Quadrant II- Transcript and Related Material

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Paper Title **: Diversity of Non chordates and Cell Biology**

Unit Number **:** Cell organelles

Module Name **: Structure of Lysosomes**

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NOTES

Lysosomes (Gk. lysis- digestive, soma- body) small vesicles enclosed in a single membrane containing acid hydrolases in the form of minute crystalline or semi crystalline granules. There are about 40-50 different enzymes in different types of lysosomes. Christian de Duve (1963) discovered (Perinuclear dense granules) and shared Nobel Prize with Palade and Claude in 1974. Novikoff (1964) observed them under electron microscope and coined the term lysosomes.

Lysosomes - present in all eukaryotic cells (except mature RBC) and absent in Prokaryotic cells .They are very few in muscle cells, and abundant in absorptive (intestine), secretory (liver) excretory (kidney) organs and cells with phagocytic activity like acinar cells, leucocytes, lungs and uterus.

Lysosomes are round / irregular of 0.2-0.8 µm - diameter. (up to 5 µm. in leucocytes, kidney cells). The interior is solid or differentiated into outer denser region and a central less dense mass with granular content. The covering membrane separates hydrolytic enzymes & cellular contents. Lysosomal membrane is protected itself by high

glycosylation of its proteins and high lipid concentration helps in fusing with other membranes

Lysosomes are known as suicidal bags because of its digestive (destructive) enzymes or acid hydrolases. Once membrane rupture, it results in the lysis of all the contents come in contact with the enzymes. .

Lysosomal membrane stability depends on the concentration of stabilizers and labilizers. Important stabilizers are Cholesterol, Corticosteroids,(Cortisone, Cortisol) Chloroquine and Labilizers are the absence of the oxygen, or the presence of excess of vitamins A and E, androgens, estrogens, bile salts, carcinogens, silica, asbestos particles, heat, many drugs, X-rays and ultra-violet rays.

Formation of Lysosomes (GERL system) Endoplasmic reticulum and associated ribosome synthesize precursors of hydrolytic enzymes and pinched off as vesicles In Golgi complex .These precursors are changed to enzymes and vesicles pinched off from the maturing face. Golgian vesicles are joined by endosomes to form Lysosomes.

Polymorphism is existence of more than one morphological form Lysosomes pass through various stages in the same cell. There are four important types of lysosomes based on morphology and function.

1. Primary/ Protolysosomes / Storage granules. hydrolytic enzymes from ribosomes, accumulated in the ER and processed in the Golgi complex and are released as secretary vesicles - Primary lysosomes.

2. Secondary / phagolysosomes / Heterophagosomes or digestive vacuoles. Phagosome fuse with lysosome to form Secondary/Phagolysosomes, It helps in digestion. Digested food is absorbed into the cytoplasm and secondary lysosome is left with undigested food.

3. Residual Bodies (Tertiary / Telolysosomes) with indigestible food and are expelled by exocytosis or ephagy. Failure to remove residual bodies results in storage diseases like

Hepatitis – liver inflammation as it helps in survival of hepatitis virus,

Pompe's disease – due to accumulation of glycogen, results in defective musclular function

Hurler's disease – symptoms include cartilage and bone abnormalities - limb deformities, heart diseases

Polynephritis - symptoms include cloudy, dark, bloody, or foul-smelling urine with frequent and painful urination.

Ageing - is also due to accumulation of residual bodies.

4. Autophagic Vacuoles (Autophagosomes, Auto/ Cytolysosomes) degenerated or injured intracellular organelles wrapped over by membranes recognized by the Primary lysosomes and its fusion results in Autophagy or Auto digestion, hence referred as **Cell scavengers**.

The worn out or aged cells disposed off by the process called Apoptosis, hence referred as **disposal bags**.

The digested products are used for new synthesis hence referred as **recycling centers.**

Autophagic vacuoles provide nourishment during starvation (Primary Lysosome + Mitochondria)

Important enzymes of the lysosomes are Proteases which include cathepsin act on Proteins, mainly execute autophagy, Collagenases act on collagens and peptidases act on peptides. Nucleases act on Nuceic acids Ribonucleases acting on RNA and Deoxyribonucleases act on DNA. Phosphatases act on Phosphate monoesters.and phosphodiesterases act on Phosphodiesters,Galactosidases act on Galactosides ,Glucosidases act on Glycogen, mannosidases act on Mannoses and Glycoproteins.Sialidases act on Sialic acid derivatives. Lysozymes act on mucopolysaccharides, Hyaluronidases act on Hyaluronic acid and Chondroitin sulphate, Phospholipases act on Lecithin and Phosphotidyl ethanalamine and Esterases act on fatty acids and break them into simpler forms.