



# The Endocrine System



## ANATOMY

☒ Sheet

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Number:

3

Subject:

Parathyroid glands

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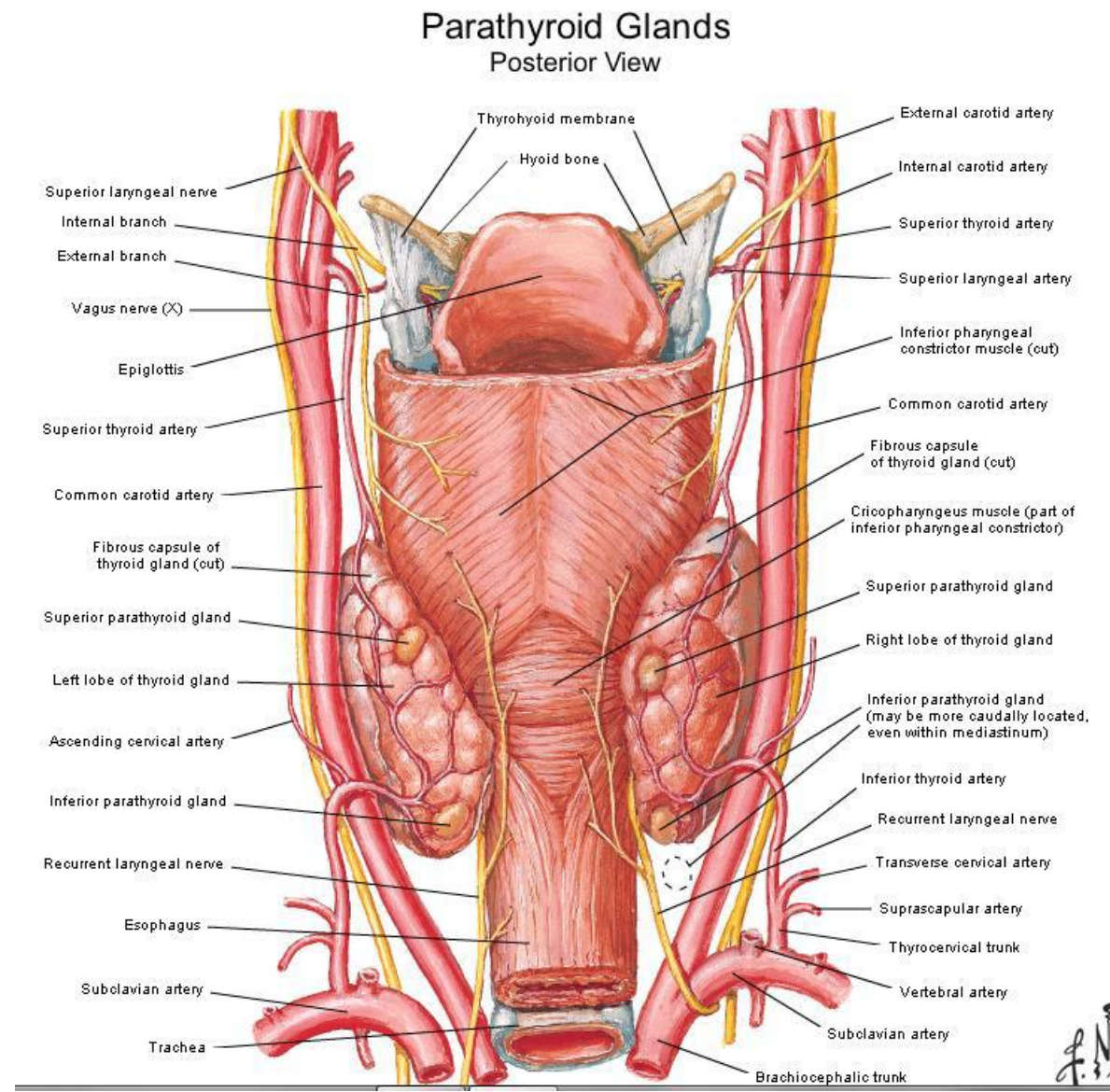
Doctor:

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## Function of the parathyroid glands: calcium homeostasis



## History:

Parathyroid glands is the last organ discovered in the human body.

1849: Sir Richard Owen is the 1<sup>st</sup> one to describe parathyroid glands after an examination on Rhinoceros (وحيد القرن).

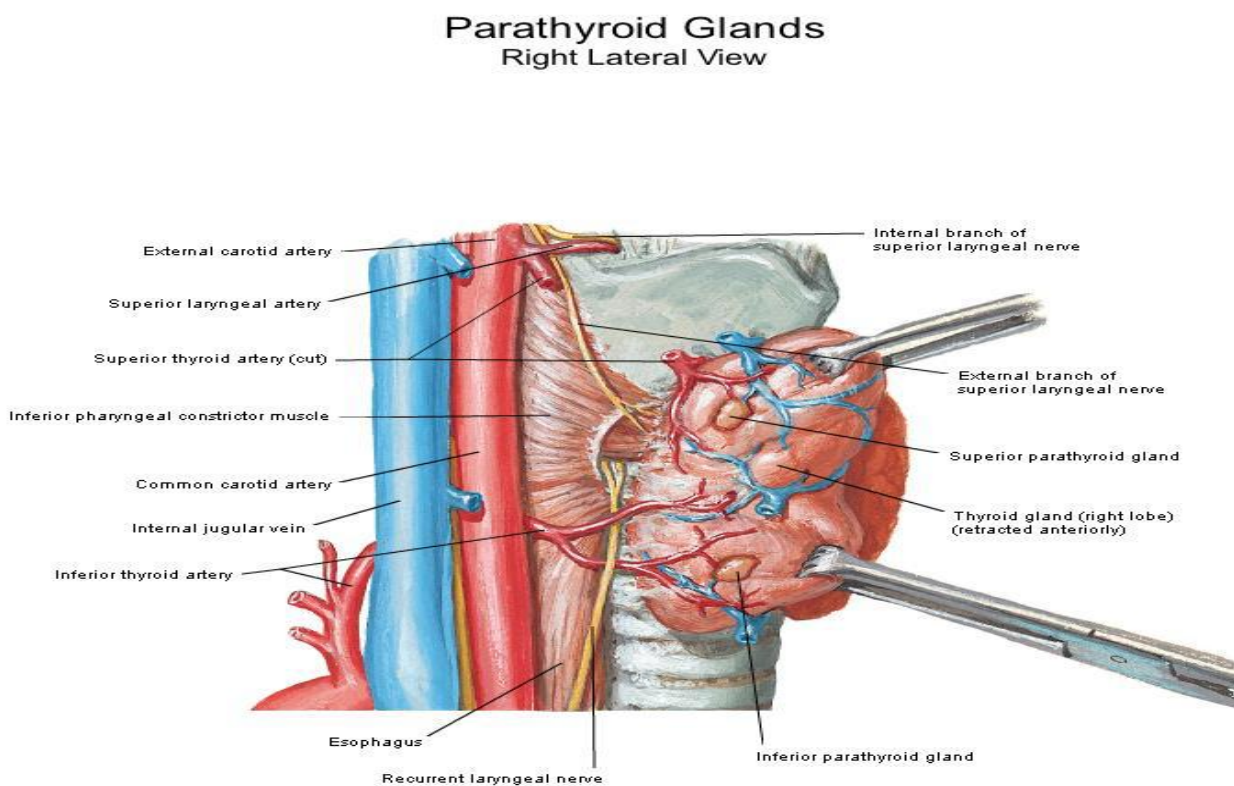
1879: Anton Wolfer described tetany due to the due to damage or removal of the parathyroid glands during surgery.

1880: Ivar Sandström a Swedish medical student grossly and microscopically described parathyroid glands , they where in the posterior of the thyroid gland so he named them Parathyroid glands.

1909: Calcium measurement was possible in and association with parathyroid.

1925: the 1st successful parathyroidectomy on 38 yr old man with severe bone pain secondary to osteitis fibrosa cystic, this disease causes multiple fractures of the bone, including the spine which leads to shortening of the patient.

## Anatomy & Relation:



**There are Four** parathyroid glands on the posterior surface of thyroid gland , two on the right side and two on the left side. Each pair consists of **superior** and **inferior** glands , they are small in size about ~2-3mm in diameter and 20-40g each and (130mg total weight) , but essential for life , and each one is surrounded by a thin CT capsule.

The **superior** glands are fixed in location , residing lateral and posterior to the upper pole of the thyroid at the level of the cricothyroid cartilage , however. The

**inferior** are not , they are located in a area of 1.5cm diameter from the lower pole of the thyroid .

\*Vagus nerve lie Posteriorly within the carotid sheath , and it gives a superior laryngeal nerve (give this branch just above the thyroid cartilage , which give two branches : **external**(which run in the cricothyroid space that separate the cricothyroid muscle from the thyroid) & **internal**) and inferior laryngeal nerve ( recurrent laryngeal nerve) .

\*The superior parathyroid glands are **closely related** to the Recurrent laryngeal nerve.

There are 2 recurrent laryngeal nerve ( in the left & right) and they're not the same , The left and right recurrent laryngeal nerves follow different pathways. The nerve on the right runs around the subclavian artery and obliquely. The recurrent laryngeal nerve on the left runs around the arch of the aorta and is parallel to the tracheoesophageal groove. The recurrent laryngeal nerve is an important nerve ,it enter the cricothyroid membrane to supply all the intrinsic muscles of the larynx, with the **exception** of the cricothyroid muscles.

**NOTE:** the thyroid gland is fixed to the trachea by the posterior suspensory ligament of the thyroid which is related to the entry of of the recurrent laryngeal nerve to the cricothyroid membrane .

## **Embryology:**

The parathyroid glands develop at 6<sup>th</sup> week and migrate caudally at 8 weeks.

superior parathyroid glands develop with the thyroid gland from the fourth branchial pouch , while inferior glands descend with the thymus from the third branchial pouch. Thus the inferior glands travel a longer distance to reach their final destination. Therefore, their location is variable. While the superior glands travel a short distance so their location is fixed.

## **Blood supply:**

Note: the parathyroid gland contains fenestered capillaries.



The blood supply to the superior parathyroid glands comes from the superior and inferior thyroid arteries. However, the inferior parathyroid glands receive blood only from the inferior thyroid artery.

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

## **Histology:**

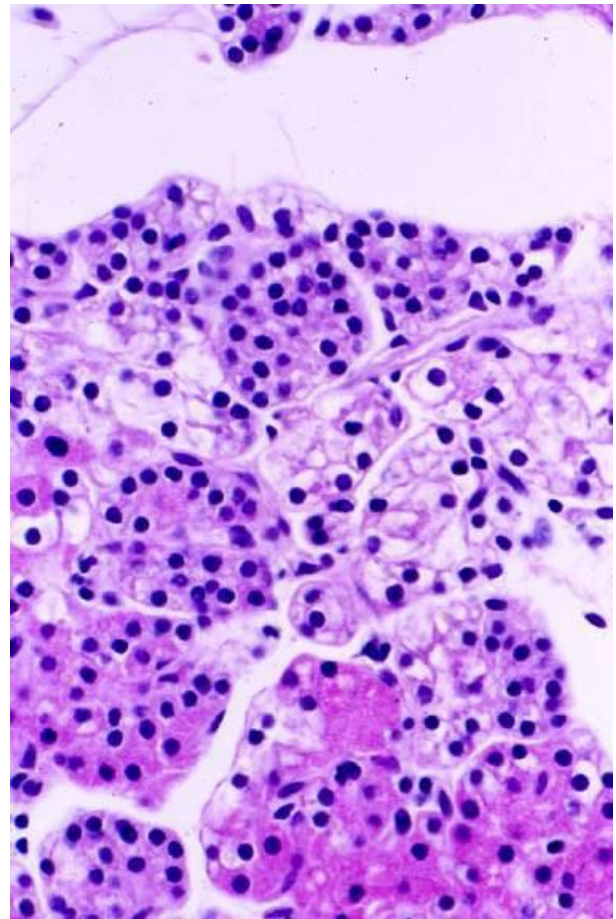
Each parathyroid gland is surrounded by a C.T capsule which is important to keep the parathyroid intact when operating on the thyroid gland.

Inside the capsule there are parenchymal cells separated by a delicate C.T septa.

3 Types of cells :

1. Fat cells: begin forming at puberty and increase in number with age
2. chief cells which are most abundant cells in the parathyroid gland. Their function is to produce large amount of PTH (parathyroid hormone) which regulates calcium and phosphate levels in the blood. The number of cells decreases with age. The cells are small, polygonal with a central nucleus and irregular granules and weakly acidophilic cytoplasm. They have receptors on their surface (Calcium sensor receptor, Receptor for Vitamin D and other receptors)
3. Oxyphil cells: are derived from chief cells at puberty. They are capable of secreting small amounts of PTH. These cells have large nucleus ,cytoplasmic granules and contain large amounts of abnormal shaped mitochondria making them acidophilic. They can be differentiated from chief cells since they are larger and darker (more acidophilic) but lesser in number.

Note: Oxyphils are also known as oncocytes (epithelial cell characterized by an excessive amount of mitochondria, resulting in an abundant acidophilic, granular



cytoplasm),,, ["Oxyphil" is a general term for a type of cells that are present in multiple sites in the body, not only in the parathyroid glands]

## **Parathyroid hormone(parathormone):**

PTH is a polypeptide hormone that is primarily synthesized as 110 amino acids. Later, it may be cleaved into a shorter polypeptide chain. The most potent form of the hormones is 84 amino acids long. Parathyroid hormone functions in calcium homeostasis which regulates metabolic activities. PTH causes an increase in blood calcium levels. The main reservoir of calcium in the body is bone. Thus, to increase the amount of  $\text{Ca}^{++}$  in the blood, PTH promotes reabsorption of  $\text{Ca}^{++}$  from bones by activating osteoclasts. It also converts vitamin D into the active form 1,25 dihydroxycholecalciferol. Vitamin D works on the small intestine to increase calcium absorption (Vitamin D is involved in regulating the amount of calcium in your blood). In addition, PTH decreases kidney excretion of calcium. Note: normal blood calcium levels range between 8.5 -10.5 mg/dl

## **Pathology:**

Hyperparathyroidism may be primary, secondary or tertiary.

Primary hyperparathyroidism occurs due to a problem in the chief cells. It is most common in most menopausal women. It is most common in most menopausal women.

Secondary hyperparathyroidism is the result of another disease that initially causes low levels of calcium in the body and over time, increased parathyroid hormone levels(low levels of calcium in blood means that your parathyroid glands are being stimulated all the time to try to increase your blood calcium) . It is a consequence of chronic renal failure or decreased reabsorption of calcium which will eventually result in an increase of chief cell function.

If primary hyperparathyroidism occurs as a result of secondary hyperparathyroidism, it is considered tertiary hyperparathyroidism.

The Increase of PTH cause a decrease in the calcium level in the bone and increase it in blood (hypercalcemia)

## **Complications of excess PTH:**

- abdominal cramps
- bone disease and bone pain
- increased calcium in the kidney leading to renal stones
- pancreatitis
- nervous system disorders

## **Treatment:**

Primary hyperparathyroidism: surgical removal

secondary hyperparathyroidism : medical intervention to treat the cause

tertiary hyperparathyroidism: both surgical and medical intervention

We make a parathyroidectomy for patient who have parathyroid adenoma ( usually it's one of these 4 glands not all of them ) and we make an incision of 2cm in this operation (minimal invasive parathyroidectomy)

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Special thanks to the people that helped me in this sheet.

And I apologize for any mistake I may have made.

Best of luck.

محمود درويش

على هذه الارض ما يستحق الحياة