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PART THREE :

CONNECTIVE

TISSUE

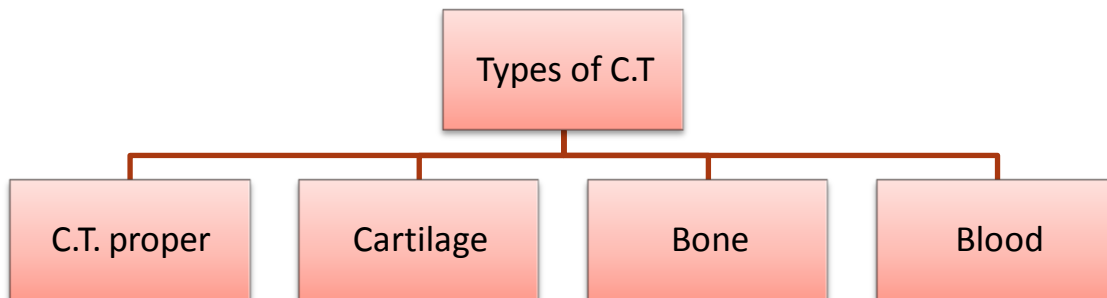
Connective Tissue (C.T.)

- **Definition of C.T. :**

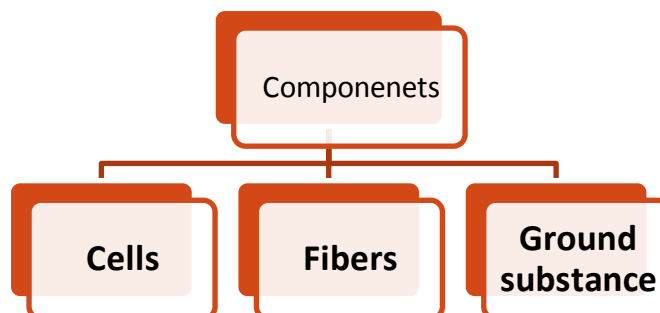
It is a basic type of tissue, of mesodermal origin, Which provides structural and metabolic support for tissues and organs.

- **General characteristics:**

1. are formed of widely separated, few cells with abundant extracellular matrix.
2. Originate from mesenchyme (an embryonic C.T.) which develops mainly from mesoderm.
3. most C.T. are vascular.



C.T. PREOPER



(Fibers AND Ground substance are Extracellular matrix)

Cells of C.T.

A) Fixed cells : (Cell remain in place within the connective tissue (long lived)

1. Fibroblasts.
2. Pericytes.
3. Adipose cells (Adipocytes; Fat cells).
4. Mast cells.
5. Macrophages (Fixed ; Resident).

B) Free cells (Transient or Wandering Cells) :

(Originate from bone marrow and circulate the blood stream)

1. Plasma cells.
 2. Macrophages (Free; elicited).
 3. Leucocytes.
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1. FIBROBLASTS :

(L/M) Types:

- 1- active fibroblasts*.
- 2- Inactive fibroblasts = Fibrocytes

(E/M) Function:

- 1- Synthesis of proteins of extracellular matrix.
- 2- Healing of wounds.

N.B. Fibroblasts are the most abundant cell type in the C.T.

*** Active fibroblast :**

• **(L/M)**

- Basophilic.
- longated, fusiform cells
- Nucleus: dark-stained, large, granular, ovoid, with well-defined n.

• **(E/M)**

- Prominent golgi apparatus.
- Abundant RER.

PERICYTES :

- Pericytes partly surround endothelial cells of blood capillaries and small venules.
 - Derived from undifferentiated mesenchymal cells.
 - Pericytes have long 1ry. & 2ry. Processes.
 - Pericytes are surrounded by their own basal lamina which may be fused with that of endothelial cells.
 - Pericytes may differentiate into:
 - 1- SMCs: in the wall of arterioles & venules.
 - 2- Endothelial cells: also in the wall of arterioles & venules.
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MACROPHAGES

(L/M)

- Large (10-30 μm).
- Irregular (uneven) outlines -Why?
Short blunt projections to finger-like filopodia that folds in more active cells.
- Nucleus: Small, eccentric, dark, and kidney-shaped.
- Nucleolus: Usually don't appear.
- Basophilic cytoplasm, Many vacuoles & small dense granules.

(E/M)

- Well-developed Golgi.
- Abundance of lysosomes.
- Prominent rER.
- Phagosomes (phagocytic vacuoles).

N.B. They can divide.

Origin: From monocytes.

Life span: About 2 months.

Function of macrophages :

- 1- Phagocytosis.
- 2- Antigen processing and presentation.
- 3- Production of cytokines and chemotactic factors.

Macrophages types:

- 1- Fixed (Resident) macrophages.
- 2- Free (elicited) macrophages.

Functional types:

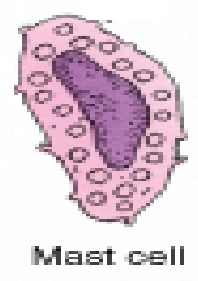
- 1- Phagocytes.
- 2- Antigen-presenting cells.

MAST CELLS

(L/M)

- Large cells (20-30 μm) (largest of fixed cell)
- Oval cells .
- Nucleus : Centrally placed, spherical.
- Numerous cytoplasmic granules.

N.B. These granules are stained metachromatically with Toluidine Blue-why? Heparin (or chondroitin SO₄)



Mast cell

(E/M)

- Numerous membrane-bound cytoplasmic granules.
- Several mitochondria.
- Few rER.
- Small Golgi.

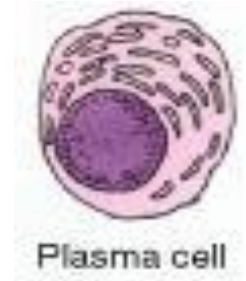
N.B. Occasionally undergo cell division.

Function: Synthesis of histamine and heparin.

PLASMA CELLS

(L/M)

- Large (20 μm), ovoid cells
- Intensely Basophilic cytoplasm -why?
- Negative Golgi apparatus.
- Nucleus: Spherical, eccentric, clock-face (spoked) appearance.



(E/M)

- Abundant rER.
- Well-developed Golgi complex.
- Few mitochondria.

Origin: are derived from B-lymphocytes.

Life span: 2-3 weeks.

Function: Synthesis and release of Ig antibodies .

ADIPOSE CELLS (ADIPOCYTES) OR (FAT CELLS)

- 1- Unilocular fat cells (in white adipose T.).
- 2- Multilocular fat cells (in brown adipose T.).

(A) White (Unilocular) adipose cells:

(L/M)

- Polyhedral, large (50-120),
- Large dissolved single fat droplet.
- Thin rim of cytoplasm at the periphery.
- Nucleus: flattened, peripheral.
- Signet ring appearance -Why?

(E/M)

- sER (in thin rim of cytoplasm)
- Few Mitochondria (in cytoplasm around Nucleus).
- Sparse rER.
- Small Golgi
- Abundant free ribosomes.
- The fat droplet is not bounded by memb.

N.B. Each cell is surrounded by basal lamina-like subst. & supported by reticular fibers.

Sites of unilocular adipose cells:

- 1- In loose C.T.(throughout the body).
- 2- In white adipose tissue.

(B) Brown (multilocular) adipose tissue:

• L/M:

- Formed of multilocular adipose cells. Heavily supplied with blood vessels. (that's why brown). Numerous mitochondria. (that's why brown as well).

• Function:

- Synthesis, Storage & release of fat. Thermal insulator.
- Shock absorber.
- Present in infants of most mammals.

FIBERS OF C.T. PROPER

1- Collagen Fibers.

2- Reticular Fibers.

3- Elastic Fibers.

Collagen Fibers :

- They are made up of the protein collagen (Tropocollagen molecules).
 - **Types: (about 27 members):**
 - 1- Collagen type I :
fibrils, fibers, bundles.
Dermis, tendons, ligaments,
bone, fibrocartilage, dentin.
The most numerous in C.T. Acidophilic fibers.
 - 2- Collagen type II :
fibrils (& slender fibers), Hyaline & elastic Cartilages, vitreous body.
 - 3- Collagen type III (Reticular Fibers):
Fibrils, fibers, network
In stroma of organs & red bone marrow.
 - 4- Collagen type IV:
no fibrils, no fibers.
In lamina densa of basal lamina.
 - 5-Collagen type V:

Forms thin fibers associate with type I, e.g. placenta.
 - 6-Collagen type VII :

- Attach lamina to lamina reticularis.
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RETICULAR FIBERS

- Consist mainly of collagen type III.
- Have CHO-coat (glycoprotein).
- Form extensive network.
- **Staining:**
 - ✓ With H&E: invisible.
 - ✓ With silver salts: black.
 - ✓ With PAS: +ve.

ELASTIC FIBERS

- **Consist of** : Elastin & microfibrils.
N.B. Elastin is amorphous material.
- **Features**: Branching, elastic & weak acidophilic.

TYPES OF C.T. PROPER

1. Loose (Areolar) C.T.
2. Dense collagenous C.T.
3. Elastic C.T.
4. Reticular C.T.
5. Adipose Tissue.
6. Mucous C.T.
7. Mesenchymal C.T.

N.B. Embryonic C.T. 6 & 7.

1. LOOSE(AREOLAR) C.T. :

(L/M)

- Contains the all main components of C.T.P. (no predominant element in loose C.T.)
- Fibroblasts and macrophages are the most numerous cells.

Sites:

- Papillary layer of the dermis.
- Hypodermis
- Serosa (peritoneum, pleura)
- Lamina propria
- Tunica adventitia of blood vessels.

2. DENSE COLLAGENOUS C.T.

(L/M)

- Few fibroblasts + Predominance of collagen fibers (type I).
- Subtypes & Sites of D. Collagenous C.T. :

- 1- Dense irregular: e.g. Reticular layer of dermis.
 - 2- Dense regular: e.g. Tendons, aponeurosis, ligaments.
- D. Collagenous C.T. with few fibroblasts

3. ELASTIC TISSUE :

(L/M)

Coarse branching Elastic fibers + Fibroblasts

(or: Fenestrated Elastic membranes + Smooth muscle cells in the wall of arteries).

Sites:

Ligamentum nuchae, ligamentum flava,
Suspensory ligament of the penis, Arteries.

4. RETICULAR TISSUE :

(L/M)

Reticular fibers + Reticular cells (specialized fibroblasts)

Sites:

- Stroma of organs: Liver, L.N., spleen, islets of Langerhans, smooth muscle, adipose tissue.
- Stroma of hemopoietic tissue: B.M.

5. ADIPOSE TISSUE :

- 1- Unilocular (White) adipose tissue.
 - 2- Multilocular (Brown) adipose tissue
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1. Unilocular adipose tissue (White adipose tissue):

(L/M)

- Is formed of lobules of unilocular adipose cells.
- Highly vascular (Heavily supplied with blood vessels.) .

Function:

- 1- Synthesis, Storage & release of fat.
- 2- Thermal insulator.
- 3- Shock absorber.

Sites:

- Subcutaneous layers especially in buttock & hips.
- Abdominal wall.
- Female breast.
- Around the kidney.

N.B. White adipose T. appears only after birth.

6. MUCOUS TISSUE :

- **(L/M)**

- 1- Ground substance (mainly Hyaluronic acid).
2. Few fibers (type I & type III collagen fibers).
3. Fibroblasts.

- **Sites:**

- 1- Umbilical cord (Wharton's jelly).
- 2- Subdermal C.T. of the embryo.
- 3- Pulp of young teeth.

- Known as Wharton's jelly.

BASAL LAMINA AND BASEMENT MEMBRANE

Structure:

It is formed of:

1- Lamina densa: network of type IV collagen + Electron dense region .

2- Lamina lucida (lamina rara):

- an electron-lucent layer on one or both sides of the lamina densa.
- It consists mainly of glycoprotein laminin.

3- Reticular lamina (Lamina reticularis) (Lamina fibroreticularis).

Basal lamina: 1+2 (E/M term)(20-100 nm thick)

It is visible only by E/M.

Basement membrane: 1+2+3 (is seen by L/M as PAS +ve structure)

Basement Membrane:

1- L.Rara.

2- L.Densa .

3- L.Fibroreticularis .