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Lecture title: Metabolic overload

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Summary:

I- Protein disorders:

1- Hyaline degeneration or hyalinosis

Def.: Hyaline used to describe proteinaceous substance with glossy, solid, dense, and smooth homogenous structureless translucent smooth eosinophilic material microscopically stains pink with eosin. So, hyaline degeneration is reversible change. It may be deposit intracellular or extracellular. The hyaline is seen physiologically in the superficial layer of the skin, cornea of the eye and in ovulation scars of the ovary.

The types of hyaline degeneration are:

1. Connective tissue hyaline It occurs in old scars, mesodermal tumors, in the walls of diseased blood vessels as in atherosclerosis, afferent arterioles of kidneys as a result of hypertension, glomeruli in diffuse glomerulonephritis. In muscle **Zenker's degeneration** or hyaline degeneration of the skeletal muscles, which occurs in case of vitamin E deficiency and bacterial toxins

Macroscopic picture the hyaline material may be too small to be seen. Hyaline degeneration is observed in case of large area affected. The affected tissue is translucent, firm, glassy, shiny and inelastic. In muscle, the affected muscle appear grayish-white resemble fish-flesh, friable and flabby.

Microscopic appearance the collagen fiber fuses together, become thick loses their striation and converted into a homogenous translucent structureless eosinophilic material. The nucleus not affected. In muscle, the muscle fibers are swollen, more eosinophilic and lose the cross striation.

Causes The main cause is a lack of nutrients. Moreover, it occurs in old age and in injured tissues besides toxic substances carried through circulation.

2. Epithelial or cellular hyaline It observed in corpora amylecea which seen in acini of the mammary gland, lung alveoli and the acini of the prostate gland (in senile). It appears as round, homogenous, or concentrically laminated pink bodies tinged zonally with blue. Moreover, it observed in old thrombi, islets of Langerhan's in diabetes mellitus, hyaline and cellular casts inside renal tubules, hyaline globule in the degenerated hepatocytes in heavy alcohol drinker, which called Mallory's bodies. Russell's bodies are seen in plasma cell in old chronic inflammation undergoes hyalinosis and changed to red oval a nuclear body.

Hyaline droplet degeneration: It seen in animals suffered from chronic nephritis. Microscopically, Large hyaline droplet appear in the proximal convoluted tubules resulted from excessive protein filtration from the diseased glomeruli and the tubular reabsorption is overloaded.

2- Amyloidosis or amyloid infiltration

Amyloid infiltration is one of the serious condition results from extracellular deposition of a homogenous translucent eosinophilic proteinaceous substance (amyloid) that resemble starch in its chemical reaction. Formerly, the amyloid was 6 thought to be starch like, so it called amyloid; however, it is now known to be composed of protein. Once amyloidosis begins, it really cannot be stopped.

Causes: The mechanism responsible for formation of amyloid is not known but some evidence seems to indicated that it is precipitate result from antigen-antibody reaction.

Types of amyloidosis

1. Primary amyloidosis is not really primary but is secondary to plasma cell dysplasia. The primary amyloidosis is rare and usually of unknown causes. It has two types. The first one is systemic or generalized, which has seen in heart, tongue, intestine, skin and skeletal muscles. The second is localized type and is seen in larynx, urinary bladder and the heart.

2. Secondary amyloidosis or reactive systemic amyloidosis. It is secondary to certain chronic destructive diseases as tuberculosis, chronic bronchopneumonia, chronic suppurative arthritis, chronic suppurative oesteomyelitis, lung abscess, chronic pyelonephritis, and chronic empyema. Moreover it is seen with malignant tumors as multiple myeloma and renal carcinoma.

Staining of amyloid material Amyloid was detected by adding aqueous iodine solution to the surface of affected organ, which stain brown. Moreover, the **Congo red** is used for the detection of amyloidosis clinically. In paraffin sections, the amyloid stain pink by H & E, rose red by methyl violet, gentian violet and crystal violet stains and orange red by Congo red.

Macroscopic appearance The affected organ is increased in size and weight beside sharp border. The color is pale and firm in consistency. Cut section shows flat waxy translucent surface. The kidney may be appear unchanged, or pale, firm and enlarged or atrophied in late stage. Two types of amyloidosis are present in spleen. The spleen is moderately enlarged rubbery and firm. In cut surface of focal type, It shows waxy light brown bodies against red background (sago grain). The diffuse type shows diffuse amyloid deposit in the form of waxy translucent streaks. The amyloidosis in liver represented by waxy light brown streaks (amyloid) deposit among yellowish brown hepatic tissue.

Microscopic appearance Amyloid is most prominent in spleen, liver and kidneys and deposited mainly in the loose connective tissue between the endothelial lining and the adjacent cells of capillaries and around the sinusoids leading to narrowing in of the capillaries, 7 sinusoids or arterioles or venules. The narrowing leading to ischemia of the affected organ and the cells suffer from pressure atrophy and necrosis. The amyloid appear as pale eosinophilic homogenous translucent in section stain by H and E. In liver the amyloid is deposit in tunica media of the arterioles and venules, between the sinusoids and the hepatic cells. The liver cells degenerate from anoxia and show pressure atrophy and necrosis. In the kidneys, the amyloid is deposit in the tunica media of the arteriole and venules. basement membrane of glomerular capillaries and basement membrane of the collecting tubules. Moreover, the renal epithelium shows fatty changes. In focal amyloidosis in spleen, The amyloid is deposit in the walls of the central arterioles of the lymph follicles and in the stroma of the lymph follicles causing narrowing of the arterioles and replacement of the follicles by eosinophilic homogenous translucent material. In diffuse type (bacon spleen) the amyloid is deposited in the sinusoids of red pulp.

Significance Amyloidosis is producing its serious effects through destruction of the parenchymal cells and overloading of reticuloendothelial system by amyloid precursors. Although, the amyloid deposit interfere with normal function of any organs, the fatal effects occurs in kidneys and animal usually die from uremia. Amyloidosis may be reversible in the liver and not in the kidneys.

3- Fibrinoid change or degeneration:

Is a term used to lesions occurring in **wall of blood vessels**. Sometimes called fibrinoid degeneration or necrosis but it is inappropriate due to the changes occur outside the cell. Fibrinoid is amorphous, bright, esinophilic protein material Fibrin (plasma protein) is a major component along with serum proteins particularly immunoglobulin.

Causes:

1- Direct injury resulting from viruses and toxins to the endothelium and muscular layer (intema and media layer) of vessel.

2- Indirect injury like in the activation of complement lead to acute inflammation lead to deposition of plasma proteins

Microscopic appearance:

The depositions of plasma proteins specially fibrin in the blood vessel stain with red (eosin) by H&E depending on its deposition in the intema or media.