Connective Tissue

Connective tissue proper

Early during embryological development the ectoderm and endoderm become separated by the third layer, the mesoderm.

The tissue formed by the cells of this layer is known as **mesenchyme**, and it is from mesenchyme that the (c.t.) of the body develop these include:-

(Connective tissue proper, cartilage, bones, and blood). Mesenchyme is typically a loose spongy tissue.

Connective tissue differ from epithelium **by presence of abundant intracellular material, or matrix. Matrix is composed of fibers and amorphous ground substance**. In any type of connective tissue there are three elements to consider:-

(**The cells, the fibers and the amorphous ground substance**). The elements are bathed in tissue fluid.

- **Amorphous intracellular substances:** Some of the amorphous intracellular substances are in form of stiff gels and thus help to provide strength and support for tissues, but their main function is that of providing a medium through which tissue fluid containing nutrients and waste products. Amorphous intracellular materials, in the form of sols and gels, permit such a diffusion from capillaries much more readily than do the fibrous kinds which are embedded in the amorphous materials.

• **Fibrous intracellular substances**: The function of fibers providing strength and support for tissues is performed mainly by the fibrous intracellular substances which include three types of fibers:-

1-Collagenous fibers: Are found in all types of connective tissues and consist of the protein collagen. They are extremely tough and in bulk in the fresh state (e.g. in tendons) appear white, and hence also called white fibers.

The fibers have a straight or slightly wavy course, are of intermediate length, 1-12 µm in diameter, and may be loosely or densely packed depending upon location and functional need. In the fresh state collagenous fibers are soft and flexible, relatively inelastic, and of high tensile strength. The fibers are transparent and homogenous but show a faint longitudinal striation. They are eosinophil and are stain red by van Gieson's stain. The fibers may branch.

Collagenous material in boiling water becomes hydrated and soften , forming gelatin. The fiber can be digested by pepsin in acid solution and by the enzyme collagenase. Often treatment with salts of heavy metals or tannic acid collagen forms an insoluble product , e.g. tanning process in the preparation of animals hides (leather) , which consist chiefly of collagen.

2-Reticular fibers: Are fine collagenous fibers arranged to form net-like supporting framework or reticulum. They occur as fine networks around small blood vessels , muscle fibers , nerve fibers , and fat cells. They are not seen easily in H. & E (**H&E** is **the combination of two histological stains: hematoxylin and eosin. The hematoxylin stains cell nuclei a purplish blue, and eosin stains the extracellular matrix and cytoplasm pink)**. sections but can be demonstrated by silver impregnation methods.

They being colored yellow or brown

They stain more darkly with the **periodic acid-Schiff (PAS)** technique than do collagenous fibers.

3-Elastic fibers: Are present in loose fibrous connective tissue and are seen as long thin highly retractile, cylindrical threads or flat ribbons, ranging in size from less than a micron to 4 µm in diameter. They may form extensive perforated sheets e.g. around blood vessels. In the fresh state adults elastic tissue in bulk has a yellowish color. Elastic fibers yield easily to stretching and return to their former length when tension is released.

1- Fibroblast: Is one of the most numerous cells of areolar connective tissue, the other being macrophage, fibroblasts are considered to be responsible for the formation of the fibers and also are thought to elaborate most of the amorphous component of the matrix. They are large, flat, branching cells which appear fusiform or spindle-shaped in profile. The branching processes are slender. The nucleus is oval or elongated and has a delicate nuclear membrane, one or two distinct nucleoli. In connective tissue spreads, the nucleus appears pale in section material, it usually appears shrunken and deeply stained with basic dyes. Fibroblasts are regarded as fixed cells of connective tissue, but they retain throughout adults life a capacity for growth and regeneration when stimulated as on the periphery of healing wounds. A more mature cell, is smaller, without cytoplasmic projections is called fibrocyte.

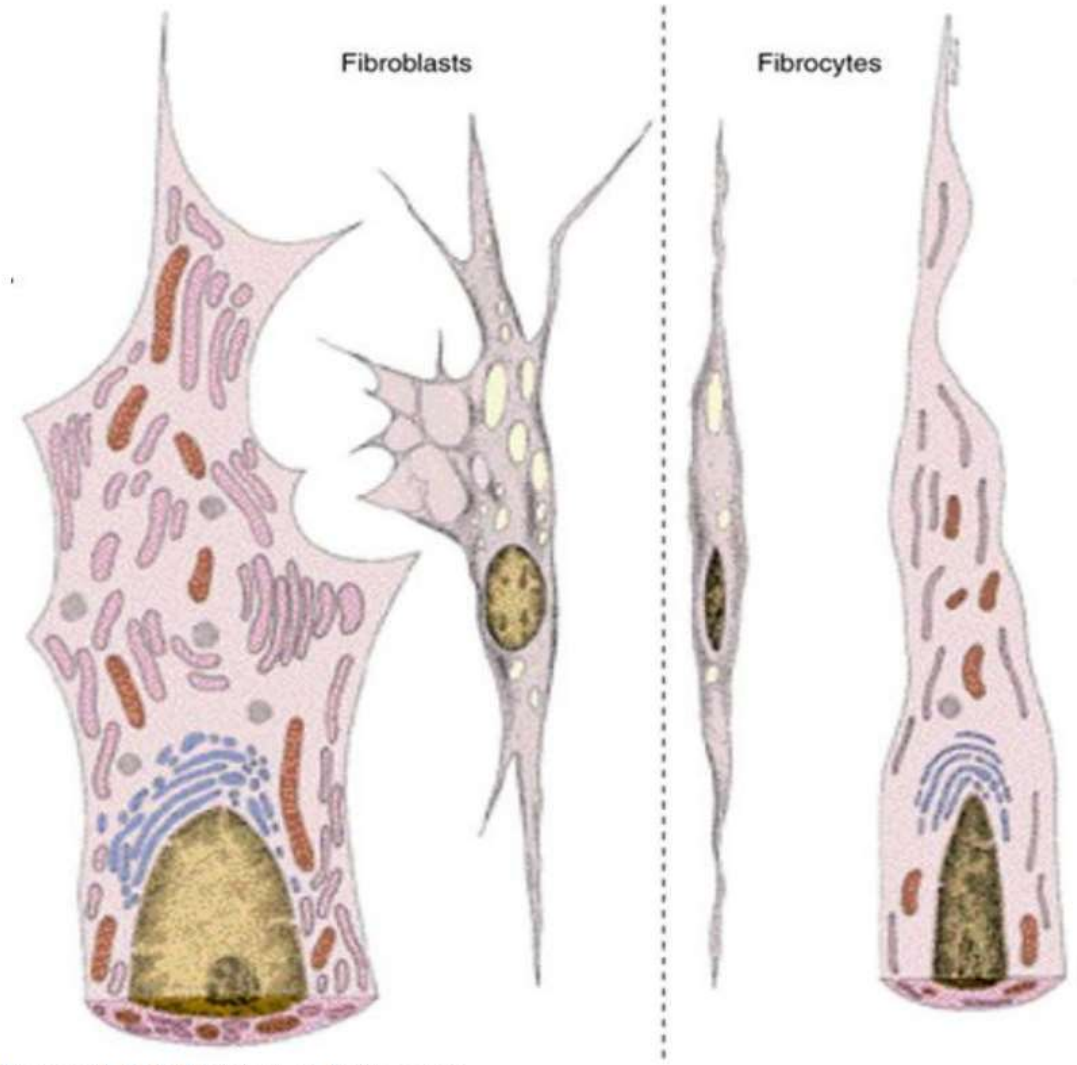


Figure 2-1: Fibroblast and Fibrocyte.

2- Macrophages: Often termed histocytes, macrophages are almost as numerous as fibroblasts in loose connective tissue and are most abundant in richly vascularized areas. They may be either attached to the fibers of the matrix or free within the matrix , they are irregularly shaped cells with short and blunt processes. The nucleus is ovoid. These cells when they are activated can be distinguished readily from fibroblasts , owing to their ability to ingest particulate matter. Then

the cells appear much larger and the cytoplasm is filled with granules and vacuoles containing ingested material. Macrophages are important agents of defense, because of their mobility and phagocytic activity , they are able to act as scavengers , engulfing extravasated blood cells , dead cells , bacteria , and foreign bodies. Macrophages also are secretory cells that produce and secrete several important substances , including enzymes.

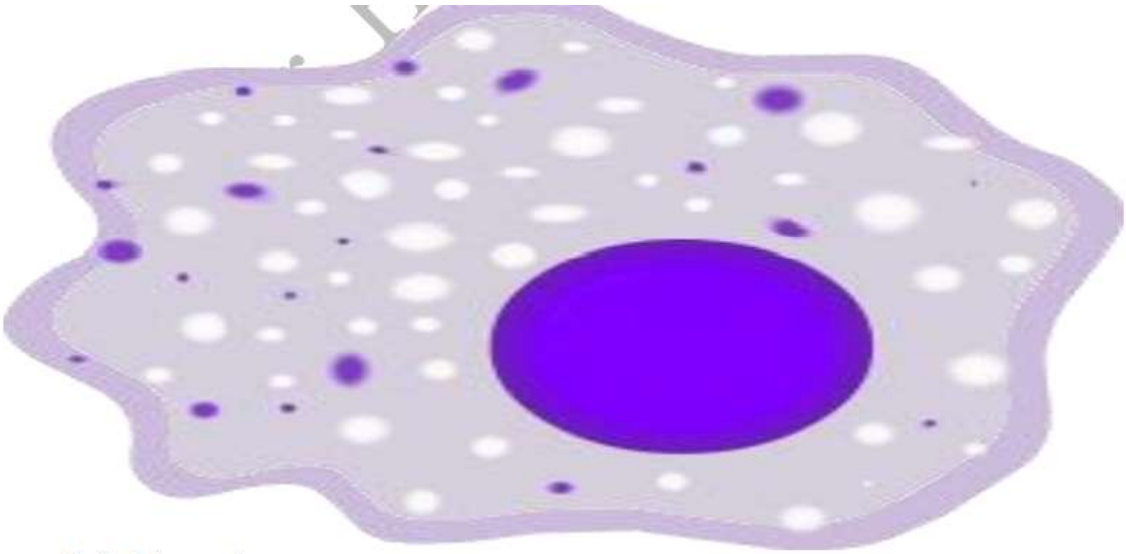


Figure 2-2: Macrophage.

3- Fat cells: These conspicuous cells are a normal component of areolar tissue. They occur singly or in clumps along small blood vessels. If they accumulate in large numbers, the tissue is transformed into adipose tissue. In fresh tissue they appear as glistening droplets of oil surrounded by an exceedingly thin rim of cytoplasm. Each fat cell contains a single large droplet of oil, and the thin rim of cytoplasm in one area the flattened nucleus. The fat droplet can be stained with osmic acid or with Sudan dyes, but in most histological preparations the lipid has been extracted leaving only the delicate protoplasmic envelope.

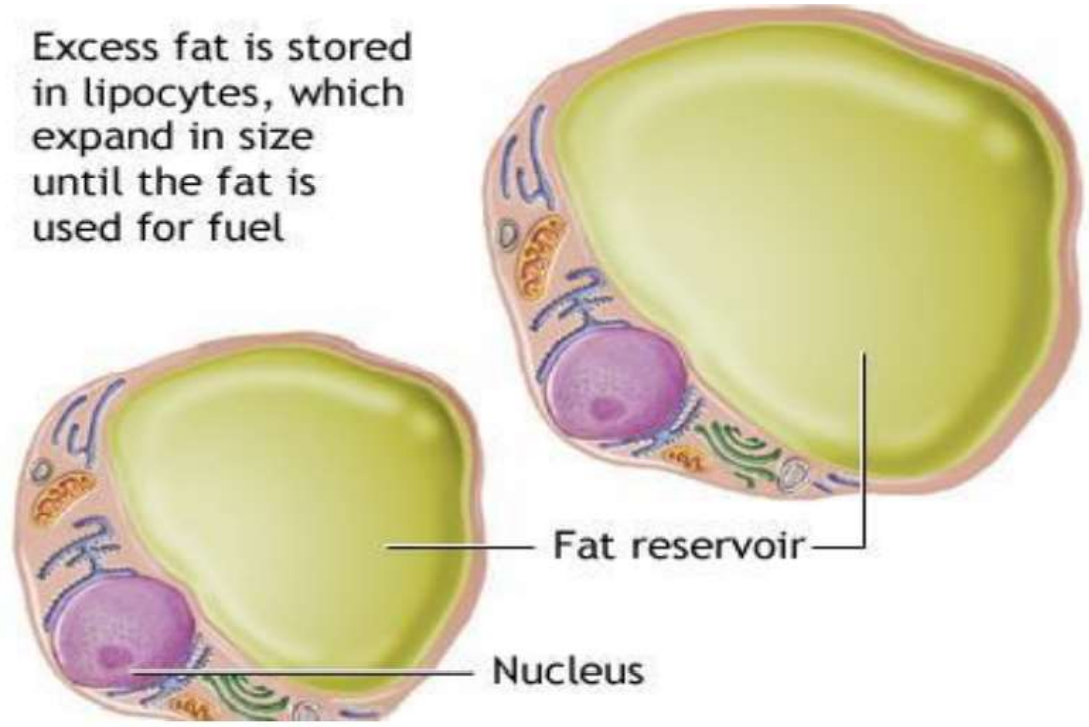
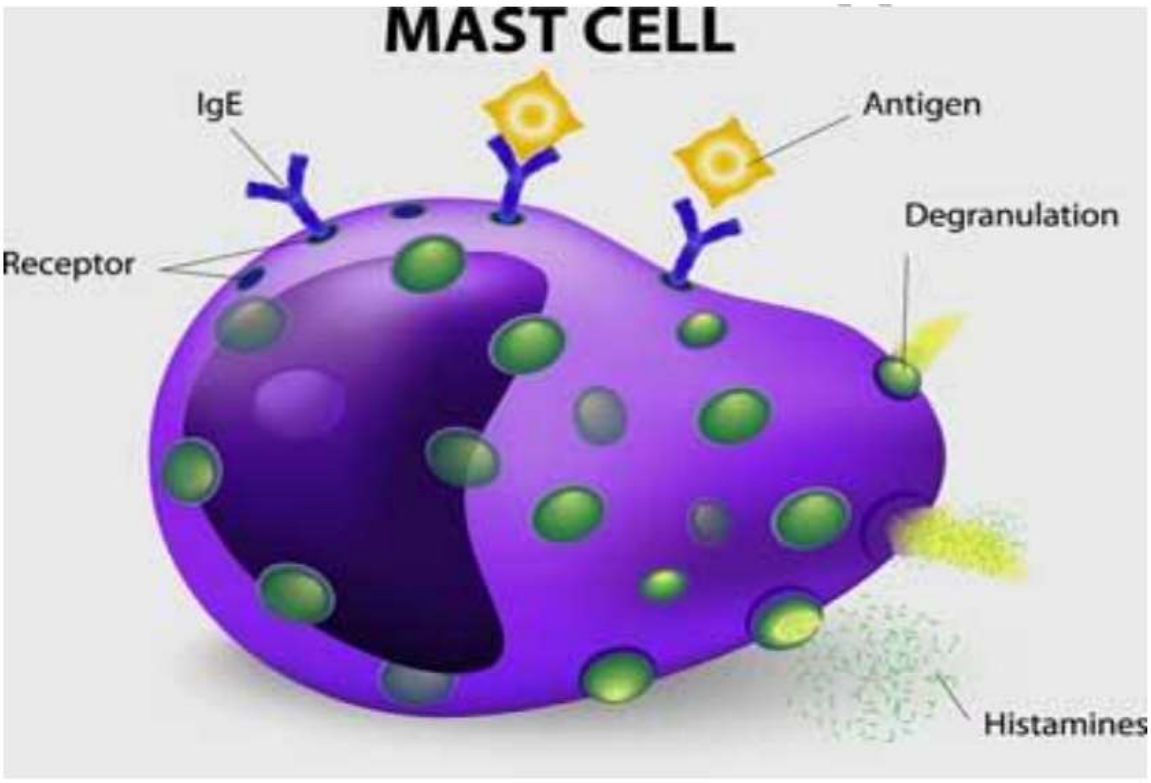


Figure 2-3: Fat cell.

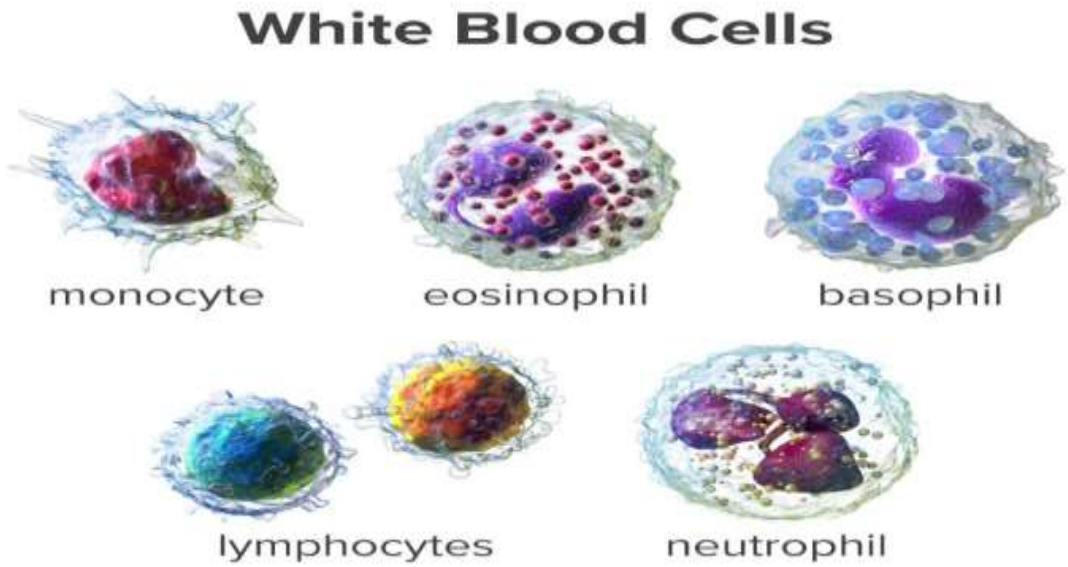
4- Mast cells: Are widely distributed in connective tissue, but tend to occur in small groups in relation to blood vessels. Mast cells are identified easily by their content of cytoplasmic granules. They are irregularly oval in outline. The nucleus is small and, spherical, and centrally situated. Mast cell produce an anticoagulant similar to heparin, and also contain and secrete histamine which causes vasodilation.

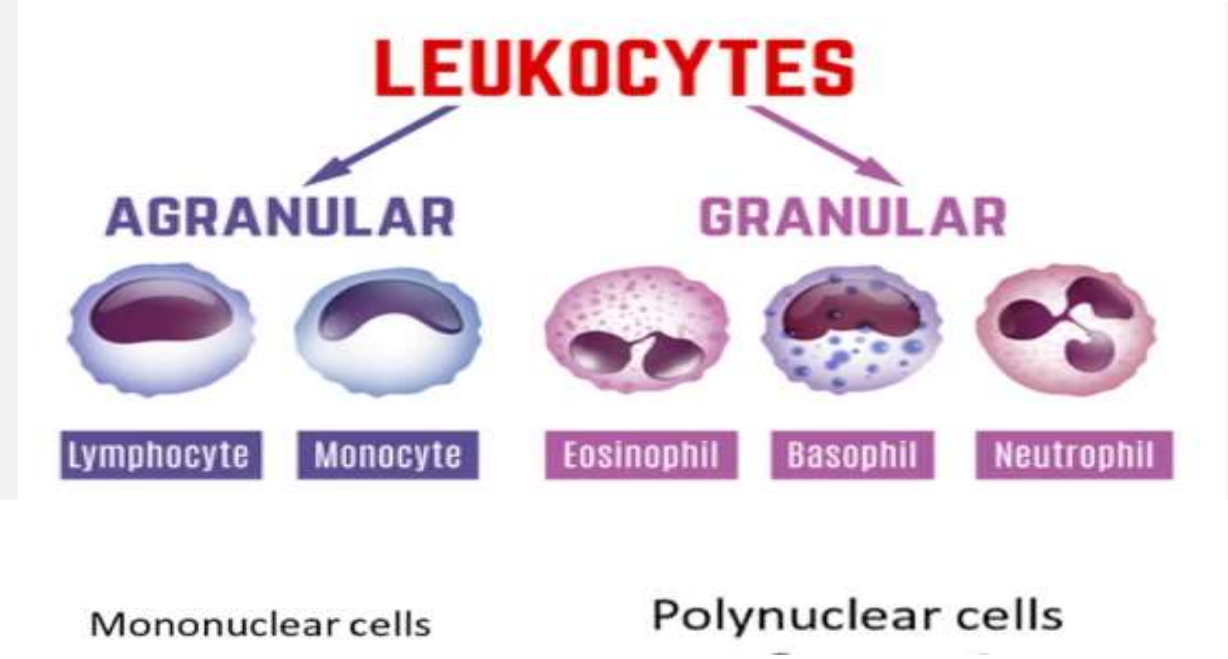


5- Plasma cells: Are few in number in connective tissue in most areas of the body. They are numerous in sites subject to penetration by bacteria and foreign proteins (e.g. intestinal mucosa). Plasma cells are large, ovoid cells that have a basophilic cytoplasm. The nucleus is spherical and eccentrically placed. Their principal function is the production of antibodies.

Figure 2-5: Plasma cell.

6- Leukocytes: White blood corpuscles are frequently found in c.t. In general they migrate across capillary walls from the blood.




LEUKOCYTES
AGRANULAR
GRANULAR
Lymphocyte
Monocyte
Eosinophil
Basophil
Neutrophil
Mononuclear cells
Polynuclear cells