Edited by:
Mona Moubarak

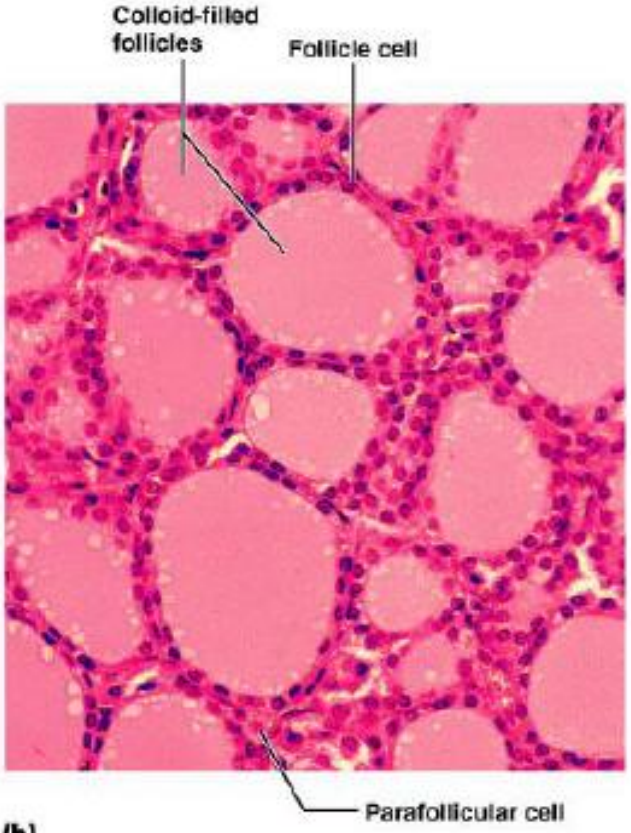
THYROID GLAND

It's unique in terms of storing its products, it has a space called follicle where it stores its hormones. It has its importance in the manifestation of the diseases of the gland.

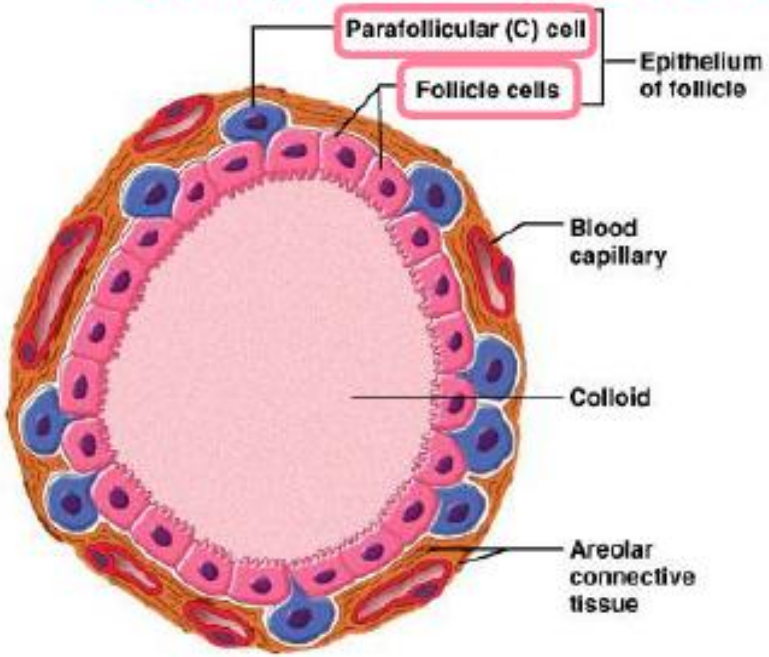
The thyroid gland is the only endocrine gland that stores its secretory product in large quantities—normally about a 100-day supply.

Storage for 100-days means that : some diseases of the thyroid gland may go subclinical without knowing that the storage is going down , until it reaches severe limits of decreased amounts of products. So the treatment of the thyroid gland to be able to work again is : to refill the follicles with the hormones.

Thyroid gland is an endocrine gland so its structure should be fibrous capsule surrounding an aggregation of epithelial cells. But as we said thyroid gland is unique because it's storing its products, so it will have a different arrangement which is the follicles.



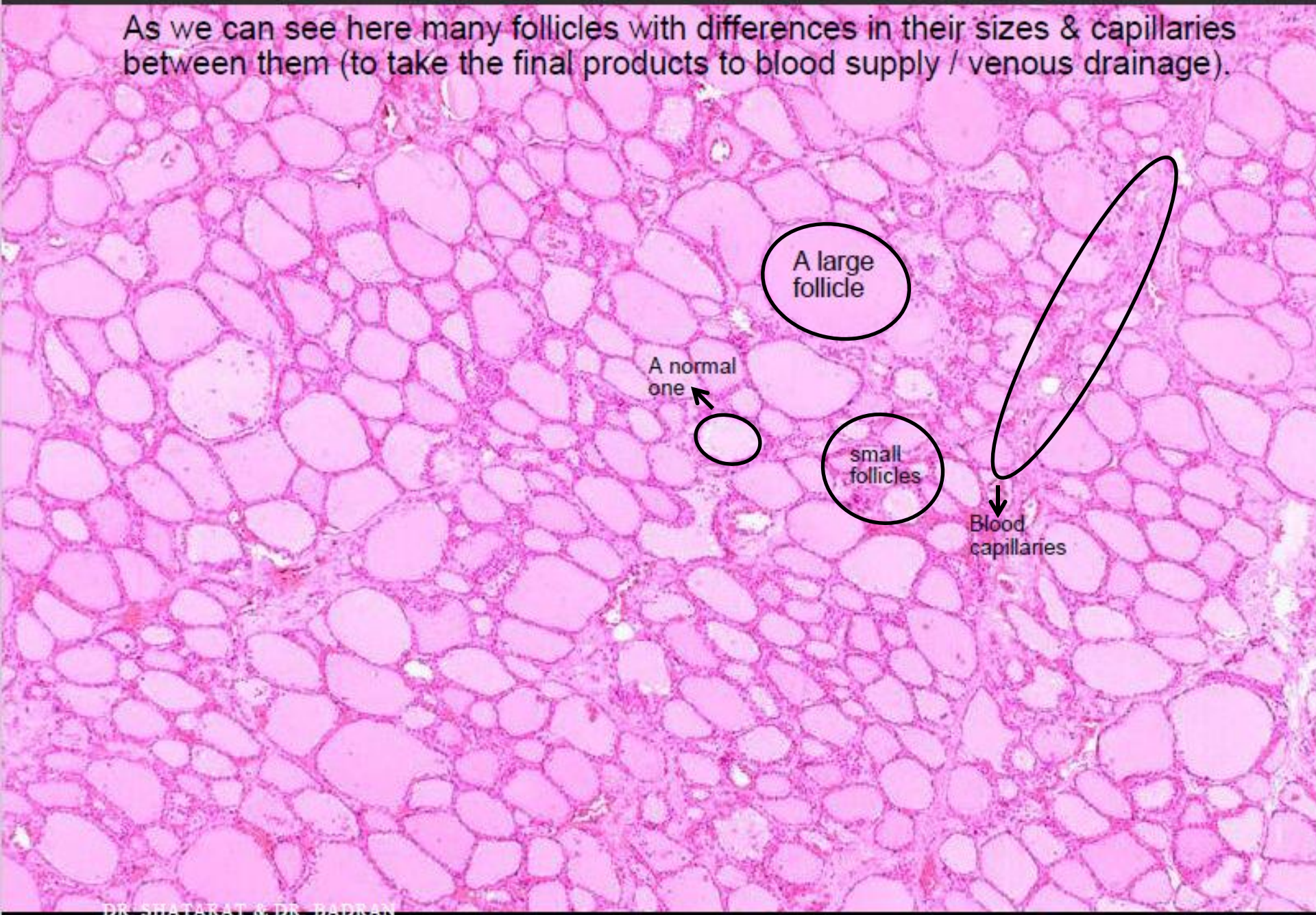
It is composed of 2 types of cells:

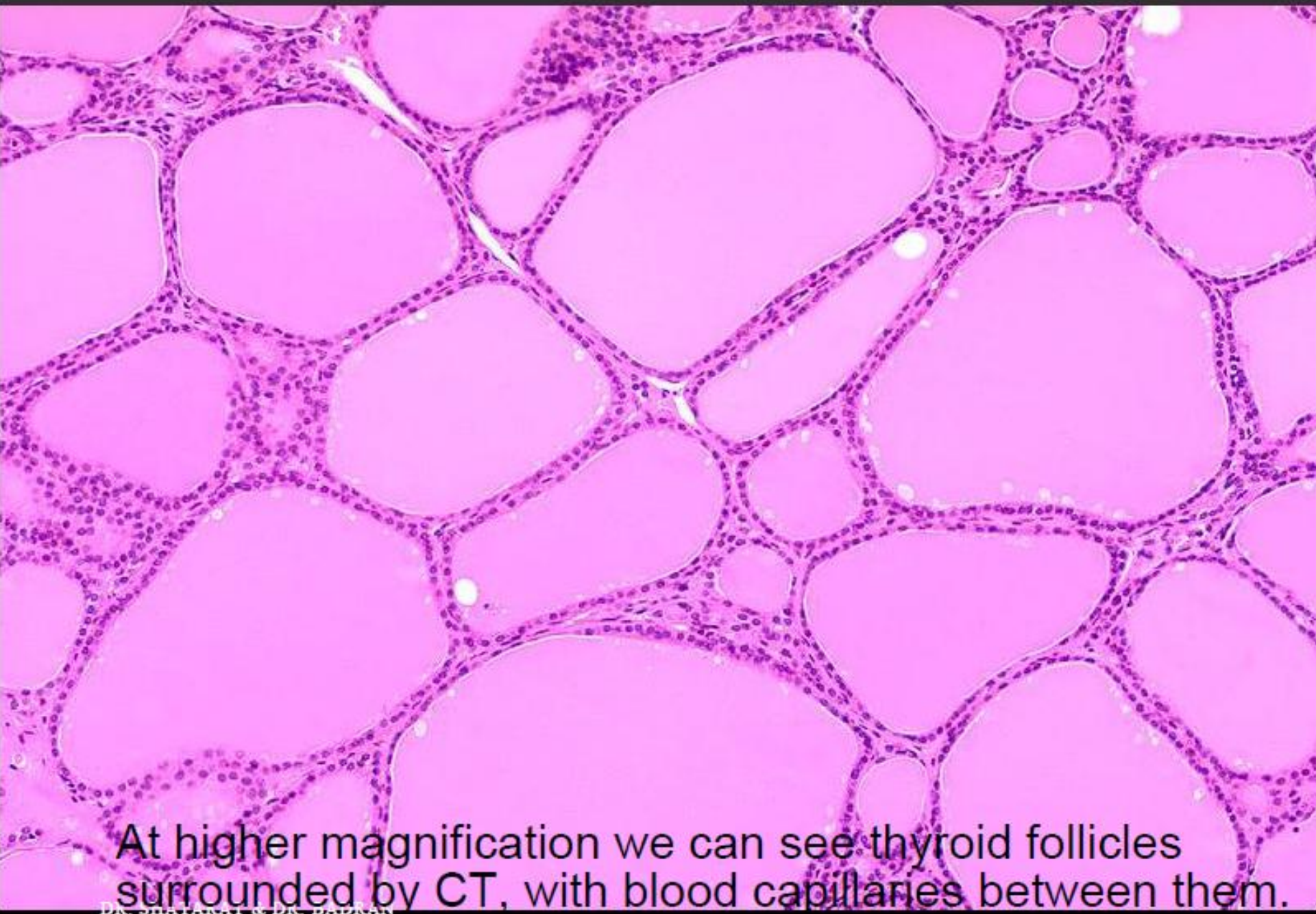


Thyroid follicle:

- The structural and functional unit of the thyroid gland.
- Consists of a group of cells (which are follicle cells and they make the walls of the follicle) resting on the same basal lamina surrounding a lumen filled with colloid. (where the products of the gland is stored).
- The follicles are variable in size.
- Hormones are stored in the follicles.
- Each follicle is surrounded by variable amount of connective tissue.

As we can see here many follicles with differences in their sizes & capillaries between them (to take the final products to blood supply / venous drainage).





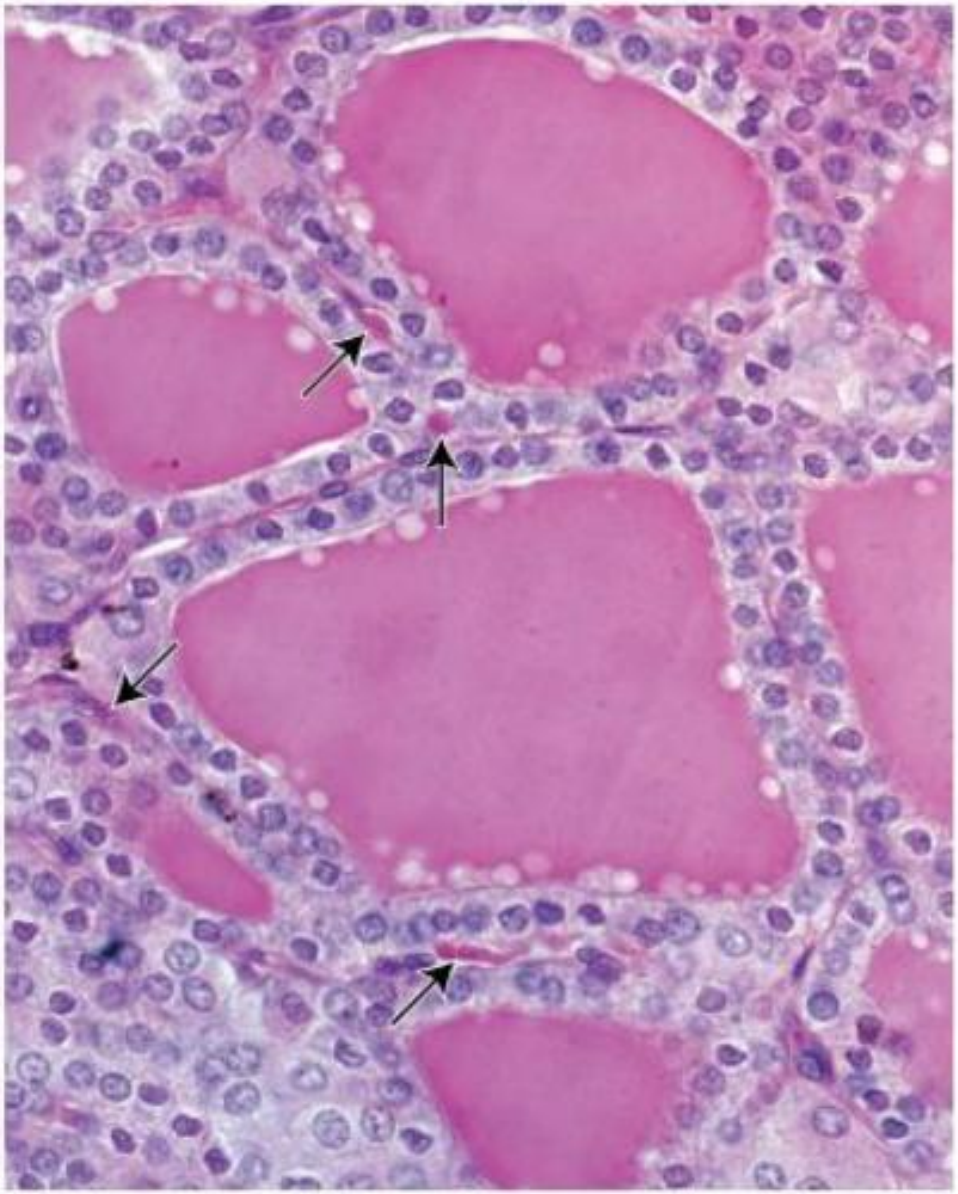
At higher magnification we can see thyroid follicles surrounded by CT, with blood capillaries between them.

First type of cells:

Follicular cells (principal cells):

- Squamous-columnar cells according to activity.
- Basophilic cytoplasm.
- Nucleus: round-ovoid with 2 nucleoli.
- Many rER.
- Numerous apical lysosomes and mitochondria.
- Supranuclear Golgi complex.
- Apical microvilli.
- Numerous vesicles in the cytoplasm.

we may find them at normal conditions varying from being squamous (short) to columnar cells (longer) depending on the activity of the gland.



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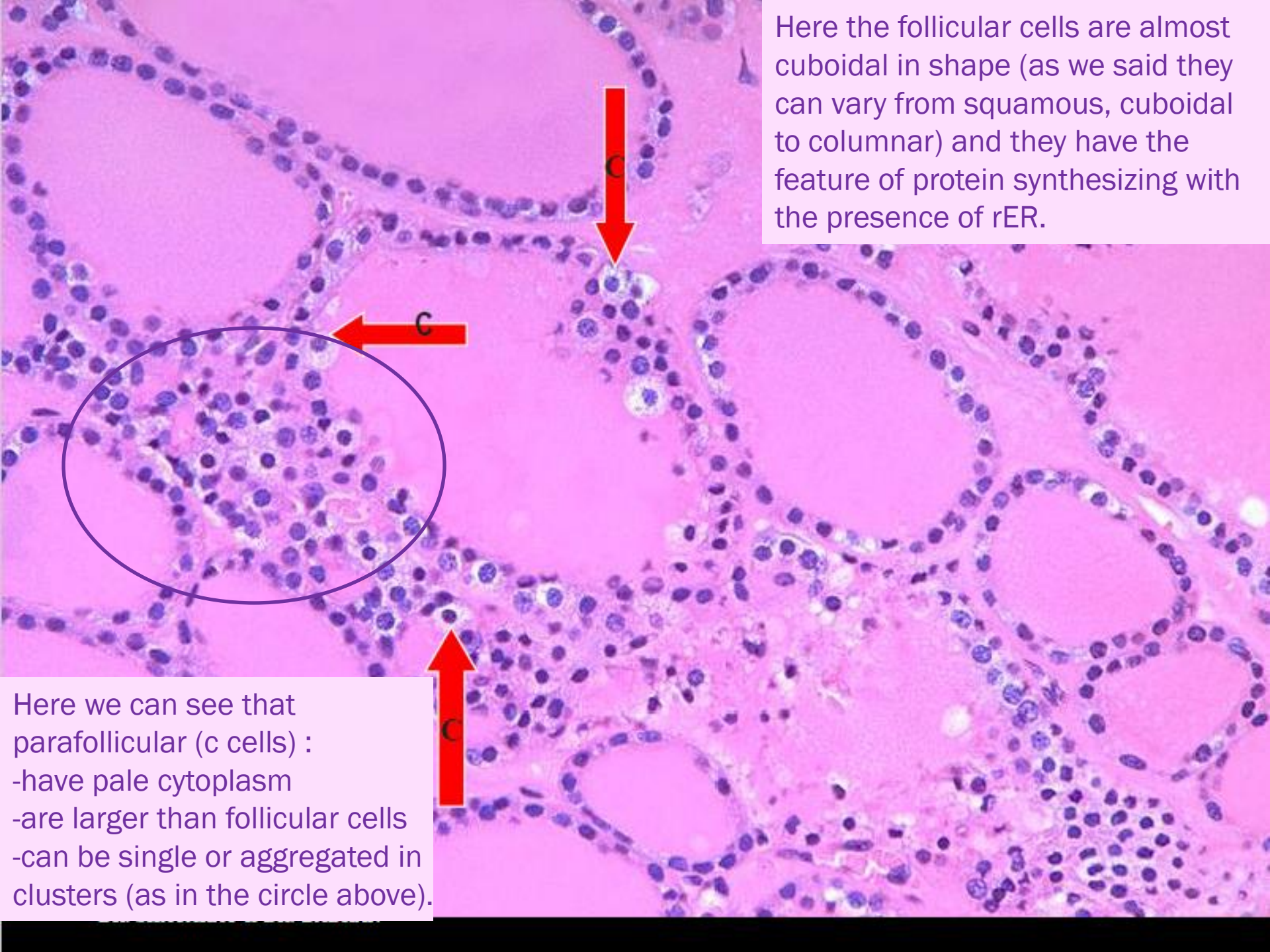
Second type of cells:

Parafollicular cells (Clear cells, C cells):

- Pale staining, larger than follicular cells.
- Occur singly or in clusters among follicular cells.
- Overlapped by follicular cells.
- E.M:
  - Moderate rER.
  - Well-developed Golgi.
  - small, dense, basal secretory granules.
- Secrete calcitonin:
  - Inhibits bone resorption by osteoclasts.
  - Stimulated when Ca^2 is high.



Here the follicular cells are almost cuboidal in shape (as we said they can vary from squamous, cuboidal to columnar) and they have the feature of protein synthesizing with the presence of rER.

Here we can see that parafollicular (c cells) :
-have pale cytoplasm
-are larger than follicular cells
-can be single or aggregated in clusters (as in the circle above).

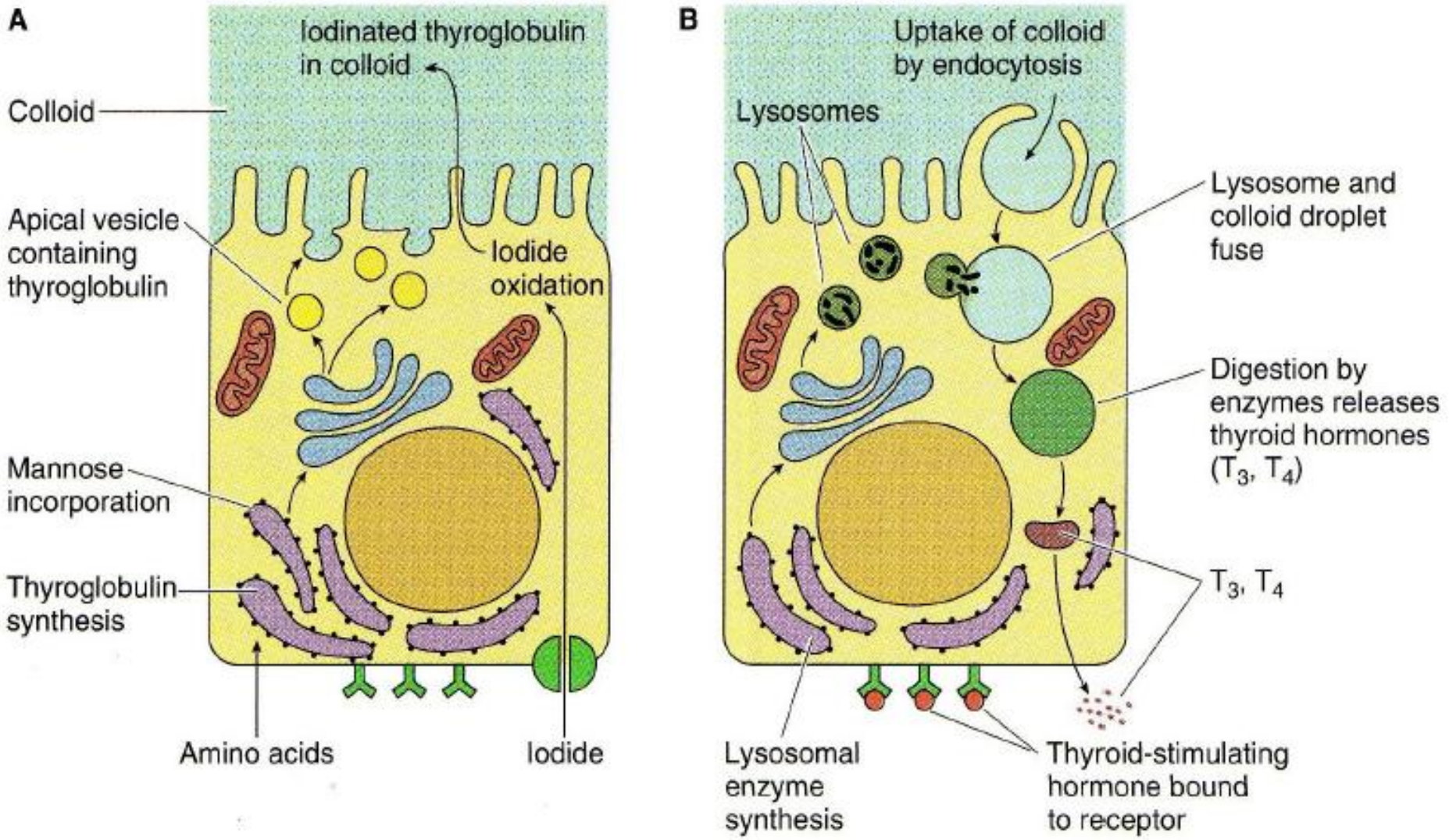
We mentioned in the last lecture the fact that the thyroid gland is made out of 2 origins in terms of embryology :

- 1. originally the thyroid gland is an endodermal thickening from the floor of the pharynx between tuberculum impar & the copula , then it descends down.
- 2. the second origin is coming from the 5th pharyngeal pouch as neural crests, they migrate and settle themselves in the 5th arch in the shape of ultimobranchial bodies then they migrate into thyroid gland and they don't integrate in the follicle instead they sandwich themselves between the already existed follicles, because of that the 2nd type of cells of the thyroid gland are not mixed with the follicles (rather they are between them) because of that they're called interstitial / parafollicualr cells (para= neighbor , because they are neighboring follicles).

so surely the 2 types of cells are having different function & they secrete different hormones .

The thyroid gland is made of aggregation of follicles that are made of principle (follicular) & parafollicular (c cells) and they are surrounded by CT .

This is the only difference between the thyroid gland and other glands in terms of storing its products in colloids.

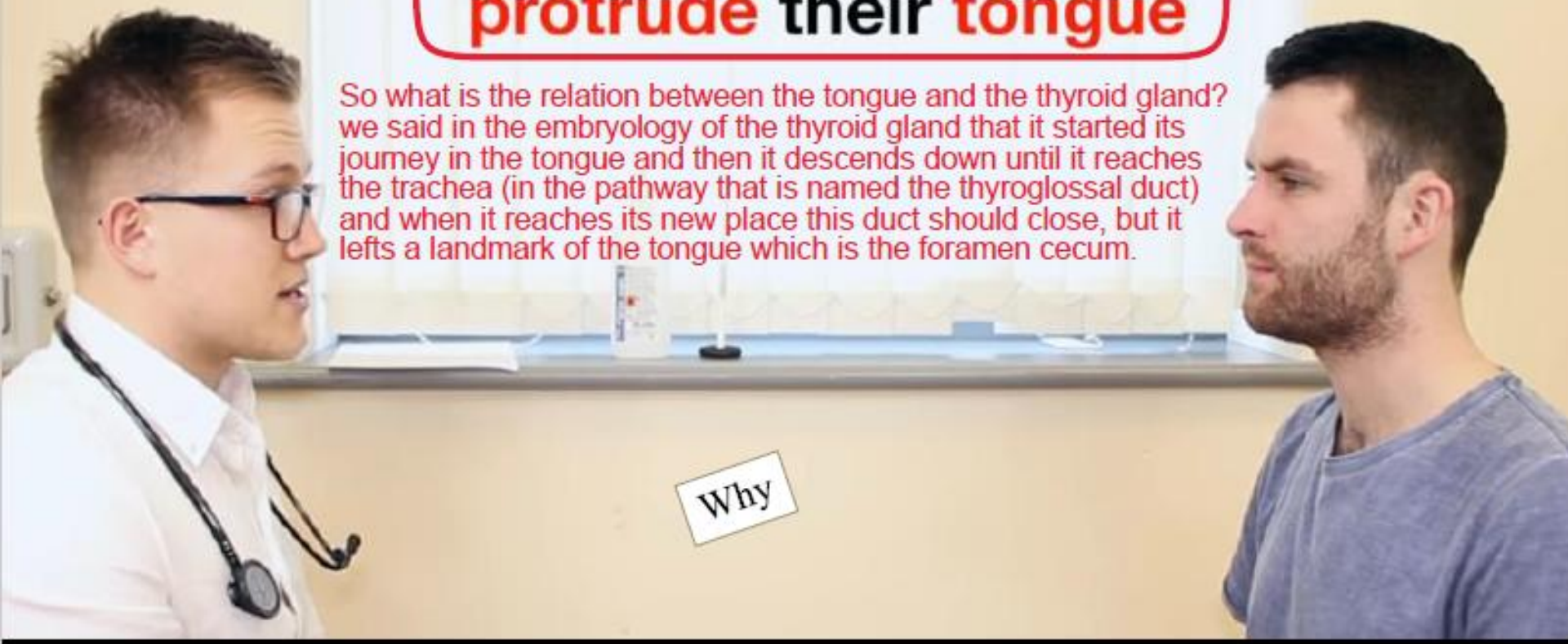


The doctor didn't say anything about this slide

Now here is the most important features to test the thyroid gland :

Ask patient to protrude their tongue

So what is the relation between the tongue and the thyroid gland? we said in the embryology of the thyroid gland that it started its journey in the tongue and then it descends down until it reaches the trachea (in the pathway that is named the thyroglossal duct) and when it reaches its new place this duct should close, but it lefts a landmark of the tongue which is the foramen cecum.



Sometimes and due to many factors the thyroid gland may arrest its journey or the thyroglossal duct may not close and thyroglossal cyst may develop.

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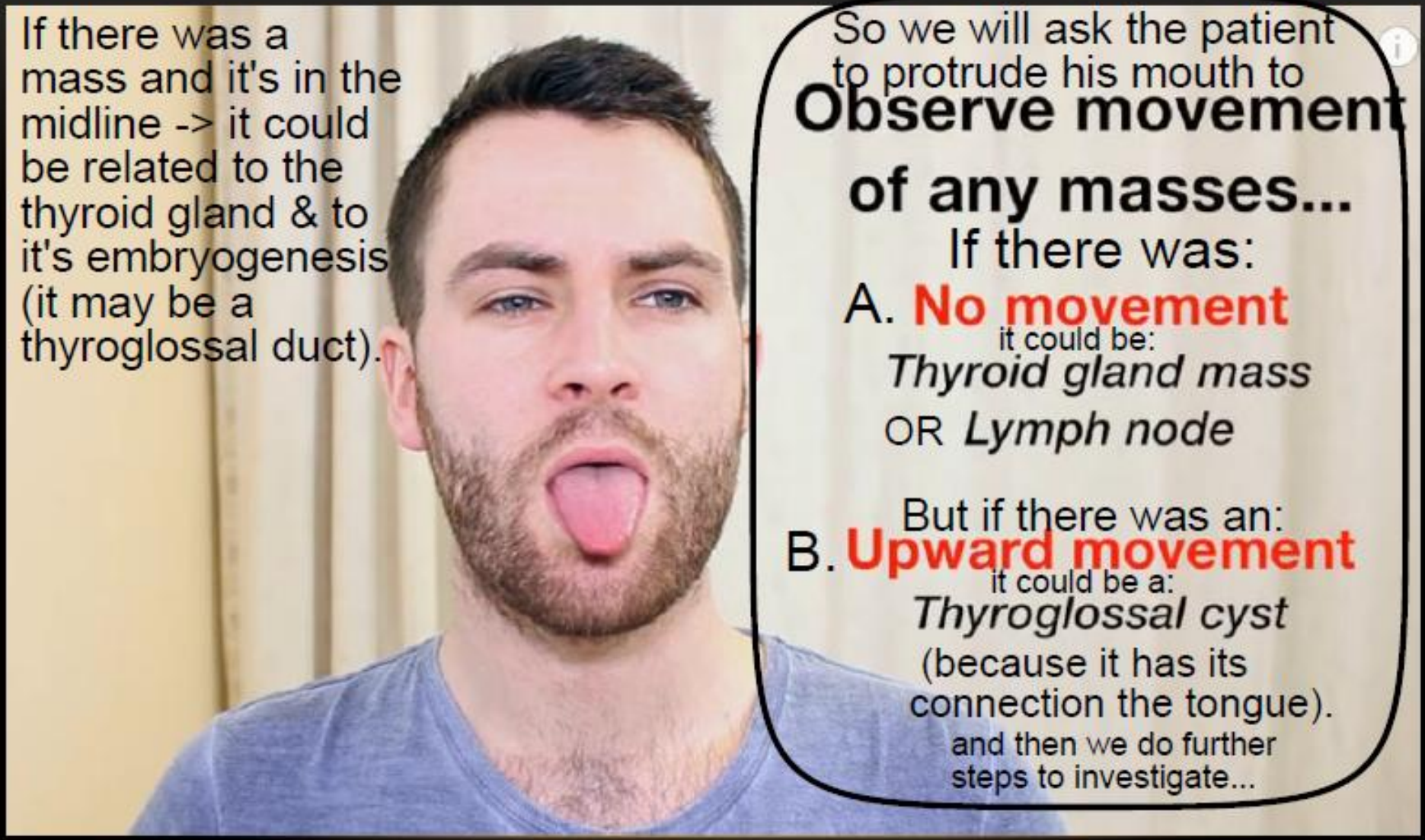
If there was a mass and it's in the midline -> it could be related to the thyroid gland & to it's embryogenesis (it may be a thyroglossal duct).
So we will ask the patient to protrude his mouth to
Observe movement of any masses...
If there was:
A. No movement
it could be:
Thyroid gland mass
OR Lymph node
But if there was an:
B. Upward movement
it could be a:
Thyroglossal cyst
(because it has its connection the tongue).
and then we do further steps to investigate...

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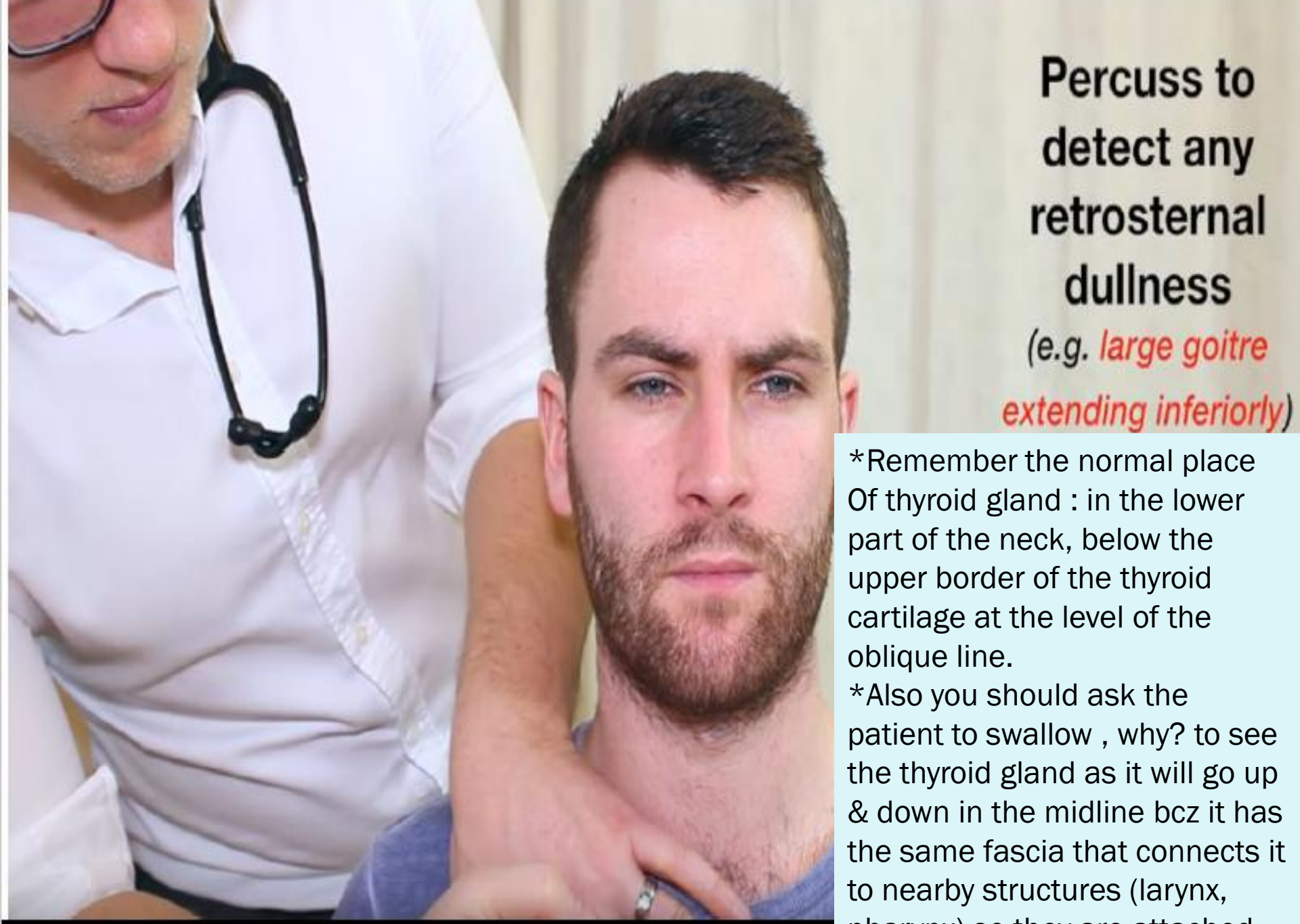
PERCUSSION

We said that normally developed thyroid gland which has been exposed to any disease / mass, the enlargement can't go up (because of the fascia & the muscles) but it can easily descend downward & reach the manubrium (plunging/ restrosternal goiter). Also you'd be asked to do percussion on the manubrium of the sternum , to detect retrosternal dullness , because that area have special sound but when the thyroid gland is there, this sound would be changed into a dull sound = there is something lined behind the manubrium which could be the thyroid gland .



*Remember the normal place Of thyroid gland : in the lower part of the neck, below the upper border of the thyroid cartilage at the level of the oblique line.

*Also you should ask the patient to swallow , why? to see the thyroid gland as it will go up & down in the midline bcz it has the same fascia that connects it to nearby structures (larynx, pharynx) so they are attached to each other

PARATHYROID GLAND

Gross anatomy

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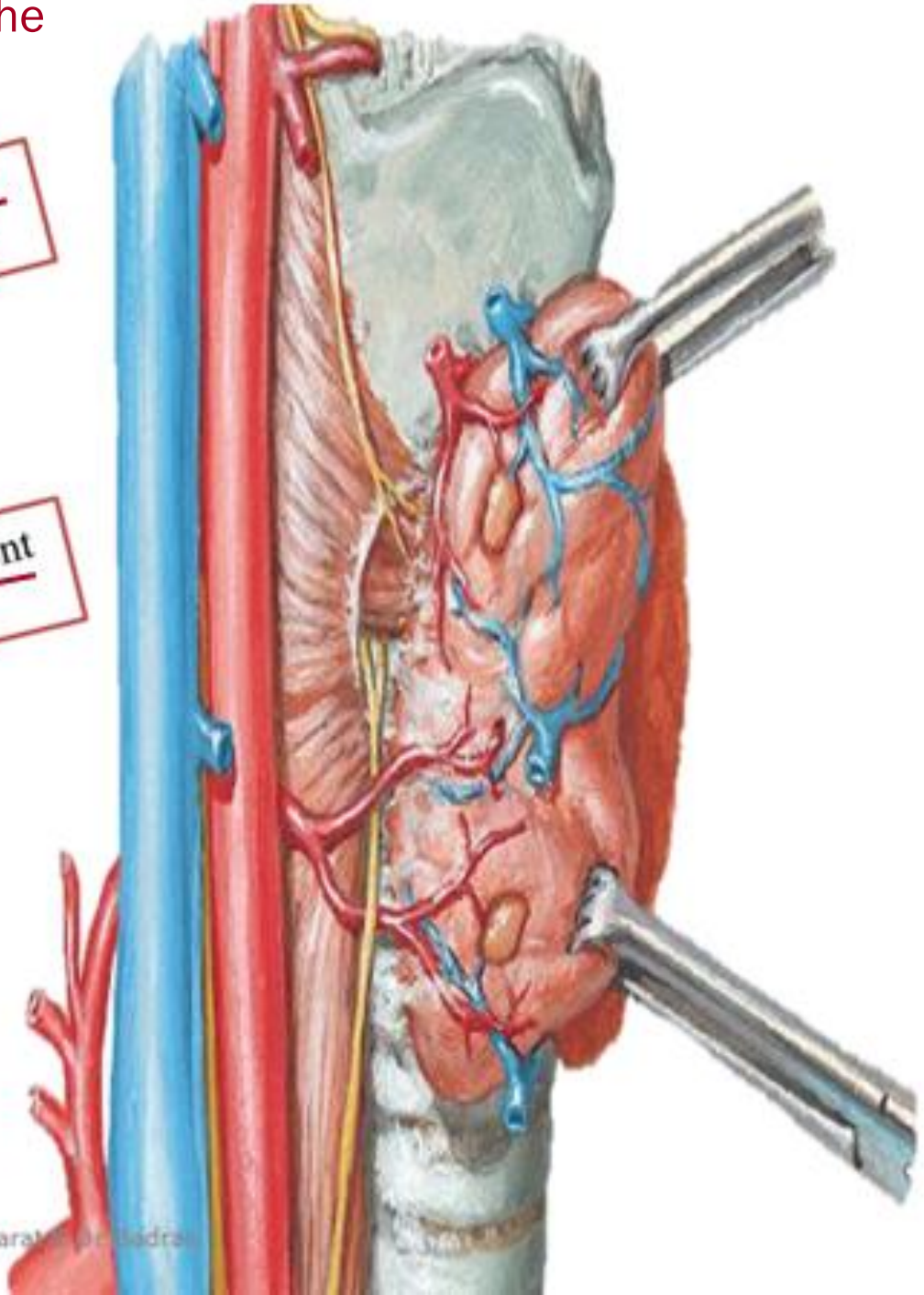
The **parathyroid** glands lie **posterior** to the **thyroid** gland, we should take care of them in thyroid gland **operations**.

Superior glands usually dorsal to the external laryngeal nerve at level of cricoid cartilage

Inferior glands located ventral to the recurrent laryngeal nerve.

We talked about these 2 nerves and their relations to nearby blood vessels :

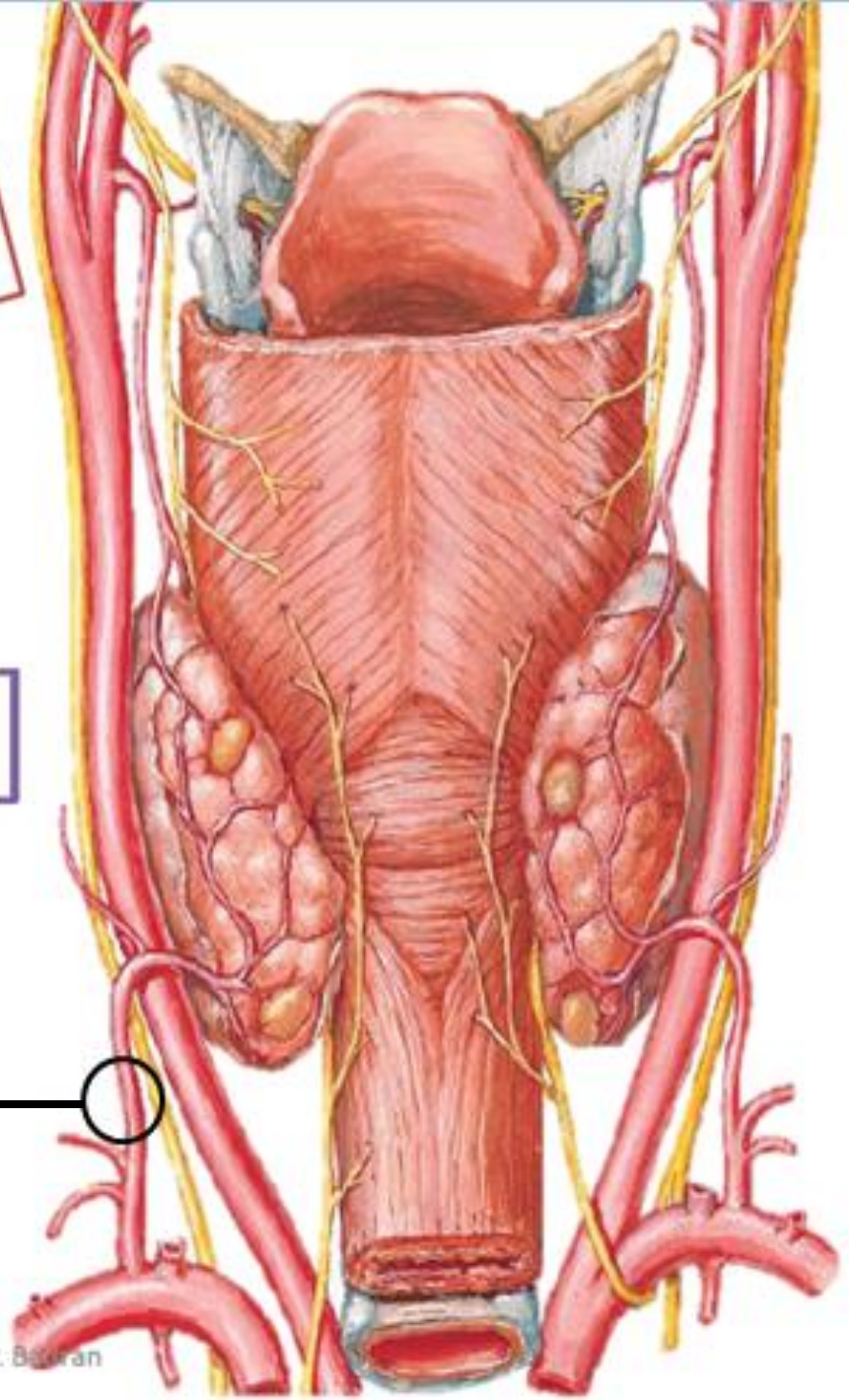
- **External** laryngeal near **superior** thyroid artery.
- **Recurrent** laryngeal near **inferior** thyroid artery.



Most of the blood supply comes from branches of inferior thyroid artery, although branches from superior thyroid supply ~ 20% of the superior gland

Glands drain ipsillaterally by superior, middle, and inferior thyroid veins.

→ Same as thyroid veins.



Here is **the inferior thyroid artery** coming from **subclavian** A -> **thyrocervical** trunk -> **inferior thyroid** A -> may reach superior parathyroid. Don't forget that **the recurrent laryngeal nerve** passes **near** this artery, so during any operation/thyroidectomy we **ligate** this artery **far away** from the gland.

NOW WE'LL TALK ABOUT THE EMBRYOLOGY OF THE PARATHYROID GLAND:

1st pouch -> tympanic cavity / austachian tube.

2nd pouch -> tonsillar fossa / palatine tonsils

3rd pouch-> ventral & dorsal wings- >2 glands:
*ventral wing -> thymus (different from thyroid)
*dorsal wing -> inferior parathyroid gland

4th pharyngeal pouch (also dorsal & ventral wings) :
*dorsal wing -> superior parathyroid gland - > descends downward + attach thyroid gland

^ As the thymus descend down it takes with it the parathyroid gland behind manubrium to superior mediastinum & anterior part of inferior mediastinum and stay there , in adult age it will be transformed to fat tissue .

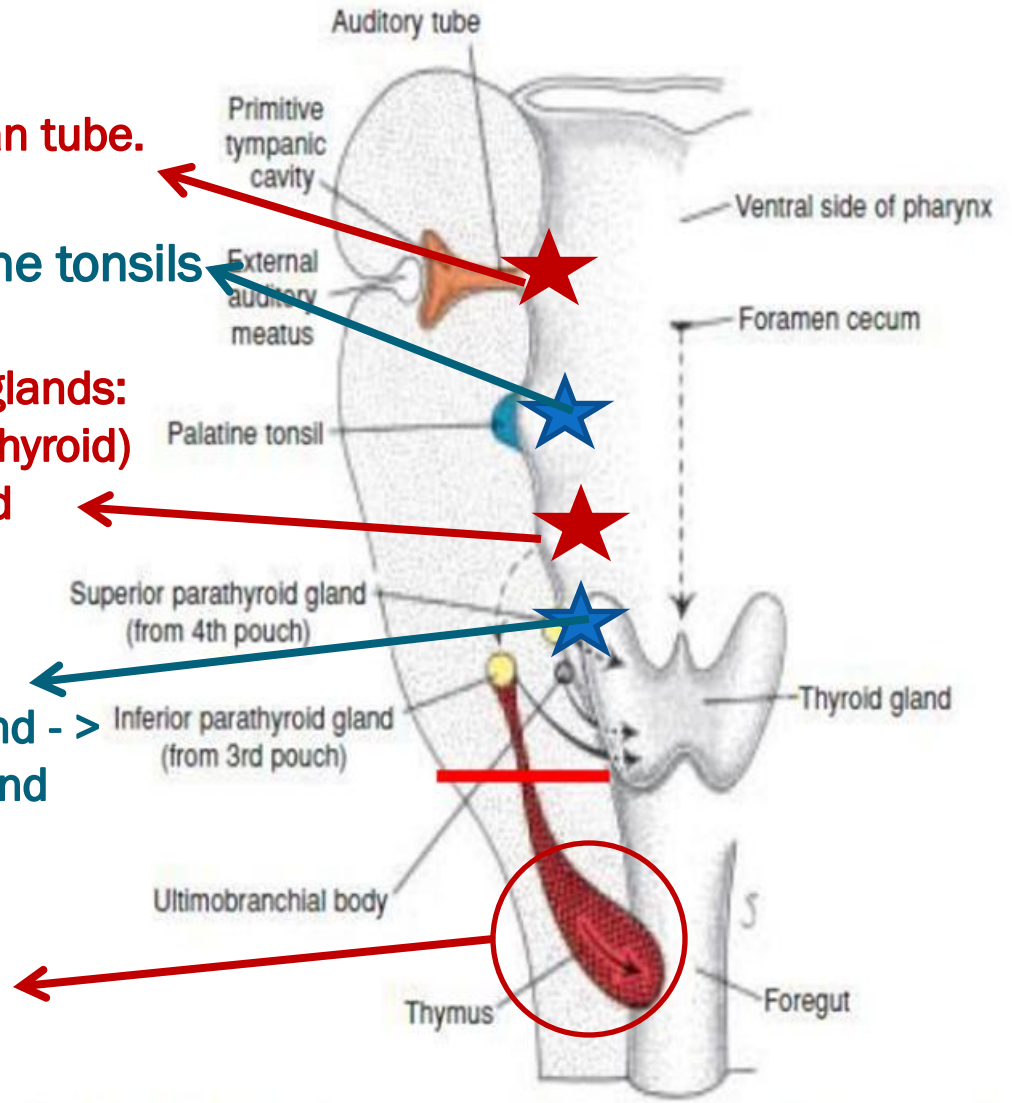


Figure 15.11 Migration of the thymus, parathyroid glands, and ultimobranchial body. The thyroid gland originates in the midline at the level of the foramen cecum and descends to the level of the first tracheal rings.

Embryology

Epithelium of the dorsal wing of the fourth pharyngeal pouch forms THE SUPERIOR PARATHYROID GLAND

In the fifth week, epithelium ***of the dorsal wing*** of the third pouch differentiates into **INFERIOR PARATHYROID GLAND** **while** the ***ventral wing*** forms THE THYMUS

Both gland primordia lose their connection with the pharyngeal wall, and the thymus then migrates in a caudal and a medial direction, pulling the **inferior parathyroid with it**

When the parathyroid gland loses contact with the wall of the pharynx, it attaches itself to the dorsal surface of the caudally migrating *thyroid* as the superior parathyroid gland

The inferior parathyroid glands occasionally migrate to the level of the aortic arch or, rarely, fail to migrate, remaining in the high neck.

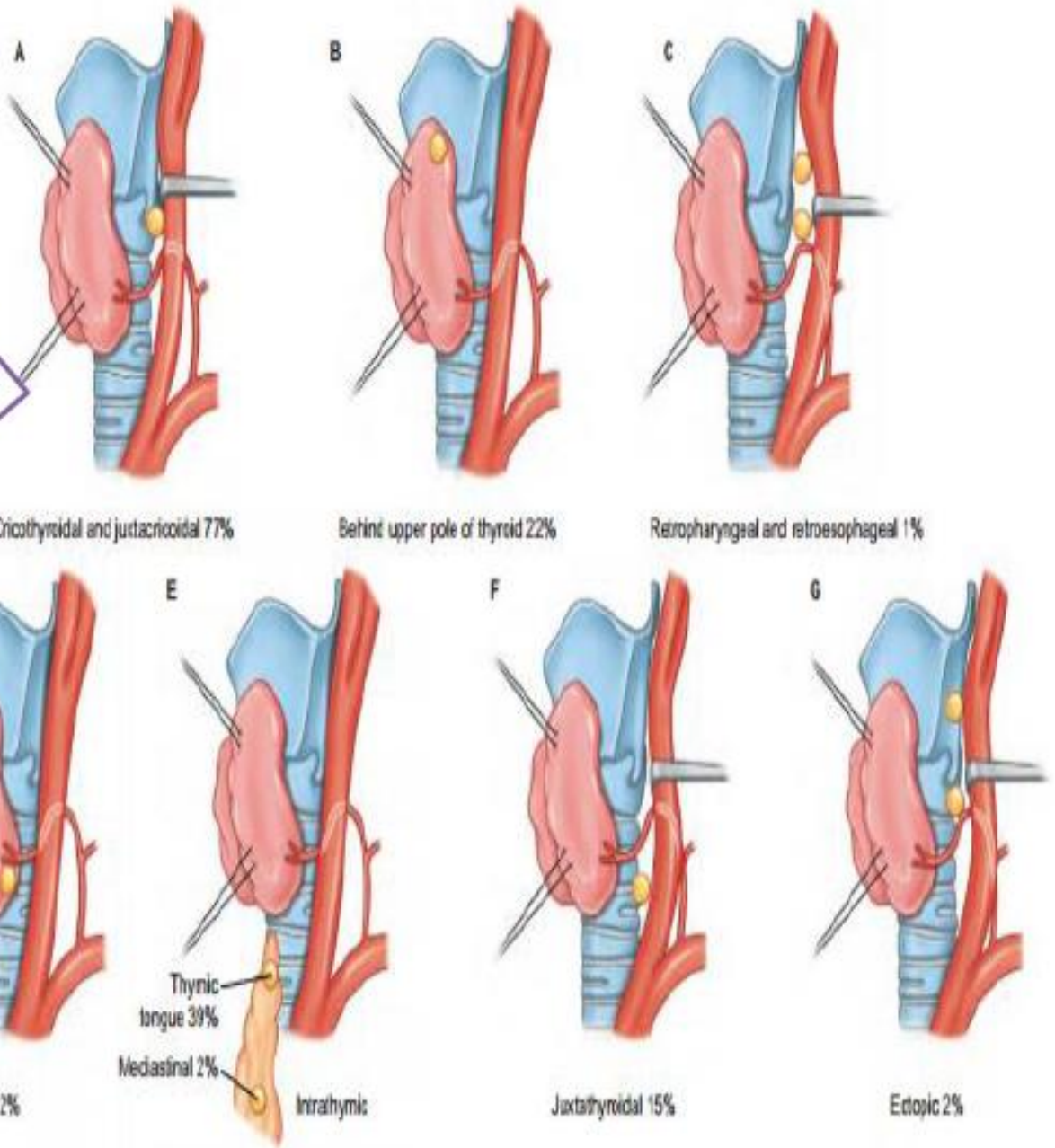


Fig. 28.23 Distribution of superior (**A–C**) and inferior (**D–G**) parathyroid glands. **A**, Cricothyroidal and juxtathyroidal; **B**, Behind upper pole of thyroid; **C**, Retropharyngeal and retroesophageal; **D**, Lower thyroid; **E**, Intrathymic; **F**, Juxtathyroidal; **G**, Ectopic.

Explanation in the next slide

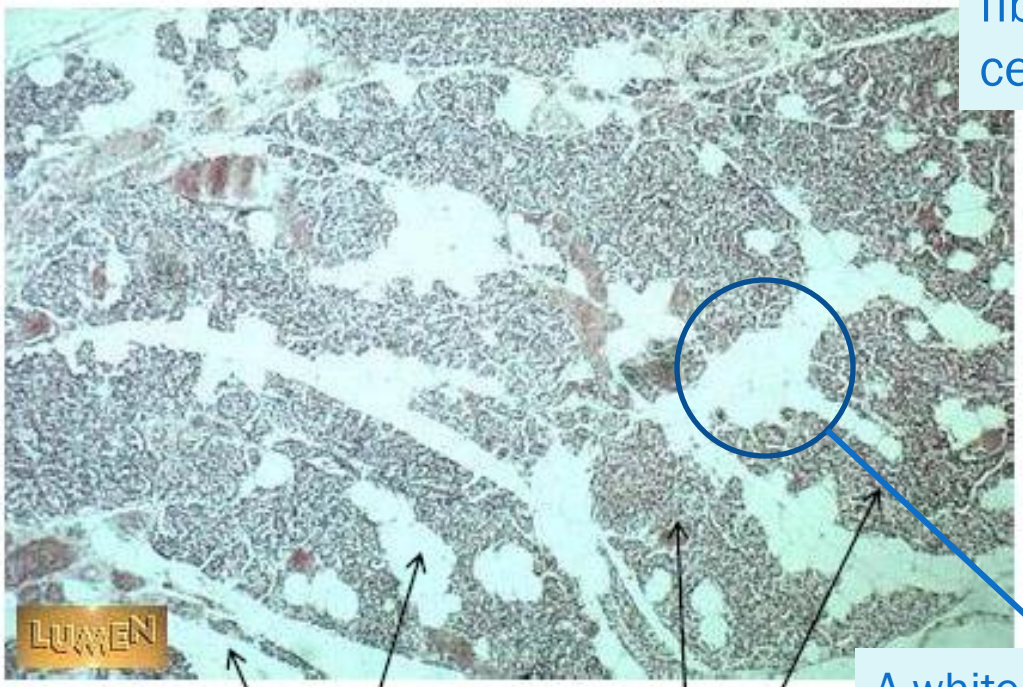
EXPLANATION OF THE LAST SLIDE WHY INFERIOR PARATHYROID?

- superior parathyroid + her sister (the thyroid gland itself) which is not faraway from it -> so it easily finds it target.
- But the inferior parathyroid + her sister (the thymus gland) which takes its journey from the neck down to superior mediastinum , therefor sometimes the sisters can't be separated and parathyroid gland could be found in many places in the superior mediastinum around the aortic arch.
- The most important thing to know is that any structure that migrate from one place to another can be arrested due to many reasons in one of the steps of path of migration (testes, thyroid& inferior parathyroid glands) .

Histology

Parathyroid Gland – low power

At lower magnification we can see: fibrous capsule + clumps/cords of cells + capillaries between them.



Low power of parathyroid, showing random cords of cells. The parathyroid is somewhat lobulated in appearance and considerable adipose tissue is intermingled with secretory portions.

Adipose tissue

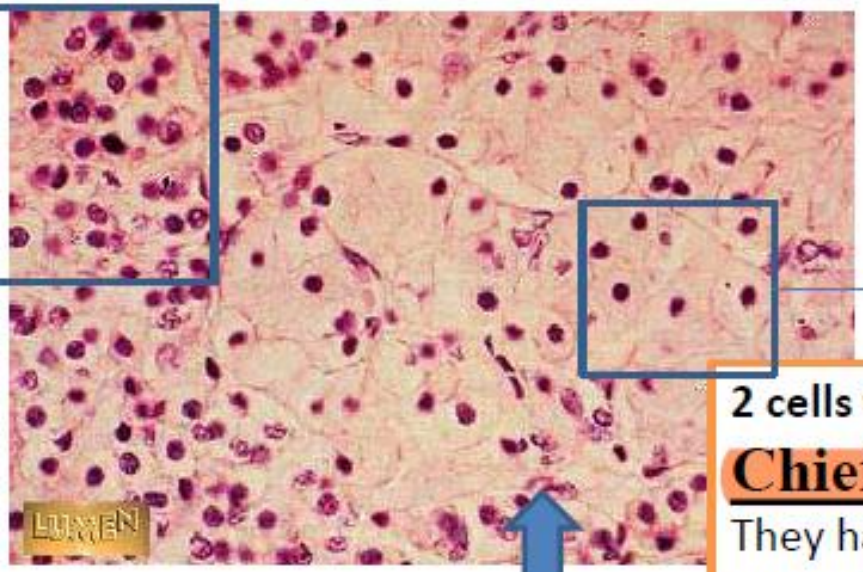
Cords of cells

A white stain (on H&E) = fat cells or alveolar cells, here it is fat cells (because here the nearby structures are different from respiratory system) this way you can identify parathyroid gland from other glands.

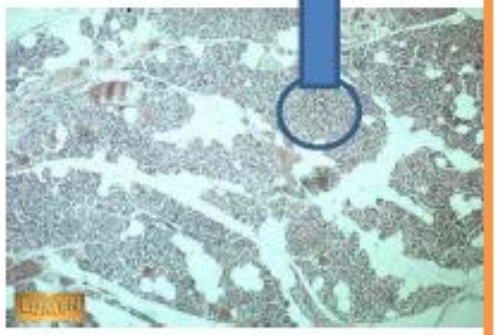
Basic structure of endocrine glands: no ducts, clumps/cords with capillaries between them , surrounded by fibrous/ connective tissue .

Parathyroid Gland – high power

At higher magnification we can identify 2 types of cells: oxyphil & chief cells.



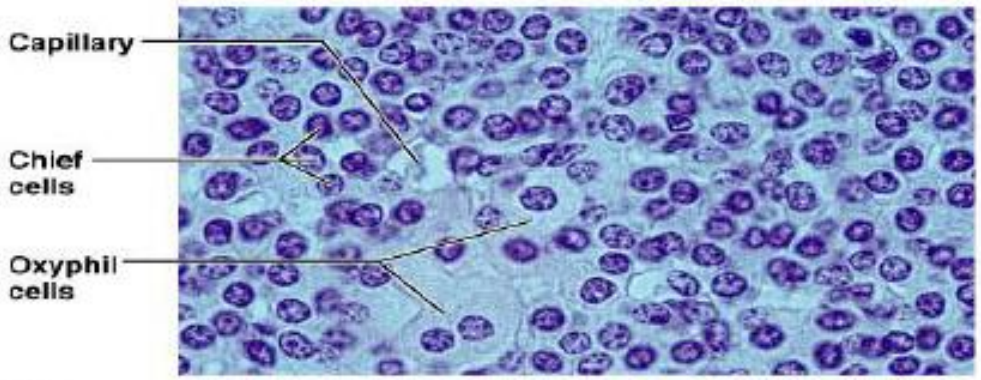
Their function is not well-known



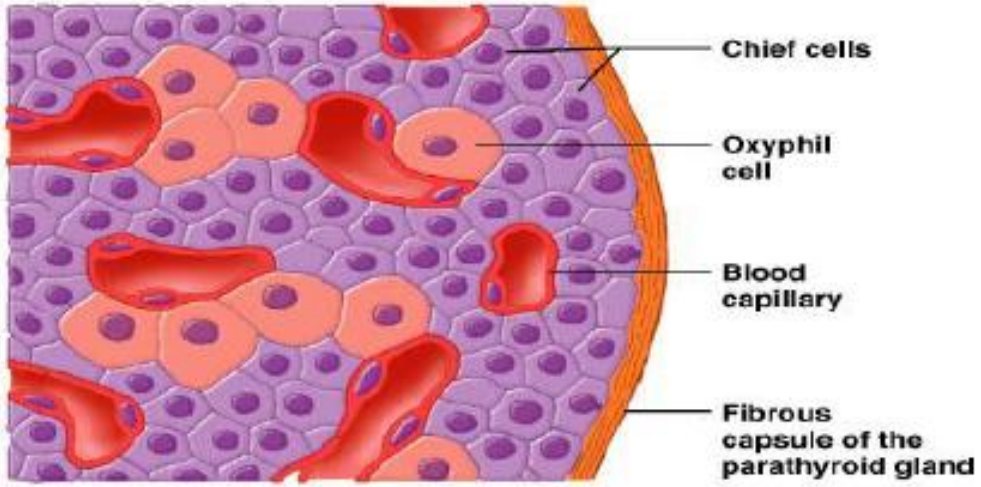
2 cells types of the Parathyroid:

Chief cells secrete parathormone (PTH). They have large round nuclei with a small amount of clear cytoplasm.

Oxyphil cells have smaller, darker nuclei and relatively larger amount of cytoplasm. The significance of the oxyphil cells is not clear. Some oxyphil cells show low levels of PTH synthesis, suggesting that these cells are transitional derivatives of principal cells.



(b)



(c)

we can see :

-Abundance of principle/chief cells which are smaller in size but with a larger nucleus.

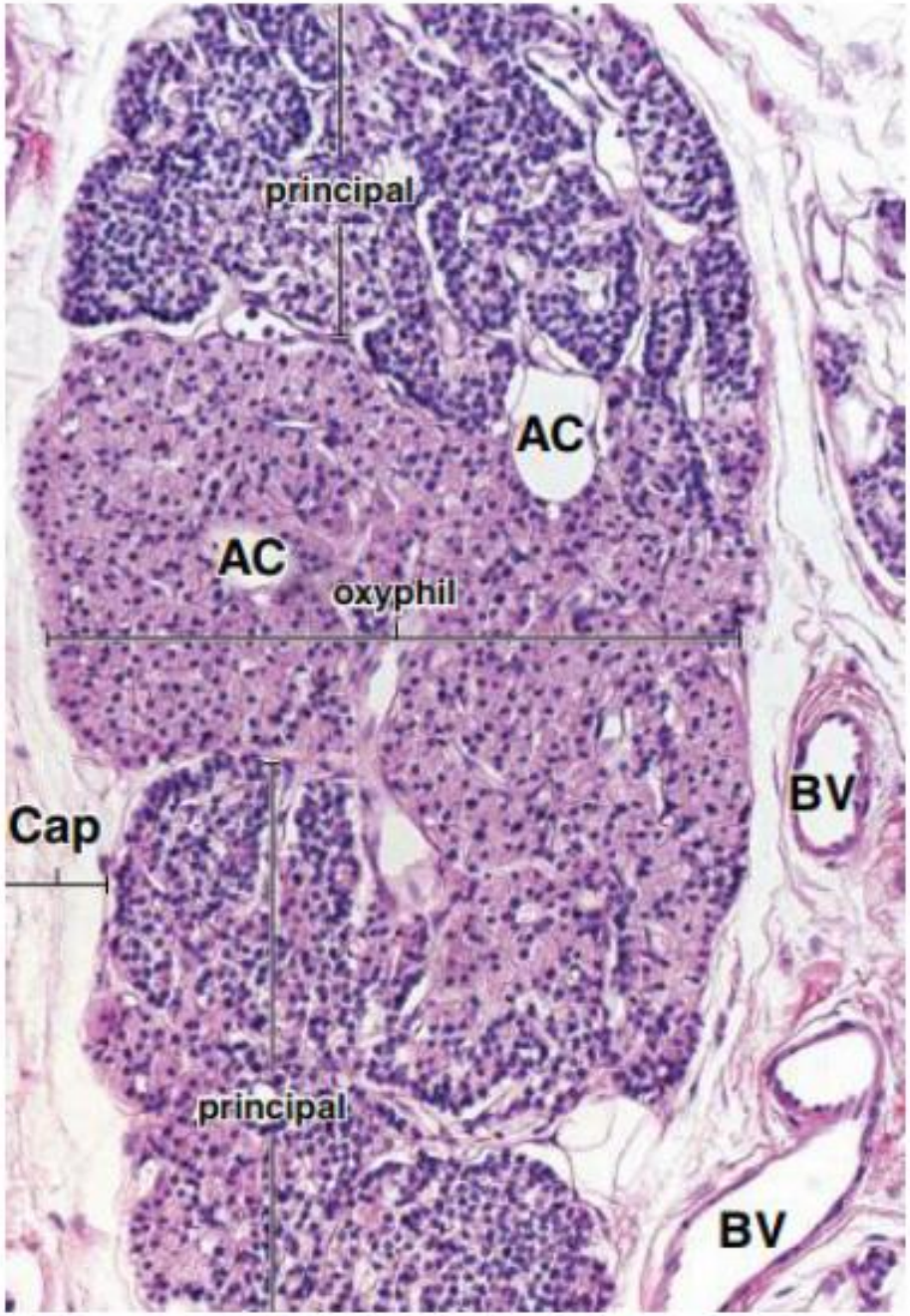
- Scattered oxyphil cells which are larger than chief cells with a smaller nucleus.

*Both types can be arranged in clusters (as in the next slide).

Read only

• Photomicrograph of human parathyroid gland. This H&E–stained specimen shows the gland with part of its connective tissue capsule (Cap). The blood vessels (BV) are located in the connective tissue septum between lobes of the gland. The principal cells are arranged in two masses (top and bottom) and are separated by a large cluster of oxyphil cells (center).

The oxyphil cells are the larger cell type with prominent eosinophilic cytoplasm. They may occur in small groups or in larger masses, as seen here. The principal cells are more numerous. They are smaller, having less cytoplasm, and consequently exhibit closer proximity of their nuclei. Adipose cells (AC) are present in variable, although limited, numbers



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