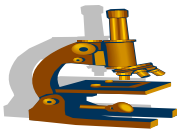

Faculty of Medicine **Histology Department**

CELL INCLUSIONS

Lecture 13 (2nd Week)
In
Block 102PMS

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Assiut University/ 2023-2024

Learning objectives (*2nd week/Lecture 13*)

After the lecture, students should be able to:

- **Define cell inclusions & enumerate them.**
- **Identify glycogen granules.**
- **Discriminate lipid droplets.**
- **Recognize types of pigment& mineral deposits.**

Cytoplasmic/ cell Inclusions

Cell/ cytoplasmic inclusions are cytoplasmic deposits filled with stored macromolecules and accumulated metabolites with little or no metabolic activity themselves.

- **Glycogen granules:** are aggregates of the carbohydrate in the cytoplasm and the major storage form of glucose and is a ready source of energy. So; glycogen is abundant in cells with high metabolic activity.
- liver cells , skeletal muscle, cardic muscles and chondrocytes may have high glycogen deposits in their cytoplasm.
- Glycogen accumulation occurs in glycogen storage diseases and diabetes mellitus.

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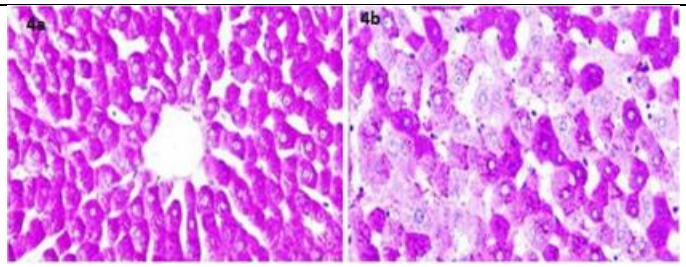
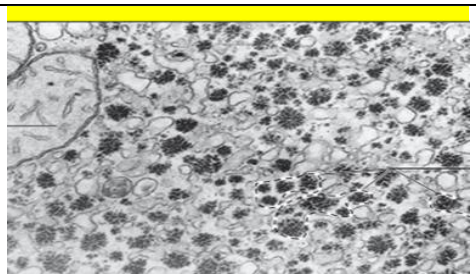
<tr>
<td> 

In light microscope glycogen granules appear as pink/ red clumps when stained with periodic acid-Schiff (PAS).</td>
<td> 
In the electron microscope, glycogen particles are seen as electron-dense clusters</td>
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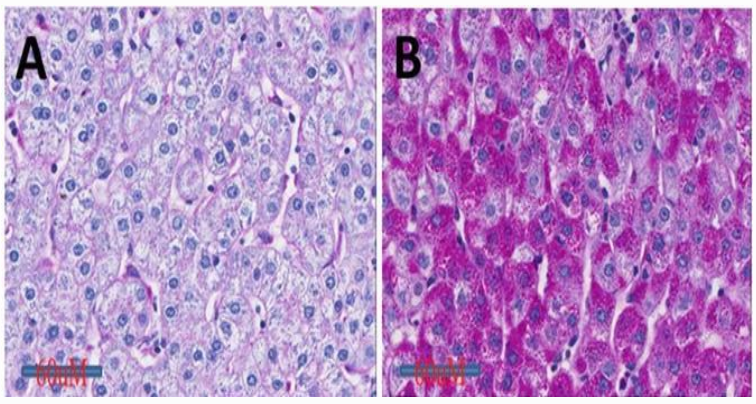
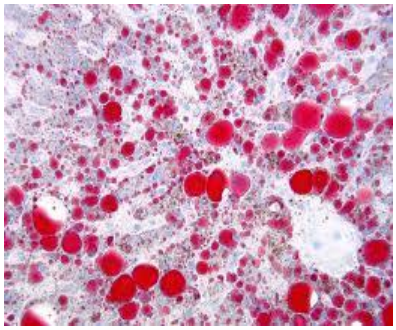
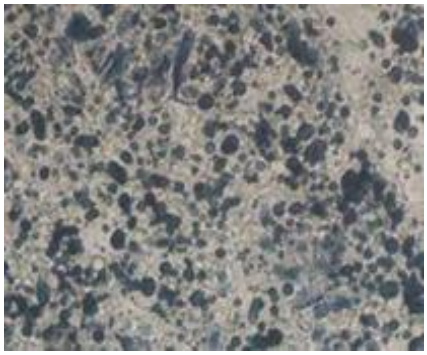
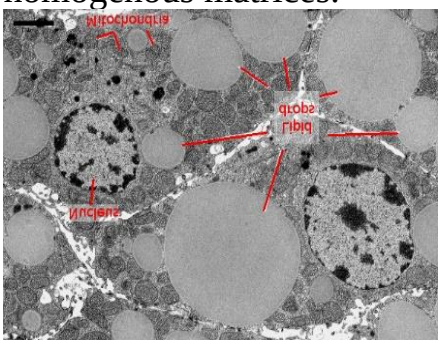
<td> 
</td>
<td>PAS-D stain/ <u>a control section</u> from a normal human liver stained with PAS after diastase digestion (A) and a duplicate of the section stained with a PAS stain only (B).
After diastase digestion, which selectively degrades glycogen, PAS staining was no longer positive, confirming glycogen accumulation</td>
</tr>
</table>

▶ **Lipid droplets storage;** are a common cytoplasmic feature of many cells.

- The liver has a central role in lipid metabolism; therefore, hepatocytes have numerous lipid droplets.
- Cells that synthesize steroid hormones (adrenal gland) also have numerous lipid droplets.
- Special stains are required to visualize lipid droplets in the light microscope as Sudan black, Osmic acid, and oil O red.

lipid droplets in liver stained by oil O red	**lipid droplets in liver stained by sudan black**	Lipid droplets by TEM appear as spherical clusters with homogenous matrices.
		

Note

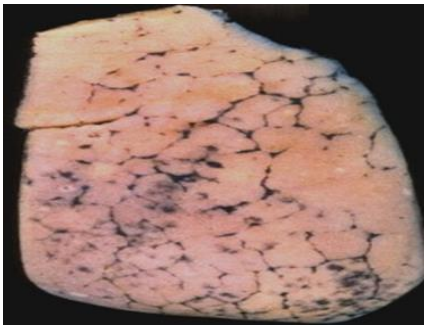
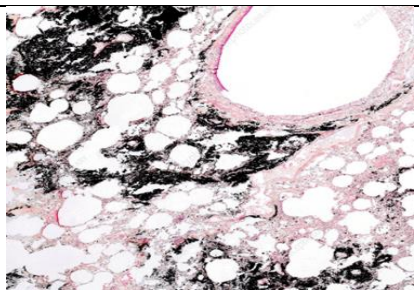
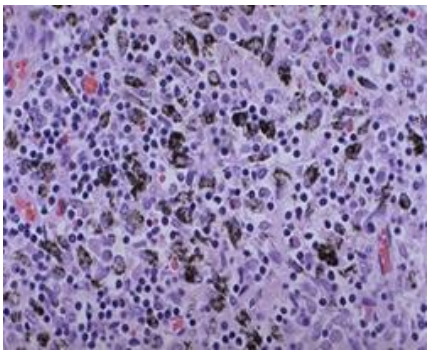
See also, adipocytes (fat cells) in connective tissue cells lecture.

▶ Pigment deposits of naturally colored material, including:

A- Exogenous pigments: Substance gained access to the body cells from outside by inhalation, implantation (injection), and ingestion.

1. **carotenoid pigments;** Originating from the carotene present in colored vegetables (carrots & tomatoes) which enter the body with food.
2. **Carbon pigments ; Occurs as black particles** found in (Lung & lymph node).
   - Source: Mine dust, Car exhausts (air pollution) and tobacco smoking.
   - Fail to stain and non reactive.

- Exogenous pigments include also; dust, metals or tattoo colors.

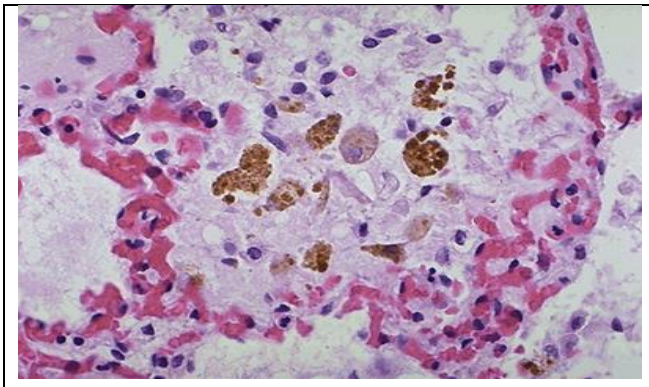
Carbon pigment between lung lobules (Anthrcosis) 	 Accumulation of carbon pigment in lung tissue due to coal dust, smoke or air pollution HX&E	Carbon pigments in macrophages of lymph node HX&E 

B- Endogenous pigments: Produced within the tissue cells and serve a physiological function.They are by-products of normal metabolic process and classified into:

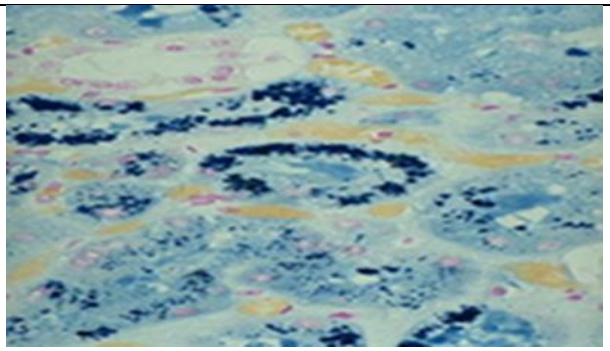
1- Haematogenous (blood derived) endogenous pigments:

a-Haemosiderins **b- Haemoglobin** **c- Bile pigment**

a- Haemosiderins: Are Yellow to brown granules is prominent in phagocytic cells (macrophages) of the liver, spleen, and bone marrow due to phagocytosis of red blood cells.



Haemosiderin pigments by H&E



Perls Prussian blue reaction stains haemosiderins granules blue color

▶ Clinical correlation (reading only)

Excess haemosiderins pigments causes:

1- **Haemosiderosis**; due to iron overload may be therapeutically/ blood transfusion and deposite in reticuloendothelial system (bone marrow, liver and spleen). **So, hemosiderin** is prominent in phagocytic cells (macrophages) of the liver and spleen, due to phagocytosis of red blood cells.

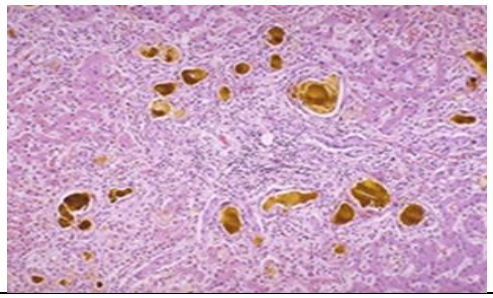
2- **Haemochromatosis**; iron absorption mechanism impaired in small intestine and **hemosiderins** deposites in many tissues.

b- Bile pigments: Yellow to brown pigment result from;

1. RBCs breakdown which give Biliverdin, conjugated and unconjugated bilirubin

2. Excess bile production

Bile accumlated in liver HX&E



2- Non haematogenous endogenous pigmens:

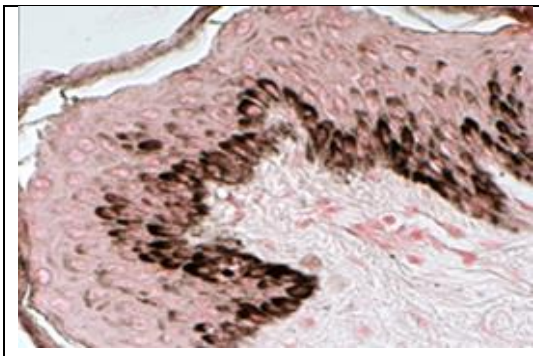
a- Melanin pigments **b- lipofuscin pigments**

a. Melanin pigments: dark brown granules normally produced in melanocytes that found in, skin, hair , and eye giving them their pigmentation. Melanin is a complex polymer that synthesized from the amino acid tyrosine and stored in melanosomes (cytoplasmic organgelles of melanocytes). In skin, melanin pigments absorbs harmful UV rays and protects the DNA from sun damage.

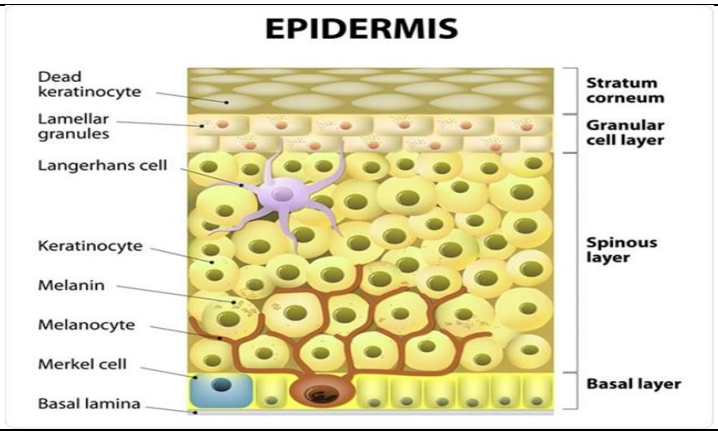
In addition, melanin is located in different areas of human body including;

- The substantia nigra (brain).
- Stria vascularis of the cochlea (part of inner ear).

Melanin pigments are detected by Masson Fontana stain reaction.



Skin section; Masson Fontana especial stain reaction of melanin



❖ **Melanin pigments of the eye (ocular melanin):** In the eye melanin presents in the

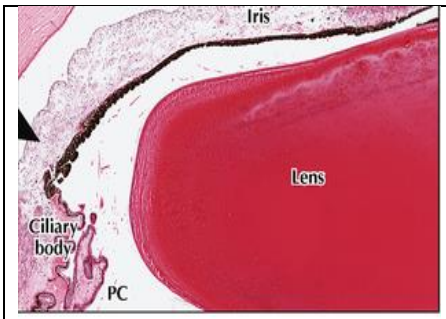
a- Uveal tract (iris, ciliary body and choroid)

The iris is responsible for the coloration of the eye which ranges from blue to dark brown.

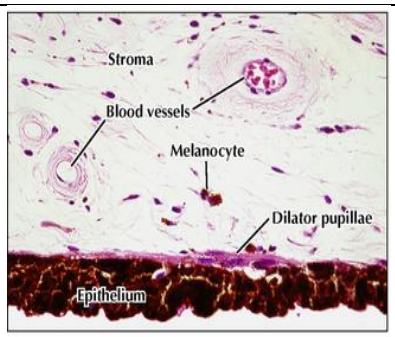
b- Retina

❖ Retinal Pigment epithelium; contain **melanin** that absorbs incident light that enters through the retina and prevents over stimulating the rods and cones.

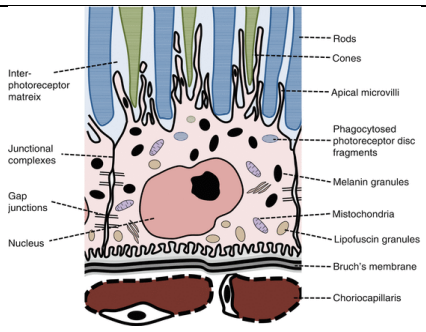
❖ **The rhodopsin & photodopsin are photosensitive/ visual pigments** produced by (Rods & Cons) the photoreceptor cells of the retinae. They have an impotant role in vision process.



▲ **LM of the anterior part of the eye.** The iris is between the anterior (**AC**) and posterior (**PC**) chambers, and thus between the cornea and lens. Its root is continuous with the ciliary body. 20×. *H&E.*



▲ **LM of the core of the iris.** The dilator pupillae muscle forms the inner layer of the heavily pigmented epithelium that covers the posterior surface. The stroma—loose connective tissue—contains many blood



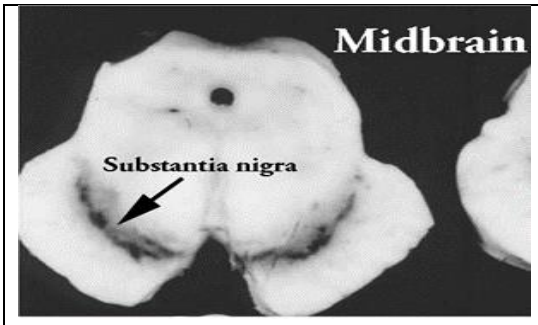
Retinal pigment epithelial cell

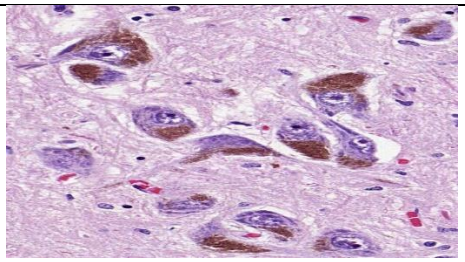
❖ **Melanin pigments in the ear:**

Melanin granules are synthesized by (Otic melanocytes) that found in the stria vascularis of inner ear cochlea . Melanin granules acts as a free radical scavenger, has the ability to protect the cochlea from ototoxic drugs, and in maintaining the body balance.

❖ **Melanin pigments in the brain: (Neuromelanin)**

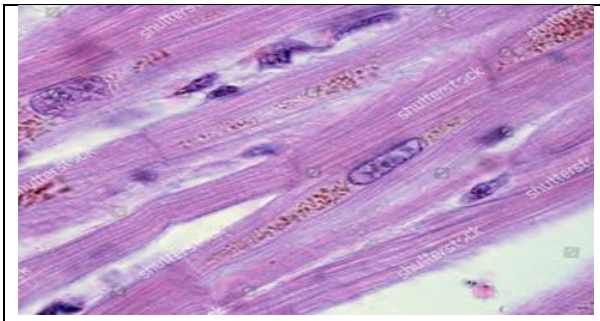
In the brain, dopamine neurons of substantia nigra of mid-brain, produce neuromelanin.



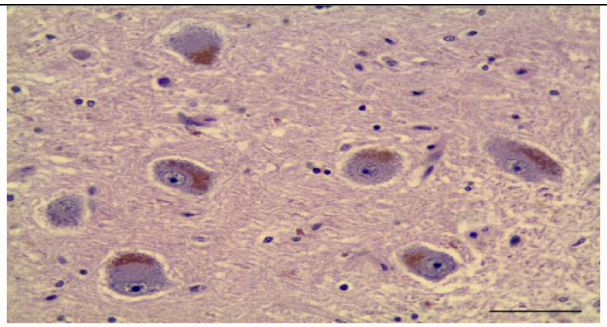


Neuromelanin (the brown patches) in dopamine neurons.

b- lipofuscin pigments: Pale brown granules found in most cells but, especially, in non-dividing cells (eg, neurons and cardiac muscle). **They derived from residual bodies after lysosomal digestion. It increase with aging. It is also kown as wear-and tear or aging pigment**



Cardiac muscles with lipofuscin granules HX&E



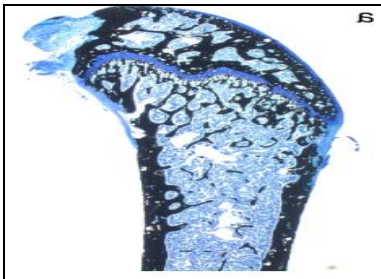
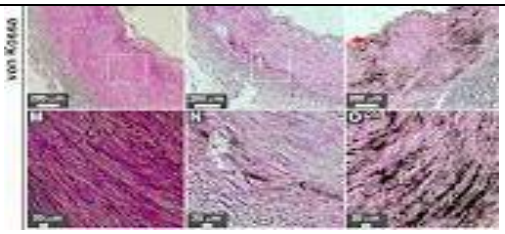
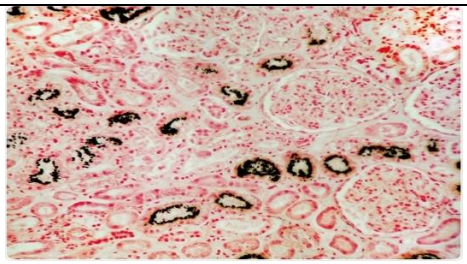
Lipofuscin accumulation in neurons HX&E

C- Endogenous minerals

Minerals are metal or non-metal ions needed for cell growth and other biological functions. Example; calcium, iron, copper, lead, phosphates and silica.

Calcium is one of the body's electrolytes, which are minerals. About 98% of the body's calcium is stored in the skeleton and teeth, but cells (particularly muscle cells) and blood also contain calcium. Calcium is essential for the; formation of bone and teeth, muscle contraction, nerve impluse, normal functioning of many enzyme, Blood clotting and normal heart rhythm.

Von Kossa stain is used to detect the **presence of calcium deposits in the body**.

 Normal calcium in bone	 Ca^2 deposition in arteries stains with Van Kossa	 Ca^2 deposition in kidney stains with Van Kossa

Note; The joints, blood vessels, kidneys and skin are most often affected by abnormal deposition of calcium.

References:

- Elsevier's Integrated Histology 2007
- Lippincott Illustrated Reviews: Integrated Systems 24th ed. 2015
- Junqueira's Basic Histology Text & Atlas 13th ed. 2013

Self- Assessment

1- …….. is a non haematogenous pigment

2- …….. have large amount of glycogen

3- Haemosiderins are ……..

4- Carbon is an ……. Pigment

5- …….. is a special stain of lipid