

Distribution, Shape, Size and Relative Position in the Cell.

The ER is found in all the eukaryotic cells, except some physiologically specialized cells such as mature RBCs of vertebrates, Sieve Element cells in plant phloem. Some cells in the early embryonic stages also lack the ER system.

The shape of the ER becomes apparent only in electron micrographs. Its appearance is like a series of interconnected flattened vesicles (cisternae) originating from the nuclear envelope. The margins are tubular and the overall structure is surrounded by some large uncoated vesicles.

The ER is usually the largest organelle of most animal cells. Its membrane may account for about half of all cell membranes, and the space enclosed by the ER (the lumen, or cisternal space) may represent about 10% of the total cell volume.

Within a cell, the ER is largely found around the nucleus. This is due to continuity between the ER and the nuclear envelope.

Relation with Other Cell Organelles

As shown in Figure 1, the ER remains in physical continuity with the nuclear envelope. For this reason, the nuclear envelope is also called the Perinuclear Cisterna.

In the process of protein targeting through the secretory pathway, the ER processes the nascent proteins in the initial stages, but only to some extent. The semi-processed protein then moves to the Golgi Apparatus (GA) for further processing and sorting. Thus, the ER and GA remain in biochemical and functional continuity. The semiprocessed proteins move from the ER to the GA through the Transition Vesicles.

All the cellular components which receive their proteins by the secretory pathway (namely the Plasma Membrane, Lysosomes, Secretory Vesicles and Endosomes) are functionally related to the ER in the sense that all their proteins have been primarily processed by the ER.

To highlight the relation of the ER with other cell organelles, the following three major concepts have been put forward.

1. The GERL Concept, given by Alexei Novikoff in late 1950s, in which he suggested that cellular secretion occurs by a process that involves Golgi Apparatus (G), Endoplasmic Reticulum (ER) and Lysosomes (L).
2. The Secretory Pathway, given by Palade in 1960s, after carrying out the Pulse-chase experiments on the actively secreting pancreatic Acinar cells. He noticed that all the secretory proteins follow a common route to export, i.e. Translation by ER attached Ribosomes → RER lumen → TVs → cisGA → transGA → Discharge Vesicles → Cell Exterior. Later researches established that the same route is also taken by the proteins which are to be targeted to the PM, Lysosomes, and members of the Endomembrane system. This common pathway is called the secretory pathway.
3. Endomembrane Concept is mainly a structural concept given by D. James Morre and Mollenhauer in 1974. The Endomembrane System consists of the endoplasmic reticulum, the nuclear envelope, and the Golgi apparatus. The system consists of internal compartments in the cell which synthesize macromolecules and receive macromolecules from the outside environment.

Morphology

The ER in most of the cells appears as an anastomosing network of sacs (cisternae), tubules and vesicles enclosed by a continuous membrane which extends from the nuclear envelope (NE) throughout the cytoplasm. However, in certain cells the morphology of the ER can be different. The examples are as follows.

In striated muscle the ER is specially adapted to surround the myofibrils, forming triads with invaginations of the plasma membrane called T-tubules. This structure is called the sarcoplasmic reticulum.

In plants, Plasmodesmata are microscopic channels of protoplasm facilitating transport and communication between two adjacent cells. In the core of the plasmodesmata, there are *desmotubules*. The desmotubule is connected directly to the ER of each of the adjacent cells forming a channel between the ER of neighboring cells known as the dynamic endomembrane continuum.

In the fungi, belonging to Basidiomycota, the ER forms a special structure called *parenthosome*, around the dolipore septum that incompletely separates two adjacent cells.