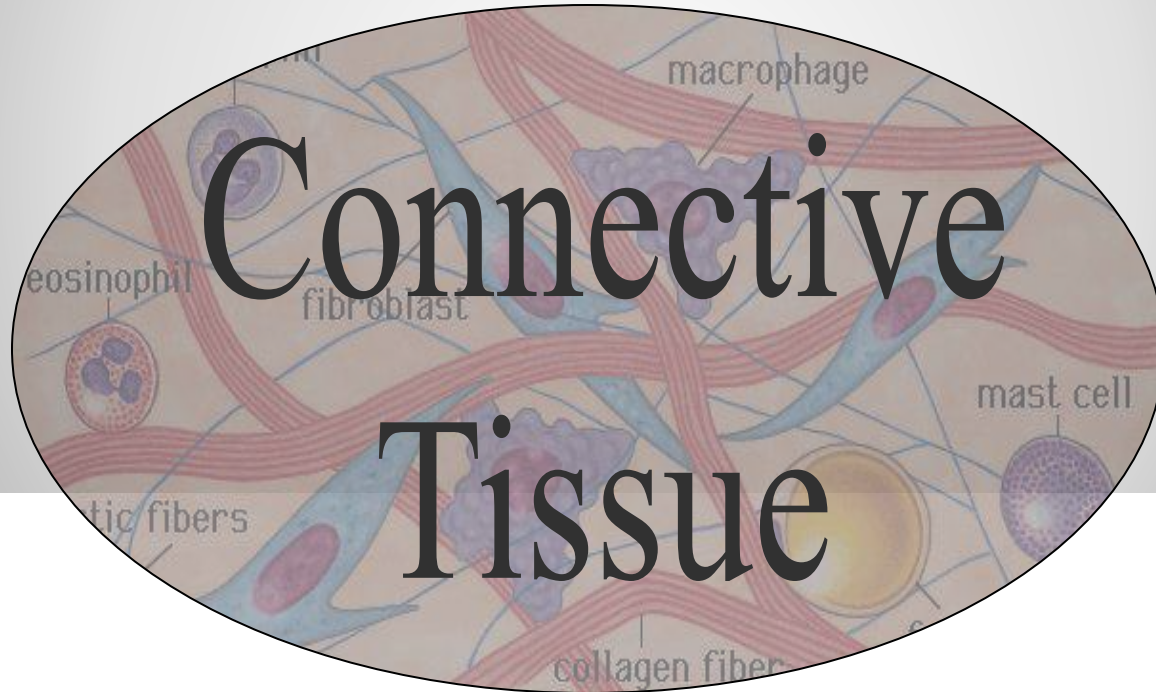


Histology lecture 5

Connective tissues

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Connective tissue (CT) is a type of body tissue

2 important features of connective tissue:
 [characterized by an abundant extracellular matrix within which are (dispersed) different types of cells and fibers.]

ECM
 عتق

* فرق بين Connective و epithelium

- few ECM
- cells are closely packed to each other

- cells are dispersed
- "widely separated from each other"
- abundant ECM

notice here wide spaces filled with ECM
 انواع مختلفة من الخيطات وتكون متناثرة عن بعضها

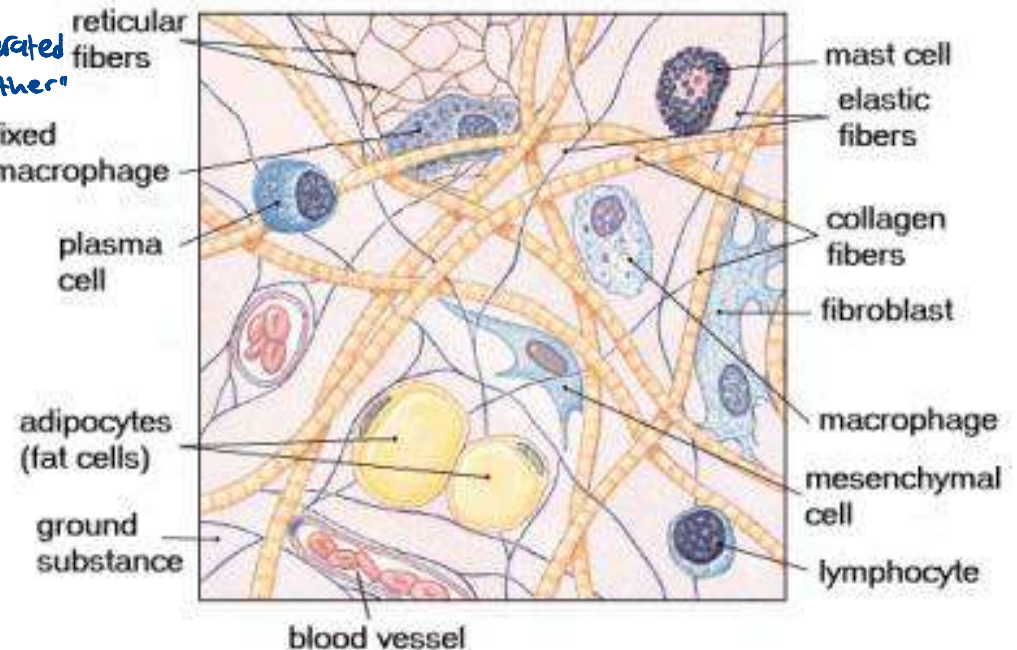


Fig.1: Image showing the components of CT: Cells, Fibers and Ground substance

- Connective tissues have several types & these several types perform different functions

General Functions of connective tissues :-

تَعْطِي سِجِلَ الْعَضْوِ

1. Provide and maintain form of organs. *Areolar connective tissue*
2. Support different tissues and organs. *fatty*
3. Connect and bind different body regions. *Cartilage & blood*
4. Provide a medium for diffusion of nutrients and waste products. *Areolar & blood*

Notice that these functions are performed by different types of connective tissues.

Note: Extra cellular matrix ^{أنواع} موجود بكل أنواع basic body tissues .

Tissue : cell + ECM → it is present in :
Connective
epithelium
nervous
muscular

* لكنه في تكلم عن ECM بال Connective باعتبار وجود الأثر التي بال Connective .
لكنه نفس الكلام الي في فيكيه عن ECM بال Connective ينطبق على باقي ال tissues .

The Cells Of The Connective Tissue

- Cells of the CT are, usually, not regularly arranged. يمكن نوع من أنواع ال
Connective tissue
 - The cells of CT could: تكون الخلايا مترتبة بطريقة معينة بس ← in general they are not regularly arranged
 - I can divide the cells of the CT into 3 general types & depending on their ^{→ Life} ^{→ origin}
 - Originate and remain in the CT all their lives (fibroblasts).
 - Originate outside the CT and then come to the CT and remain in it for the rest of their long lives (mast cells). ← تكون داخل bone marrow مع خلايا الدم ، بجرها تخرج من bone marrow الى الدم ثم تخرج من الدم الى CT ورح تظل بار CT .
 - Originate outside the CT and then come to the CT and remain in it for a short period (neutrophils). ↓ they are involved in inflammations & infections
- So they enter the CT when there is an infection
- they spend their lives circulating in bone marrow بار نوع من أنواع كريات الدم البيضاء ، بارو تكون بار bone marrow
- the blood, but when they are needed they will enter to the CT to perform a certain function → CT 4

1) Fibroblasts ⇒ cells that form fibers

هنا الى يكون CT لذلك هي أكثر نوع خلية موجودة
بار CT

- Most common cell in connective tissue.
- **Function:** [*Synthesizes fibers*] and [*produces molecules components of extracellular matrix.*]
 - fibroblasts could be found in 2 stages :
- ① Active Fibroblasts and ② inactive Fibrocytes.
 - actively synthesizing fibers
 - إذ كانت الخلية ما تصنع
- Rarely divide. Mitosis resumes when they're needed under influence of several growth factors.
 - Mitosis can occur in certain conditions under the influence of certain factors
 - Ex: if there was a damage for a tissue & I want to synthesize a new CT, فمهم 2, fibroblast-الكامل.

* Fibro- = fiber. -blast = forming.

Fibroblasts: the active form

Fibroblast

→ what are the features of a fibroblast?

- Abundant irregularly branched cytoplasm

كمية كبيرة
منه اليتوبلازم
يكون على تفرعات كثيرة

- Large, pale-staining nucleus with prominent nucleolus
- Rich in RER (rough endoplasmic reticulum)
- Golgi apparatus well developed

Features of all protein producing cells

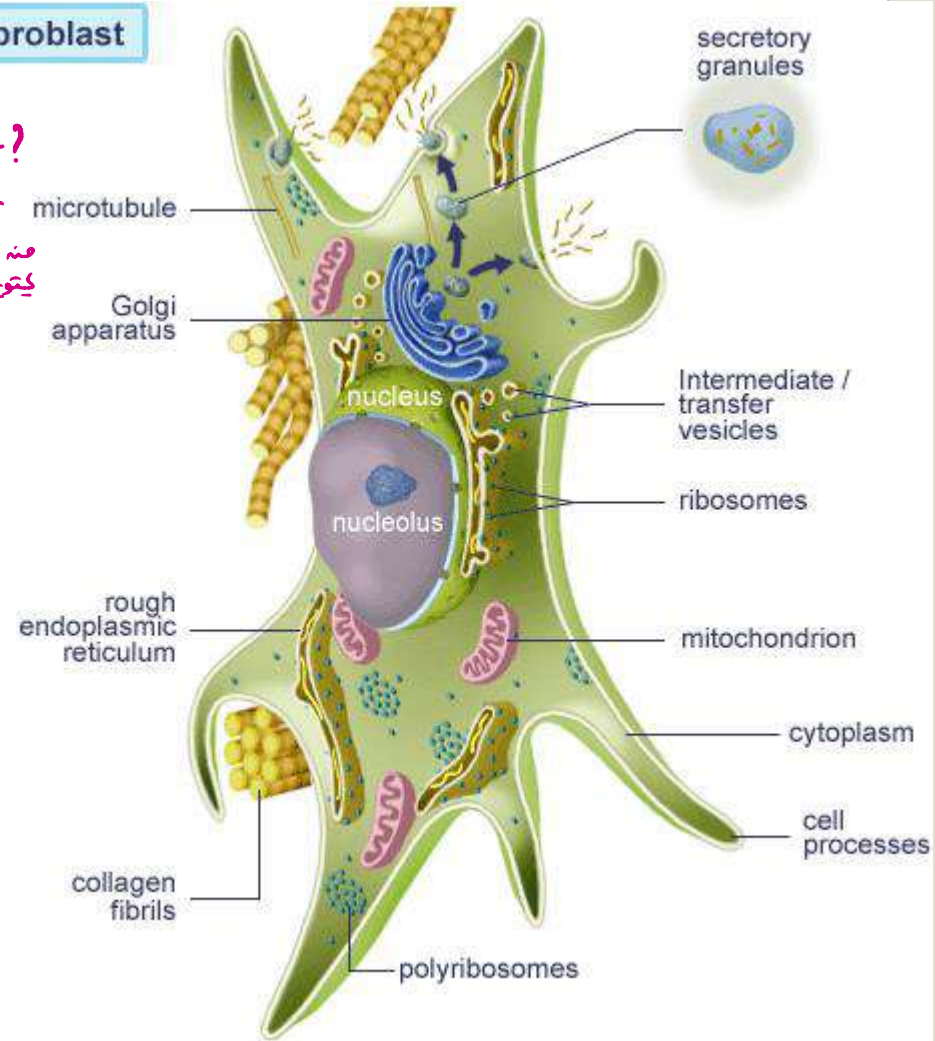


Fig.2: Histological features of fibroblasts.

* any cell that produces proteins will have these features and any cell that have these features we should suspect that it synthesizes proteins

Fibrocytes: *Inactive form*

- Smaller than fibroblasts.
- Less cytoplasmic processes.
- Nucleus smaller and darker.
- Less RER.

⇒ *not actively producing proteins.*

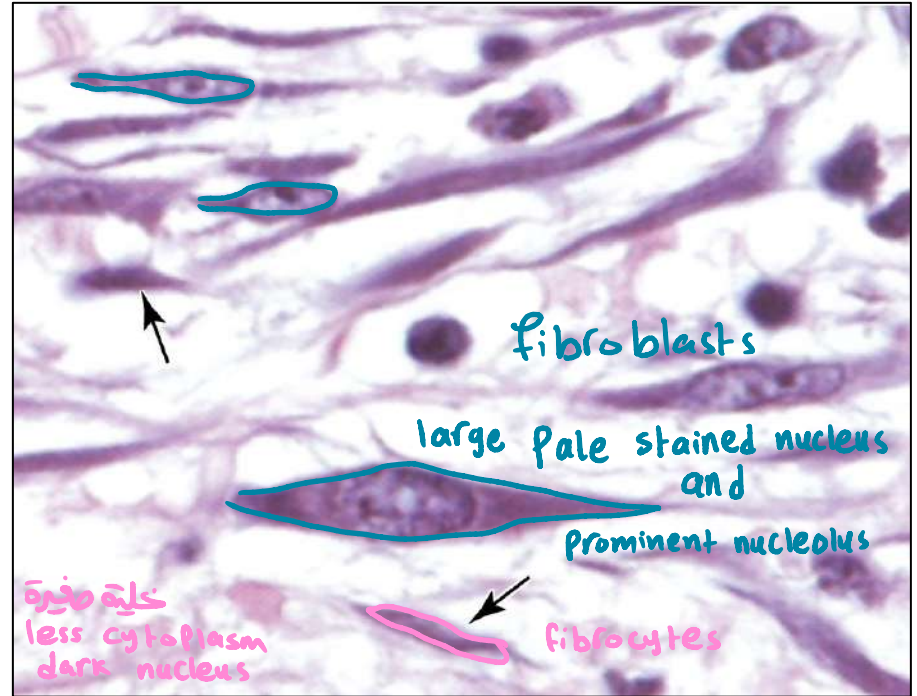


Fig.3: [Fibroblasts and fibrocytes] (arrows).

- Myofibroblasts: *they can contract* Fibroblast cells with **contractile ability. Important in [wound contraction]**

(لوقف بنظوه) - Important in wound healing
 جروح بسيطة "micro wounds"

لوهار عندي جرح في جسم الانسان،
 the edges of the wound will separate from each other, this is not allowed in the body, why?
 لأنه بين توجد edges عند بعض يصير تراخي يجب أن يُملأ لأنه إذا فُقدت العزائ
 It could be filled with the wrong type of tissue

-cyte = cell. Myo- = related to muscles, from greek *mys* = mouse (because movement of muscles resembles mice). 7

So when I have the 2 edges separated from each other the myofibroblast will come to the wound & extend their processes & touch the edges & contract so they will approximate (pull) the edges together until they touch each other

2) Macrophages and the Mononuclear phagocyte system

system

: a group of cells

- they have a single nucleus
- these cells are derived from mono cytes

Perform phagocytosis

So these are a group of cells that perform phagocytosis & are derived from mono cytes.
one of these is: macrophages

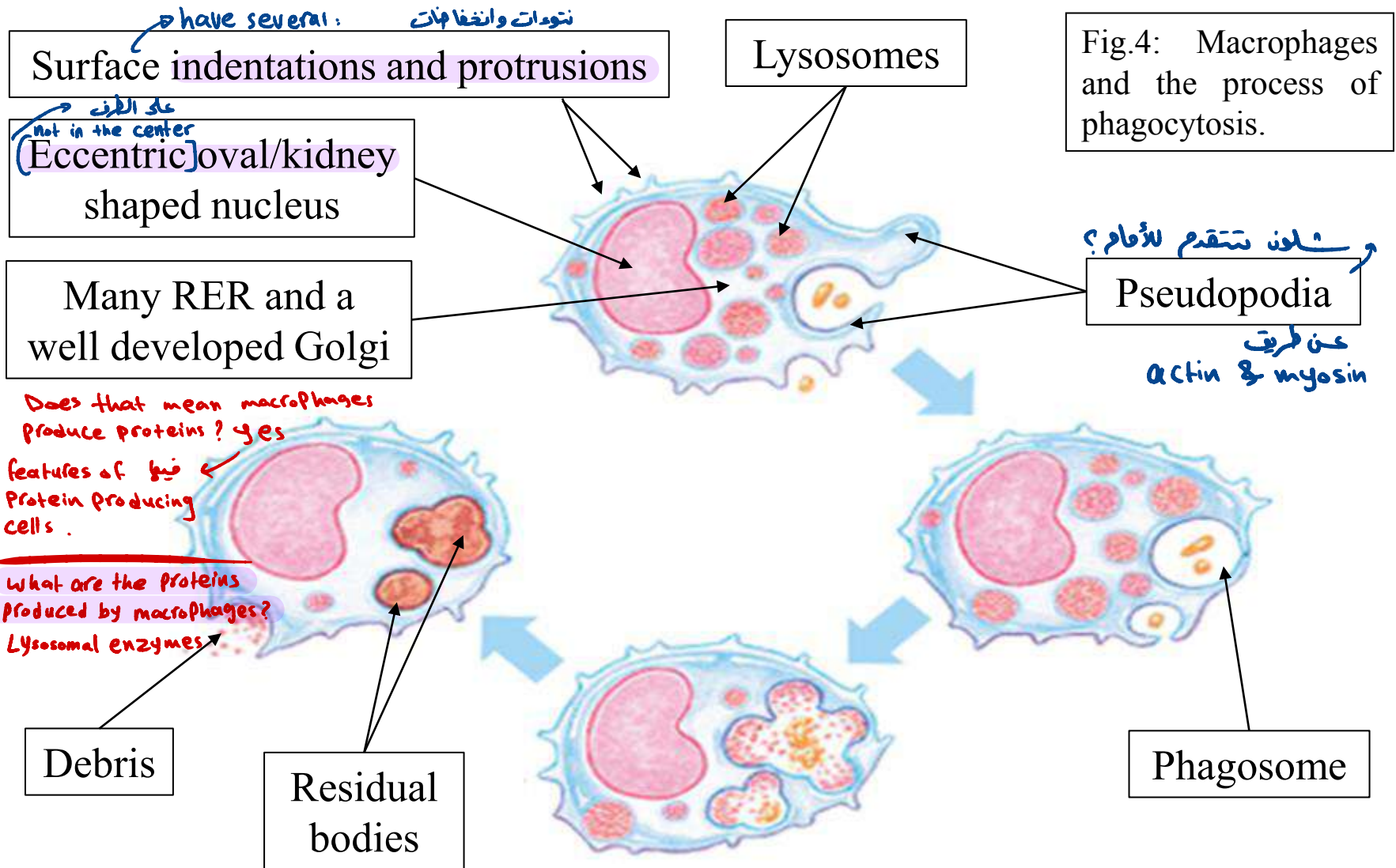
- *a type of WBC* Monocytes form in the bone marrow.
Circulate in the blood
- Travel with blood and enter the connective tissues by passing through capillary walls.
inside CT monocytes are activated, so they will convert to macrophages.
- Activated monocytes will form several types of phagocytic cells in tissues.
- Macrophages in different tissues are given different names.

- الخلايا التي موجودة بهذا ال System تتشاور مع بعض بال histology وتقوم بنفس الوظائف ولكنه نطلق عليها أسماء مختلفة بالأماكن المختلفة :

- Connective tissue Proper : Macro Phages
- Liver : Kupffer cells
- skin : Langerhan cells

متشابهة بالبنية والوظيفة
لكن غير متجانسة
but they all formed by
the same method

Macrophages



the process of Phagocytosis:

When macrophages recognize a foreign particle they will extend cytoplasmic projections called pseudopodia, these pseudopodia will surround foreign particle leading to the formation of a phagosome. This phagosome is internalized or moves inside the cell, lysosomes will combine with the phagosomes, the lysosomal enzymes will destroy the foreign particle (they will digest it).

Residual bodies

الجزء المتبقي يمكن يبق داخل الخلية بسميه

ويعني ينقرز اي الكارج و بسميه Debris

Macrophages have receptors, foreign particles \rightarrow receptors \rightarrow هذه
to produce 2 cytoplasmic projections \rightarrow هذا الاتحاد يحفز الخلية

foreign particle \rightarrow Pseudopodia \rightarrow ١١ تنمو ويحيط بال foreign particle \rightarrow فأصبح ال foreign particle

Phagosome \rightarrow ٢١ طبقة من Cell membrane \rightarrow ٢٢ أصبح Phagosome
lysosome \rightarrow ٢٣ تتحد مع lysosomes مع Phagosome \rightarrow ٢٤ لانزيمات تدمر lysosome
foreign particle \rightarrow ٢٥ تنقرز داخل Phagosome وتدمر foreign particle

Lungs, liver, skin → *أول أماكن التعرض*
exposure to foreign particles

موجودة بالظهور الأول للدفاع

Functions of Macrophages:

1) Phagocytosis (microorganisms, neoplastic cells, dead cells, debris, and abnormal extracellular elements).

2) Destruction of (red blood cells) (metabolism of iron and hemoglobin).
have a certain life span, they are destroyed by phagocytosis

3) Antigen presentation to lymphocytes.
*when antigens enter the body, they have to be destroyed → lymphocytes عادة هذه وظيفة
تسمى lymphocytes لكيما تستطيع التعرف على antigen بشكل أفضل*

4) Release of cytokines and collagenases.

molecules that are released in inflammations

enzyme that destroys the collagen

so the first step is that when the antigen is taken up by macrophages & once it becomes inside the macrophages chemical changes will occur in the antigen once it is changed it will be released again & now lymphocytes can recognize this changed antigen & the immune reaction will stop.

3) Mast Cells

الكلية الأولى
في
allergic
reaction

- Large, oval or round cells. Cytoplasm filled with basophilic secretory granules.
- Nucleus small, spherical and centrally located (may be obscured by granules).

the nucleus is basophilic & the granules in mast cells are basophilic
هذا وعادة ما يتخذ اللون الأزرق
عادة ما يشترك nucleus لأنها تفسد لون granules

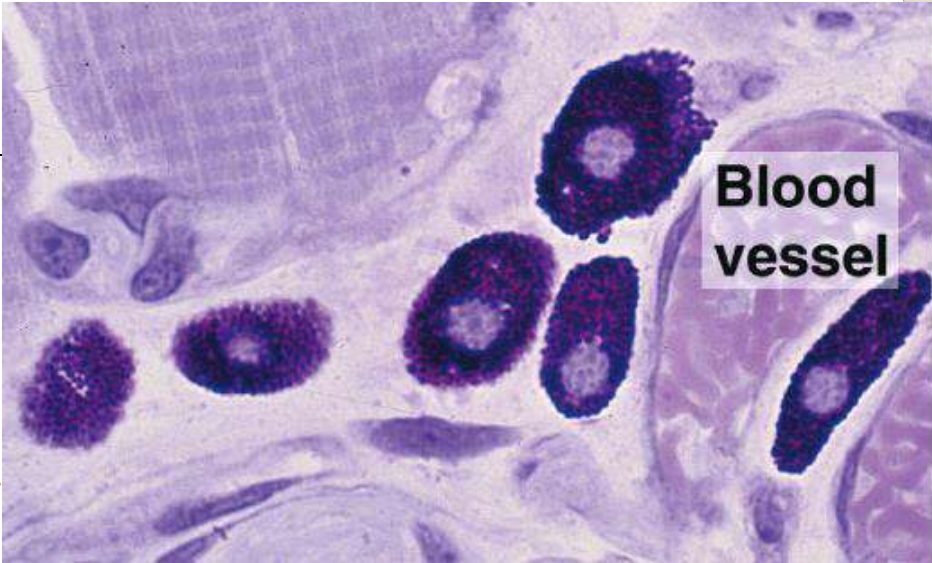


Fig.5: Mast cells. Note how the cytoplasm is intensely basophilic.

- Depending on what's contained in their secretory granules, mast cells may change the blue color of basic dyes into a different color — **metachromasia**.
- Function:** Release of heparin, histamine, and various inflammatory molecules. Important in inflammatory and allergic reactions.

Produce different types of chemicals:

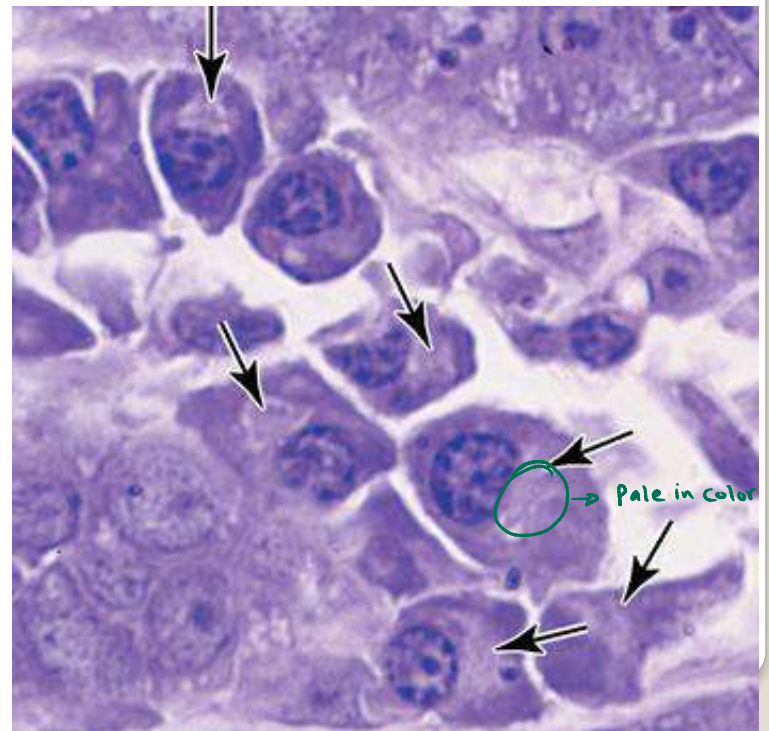
heparin (anticoagulant) histamine (most imp. responsible for allergies)

different types of molecules & each different type of molecule will react differently with the dye.

4) Plasma Cells

- ❑ Large, ovoid cells with basophilic cytoplasm because it's rich in RER (no secretory granules). Golgi and centrioles occupy a juxtannuclear position and appear pale. *in color*
- ❑ Nucleus spherical and eccentric. Has dark peripheral regions alternating with lighter regions (clock-face appearance).
فيها منطقة غامقة منطقة فاتحة
- ❑ Short life span (10-20 days). *تقوم بوظيفة معينة ثم تتراخي*
- ❑ Derived from (B-Lymphocytes)
- ❑ Function: *تقوم بوظيفة معينة ثم تتراخي* activation of antigen, once they are activated they will turn into plasma cells & plasma cells will form antibodies.
production of Antibodies.

Fig.6: Plasma cells. Note: basophilic cytoplasm, juxtannuclear pallor (arrows), and the clock-face appearance of the nucleus.



Fibers of the Extracellular Matrix

- Formed from proteins that polymerize into elongated structures.
- The 3 main types are:
 - 1) *Collagen fibers* (from protein Collagen)
 - 2) *Reticular fibers* (from protein Collagen)
 - 3) *Elastic fibers* (from protein Elastin)

1) Collagen Fibers

⇒ * الأنواع بروتين موجود في جسم الإنسان

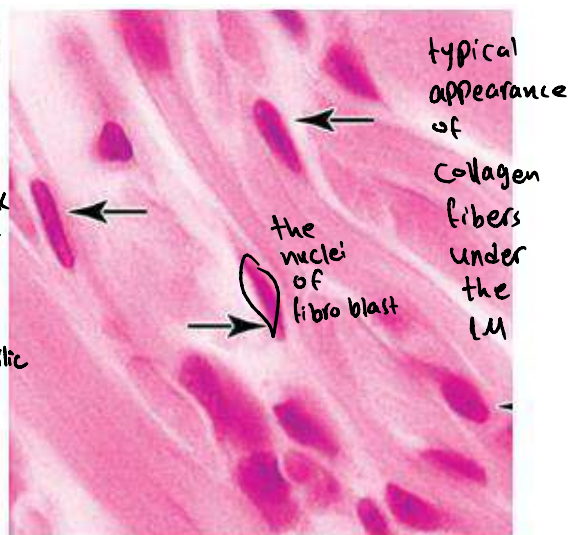
the most abundant type of protein in the human body

- Present in different tissues: skin, bones, cartilage, basal lamina, ligaments, and tendons. They give strength to the tissue.
- Several types of collagen protein exists.
- Collagen ^{time from formation until destruction} **turn-over** is slow in some organs, like ^{long turn-over: long life span} **tendons** & ^{ligaments} where the collagen is stable. In the ^{short turn-over} **periodontal membrane**, collagen has a high turn-over rate.

⇒ ^{الأشياء يربط الأسنان بتجويف الأسنان} ^{الموجودة في الفك العلوي والسفلي} ^{Periosteal membrane} ^{الأشياء محفة المخاطات كثيرة بالتالي} ^{هذا هو سبب} ^{أنه يتجدد} ^{في وقت قصير} ^{collagen fibers} ^{for a lot of} ^{محرض} ^{may be destroyed} ^{pressure (force)} ^{easily}
- Collagen fibers may be in the form of ① thick bundles (as in tendons and ligaments), ② fibrils (as those that anchor the basal lamina to underlying tissues), or ③ networks.

(a) LM

they appear red/pink in color because they're acidophilic

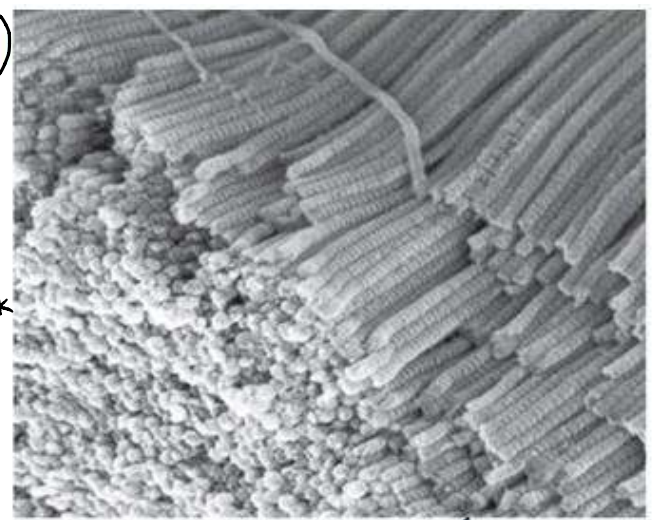


typical appearance of collagen fibers under the LM

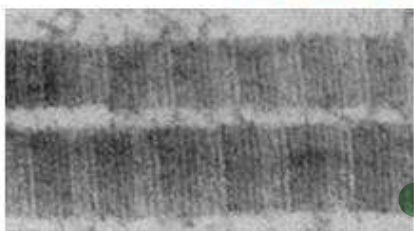
the nuclei of fibro blast

(c) SEM

الكفول الرفيعة fibrils
alternating light & dark areas
لكنه تين بار SEM

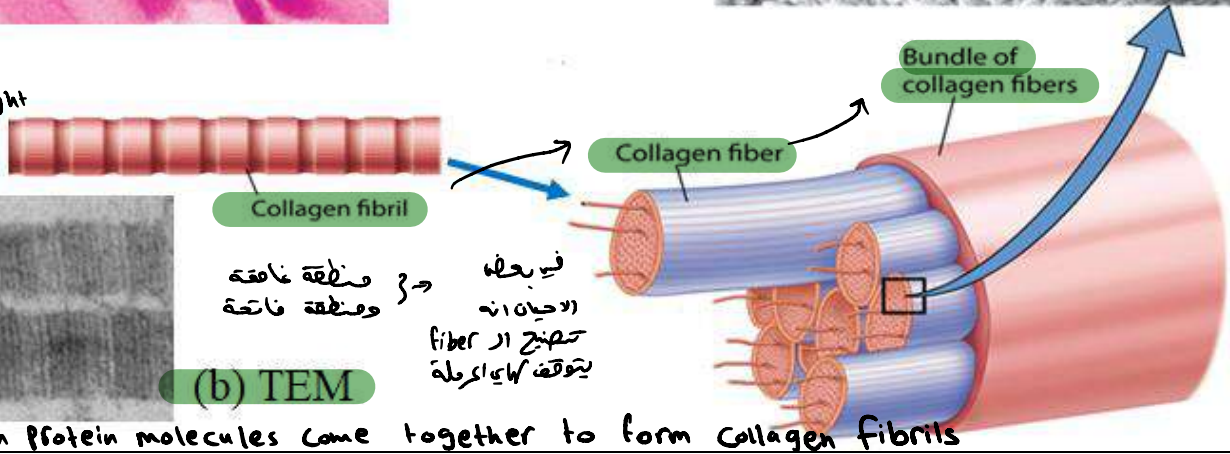


they are characterized by alternating dark & light areas



(b) TEM

منطقة فاتحة
منطقة غامقة
فibrils
الاصباح
تتوقف كما انظمة
fiber



Collagen protein molecules come together to form collagen fibrils

Fig.7: Collagen fibrils, fibers, and bundles. Molecules of collagen protein form collagen fibrils with alternating banding. Several fibrils form a fiber. In some organs, several of these fibers form a bundle. (a) Typical acidophilic appearance of collagen fibers under the LM (arrows indicate nuclei of fibroblasts). (b) TEM image of fibrils, note the banding. (c) SEM of the numerous fibrils in a fiber (the banding can also be seen).