Department of biology

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((Theoretical Histology))

Stage (-3-)

LEC- (6)

Connective Tissue

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Connective tissue:

It is a tissue of mesodermal origin that forms a matrix beneath the epithelial layer and is a connecting or supporting framework for most of the organs of the body.

- Unlike epithelium, connective tissue is made of **fibers**, **matrix (ground substance)**, and **cells.**
- **cells** and **fibers** are embedded in the **extracellular matrix.**

General Features of connective tissue:

1. Contain three basic elements: cells, ground substance (Extracellular Matrix) and fibers.
2. Matrix which may be fluid, semi-fluid, gelatinous, fibrous or calcified is usually secreted by the connective tissue cells
3. Do not usually occur on free surfaces.
4. Have a nerve supply.
5. Highly vascular.
6. Cells in connective tissue are derived from mesenchymal cells.

Functions of Connective tissue:

The functions of the various types of C.T. are generally depending on the types of cells, fibers, and the characters of the ground substances in the matrix.

1- Support : Connective tissue gives structural and mechanical support to the body by binding the cells and organs together

2- Protection: by forming the capsules around body organs and supporting their internal architecture (Protects and insulates internal organs).

3- Filling the spaces between the different organs, and gives shape to the organ.

4- Repair of wounds by fibrosis (formation of irregular collagenous scar tissue).

5- Transport: The connective tissue matrix serves as a medium through which nutrients and metabolic wastes are exchanged between cells and blood.

6- Storage: Adipose tissue is the storehouse of energy (lipid) , loose areolar connective tissue stores water and electrolytes.

7- Defense: Most of the cells of connective tissue are involved in the defense of the body either by phagocytosis of foreign body or by producing specific antibodies against antigen.

- Connective tissue composed:

1- C.T. fibers

2- C.T. cells

3- ground substance (matrix)

1- Connective tissue fibers:

1-The fibers of connective tissue are elongated structures formed from proteins that polymerize after secretion from fibroblasts.

2- Three main types of fibers include (**collagen**, **reticular**, and **elastic fibers**).

3- Collagen and reticular fibers are both formed by proteins of the collagen family.

4- Elastic fibers are composed mainly of the protein elastin.

5- These fibers are distributed unequally among the different types of connective tissue, with the predominant fiber type usually responsible for conferring specific tissue properties.

Type of fiber	Composition	Properties	Location	Function
1- Collagen	Collagen type I, II	Inelastic, eosinophilic	bone, cartilage, tendons and ligaments	1- Strong, resist pulling forces. 2- Promote flexibility and toughness.
2- Reticular	Collagen type III	Inelastic, branched and argyrophilic	blood vessels ,spleen and lymph nodes	1- Support walls of blood vessels. 2- Supporting framework for soft organs.
3- Elastic	elastin and fibrillin	Elastic and eosinophilic	skin, blood vessel walls. and lung tissue	Promote resilience.

2- ground substance (matrix)

A) Is an amorphous, highly hydrated, colorless, transparent and homogenous substance that fills the spaces between cells and fibers.

B) Viscous complex, made of molecules (proteins +carbohydrates) , these molecules (proteoglycans) form a meshwork that is filled by water and electrolytes, involved in maintenance of fluid balance

C) Is a gel-like material in which the cells and fibers of connective tissue are embedded.

D) Ground substance serves as a lubricant, helps prevent invasion of tissues by foreign agents, and resists forces of compression.

3- Cells of connective tissue:

Various types of cells are present in the C.T, these are grouped into Fixed and Free cells, each group performing a special function .

A- Fixed cells (intrinsic cells) ……. Its responsible for production and maintenance of ECM

1- fibroblasts and fibrocytes.

2- Undifferentiated mesenchymal cells.

3- fat cells (adipocytes).

4- fixed macrophage

B- Free cells (extrinsic cells / wandering cells) …….. Its responsible for tissue reaction to injury or invasion of microorganisms

1- free macrophages.

2- plasma cells

3- mast cells

4- leucocytes – migrated from blood

A- Fixed cells (intrinsic cells)

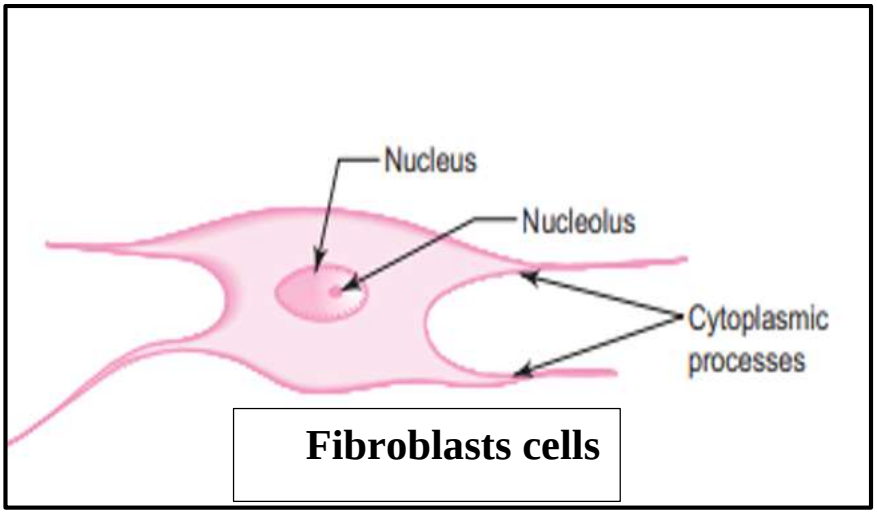
1. Fibroblasts cells

A- Most commonly seen cells; flat and fusiform in shape with slender processes.

B- Responsible for the formation of fibers and ground substance.

C- Often associated with collagen fibers.

D- Old inactive fibroblasts are called fibrocytes.



Fibroblasts cells

2- Undifferentiated Mesenchymal cell (MSCs)

A- Stellate in shape with delicate cytoplasmic processes.

B- Pluripotent cells, which develop into new cell types when stimulated like (**osteoblasts** , **chondrocytes** , **myocytes** , and **adipocytes)**.

C- Resemble fibroblasts.

D- Found along the periphery of blood vessels, therefore they are also called adventitial cells (**pericytes**)

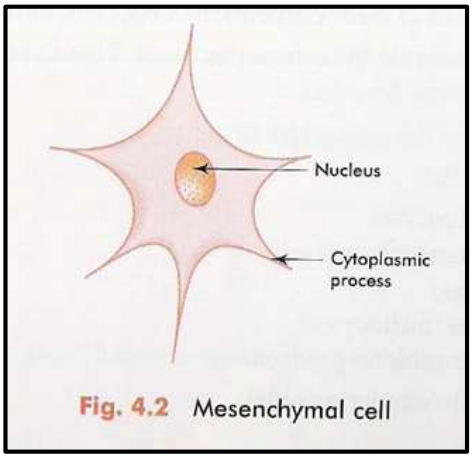


Fig. 4.2 Mesenchymal cell

3. Fat cells (adipocytes)

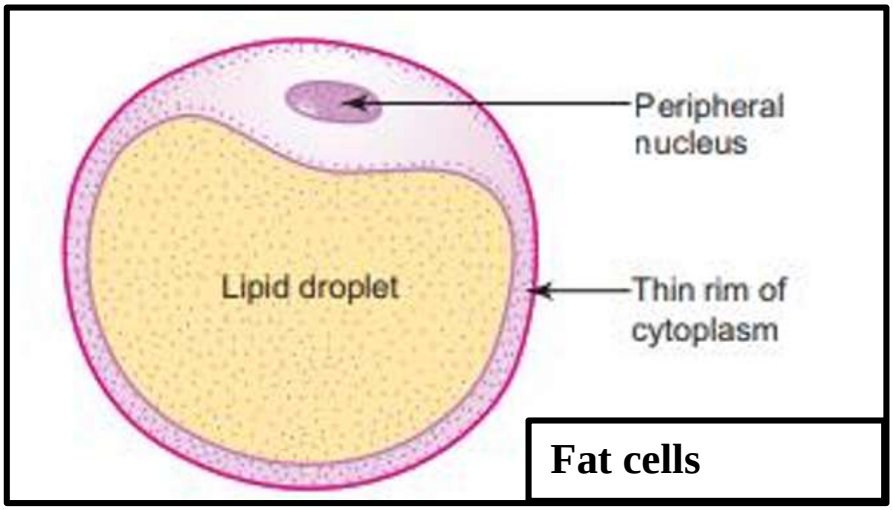
A-Store energy (lipid).

B- large cells (50 μm). Each cell contains a large single lipid droplet (unilocular) which appear under microscope it have (thin rim of cytoplasm and peripheral nucleus resembles a signet ring).

C- Incapable of division.

D- Aggregate to form adipose tissue.

E-Are supported by reticular fibres.



Fat cells

4. Fixed macrophages:

A- irregular in shape with numerous filopodial processes.

B- Have dark eccentrically (nucleus).

C- containing many lysosomes, derived from blood monocytes, involved in phagocytosis against bacterial invasion.

- **Macrophages localized in certain region of the body were given specific names: -**

♥ **Kupffer cells: in liver**

♥ **Dust cells: in lung**

♥ **Langerhans cells: in skin**

♥ **Osteoclast: in bone, chondroclast: in cartilage**

♥ **Monocytes: in blood**

♥ **oligodendrocyte: in brain**

B- Free cells (extrinsic cells / wandering cells)

1- Free macrophages

During antigenic stimulation or inflammation, the fixed macrophages withdraw their processes and become free macrophages.

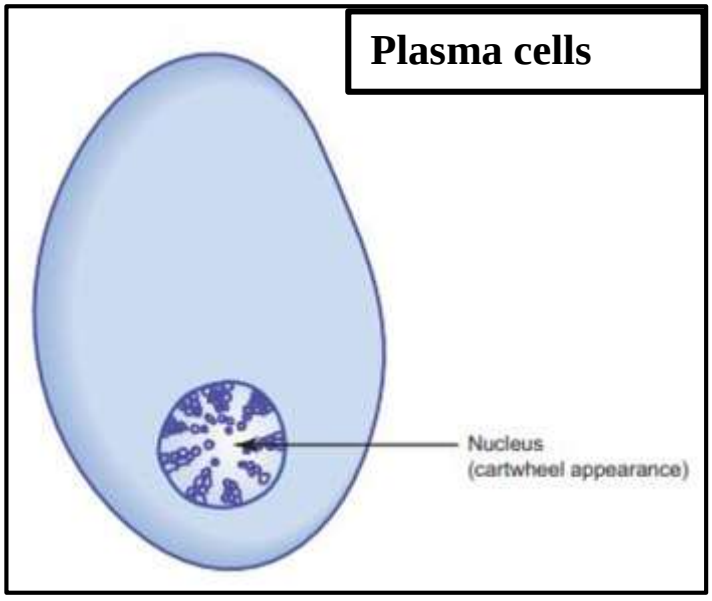
2- Plasma cells

A- Are oval cells with basophilic cytoplasm.

B- Have eccentrically placed nucleus (with clumps of heterochromatin distributed around the periphery of the nucleus- cartwheel appearance).

C- Are involved in the defense of the body by producing antibodies (immunoglobulins).

D- The plasma cells are found more in the lamina propria of gastrointestinal and respiratory tracts, (which are the possible sites of entry of bacteria and foreign bodies).



3- Mast cells

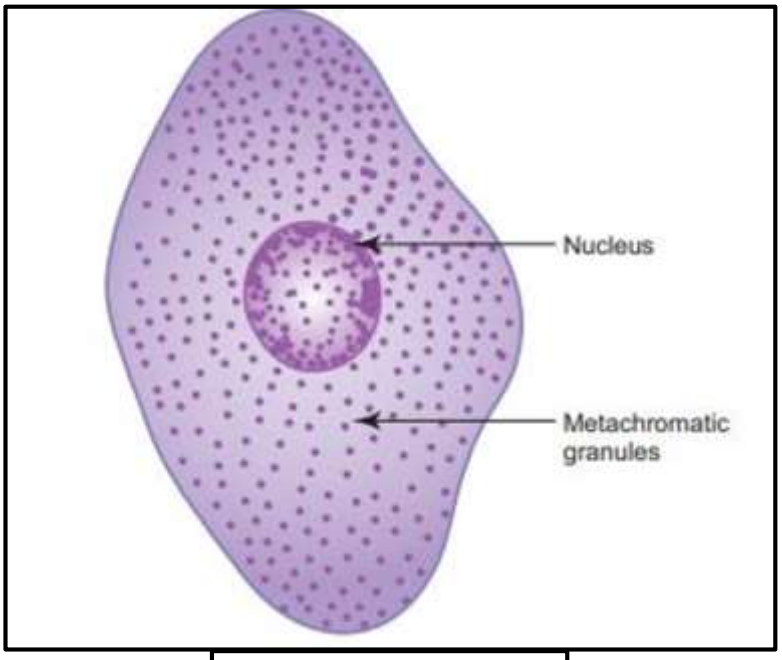
A- Are round or fusiform cells with centrally placed round nucleus.

B- Are found along small blood vessels.

C-Their cytoplasm is filled with metachromatic granules.

D- These granules contain histamine, a vasodilator and heparin, an anticoagulant.

E-Are involved in inflammatory reactions, allergies and hypersensitive states.



Mast cells

4- leucocytes: white blood cells derivative connective tissue cells**:**

A- Granulocytes

- Neutrophils
- Eosinophils
- Basophils

B- A granulocytes

- **Lymphocytes**
- **Monocytes**