Golgi apparatus

This cytoplasmic organelle is named after its discoverer Camillo Golgi (1898). These are also called lipochondria. For several years there was considerable disagreement about the existence of that organelle. Many biologists believed that it was an artifact of fixation or staining procedures. Phase contrast microscope studies in the early 1940s also indicated the existence of Golgi bodies. Study of electron micrographs of thin sections of cells in the 1950s finally proved the existence of Golgi bodies in all the cells of eukaryotes (Fig. 6.1). It does not exist in the prokaryotes.

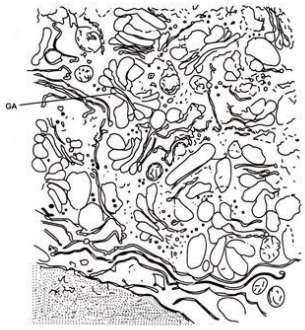

Fig. 6.1 Electron micrography of root cell of maize showing golgi bodies (GA) in ground plasm.

Structure

Electron microscopic studies have revealed that it consists of series of compactly grouped smooth contoured membrane limited vesicles of variable shapes and dimensions and variable number of small vacuoles (Fig. 6.2). They are selectively stained with Neutral red stain and differ from mitochondria in staining property because they do not take Janus green stain. When the cytoplasm is centrifuged the mitochondria settle down first and Golgi bodies afterwards. This indicates that Golgi bodies are lighter than the mitochondria. The presence of Golgi bodies in plant cells has been denied by some early cytologists, but the electron micrographs in recent years have revealed that these bodies are of universal occurrence in both plant and animal cells.

The vesicles of Golgi bodies are chiefly of two types:

1. Small and spherical vesicles.
2. Broad flattened vesicles in parallel or semi-circular array, cisternae (Fig. 6.3).

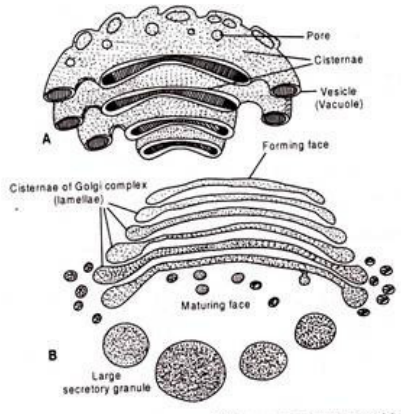

Fig. 6.2 Golgi body: A. Dictyosome, B. Dictyosome and secretory vesicles.

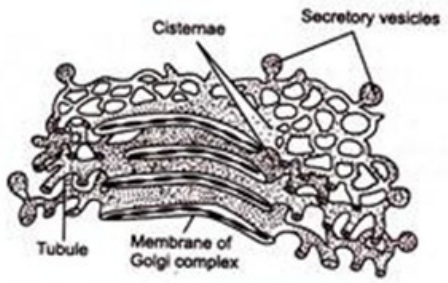

Fig. 6.3 Golgi body (ultrastructure) showing cisternae in the centre and small secretory vesicles on the surface.

The cisternae are characterized by their dilated edges. They are compactly arranged in parallel fashion. The stack of flattened cisternae or saccules is known as dictyosome. Dictyosome has a polarity; convex side forming the outer faces and concave side forming the inner face. Cisternae on the outer face are very flat and thin whereas those on the inner face are comparatively much dilated and thick. Number of vesicles per dictyosome varies probablydue to different functional stages of Golgi complex. Unit membrane of cisternae is about 35 Å thick, smooth surfaced and not associated with ribosome granules. On outer surface dictyosome is bounded by canaliculae or cisternae of endoplasmic reticulum. Numerous spherical vesicles found in close to dictyosome are budded off by the cisternae at their ends. Palade (1956-58) has shown that Golgi bodies originate from smooth surfaced endoplasmic reticulum (Fig. 6.3). Smaller vesicles are present around the stacks of cisternae and are bounded by membranes. Central space of vesicle is clear but frequently becomes condensed and appears as small granule.

Function

Golgi apparatuses are of usual occurrence in secretory cells where they are involved in secretory process. In plant cells these bodies secrete mucoproteins, slime, mucilage, lipoproteins and other proteinaceous substances. They also synthesize hemicelluloses and some polysaccharides during cell division.

In non-secretory cells Golgi apparatus is assigned some other functions. Dictyosomes release substances in the form of tiny vesicles budded from saccules on inner face. These vesicles fuse together to form secretion granules of ever increasing sizes. These are generally transported to the cell boundary where their membranes fuse with plasma membrane and finally their contents are discharged out of cell by exocytosis (Fig. 6.4).

Some proteins synthesized in granular endoplasmic reticulum pass through the cavities of the reticulum into the dictyosomes and from there they are discharged as secretion granules. This transfer of proteins appears to take place through small vesicles budded from smooth cistemae of endoplasmic reticulum close to dictyosomes. Loss of membranes due to the budding of vesicles on inner face of dictyosomes appears to be compensated by contribution of vesicles by smooth endoplasmic reticulum on the outer face. It indicates that new saccules are formed on the outer face of dictyosomes while the internal saccules break up into secretion vesicles.

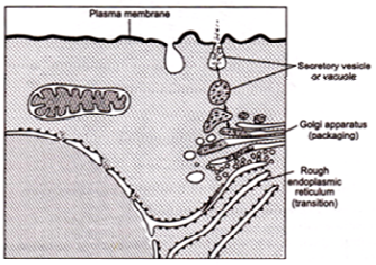

Fig. 6.4 Relation between the endoplasmic reticulum and a dictyosome *via* transition elements.

Sources:

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