Structure and Function of Golgi Apparatus

Discovery

- It derives its name from nobel laureate an italian physiologist **camillo golgi.**
- first described its presence In **1898** During an investigation on nervous system.
- Existence finally confirmed only after the advent of electron microscopey during 1950s.
- Its electron microscope structure was described by **Dalton** and **Felix** in **1954.**

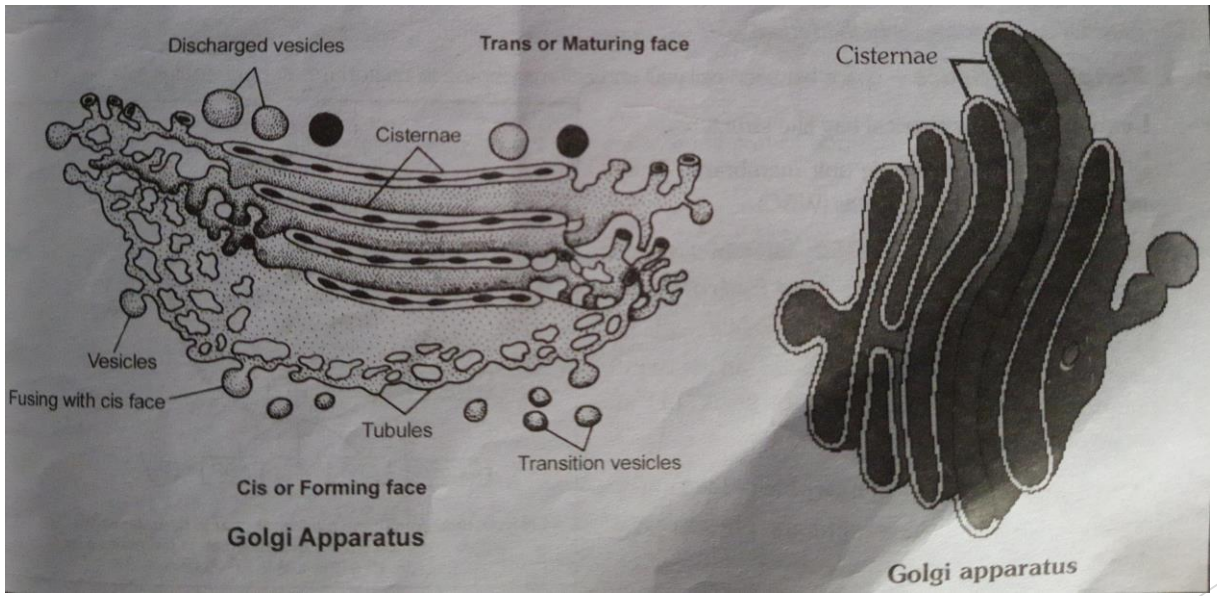
What is golgi complex?

- Also known as golgi apparatus,golgi body or golgi.
- Component of endomembrane system closely associated with endoplasmic reticulum.
- Found in cytoplasm of most eukaryotic cells and absent in prokaryotic , mammalian rbc and sperm of bryophyte, pteridophytes and sieves tubes of plants.
- Responsible of transporting , modifying and packaging proteins and lipids into vesicles.

Structure

- Electron microscope shows it as a Central stack (pile) of parallel,flattened,intercommucating sac or **cisternae** and many peripheral **tubules** and **vesicles.**
- Golgi complex varies In size and form in different cell types but usually has similar organization for any one kind of cell.

(in some unicellular eukaryotes including toxoplasma gondii,ostreococcus taurii each cell contain only one golgi stack. In majority of organism including most fungi, plants and invertebrates, each cell host multiple golgi stacks that are scattered through the cytoplasm. However in several eukaryotic species do not seem to have a stacked golgi complex. Example ÷ in **saccharomyces cerevisiae** golgi membrane **do not** form stack under normal conditions.)



Clsternae

- The cisternae vary in number from 3-7 in most animal cells and from 10-20 in plant cells.
- Usually equally spaced in the stack, separated from each other by thin layers of intercisternal cytoplasm.
- Cisternae may be flat but are often curved.
- Golgi complex has a distinct polarity, the two poles are called cis face and trans face, which act respectively as the receiving and shipping departments.
- Convex side of stack ->forming (cis) face.
- Concave side of stack -> maturing (trans) face.
- Secretory materials reach the Golgi complex from SmoothEndoplasmic Reticulum (SER) by way of transport vesicles which bud off from SER and fuse with golgi cisternae on the cis face.From the trans face Secretory vesicles arises that carry the processed material to their destination.

Tubules

- A complex array of associated vesicles and anastomosing tubules (30 to 50 nm diameter) surround the dictyosome and radiate from it. In fact, the peripheral area of the dictyosome is fenestrated (lace-like) in structure.

Vesicles

- The vesicles (60 nm in diameter) are of three types:
- **Transitional vesicles** are small membrane limited vesicles which are thought to form as blebs from the transitional ER to migrate and converge to cis face of Golgi, where they coalesce to form new cisternae.
- **Secretory vesicles** are varied-sized membrane-limited vesicles that discharge from margins of cisternae of Golgi. They, often, occur between the maturing face of Golgi and the plasma membrane.
- **Clathrin-coated vesicles** are spherical protuberances, about 50 μm in diameter and with a rough surface. They are found at the periphery of the organelle, usually at the ends of single tubules, and are morphologically quite distinct from the secretory vesicles. The clathrin-coated vesicles are known to play a role in intracellular traffic of membranes and of secretory products, i.e., between ER and Golgi, as well as, between the Gerl region and the endosomal and lysosomal compartments.

Vesicle mediated transport

- Vesicles mediated trafficking involve transport between the endoplasmic reticulum, golgi apparatus, plasma membrane and lysosome.
- Vesicular trafficking require the use of special protein which forms coats on membrane in order to Form the creation of a vesicles.
- There are 3 types of coat protein: **copi , copii** and **clathrin.**
- **Copi** vesicles transport vesicles from the cis-golgi to endoplasmic reticulum. This is known as **retrograde transport.**
- **Copii** vesicles transport vesicles from endoplasmic reticulum to cis-gogli. This is known as **anterograde transport.**
- **Clathrin** mediate vessicles transport vesicles from the plasma membrane to the lysosome and from the golgi to lysosome.

Functions of Golgi complex

- Secretion
- Synthesis
- Sulfation
- Apoptosis
- Phosphorylation
- Cell- specific function

2. Synthesis

- **It is also major site of carbohydrate synthesis . Includes synthesis of glycosaminoglycans (GAGs).**
- **Golgi attaches to polysaccharides and protein to form proteoglycans.**

3.Sulfhation

- **Golgi involves in the sulfation of ceratain molecules passing through lumen via sulphotransferases that gain sulphur molecule from a donor called PAPS.**
- **Sulfation is generally performed in trans – Golgi network Sulfation occurs in GAGs of proteoglycans as well as core protein.**
- **Level of sulfation is very important to proteoglycans.**

4. apoptosis

- **Golgi has a putative role in apoptosis**
- **A newly characterized protein (Golgi anti-apoptotic protein) almost exclusively resides the Golgi and protects cells from apoptosis**
- **As yet it is an undefined mechanism**

5.Phosphorylation

- The phosphorylation of molecules requires energy in the form of ATP.
- That ATP is imported into the lumen of the Golgi utilised by resident kinases such as **casein kinase 1** and **casein kinase 2.**
- One molecule that is phosphorylated in the Golgi is Apolipoprotein, which forms a molecule known as **vldl (**very low density lipoprotein) that is a constituent of blood serum.

6.Cell-specific functions

- **Formation of cell wall and cell plate in Plant Tissues.**
- **Acrosome development in sperm cells.**
- **Secretion of Zymogen in the Exocrine cells of Pancreas.**
- **Secretion and transformation of Lipid in the liver cells.**
- **Similar secretory functions are carried out in the Brunner’s gland cells, alveolar epithelium, Paneth cells, connective tissues as well.**

Golgi biogenesis in mammalian cell

- In mammalian cells, the continuous Golgi ribbon needs to be segregated into the two daughter cells when the cell divides.
- This is achieved through a three-step process that involves disassembly (consisting of ribbon unlinking, cisternal unstacking, and vesiculation), partitioning, and reassembly of Golgi membranes (Wei and Seemann 2009b).
- In late G2 phase of the cell cycle, the Golgi ribbon is unlinked upon separation of the lateral connections between the stacks. In early mitosis, the cisternae then unstack and further disassemble into vesicular and tubular membranes (Lucocq et al. 1989).
- These mitotic Golgi membranes are then divided into the two daughter cells where they are reassembled into a functional Golgi.

Summary and conclusion

- **Golgi apparatus is made of a stack of membrane bound sacs.**
- **It receives most of the substances from Endoplasmic Reticulum.**
- **It produces vesicles which carry secretions on to the cell surface. Basically, it functions as a “post office”- where the proteins and lipids are taken,labelled and transported to other locations within the body.**

Thank you