GOLGI COMPLEX (= GOLGI APPARATUS)

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Introduction:

Golgi Complex or Golgi Apparatus is a differentiated part of the endomembrane system found in both plant and animal cells. This is spatially and temporally related to the ER on one side and by way of secretory vesicles, may fuse with specific portions of the plasma membrane. These structures were first discovered by Camillo Golgi (1898) in the nerve cells by means of a silver staining method.

Golgi complex can be considered as a sorting centre which discriminates between the proteins that are to be secreted and those that are to be delivered to the lysosomes.

Morphological Features:

(i) Golgi apparatus of the cell consists of a number of distinct units called Golgi bodies or dictyosomes.

- Dictyosome units are formed by stacks of flattened disc-shaped cisternae (1-2 μm in diameter) and associated secretory vesicles.

- In some cells there is only one dictyosome which constitutes the whole Golgi apparatus.

(ii) It is morphologically similar in plant and animal cells.

(iii) In cells with a polarised structure, Golgi Complex occupies a definite position between the nucleus and the pole of the cell.

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- In most plant cells there are many dictyosomes that do not show a special polarity.

(iv) Localization, size and development of these organelles vary from cell to cell and also with the physiological state of the cell.

(v) Number of cisternae in a dictyosome varies between 4-8.

(vi) Cisternae may have a simple disc-like shape with a smooth dilated perimeter or may have a more complex structure in which the peripheral region of the disc is extensively perforated to form a network of branched tubules, whose ends are frequently dilated

(vii) Cisternae are surrounded by a variable number of small vesicles which appear to have been nipped off the dilated peripheral region.

- Thus the three components of the Golgi complex are (a) Cisternae/flattened sacs (b) Cluster of tubules and vesicles (c) Larger vacuoles filled with an amorphous or granular content

(viii) Most of the Golgi complex appears to be surrounded by a zone from which most ribosomes, glycogen and mitochondria are absent. This is the so-called <u>zone of exclusion.</u>

- Some free polysomes have been observed at the periphery of the Golgi complex.

(ix) Each stack of cisternae forming a dictyosome is a polarized structure having a <u>proximal</u> or <u>forming face</u> (Convex)

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closer to the nuclear envelope or ER and a distal or maturing face (concave) that encloses a region containing large secretory vesicles.

This polarization is often referred to as the cis-trans axis of the Golgi complex.

Small transition vesicles or tubules converging upon the cisternae are at the cis/forming face while a saccular structure rich in acid phosphatase is associated with the trans/maturing face.

(x) Transition vesicles are derived from the adjacent ER membrane which ultimately coalesce to form a Golgi cisternal.

Topmost cisternae gradually break up into small vesicles which move through the cytoplasm to fuse with the plasma membrane.

(xi) Dictyosome is thus a dynamic structure; new cisternae are continually produced at the forming face while the oldest cisternae are gradually lost at the maturing face.

Cytochemistry of the Golgi Complex:

(i) Golgi Complex consists of about 60% proteins and 40% lipids.

(ii) Golgi complex and ER have some proteins in common.

(iii) Golgi complex isolated from plant and animal cells show marked differences in their protein and enzyme content.

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(iv) Golgi complex has a phospholipid composition intermediate between those of ER and plasma membrane.

(v) Plants have larger amounts of phosphatidic acid (30-40%) and phosphatidylglycerol.

(vi) The enzymes thiamine pyrophosphatase and several glycosyl transferases are concentrated in the Golgi apparatus.

Functions of the Golgi Complex:

(i) Major functions of Golgi complex are related to the fact that it represents a special membranous compartment interpolated between the ER and the extracellular space.

(ii) Through this compartment, there is a continuous traffic of substances, which may have been synthesized elsewhere, but which are modified and transformed while transported.

- This process also involves the flow and differentiation of membranes.

(iii) Most cytoplasmic membranes of the eukaryotic cell arise from the RER.

- This mechanism involves loss of attached ribosomes to generate SER, pinching off of vesicles which fuse with the cis face of the Golgi complex, modification of proteins within the Golgi, and production of secretory vesicles from the trans face.

- After this process of membrane flow and differentiation, vesicles can finally fuse with the plasma membrane.

(iv) Within the walls of the Golgi complex

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a vast diversity of materials may be found.

– Virtually every major class of macromolecule is transported through the Golgi and secreted, and this implies a continuous and fast turnover of the Golgi membranes.

(v) Synthesis of glycosphingolipids and glycoproteins is a major role of the Golgi complex.

(vi) Golgi complex plays a central role in the biosynthesis of gangliocides and other glycosphingolipids.

(vii) Golgi complex is involved in the synthesis, transport and release of macromolecules from the cell.

– Secretion of polysaccharides and proteins to make the cell walls is also brought about by the Golgi complex in plant cells.

(viii) Various polypeptide hormones initially produced as prohormones are activated intracellularly by the converting enzymes (proteolytic) presumably present in the Golgi apparatus.

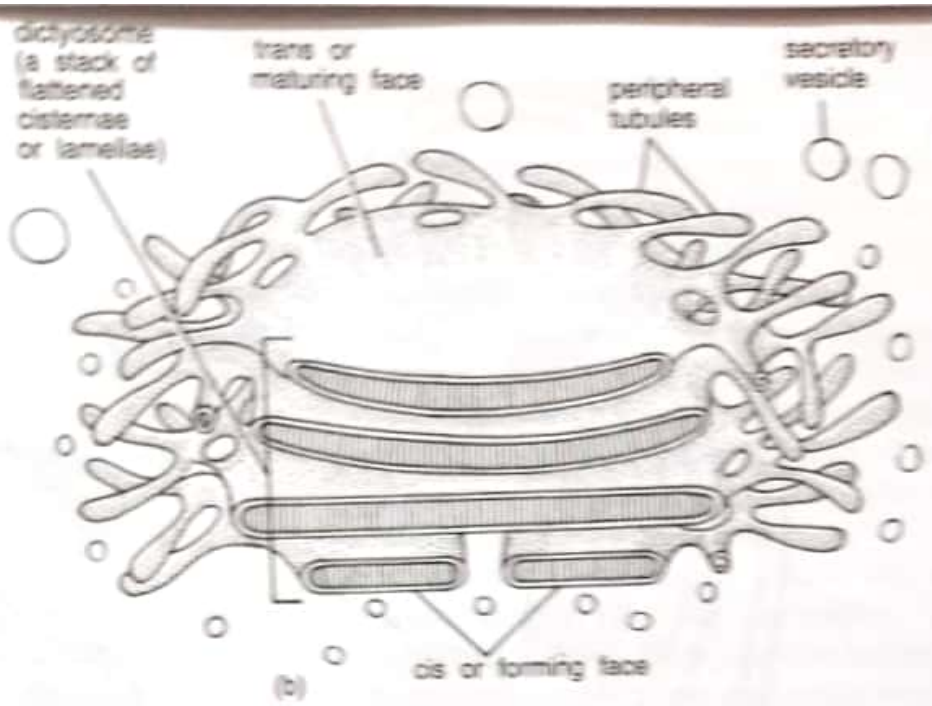
(ix) Glycosidation of lipids and proteins to produce glycolipids and glycoproteins is one of the major functions of the Golgi complex.

(x) Compartments of the Golgi apparatus have been shown to be related to its functional heterogeneity.

(Fig. below)

—X—

(a)



(b)

Fig. 3.24. Golgi apparatus structure. Cisternal stacks are shown in (a), and detailed structure shown in (b).