GOLGI COPLEX- STRUCTURE AND FUNCTIONS

Golgi apparatus is a complex network of smooth membrane enclosed organelle which helps in collection, packaging, distribution and secretion of biomolecules.

Location:

The Golgi apparatus occurs in all eukaryotic cells except male gametes of bryophytes and pteridophytes, mature sieve tubes, some fungal cells, and mature sperms and RBCs of animals. It is also absent in prokaryotic cells.

Distribution:

In most animal cells Golgi apparatus is single and localized near nucleus and often close to the centrosome. But in most invertebrate cells, it is diffused in form of two or more interconnected units. However in most plant cells, liver and nerve cells of vertebrate the Golgi apparatus consists of many independent units called dictyosomes or Golgi bodies or Golgi stacks. Their number is highly variable – from one in simple alga like Micromonas to 25000 in rhizoidal cell of aquatic alga chara. A liver cell may have up to 50 dictyosomes. The Golgi apparatus constitutes about 2 % of total cell volume.

Structure

Golgi apparatuses extremely dynamic and pleomorphic structure because of its variable shape and form in different cell types. The Golgi apparatus of plant cells consists of about 10-20 individual subunits that found scattered throughout the cytoplasm. Each individual subunit is called a dictyosome or Golgi body or Golgi stack. The zone of clear cytoplasm surrounding a Golgi body is called zone of exclusion.

Each dictyosome is about 1 -5 µ m in diameter. Under EM a Golgi body seen to consist of a stack of 3-10 flatted sacs or cisternae with a complex irregular network of tubules vesicles and vacuoles on the outer edges. The adjacent cisternae are separated by an intercisternal space of 10-30 nm. The intercisternal space contains protein cross-links that hold the cisternae together. The cisternae maybe flat, but often curved to give a definite polarity to the Golgi body.

Thus, a Golgi body has 2 distinct faces: a convex forming or cis face and a concave maturing or transface. So a cis face always facing toward nucleus while the trans face facing towards plasma membrane contains a tubular reticulum called trans Golgi network (TGN). The membranes of the maturing face are thicker (7-8µm) while those of forming face are thinner (about 4 µm).

Many small Golgi vesicles (20-80 µn in diameter) are found associated with the Golgi body. These vesicles are thought to transport proteins and lipids between the cisternae and tubules. Golgi. The transitional vesicles pinched off from the rough ER and fuse with the cis face of the Golgi.

The transport or shuttle vesicles that keep budding off from the cisternal edges tubules transport materials between the cisternae in cis – to – tran's direction. The secretary vesicles that derive from TGN carry glycoproteins, glycolipids and polysaccharides to different destinations in the cell or outside the cell. The secretary vesicles are of 2 types: smooth secretary vesicles and coated vesicles. The coated vesicles are covered by a basketlike network of protein complex consists of clathrin triskelions. The larger secretary vesicles are called Golgian vacuoles. Some of them function as lysosomes.

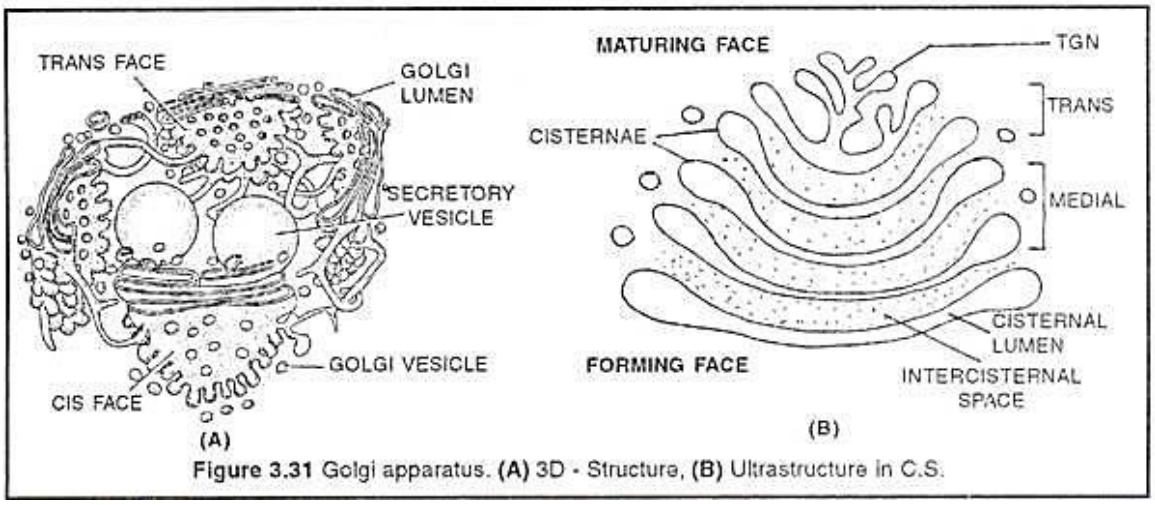

Figure 3.31 Golgi apparatus. (A) 3D - Structure, (B) Ultrastructure in C.S.

Functions of the Golgi

(i) Secretion is the major function of Golgi apparatus, which help in collection, storage condensation, modification and packaging of various materials into secretary vesicles. These release the contents to the exterior through exocytosis, e.g., secretion of mucilage by root cap cells, secretion of hormones, gum, wax, cell wall material, ground matrix of connective tissue etc.

Secretory proteins are seen emerging from the maturing face contained in a membranous dilation termed a prosecretory granule. The prosecretory granule buds off to become a condensing vacuole, which, after the removal of fluid, is termed a secretory granule or secretory vesicle. Secretory granules containing digestive enzymes are specifically referred to as zymogen granules. Under the appropriate conditions, the secretory granule moves to the cell surface and fuses with the membrane, thereby releasing its contents to the outside. This Ca++- dependent process is called exocytosis or secretion. There are two kinds of secretion:

Constitutive secretion: Secretory products are produced and released continuously.
Regulated secretion: Secretory products are released in response to specific stimuli.

(ii) It helps in formation of cell plate, cell wall and new plasma lemma during cell division.
(iii) It also helps in the formation of primary lysosomes, sperm acrosome, nematocysts in coelenterates and root hairs.
(iv) In oocytes of animals, yolk is deposited around Golgi apparatus by the process called vitellogenesis.
(v) Golgi apparatus brings about transformation of membrane (e.g. ER) into another such as plasma membrane and lysosomal membrane. It also participate in recycling of membranes.
(vi) It facilitates glycosylation (addition of carbohydrates to proteins), liposylation (formation of lipoprotein) sulphation (addition of sulphates) and phosphorylation (addition of phosphates).

Proteolysis: Cleavage of some precursor proteins, e.g., prohormones
Sorting and packaging of modified proteins: Most proteins processed by the Golgi are either secretory proteins for export or hydrolytic enzymes for cell use. These two kinds of proteins are segregated and packaged separately by the Golgi.