare; failure of kidney to develop to normal size without scarring

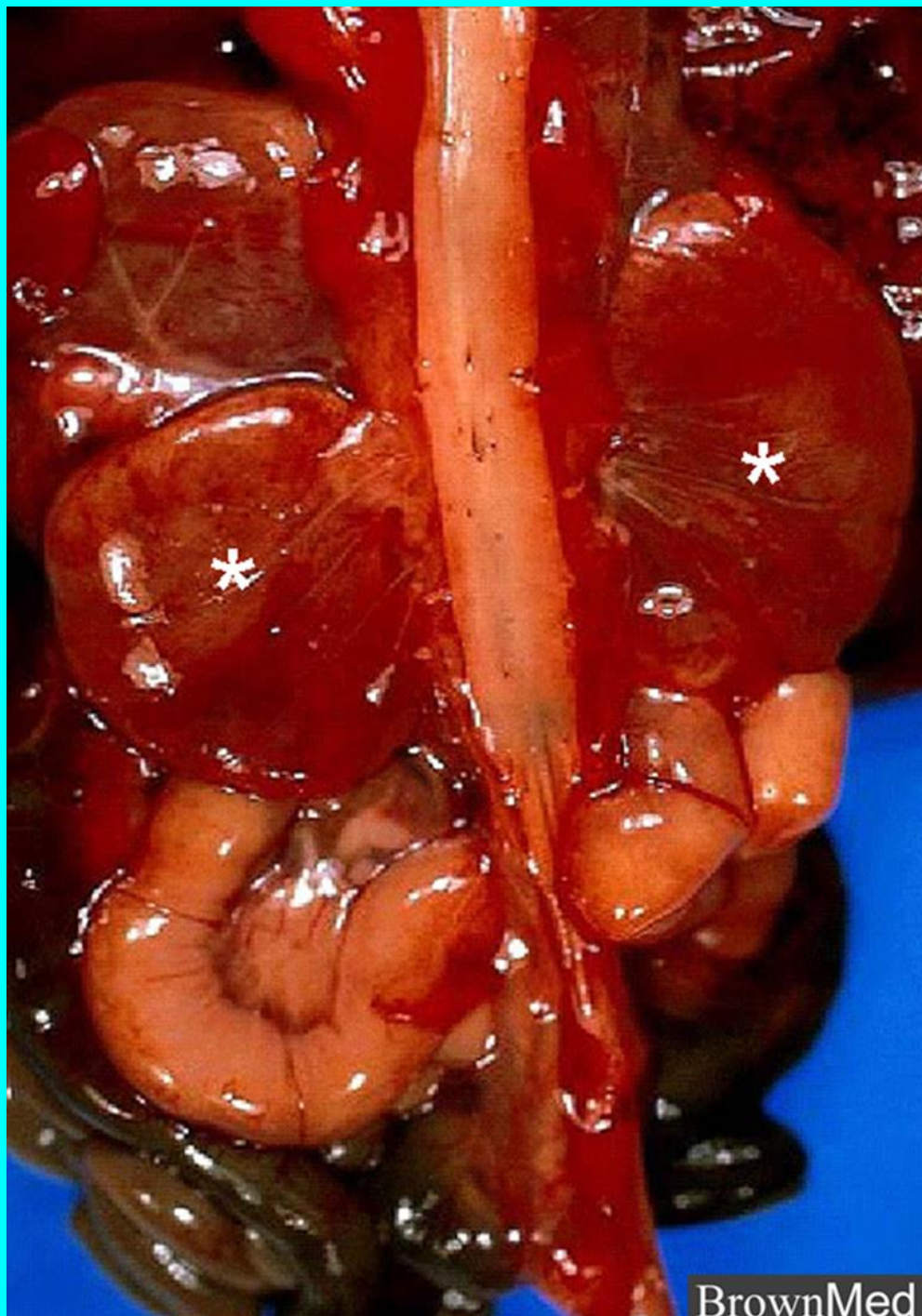
Usually unilateral with a reduced number of nephrons and pyramids (6 or less) but otherwise normal architecture

Associated with PAX2 mutations

HYPOPLASIA

BILATERAL AGENESIS

This photo shows bilateral **renal agenesis** in a posterior view of the abdominal organ block. The **adrenal glands, marked with asterisks**, normally appear as pyramidal structures capping the kidneys. In this setting of renal agenesis they spread out as oval organs of large dimensions.



NECROSIS

DEFINITION: DEATH OF TISSUE (CELLS) IN ALIVE ORGANISM (RAPID PROCESS; PATHOLOGIC)

from the Greek "νεκροσ„ nekros (dead body)

CLASSIFICATION OF NECROSIS

1. COLLIQUATIVE NECROSIS - *NECROSIS COLLIQUATIVA*
   ENCEPHALOMALACIA
2. COAGULATION NECROSIS - *NECROSIS COAGULATIVA*
   - INFARCTUS
   - CASEIFICATION (CASEATION)
   - STEATONECROSIS (FAT NECROSIS, BALSER NECROSIS)
   - FIBRINOID NECROSIS
   - CERACEOUS NECROSIS – ZENKER NECROSIS
3. GANGRENE
   - DRY GANGRENE - *GANGRAENA SICCA*
   - HUMID GANGRENE - *GANGRAENA HUMIDA*
   - GASEOUS GANGRENE - *GANGRAENA EMPHYSEMATOSA*
   - WATER CANCER - NOMA (*CANCER AQUATICUS*)

APOPTOSIS

PROGRAMMED CELL DEATH

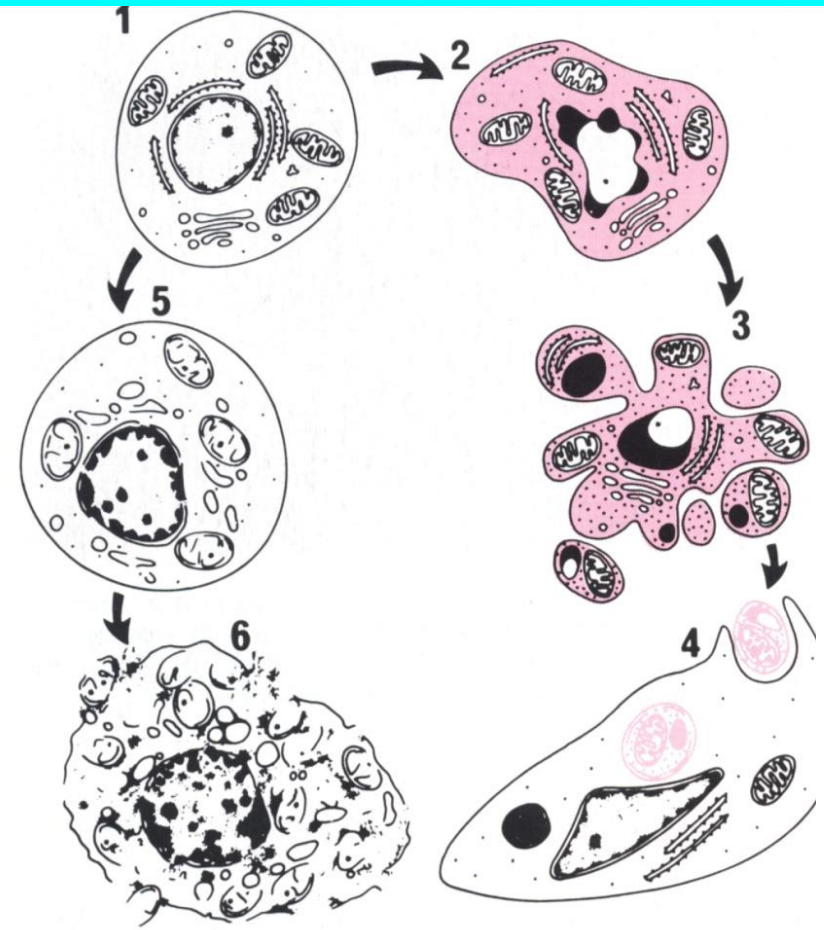
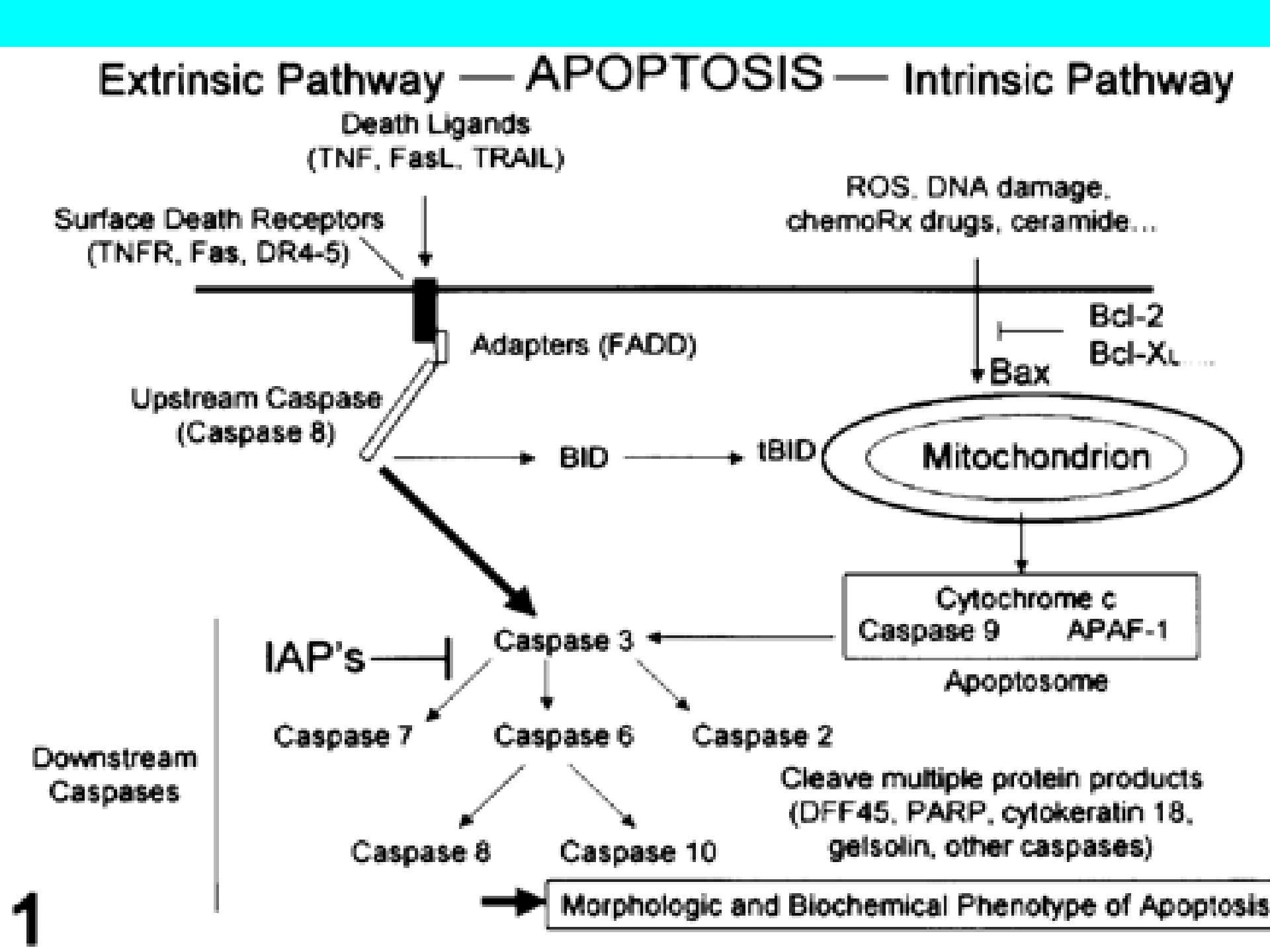


Table 1–2. FEATURES OF NECROSIS VERSUS APOPTOSIS

	NECROSIS	APOPTOSIS
Stimuli	Hypoxia, toxins	Physiologic and pathologic
Histology	Cellular swelling Coagulation necrosis Disruption of organelles	Single cells Chromatin condensation Apoptotic bodies
DNA breakdown Mechanisms	Random, diffuse ATP depletion Membrane injury Free radical damage	Internucleosomal Gene activation Endonuclease
Tissue reaction	Inflammation	No inflammation Phagocytosis of apoptotic bodies


Extrinsic Pathway — APOPTOSIS — Intrinsic Pathway
Death Ligands
(TNF, FasL, TRAIL)
Surface Death Receptors
(TNFR, Fas, DR4-5)
ROS, DNA damage,
chemoRx drugs, ceramide…
Bcl-2
Bcl-XL
Adapters (FADD)
Bax
Upstream Caspase
(Caspase 8)
BID
tBID
Mitochondrion
Cytochrome c
Caspase 9
APAF-1
Apoptosome
IAP's
Caspase 3
Caspase 7
Caspase 6
Caspase 2
Downstream
Caspases
Cleave multiple protein products
(DFF45, PARP, cytokeratin 18,
gelsolin, other caspases)
Caspase 8
Caspase 10
Morphologic and Biochemical Phenotype of Apoptosis
1

APOPTOSIS IS A CELLULAR RESPONSE IN PHYSIOLOGICAL AND

PATHOLOGICAL SITUATIONS:

1. PROGRAMMED DESTRUCTION OF CELLS DURING EMBRYOGENESIS

HORMONE DEPENDENT INVOLUTION IN ADULTS

2. REMOVAL OF CELLS IN TUMORS

3. APOPTOSIS OF IMMUNOCOMPROMISED CELLS

4. DESTROYING OF CELLS BECAUSE OF ACTION OF T- LYMPHOCYTE CYTOTOXINS

5. DAMAGE OF CELLS IN SOME VIRAL INFECTIONS OR DISEASES

6. MANY OTHER AGENTS – IN SMALL QUANTITIES CAUSE APOPTOSIS, IN LARGER QUANTITIES - NECROSIS

Apoptosis can be detected in populations of cells or in individual cells.

Many different methods have been devised to detect apoptosis such as

-The TUNEL (TdT-mediated dUTP Nick-End Labeling) analysis,

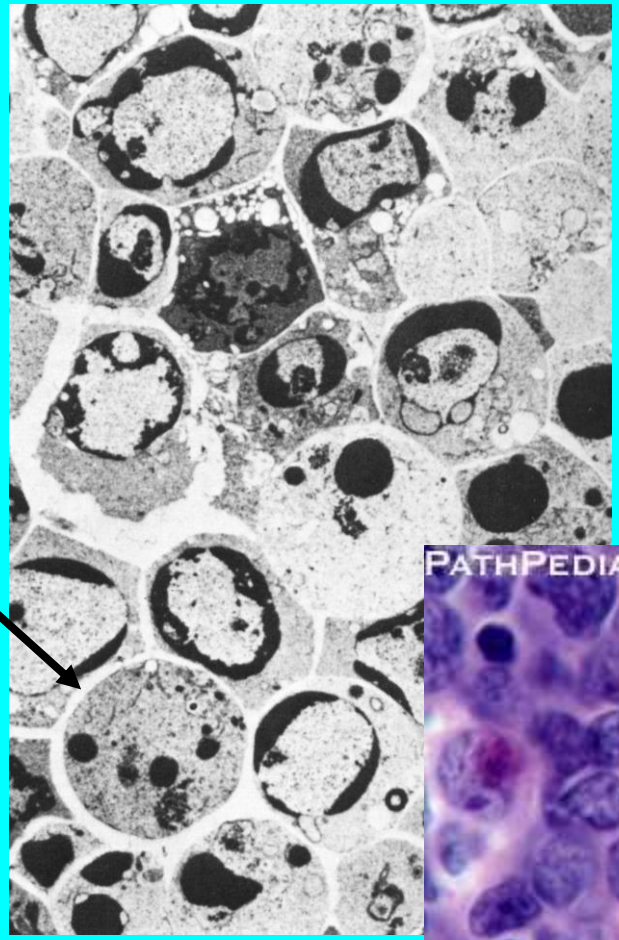
- ISEL (in situ end labeling), and

- DNA laddering analysis for the detection of fragmentation of DNA in populations of cells or in individual cells,

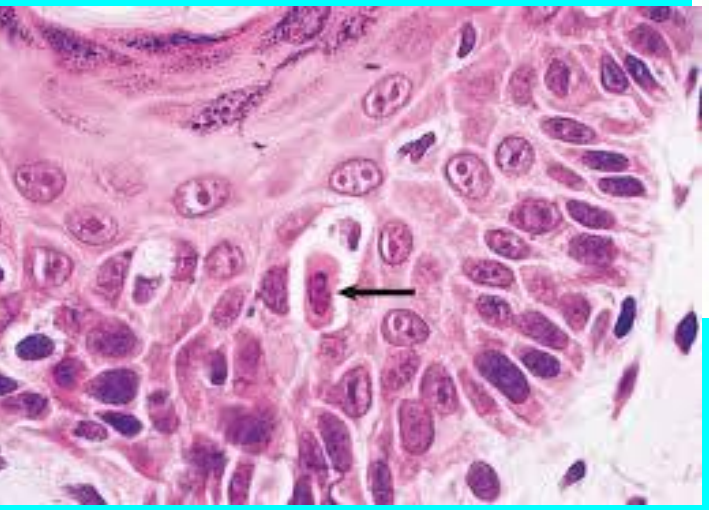
- Annexin-V analysis that measures alterations in plasma membranes,

- detection of apoptosis related proteins such p53 and Fas.

APOPTOSIS IN MALIGNANT LYMPHOMA CELLS



APOPTOTIC BODIES IN EPIDERMIS



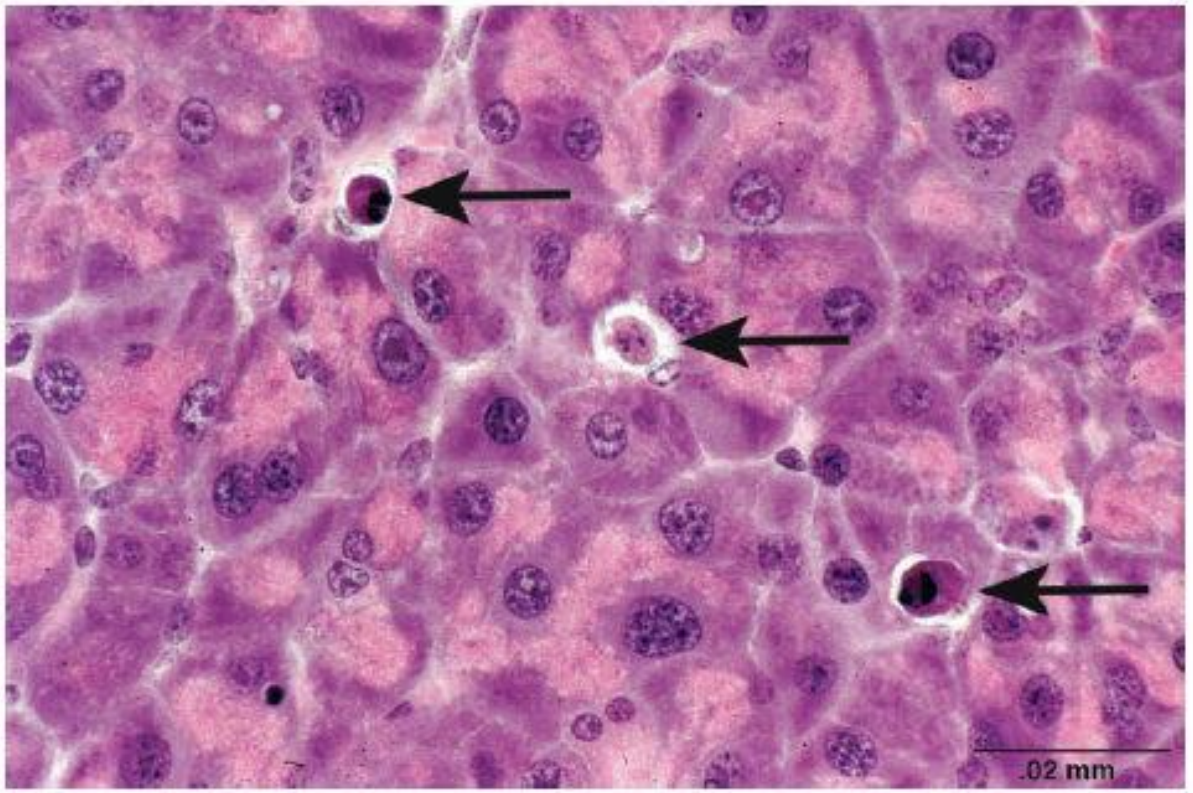


Figure 2. Apoptosis of exocrine pancreatic cells with cytoplasmic and nuclear condensation and nuclear fragmentation (arrows). Image courtesy of National Toxicology Program (NTP) archives.

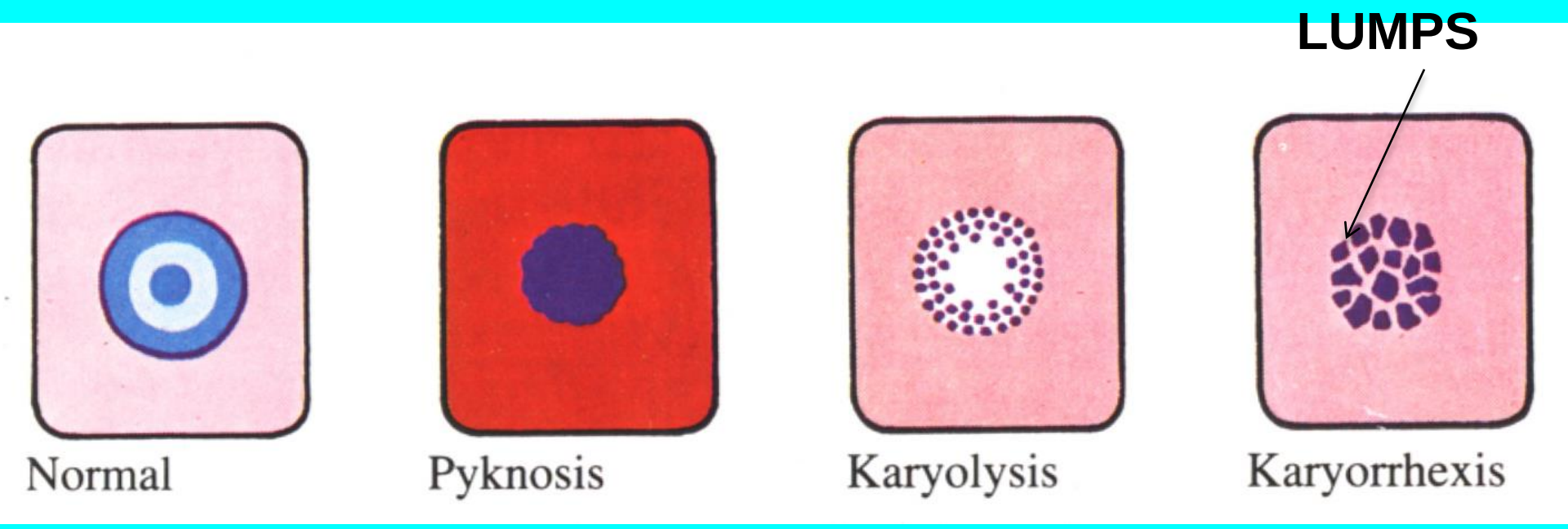
From: Susan A. Elmore et al. Toxicologic Pathology 1-16; 2016

SUMMARY

Cell death can occur by either of 2 distinct mechanisms:
necrosis or programmed cell death (apoptosis).
Necrosis is always a pathological process which occurs when cells are exposed to a serious physical or chemical insult. Sudden process !!!
Apoptosis is a physiological and sometimes pathological and controlled process by which unwanted or useless cells are eliminated during development and other normal biological processes. Usually slow process.

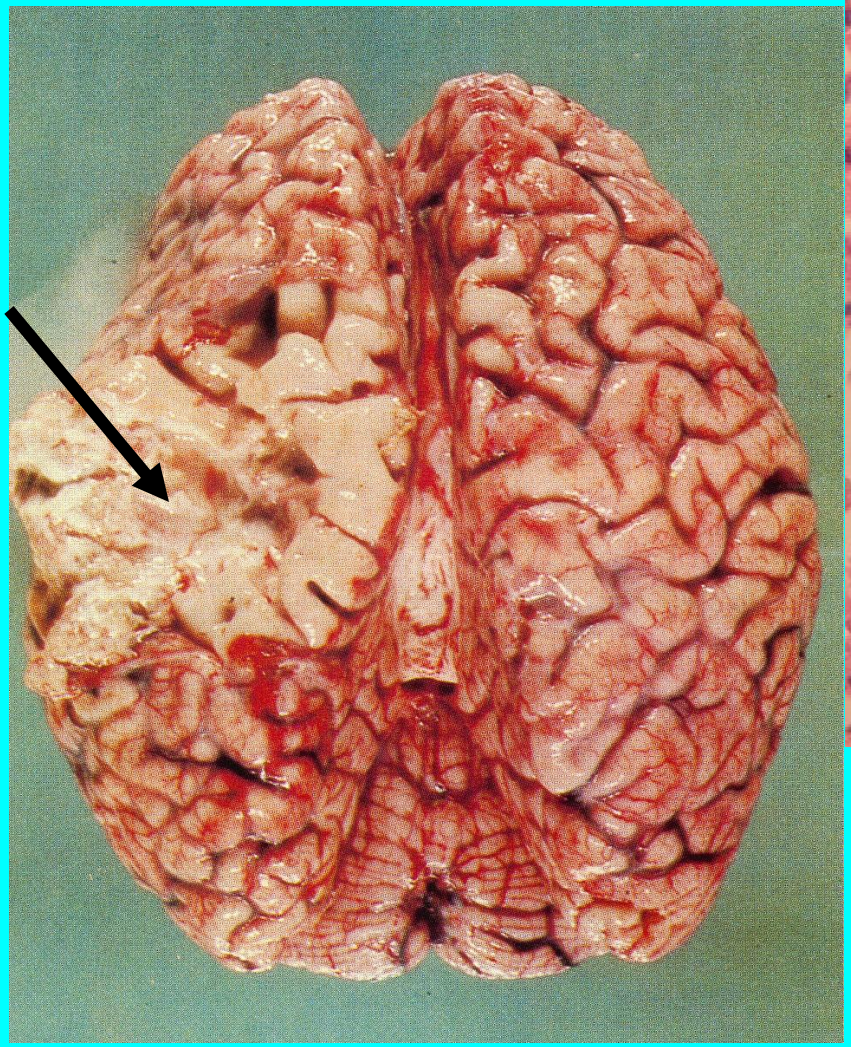

HELLO

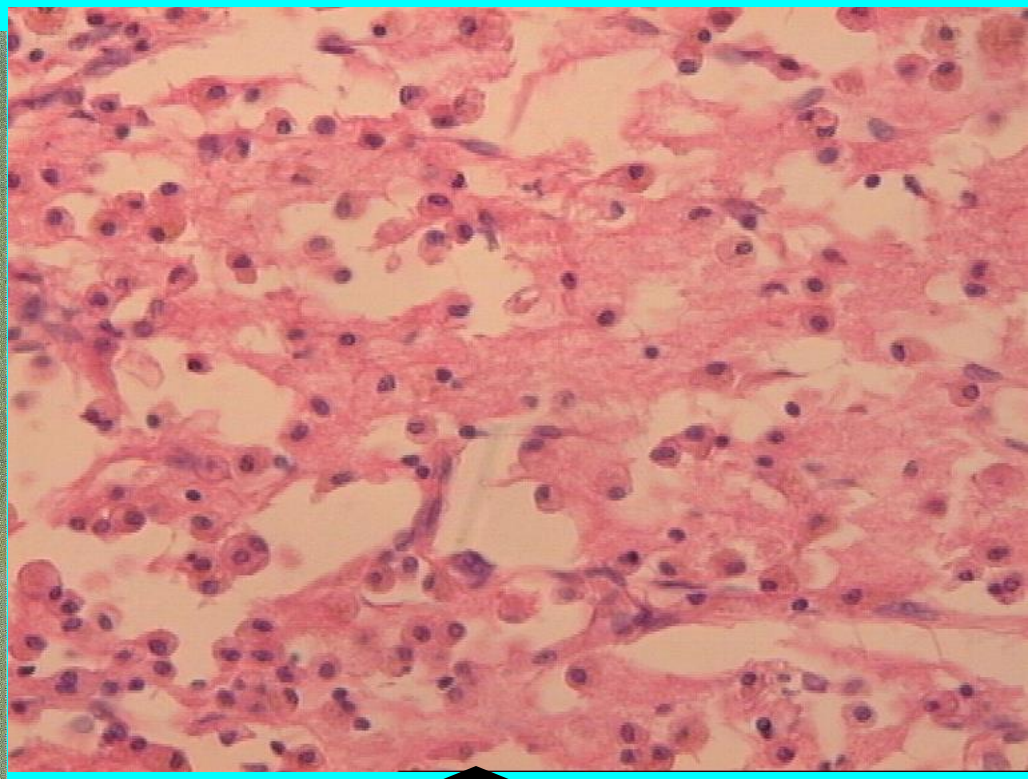
NECROSIS



DIFFERENT FORMS OF DESTRUCTION OF CELL NUCLEI IN NECROSIS

ENCEPHALOMALACIA

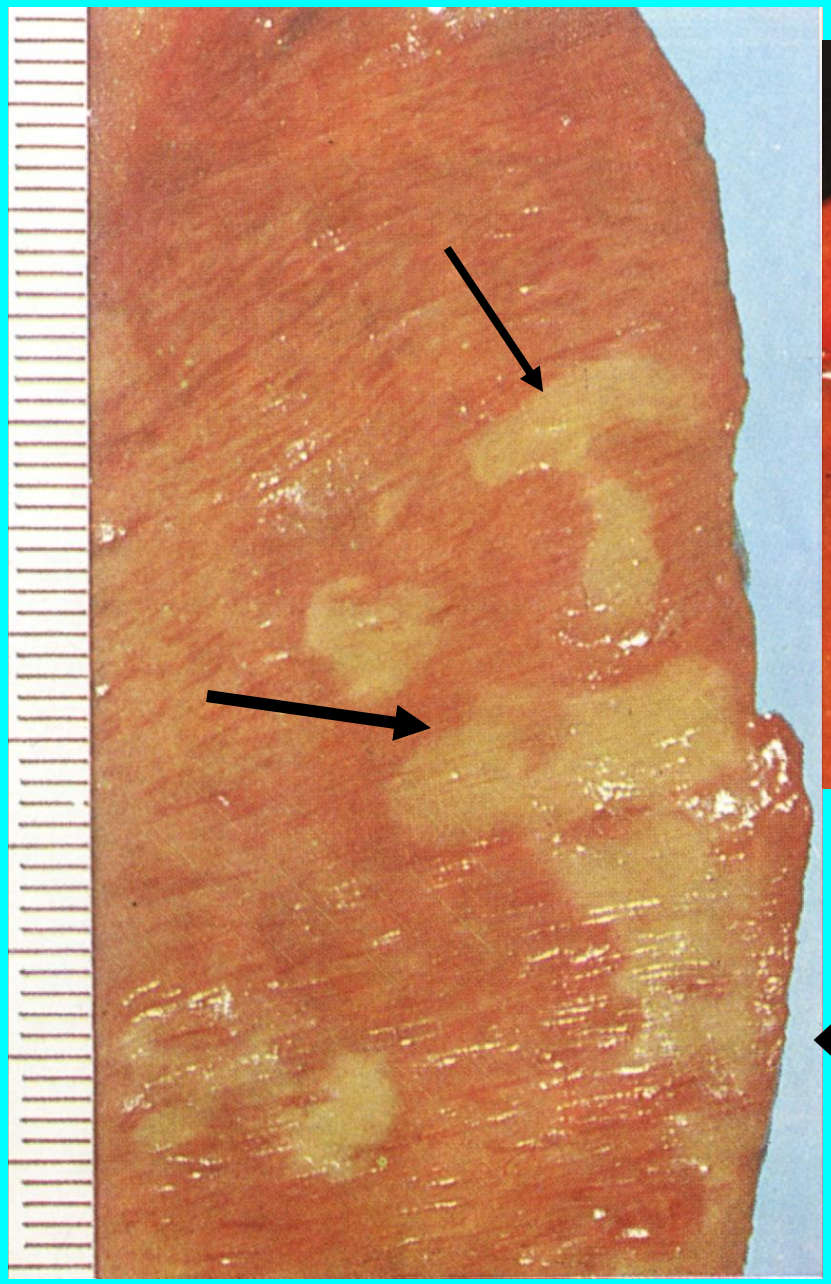


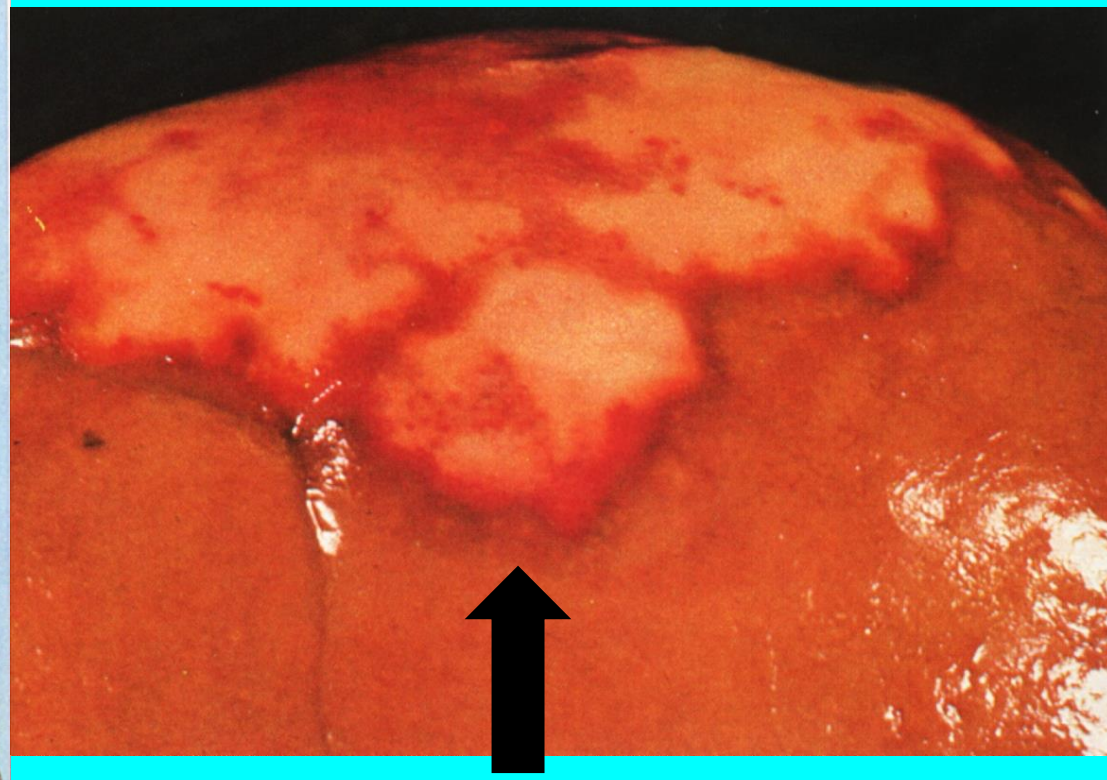


MICROSCOPIC PICTURE

MACROSCOPIC PICTURE

INFARCTUS

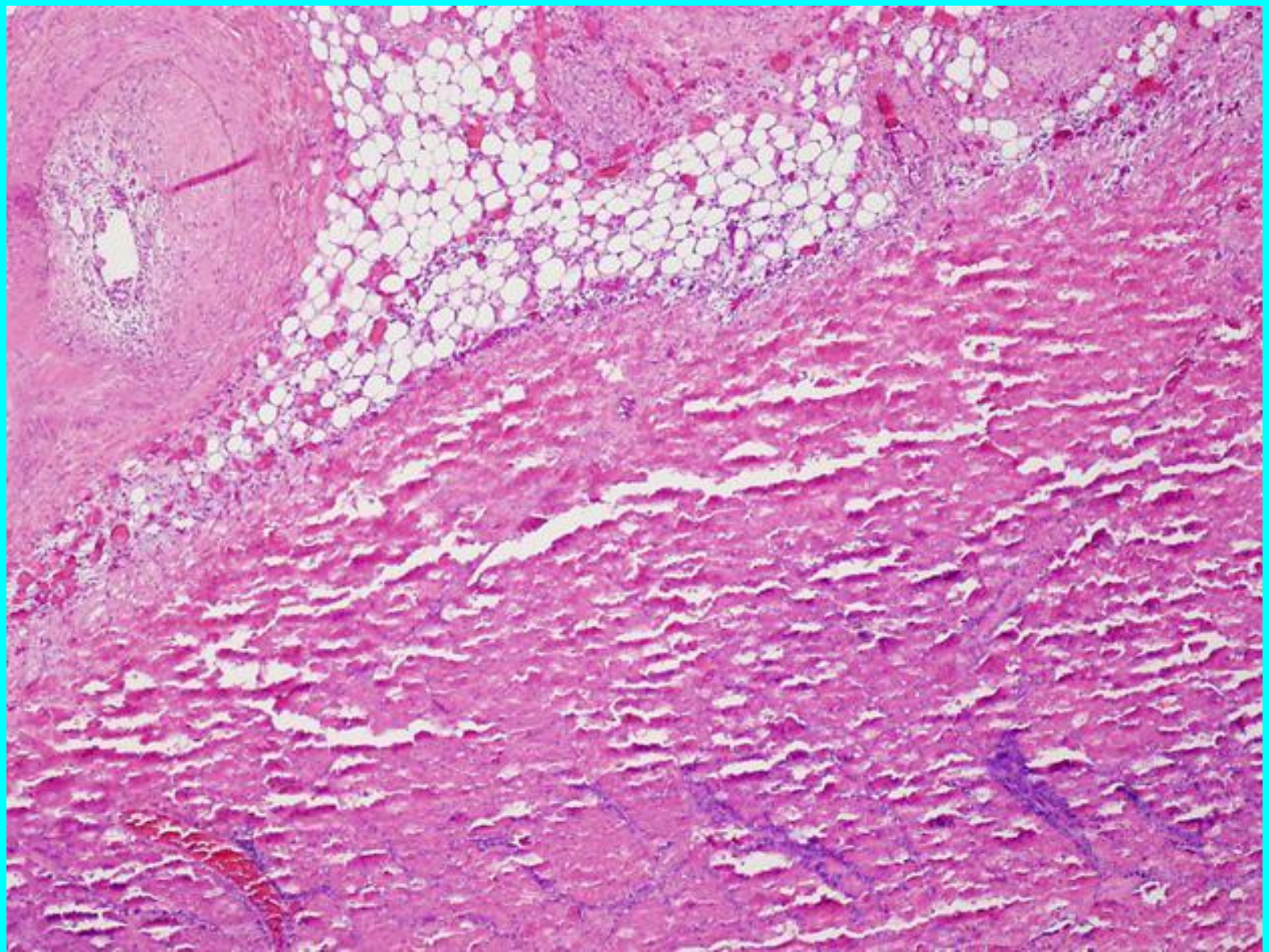




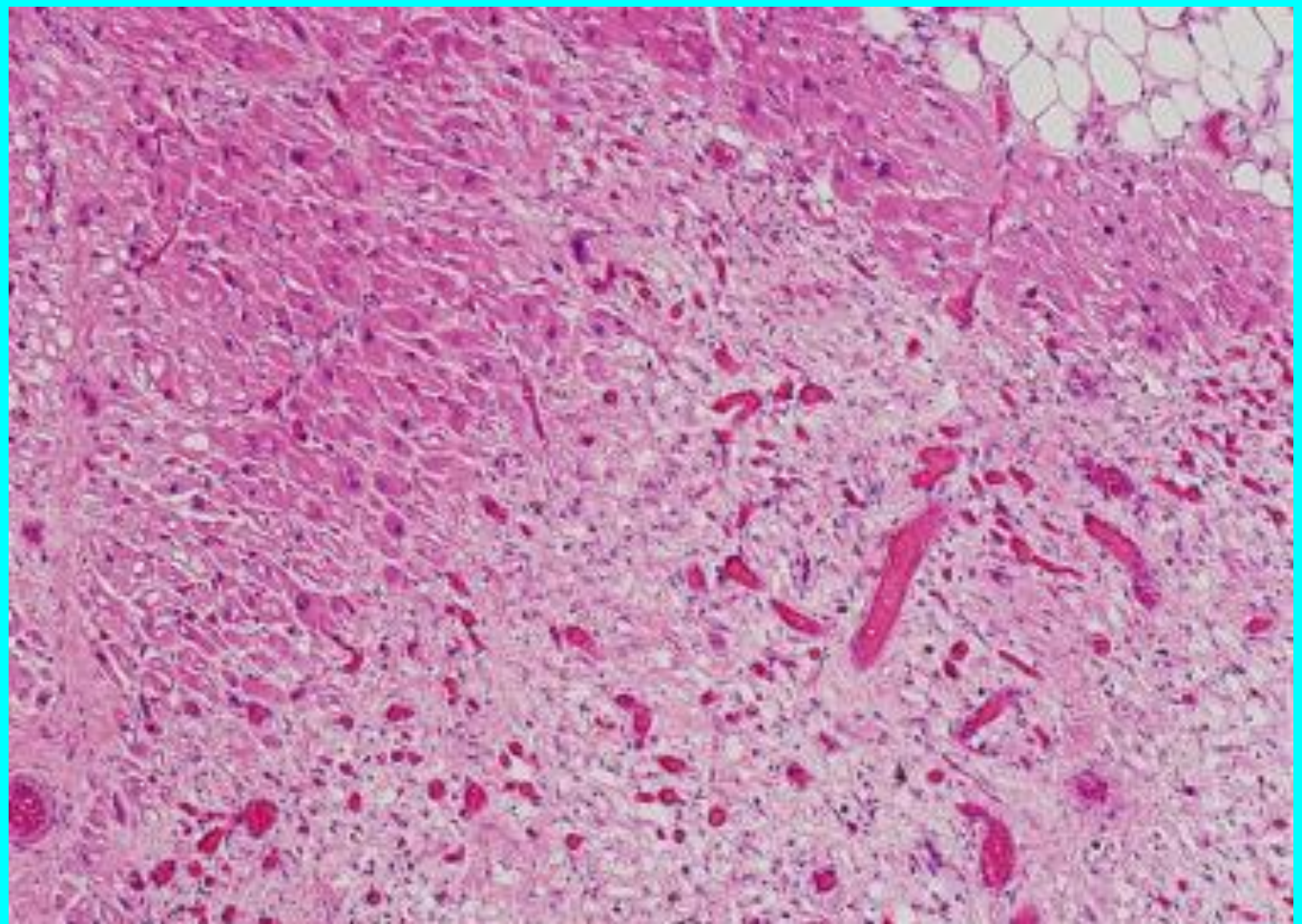
ANEMIC (PALE) INFARCT OF KIDNEY

MYOCARDIAL INFARCT

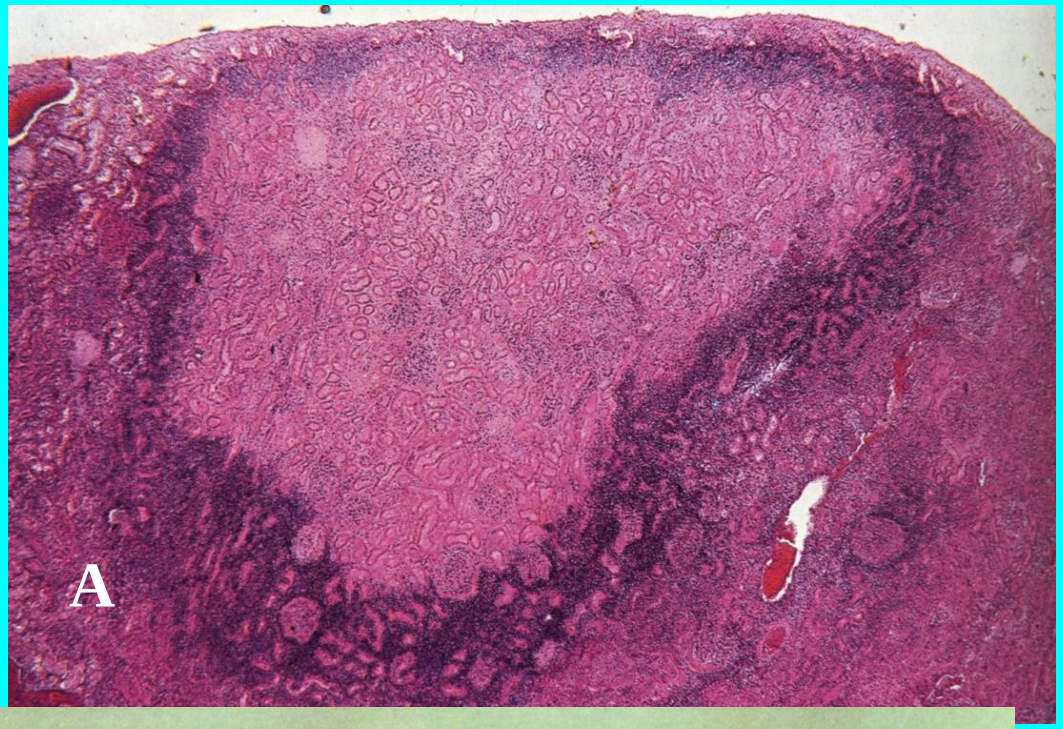
Acute myocardial infarction

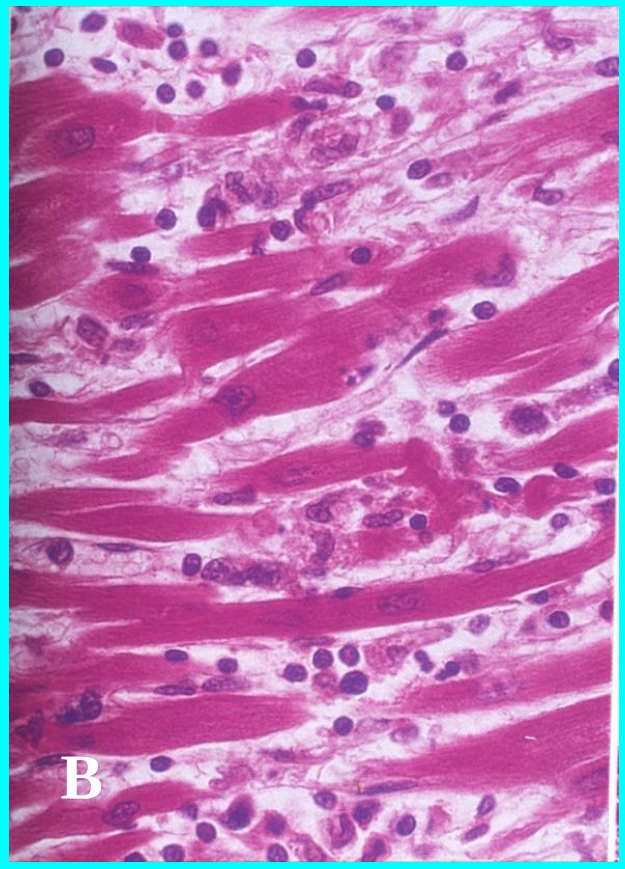


Acute myocardial infarction with early granulation tissue and neovascularization



PALE INFARCT - *INFARCTUS PALLIDUS*





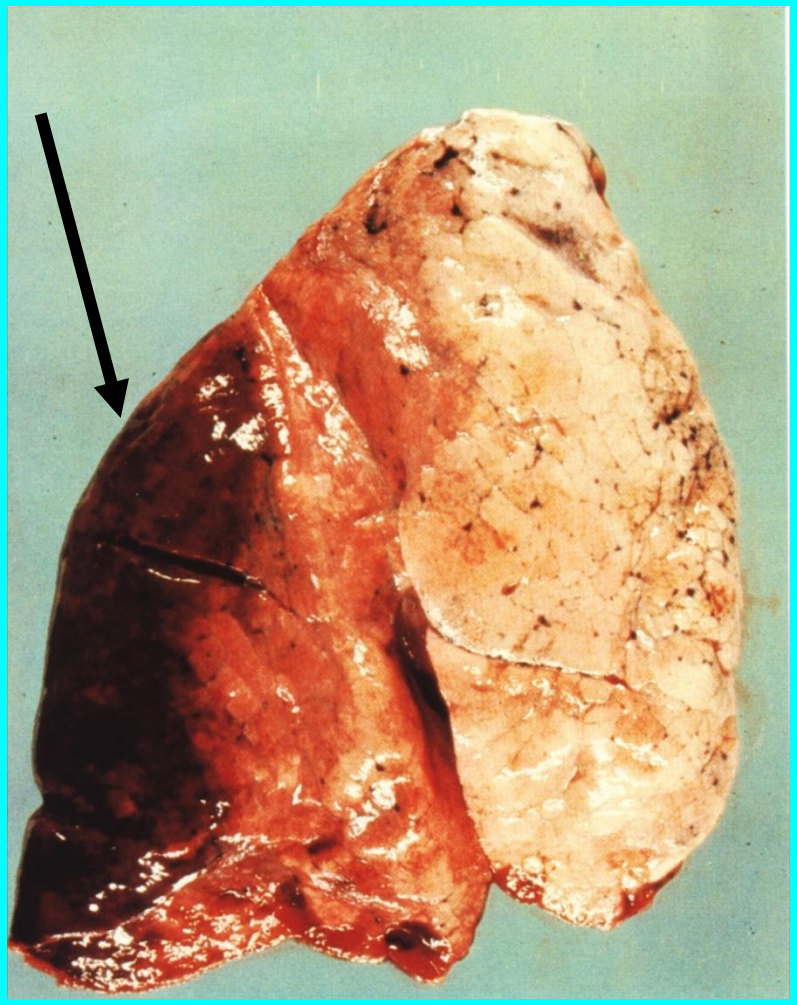
A. KIDNEY

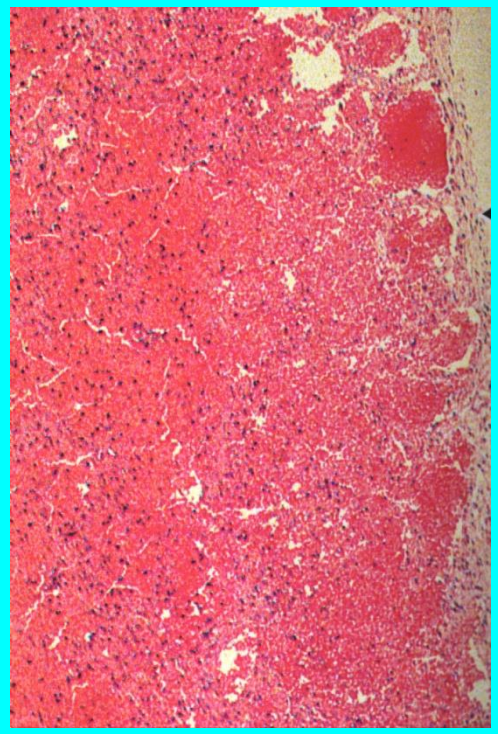
B. MYOCARDIUM

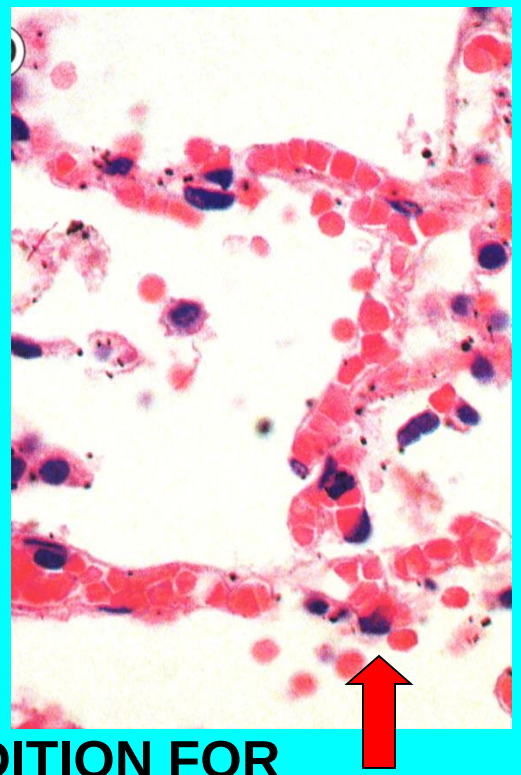
C. SPLEEN

HEMORRHAGIC INFARCT – *I. RUBER*

MACROSCOPIC AND MICROSCOPIC PICTURE OF HEMORRHAGIC INFARCT IN THE LUNG







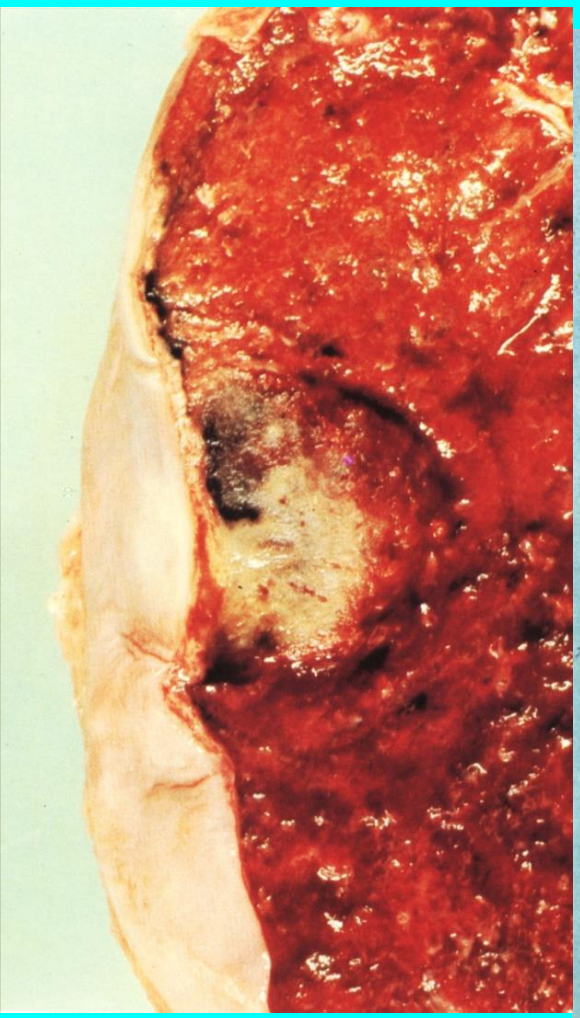
<u>REMEMBER</u>: A CONDITION FOR HEMORRHAGIC INFARCT IN LUNG IS THE OCCLUSION OF PULMONARY ARTERY AND NO OCCLUSION OF VEINS AND BRONCHIAL ARTERIES – CHRONIC VENOSTASIS IN LUNGS

Medium sized thrombomboli (blocking a pulmonary artery to a lobule or set of lobules) can produce the lesion seen below--a hemorrhagic pulmonary infarction (patient survives).

This red infarct is wedge-shaped and based on the pleura. These infarcts are hemorrhagic because, though the pulmonary artery carrying most of the blood and oxygen is cut off, the bronchial arteries from the systemic circulation (supplying about 1% of the blood to the lungs) is not cut off.

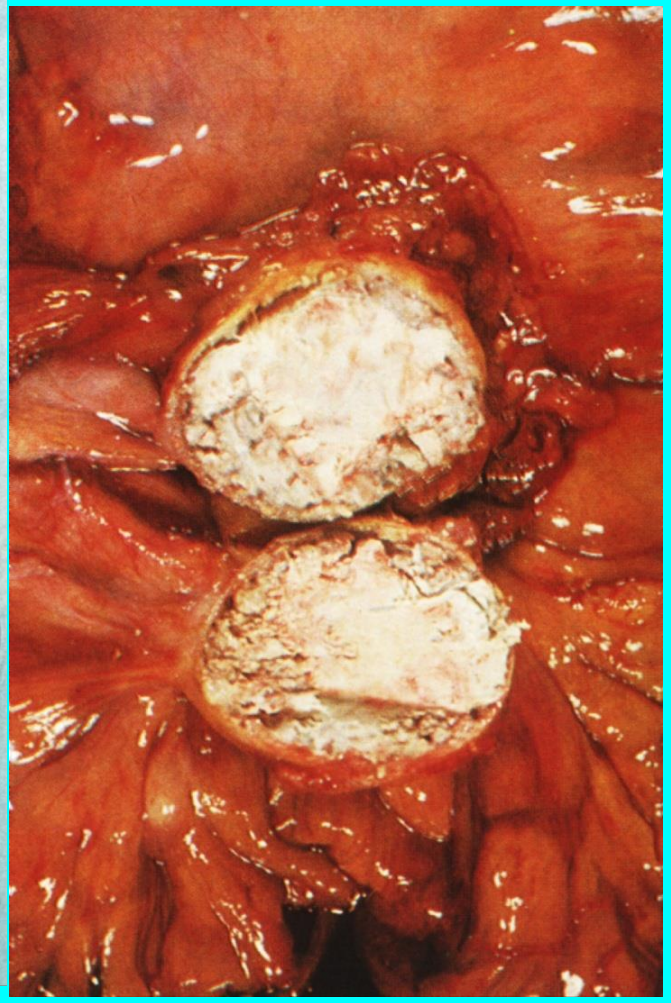
CASEIFICATION

FORMS OF CASEIFICATION



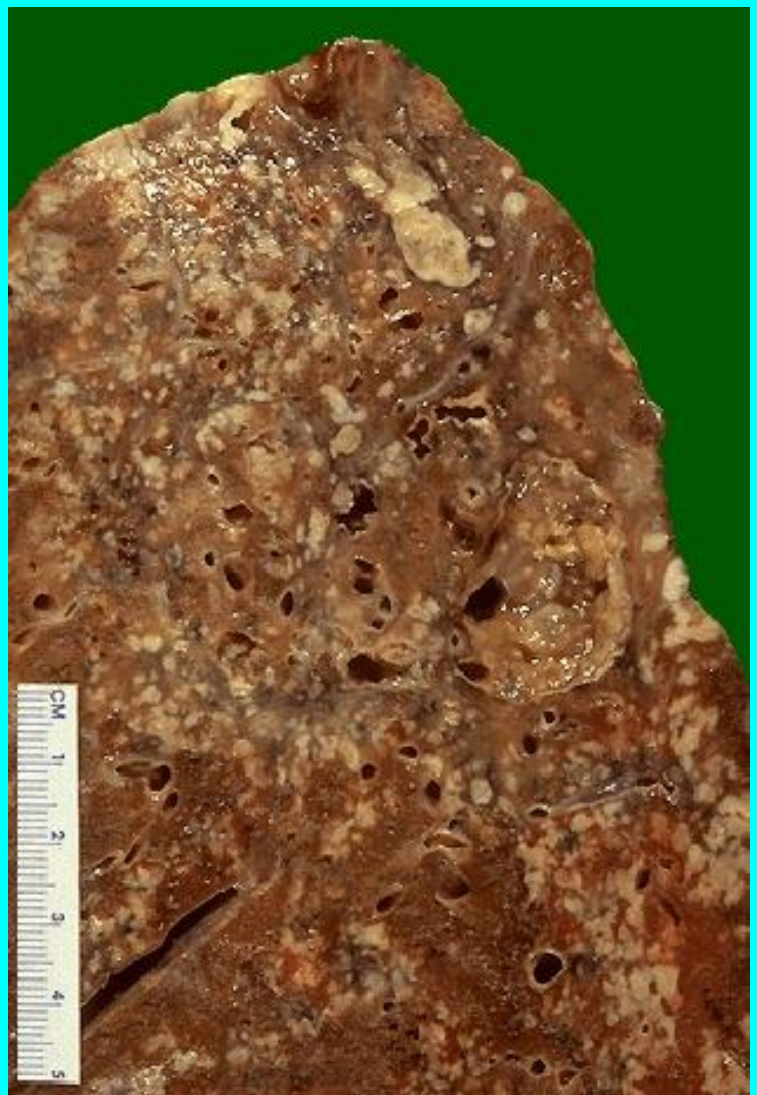
PRIMARY FOCUS IN COLLIQUATION STAGE.

TYPICAL PICTURE OF CASEIFICATION IN A LYMPH NODE



CALCIFIED CASEIFICATION IN MESENTERIC LYMPH NODE

This pattern of multiple caseating granulomas primarily in the upper lobes is most characteristic of secondary (reactivation) tuberculosis. However, fungal granulomas (histoplasmosis, cryptococcosis, coccidioidomycosis) can mimic this pattern as well.

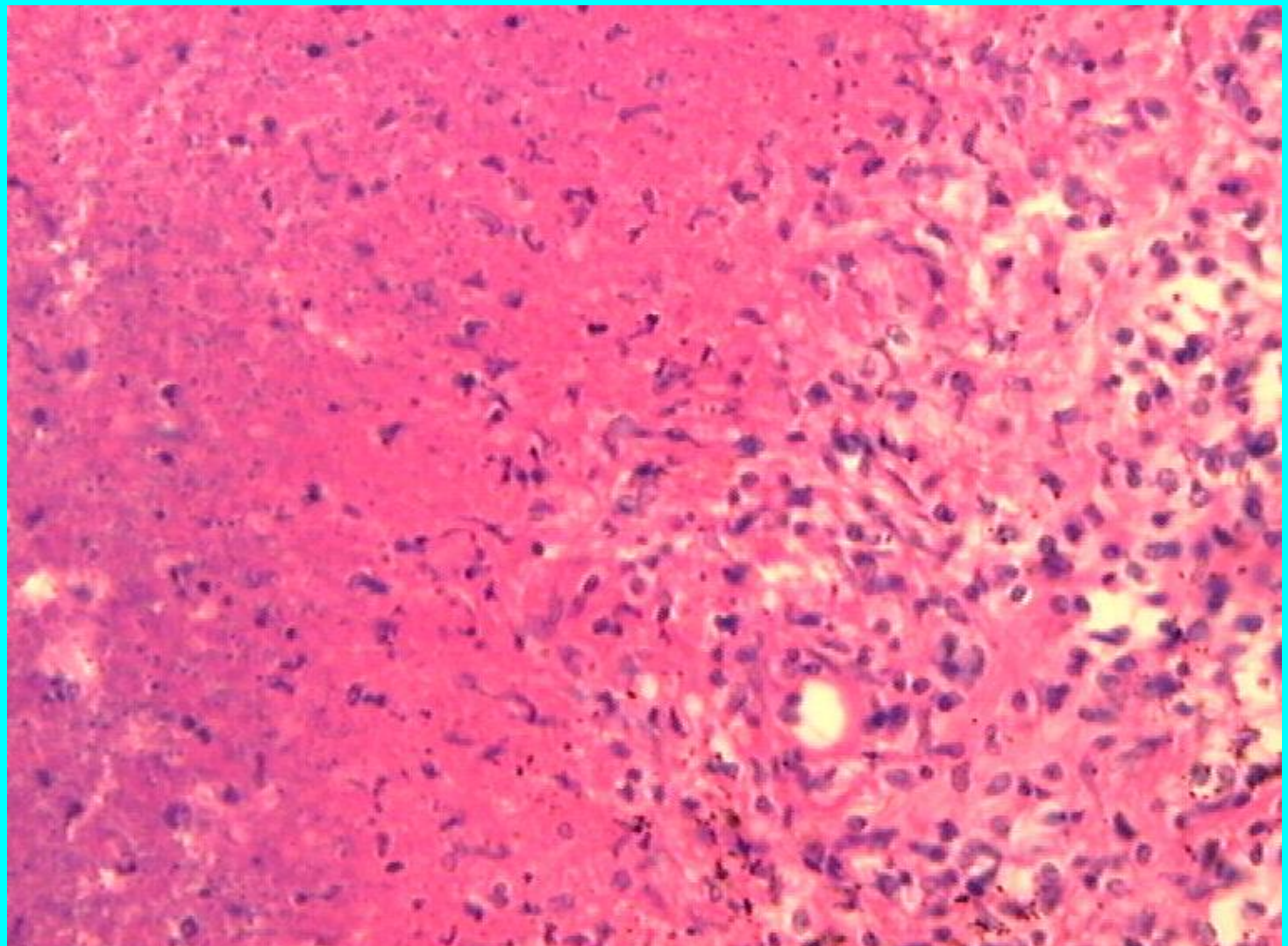


When there is extensive caseation and the granulomas involve a larger bronchus, it is possible for much of the soft, necrotic center to drain out and leave behind a cavity. Cavitation is typical for large granulomas with tuberculosis. Cavitation is more common in the upper lobes.

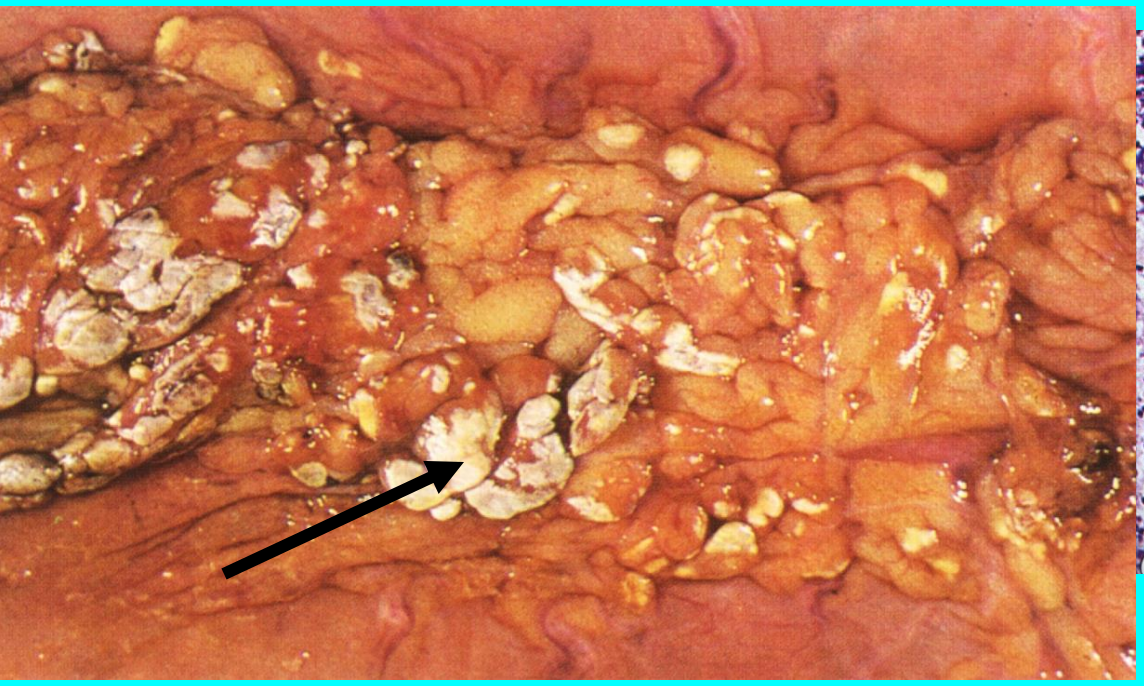
CASEIFICATION

KARYORRHEXIS – DISINTEGRATION OF CHROMATIN

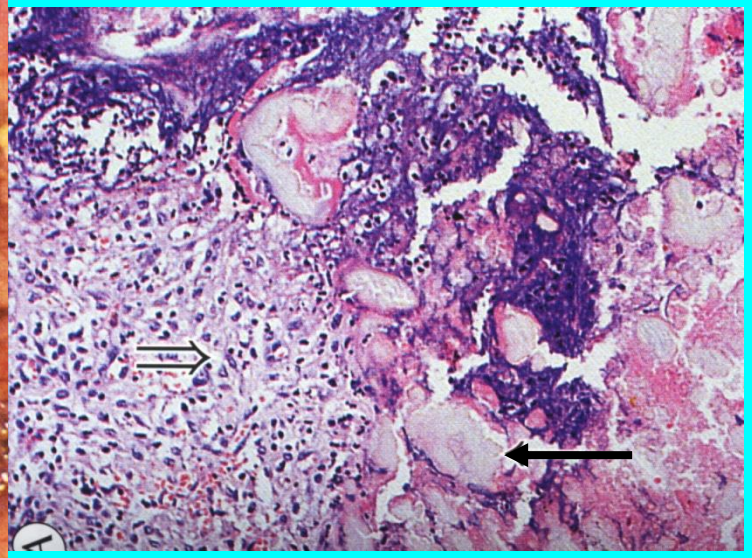
NECROSIS CANNOT BE ORGANIZED



ENZYMATIC NECROSIS - STEATONECROSIS



MACROSCOPIC PICTURE OF THE NECROSIS OF FAT TISSUE AND PANCREAS (WHITE FOCI RESEMBLING CANDLE WAX)



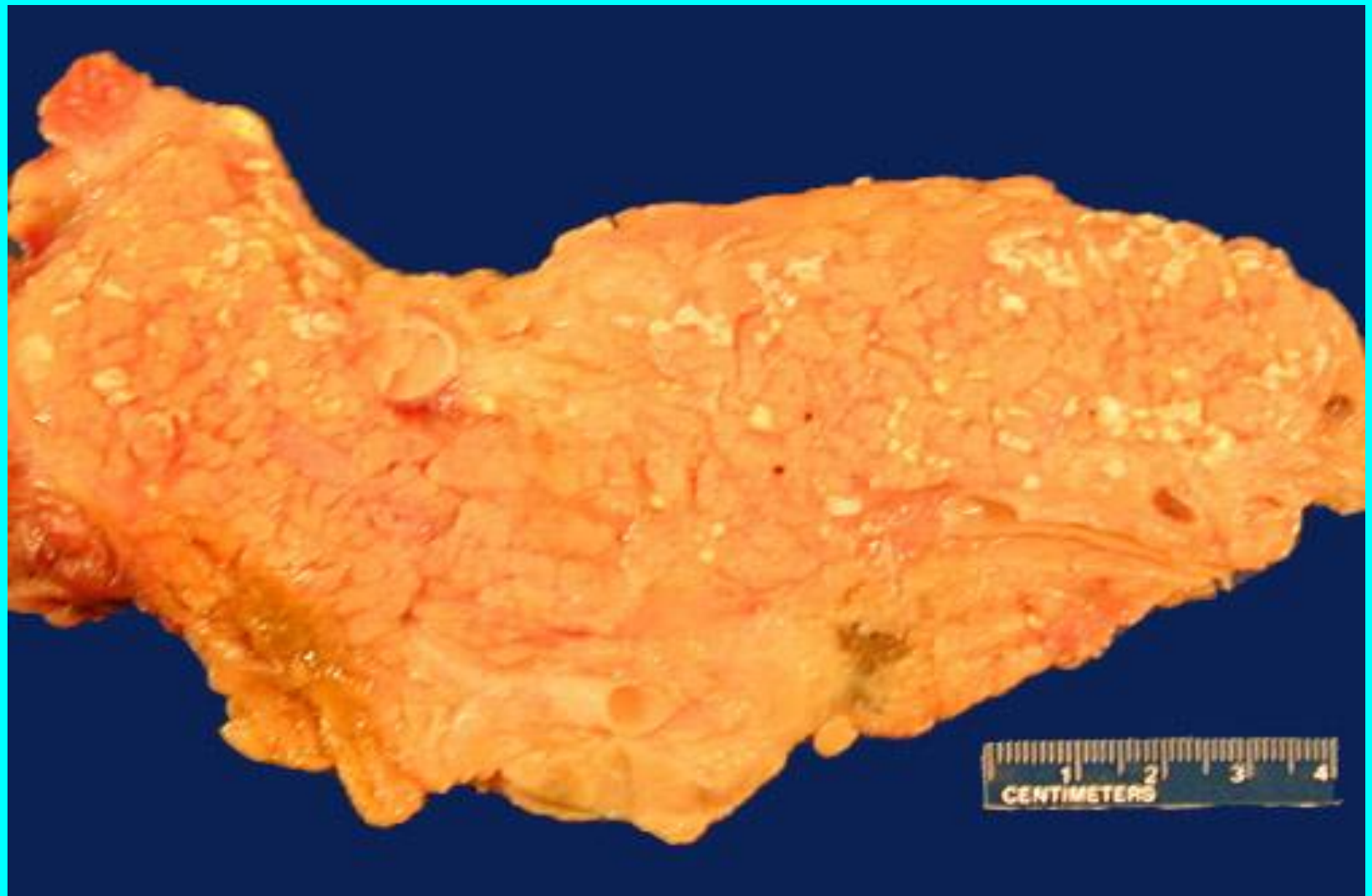
CALCIUM ,,SOAPS" IN NECROTIC FAT TISSUE

ACTIVATION OF PANCREATIC PROENZYMES (TRYPSINOGEN AND CHYMOTRYPSINOGEN) → DIGESTION OF TISSUE BY TRYPSIN AND CHYMOTRYPSIN ➡ LIPASE HYDROLYZES FAT → FATTY ACIDS BIND WITH CALCIUM ⇨ CALCIUM ,,SOAPS"

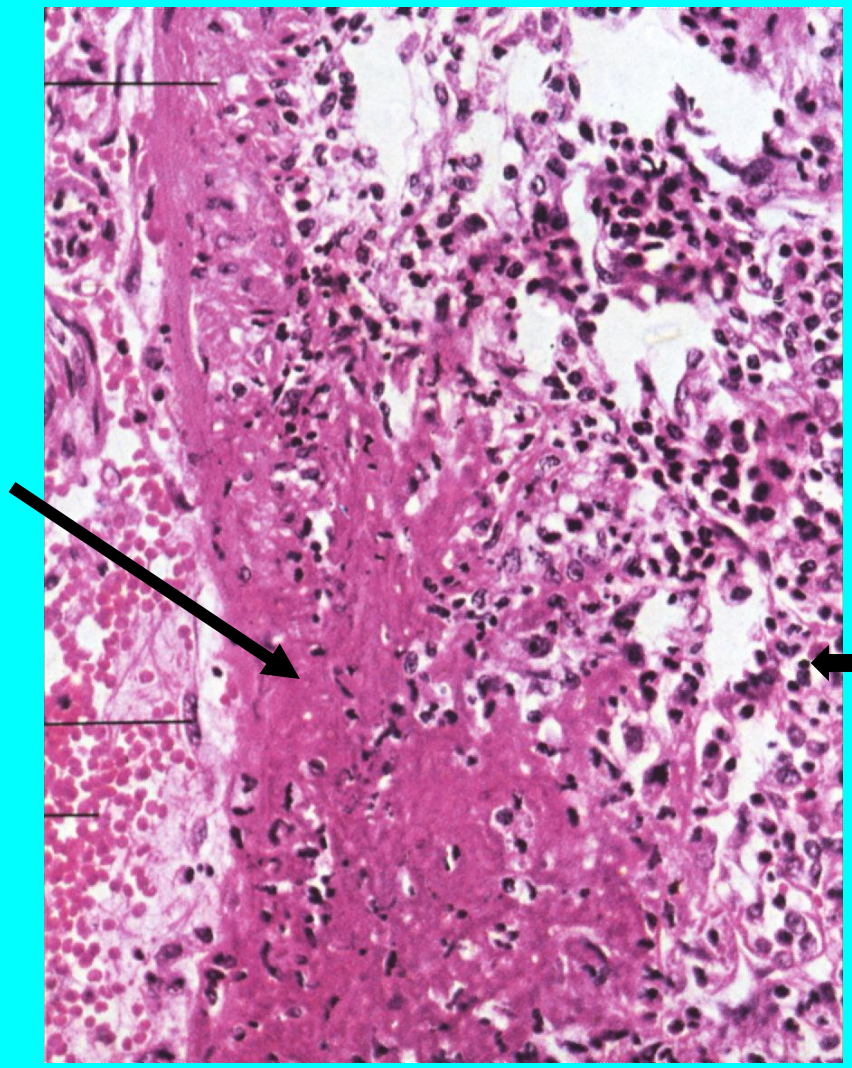
ENZYMATIC NECROSIS PANCREAS in acute pancreatitis

- **20 cases/100,000 in US, 80% associated with biliary tract disease or alcoholism**
- **Note: 1/3 to 2/3 of patients have gallstones but only 5% with gallstones develop pancreatitis**
- **75% of gallstone related cases occur in women**
- **86% of alcohol related cases occur in men**
- **Alcoholism associated: 2/3 of all cases in US, 5% in UK**
- **Due to autodigestion by inappropriately activated enzymes**

This is fat necrosis of the pancreas. Cellular injury to the pancreatic acini leads to release of powerful enzymes which damage fat by the production of soaps, and these appear grossly as the soft, chalky white areas seen here on the cut surfaces.



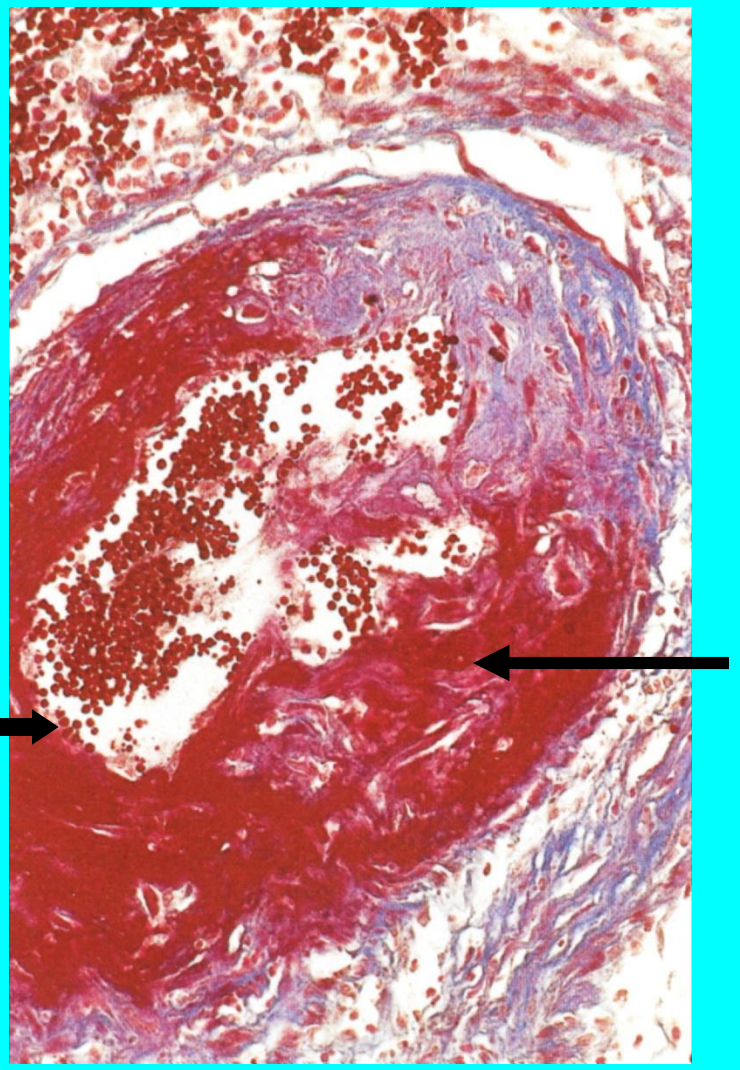
FIBRINOID NECROSIS (DEGENERATION)



DYE:

H&E

AZAN



***PANVASCULITIS NODOSA* – NODULAR INFLAMMATION OF VESSELS**

CERACEOUS NECROSIS

RARELY SEEN VERSION OF COAGULATIVE NECROSIS

COMPLICATION OF ACUTE INFECTIOUS DISEASES: TYPHOID FEVER (*TYPHUS ABDOMINALIS*), CHOLERA

AFFECTS ABDOMINAL MUSCLES !!!

MUSCLES ARE PALE-RED, SHINY, LOOK AS IF THEY ARE MADE OF WAX

MUSCLES BREAK DURING SPASMS/CRAMPING

HEMORRHAGIC INFARCTIONS IN NEIGHBOURING TISSUES ARE FREQUENT !!!

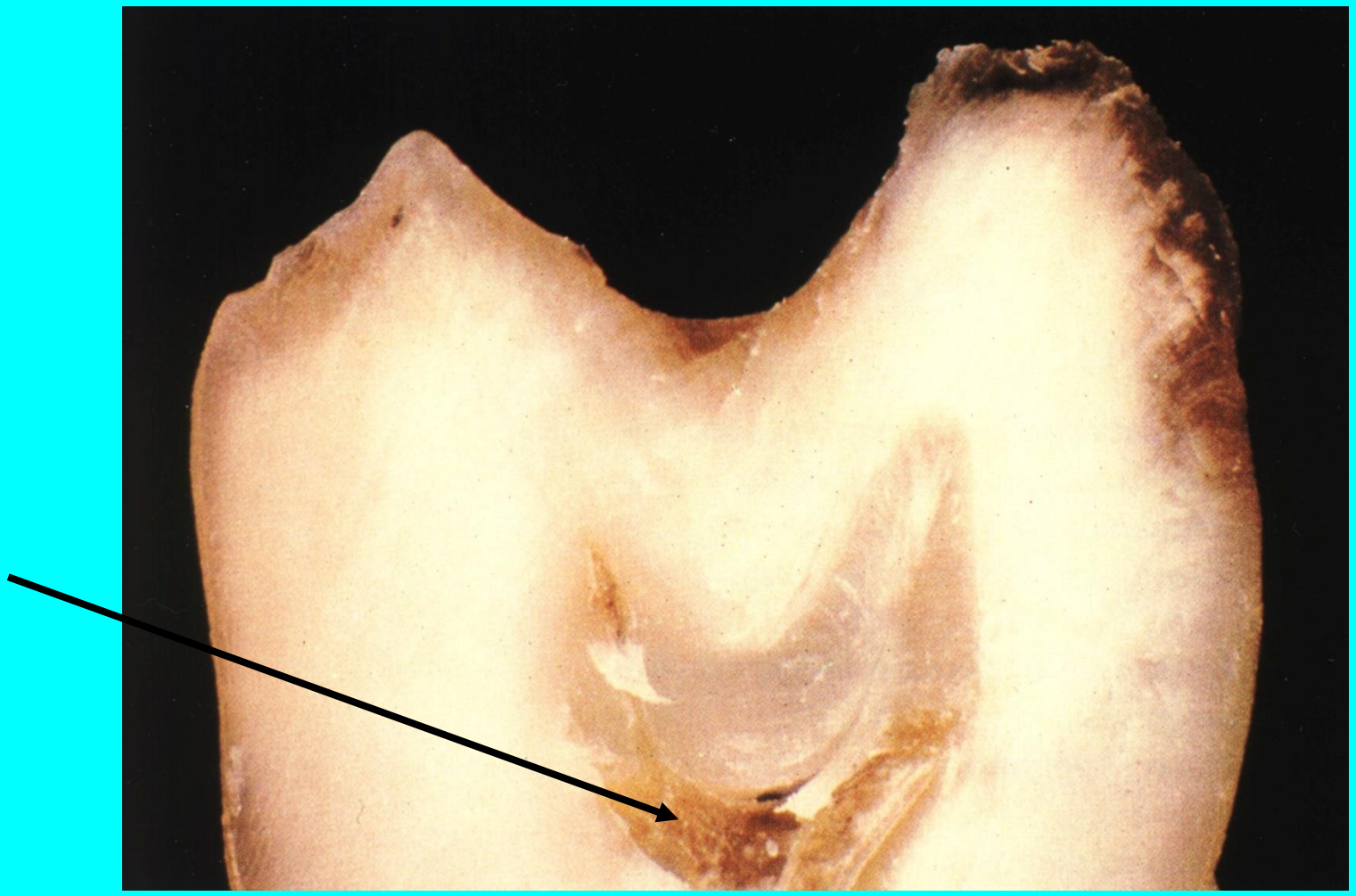
GANGRENE

HUMID GANGRENE - EMBOLUS IN MESENTERIC ARTERY

DRY GANGRENE OF FOOT WITH DEMARCATION ZONE

HUMID GANGRENE

GANGRENOUS PULPITIS



EMPHYSEMATOUS GANGRENE („MALIGNANT EDEMA")

ACUTE INFECTIOUS DISEASE WHICH RESULTS IN SUDDEN AND RAPID NECROSIS

ETIOLOGY: *CLOSTRIDIUM PERFRINGENS (WELCHII), CL.NOVYI (OEDEMATIS MALIGNI), CL.SEPTICUM*

WHERE: DEEP WOUNDS WITH LIMITED ACCESS TO OXYGEN, INJURY OF A LARGE AMOUNT OF MUSCULAR MASS.

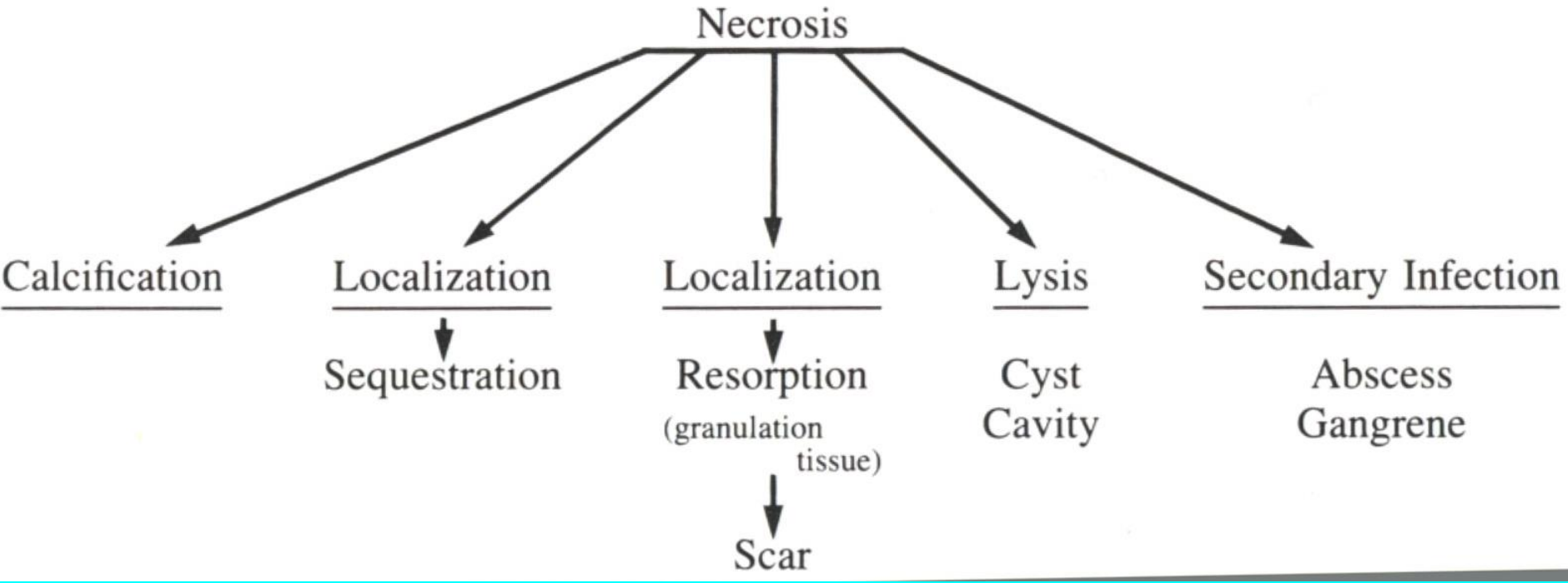
SYMPTOMS: ENORMOUS EDEMA, MUSCLES „COOKED", VESICLES FILLED WITH ODORLESS GAS, CRACKLING SOUND WHEN TISSUE IS PRESSED,

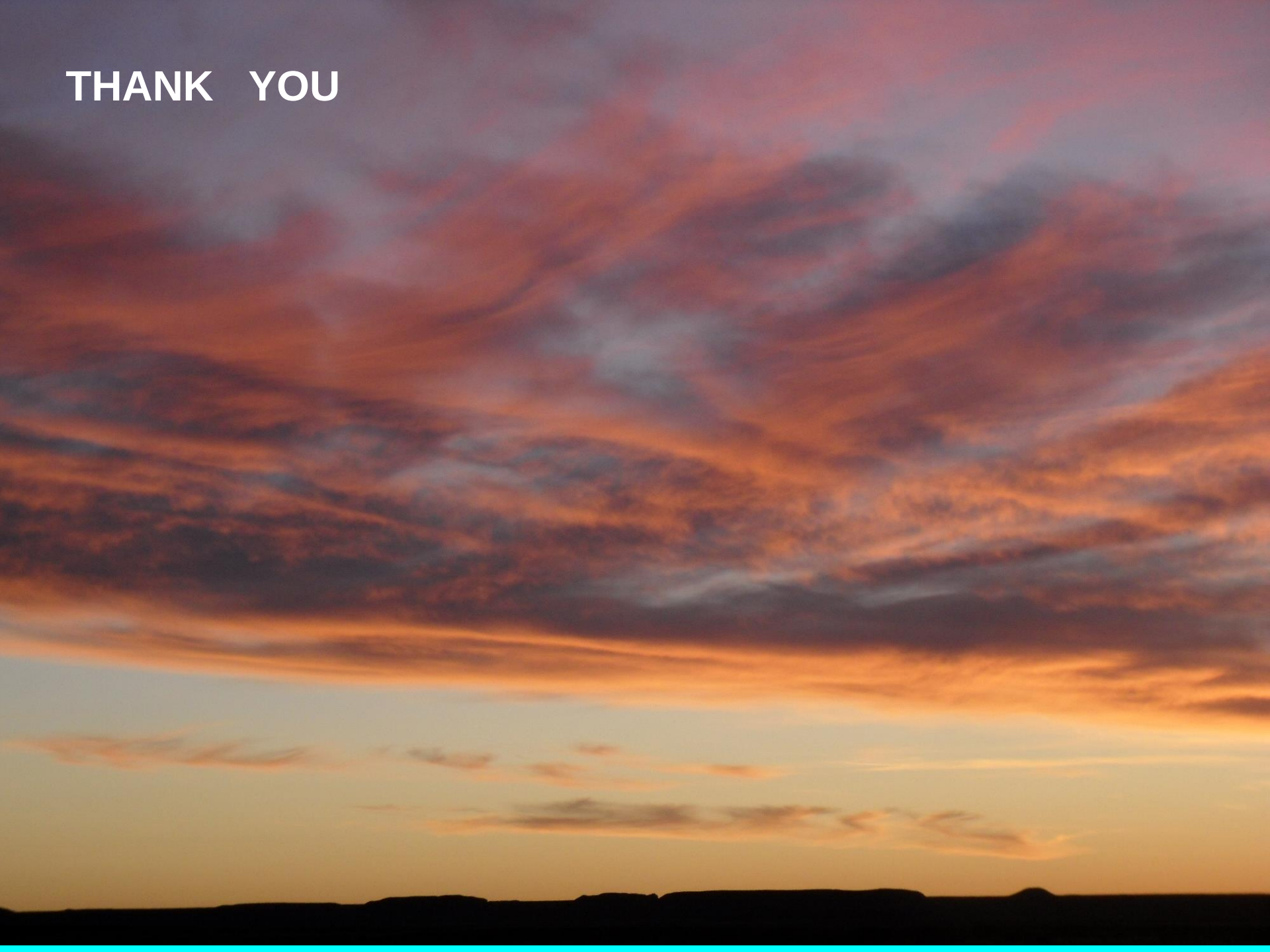
TOXEMIA,

RAPID LYSIS OF TISSUES BECAUSE OF RELEASE OF LARGE QUANTITIES OF ENZYMES

WATER CANCER - *CANCER AQUATICUS*, NOMA (GANGRENE OF MOUTH – Pseudomonas, Fusobacterium)

DIFFERENT EFFECTS OF NECROSIS




THANK YOU