ENDOPLASMIC RETICULUM

Dr. M. Roy

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Unit-I

Introduction:

Endoplasmic Reticulum(ER) is an extensive network of interconnected, membrane-bound tubules and vesicles extended through the cytoplasm. It is continuous with the nuclear envelope but not with the plasma membrane. Endoplasmic reticulum of adjacent cells is connected through the plasmodesmata. ER subdivides the cytoplasm into two main compartments — one enclosed within the membranes, and the other situated outside which constitutes the cytoplasmic matrix or cytosol. This membrane-bound compartmentalization facilitates vital cellular functions by separation and association of enzyme systems, creation of diffusion barriers, regulation of membrane potentials, ionic gradients, different intracellular pH values and other manifestations of cellular heterogeneity.

General Morphology & Structural Attributes:

(i) Size of ER varies considerably in different cell types and is related to their functions.

(ii) Some parts of the ER have ribosomes adhering to their cytoplasmic surfaces while other parts do not. The former are called rough ER(RER) while the latter smooth ER(SER).

(iii) A simple SER is found in cells engaged in lipid metabolism (e.g., Adipose cells, Adrenocortical cells).

(iv) In reticulocytes, which produce only proteins to be retained in the cytosol, ER is

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poorly developed or non-existent; although ribosomes are present.

(iv) Ribosomes of the rough ER are in the process of translating mRNA into a protein which, when complete, remains in the lumen of the ER.

– Protein, during the period of its synthesis, serves to anchor the ribosome forming it to the ER membrane.

(v) ER is a dynamic structure which exhibits both growth and turnover.

– At cell division stage it undergoes partial fragmentation.

– It has a close relationship with Golgi apparatus.

(vi) RER is well developed in cells actively engaged in protein syntheses.

(vii) In rapidly dividing cells (e.g., embryonic cells, cancer cells etc.) ER is poorly developed.

(viii) Ribophorins (= glycoproteins) are involved in mediating the attachment of ribosomes to the ER membrane.

(ix) Smooth ER forms a continuous system with the rough ER.

(x) During cell disruption, the cisternae of ER break but immediately reseal, thereby maintaining intact the topological relationships between the membranes, the lumen, and the ribosomes.

– Membranes may be stripped of the ribosomes by high salts and treatment with puromycin which stops the

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growth of polypeptide chain.

(xi) A broad spectrum of enzyme systems is built into the ER membrane which consequently plays an important part in the metabolism of the cell.

(xii) Since the endoplasmic reticulum membrane has a much greater area than that of the plasma membrane and tonoplast, the majority of membranous sacs constituting the microsomal fraction are derived from it.

Biogenesis & Functions of ER:

(i) A large portion of ER is associated with ribosomes, and thus it plays a fundamental role in the storage and processing of proteins that are destined for export from the cell.
- An elaborate series of steps leading to cell secretion.

(ii) ER represents a fundamental component of membrane system which divides the cytoplasm into two definite compartments.

(iii) ER membranes contain many enzyme systems which are able to carry out various functions, including the biogenesis of some membrane components.

(iv) Origin of ER membrane is not definitely known.
- It may develop by evagination from the nuclear envelope.
- Cytochemical studies have shown close relationship between the nuclear envelope and the ER.

(v) A multistep mechanism is supposed to be involved in the biogenesis of ER membrane lipids are inserted independently into the ER membrane, lipid biosynthesis and detoxification, special functions are of exportable proteins and glycogenolysis. Synthesis of smooth ER.

(vi) ER also occurs with the mediation of ER.