GOLGI APPARATUS:

Golgi apparatus was first discovered by **Camillo Golgi**, an Italian neurologist 1898 who named it "**natural reticular apparatus**". Now it is clear that all except a few Eukaryotic cells (mammalian RBC). have Golgi apparatus with a common element of structure and function.

MORPHOLOGY

Shape- the shape of Golgi is quite variable in somatic cell types of animals, even in the same cell, there are variation with functional stages. In some cases, it occurs as **dense reticulum** of anastomosing **trabecula**e while in others as an irregular **fenestrated plaque** a ring hollow spheres united together. In nerve cells it occurs **as a reticular** of **wide meshes** around the nucleus.

Size- The size of Golgi is variable, **small in muscle cell** and **large in nerve and the gland cell**.

Numbers: The number of Golgi apparatus per cell is also **variable.** Some cells have recorded as having **a single** apparatus, other cells with dispersed Golgi may have **hundred.**

Position: The position of Golgi is relatively fixed for each cell type. In the cells which are ectodermal in origin, the Golgi is polarized from the time of embryonic stage between the nucleus and the periphery of the cell.

ELECTRON MICROSCOPE STRUCTURE:

E/M observation of a thin section demonstrated that Golgi of animal cell has a definite characteristic sub microscopic organization. Their membranes are devoid of attached ribosomes. A Golgi consists of three main structural components i.e**. Cisternae, tubules and vesicles**.

CISTERNAE OR LAMELLAE: are most constant elements of the Golgi complex. They consist of **flattened, parallel sacs piled one upon** the **other to form stacks**. The number of stacks varies from species to species and sometimes from one developmental stage to another. In most of the plants and animals' cells there **are 3-8 cisternae**. Other cell types may have as many as **25-30 cisternae**.

According to most authors there are **two well-defined faces** of **cisternae** concave **and the convex, the concave face is referred as mature or forming or distal face and the convex side** is assumed to be the **immature or excit or proximal face**. The **cisternae lie in a parallel array are separated from each other by a space about 200-300 Aº**. What holds them together is not yet known. But in few cells a thin layer of electron opaque, sometimes dense material is seen between the cisternae, which at certain regions are more prominent to which Amos and Grimstole (1968) applied the term **nodes.**

TUBULES: The peripheral region of cisternae may show which branch and anastomose to produce **Fenestrated system**. They represent the modification and expanded cisternae in which the two membrane of the sac are more widely separated with the vacuolar space enlarged.

SMALL VESICLES: A vesicle of about 40 Aº in diameter are intimately associated with the tubules and may show continuity with them. They arise by budding or pinching off the **ends of the tubules**. These budded particles remain dispersed in the surrounding **hyaloplasm**.

FORMATION OF GOLGI: The Golgi complex is constantly being formed, changed, broken down and reformed. It has been variously described as being formed from the **plasmalemma, nuclear envelop, annulate lamellae and the endoplasmic reticulum.**

FUNCTION: Role in protein secretion:

1.proteins are formed on Several functions have been attributed to Golgi

A. **Golgi and Cell secretion**:

There are definite evidences which suggest relationship between **Golgi and Cell secretion**. Golgi are very well developed in all the cells exhibiting high secretory activity, clearly suggest that Golgi plays main role in the **formation of secretion granule**.

In some cells, formed products appear in formed products appear in the expanded ends of the Golgi lamellae. In others, the secretory products completely fill the cisternae. In some cases, the end of the Golgi cisternae

may be pinched off to form small secretory granules. In other cases, the individual cisternae on the 'maturing face' may be completely filled with secretory products and then become rounded to form secretory granules.

B. Role on protein secretion

1. proteins are formed on the ribosomes attached to ER.
2.these nascent proteins are then transferred into the ER.
3.from here they go to the Golgi complex
4.In Golgi complex the proteins are concentrated and transformed into **zymogen granules.**
5.The zymogen granules released from the Golgi complex migrate to the surface of the cell. Here **the limiting membrane of zymogen granules fuses with the plasmalemma**, thus discharging its content.
Golgi complex act as a condensation membrane for protein formed on the ribosome.

C. Synthesis of carbohydrates

Golgi is also involved in the synthesis of concentration of products rich in carbohydrates.

D. **Glycosylation**-

In many cells the protein released from the ER is combined with carbohydrates to produce complex carbohydrate like **glycoprotein, mucopolysaccharides, glycogen and glycolipids**

E: Sulphation:

Golgi complex takes part in sulphate metabolism**.**

F: plasma membrane formation:

Secretory granules originating from Golgi complex fuse with the plasma membrane during exocytosis. The membranes of the granules become incorporated into the plasma membrane and thus contributed to the renewal of membrane constituents. The Golgi complex plays an important part in the synthesis of carbohydrate, components of plasma membrane.

In plant cells the plasma membrane of the cells resulting from cell division are contributed by the Golgi complex and the Golgi complex contributes to the biogenesis of the plasma membrane by supplying it with **glycosylated molecules**.

F: **plant cell wall formation**

The cell wall of plants is made up of **fibrils** which predominantly contain polysaccharides, along with some lipids and proteins. During cytokinesis a cell plate is formed between the two daughter nuclei and has around it a membrane which later becomes the plasma membrane of the daughter cells.

G**. Lipid packaging and secretion**:

Fats are broken down in the digestive tract and are absorbed into the epithelial cells of intestine as **fatty acids** and **monoglycerides.** These substances are used in the synthesis of **lipids**. The epithelial cell secretes **chylomicrons** which contain lipids in the form of **lipoproteins.**

The overall role of the Golgi complex in lipid metabolism appears to be the **concentration and modification of secretory** materials. These changes convert the lipid droplets into **chylomicrons**. The Golgi complex also provides a membrane for the envelopment of lipid so that it can be released from cell.

H. Acrosome formation:

The acrosome vesicles lie in front of the nucleus in the sperm. In the early stages of the developing mammalian spermatids the Golgi complex appears as a spherical body with parallel flattened cisternae and many vacuoles. Later Golgi becomes irregular and the cisternae dilate to form sac proacrosomic granules appear in the center of the Golgi complex and ultimately fuse to form the acrosome.

I. Lysosome Formation:

Primary lysosomes are formed by the Golgi complex. The ribosomes synthesize lysosomal hydrolases which enter the Endoplasmic Reticulum. The E.R. formed small vesicles of these hydrolases by blebbing (budding), and the vesicles are transferred to the Golgi complex. The cisternae of Golgi complex in turn form

vesicles (the primary lysosomes) by blebbing. The primary lysosomes fuse to form secondary lysosomes.

Because of the close functional relationship between the Golgi complex, E.R. and lysosomes, Novikoff has denoted the system as (**GERL**) system. Lysosomes can also arise directly from the E. R. without Golgi complex taking any part for E.g.: liver cells and in neurons.

J. Neurosecretion:

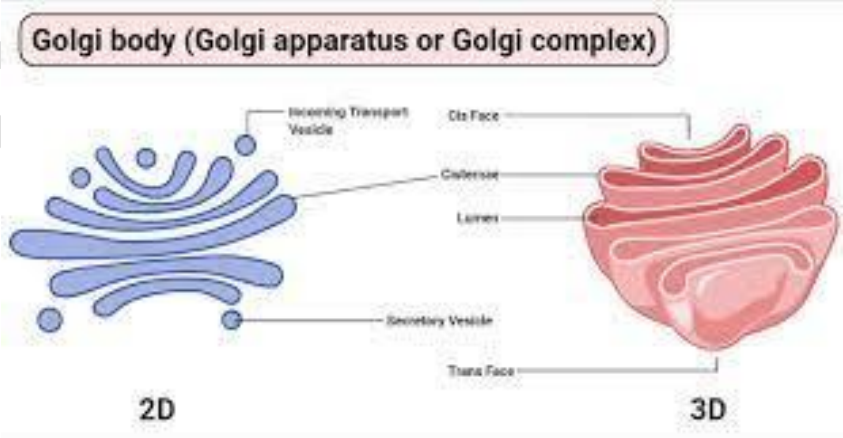
The neurosecretory materials are synthesis in the ribosome of E.R. it is then transferred in the Golgi complex, where it undergoes packing to form neurosecretory granules.

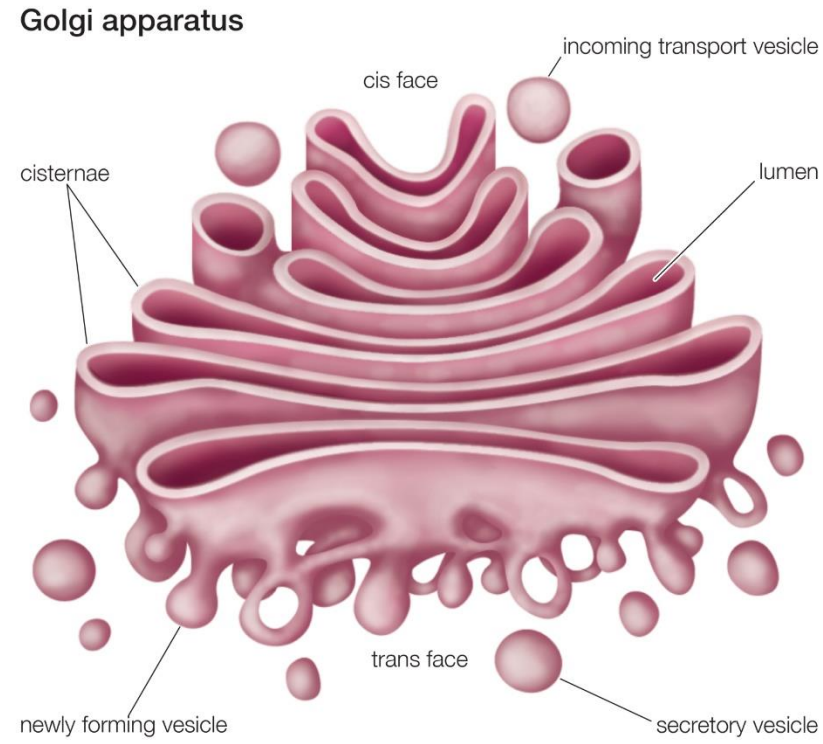
K. **Pigment formation:**

In many mammalians tumor and cancer cells the Golgi complex has been described as the site of origin of pigment granules(melanin).

L. **Regulation of fluid balance**:

A homology has been suggested between the Golgi complex and the contractile vacuoles of lower metazoan and protozoa. The contractile vacuoles expel surplus water from the cell. In certain protozoa the Golgi complex is also concerned with regulation of fluid balance.




Golgi apparatus
incoming transport vesicle
cis face
cisternae
lumen
trans face
newly forming vesicle
secretory vesicle
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