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Golgi Apparatus

(= Golgi complex, Golgi body)

In 1898, Camillo Golgi, an Italian cytologist, discovered in the cytoplasm of nerve cells, a previously unknown reticular structure after using a silver stain and termed it as Internal reticular structure. Later this structure came to be known as Golgi apparatus.

Nomenclature : With various methods of fixation and study by various investigators, Golgi apparatus has been given different names, viz.
canalicular system or trophospongium
dictyosome, Golgisome, lipochondria
Golgi bodies, Golgi substance, Golgi complex
But in 1975 De Robertis et al. recommended the use of the term Golgi substance or Golgi complex because of its staining properties.

Location

(1) Between nucleus and distal part in epithelial and secretory cells
(2) disposed in cytoplasm in liver cells
(3) as acrosome in sperm cells.
(4) Absent in RBC (mature) and poorly developed in striated muscle cells.

Number : Generally a single large structure, Paramoeba species has two large Golgi complexes while in the amoeba Stereomyxa there are many Golgi complexes.
Nerve cell, liver cell and most plant cells also have multiple Golgi complexes.

Structure under light microscope

Filamentous, plate like, vacuolar, vesicular, crescentic, cup-like or dome shaped

(2) Size, shape and development - vary from one cell another and also with the physiological state of the ce

Ultrastructure

Golgi complex is a differentiated portion of the cells membranous system, lacking ribosomes and therefore incapable of synthesising protein.
It consists of a pile or stack of 3-7 (10-20 in some algae) saccules of double membrane, giving a lamellate appearance.
The Golgi complex has a convex proximal or forming face close to nuclear envelope or to smooth endoplasmic reticulum, and a concave distal or maturing face, associated with formation of secretion vesicles.

Three types of membranous components are observed in the stack.
(1) Flattened sac or Cisternae
(2) Small tubules or vesicles
(3) Large vacuoles.

(1) Cisternae

(1) Form the central plate like part of Golgi complex
(2) Flat curved sacks stacked between forming and maturing face and separated by 200-300 A° wide spaces
(3) The membrane is 20-30 A° thick and is enclosed by unit membrane.
(4) These are arranged in parallel bundles one above the other and are very much similar to the agranular endoplasmic reticulum
(5) The number of cisternae varies from 3-12, (sps to sps)
(6) Intracellular spaces separated by 140-160 A° (14-1
(7)(8) Crescentic in appearance and are arranged concentrically with convex surfaces towards the nuclear envelop

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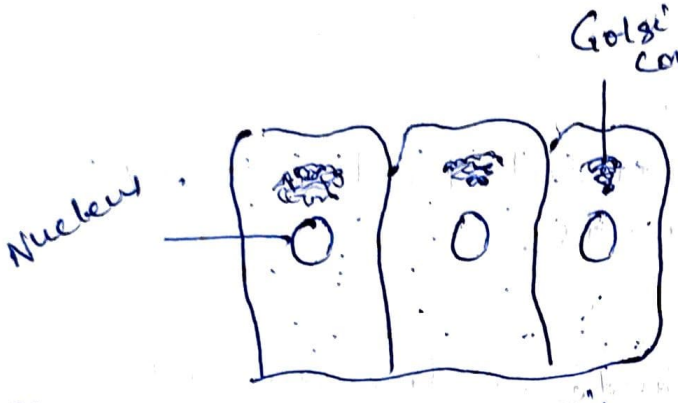
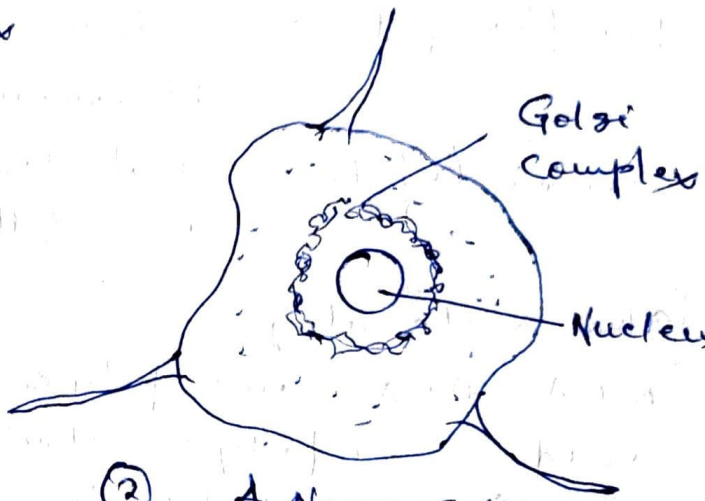
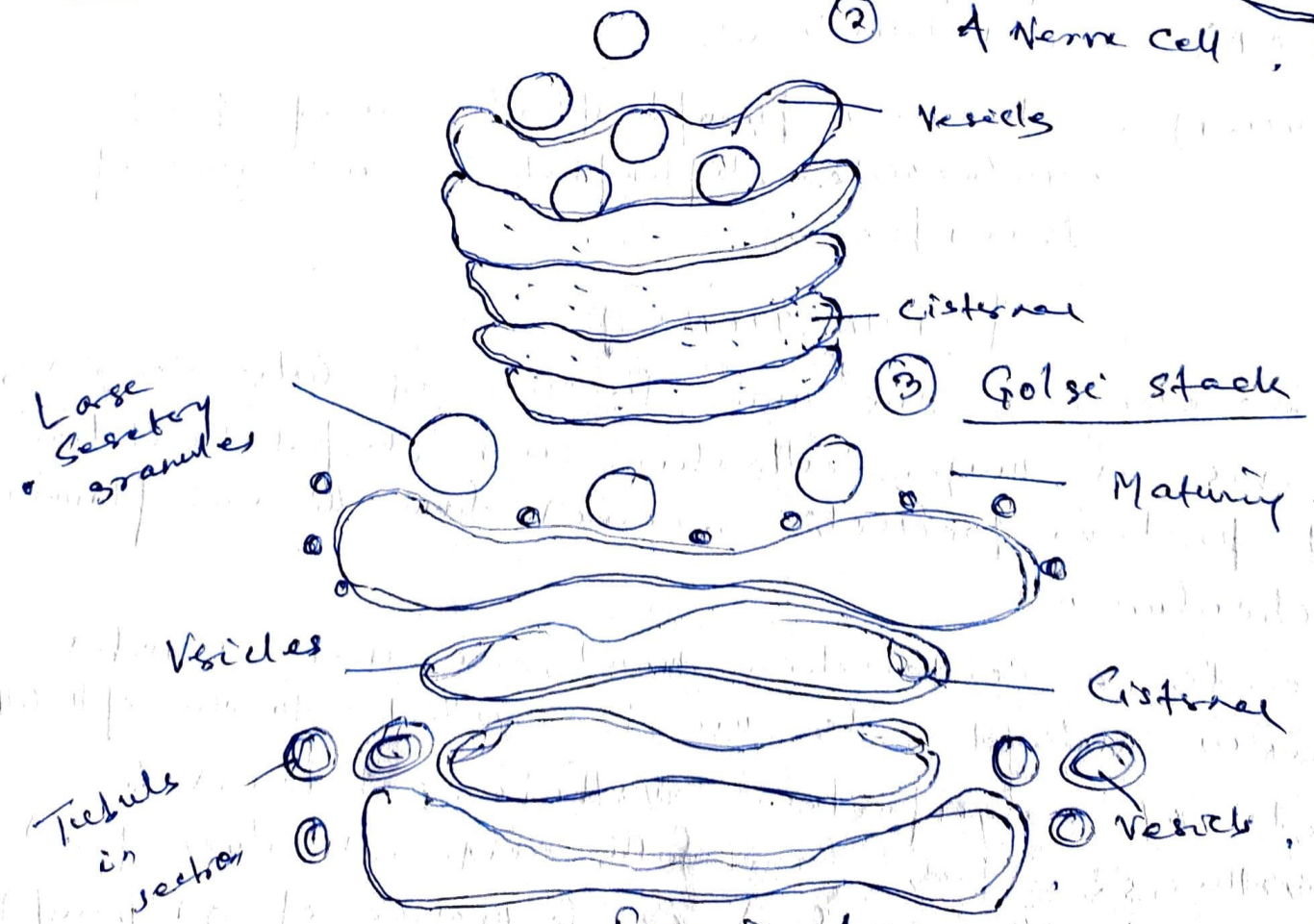
or Endoplasmic reticulum (small in size) = forming face.
The transitory vesicles and tubules that detach from E.R face to form a new cisternae.
The opposite concave face of cisternal stack represents the maturing face. (associated with secretory vesicles and vacuoles)



① Cells of intestinal epithelium



② A Nerve cell.



Ultra structure of Golgi complex

(2) Tubules - at the periphery of cisternae, appear as large vesicles in section.

(3) Vesicles - about 40 A° in diameter, occurs as free compounds or as differentiated at the edge of cisternae.

Tubular and Vesicular compounds are found at the 'forming face' while secretion vacuoles occurs at the maturing face.

Chemical Composition - essentially a phospholipoprotein (Protein 60%, lipids - 40%)

Phospholipids - include Lecithin, Cephalin and Sphingomyelin

Derived Lipids - cholesterol cholesterol esters, triglycerides and fatty acids.

Other materials

RNA, DNA, and polysaccharides in low amount- acid mucopolysaccharides, flavin adenine dinucleotide (FAD) and vitamin C.

Enzymes - thiamine pyrophosphatase acid, phosphatase - nucleoside diphosphatase and glycosyl transferase.

FUNCTIONS

(1) Secretion is the main function of Golgi Complex.

(2) serves as major collection and dispatch station of protein products received from the endoplasmic reticulum.

(3) provides a condensation membrane that absorbs various materials for use in synthetic function of the cell.

(4) Site of glycoprotein synthesis, believed to resynthesise fats from fatty acids and glycerol and appears to be involved in formation of and transport of lipoproteins.

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(5) It is likely that Golgi complex is supplier of the membrane to the cell.

(6) Site of pigment producing in mammalian tumors and cancer cells.

(7) Vitamin C is found associated with Golgi apparatus in fairly high concentration in differentiating embryonic cells.

(8) Involved in lipid transport and lysosome formation (Positive reaction to acid phosphate, a characteristic of lysosomes)

(9) has a distinct and proven role in formation of acrosome in developing mammalian spermatids

(10) The Pectin material of plant cells is synthesized by Golgi Complex

(11) The Golgi apparatus synthesizes some simple carbohydrates such as galactan, sialic acid, polysaccharides pectin from simple sugars.

(12) The production of hormones by endocrine glands is mediated through Golgi bodies.

(13) Concentrate the products of secretion that come from the endoplasmic reticulum in a dilute form.

(14) A homology has been suggested between contractile vacuole of protozoa and GC of animal cells. (It may have a role in expulsion of water from cells to medium)

The Golgi complex appears to be important only next to ribosomes. It is a chemical factory for many activities of the main agency for building a variety of large carbohydrates that serve many vital purposes.