PARATHYROID HORMONE

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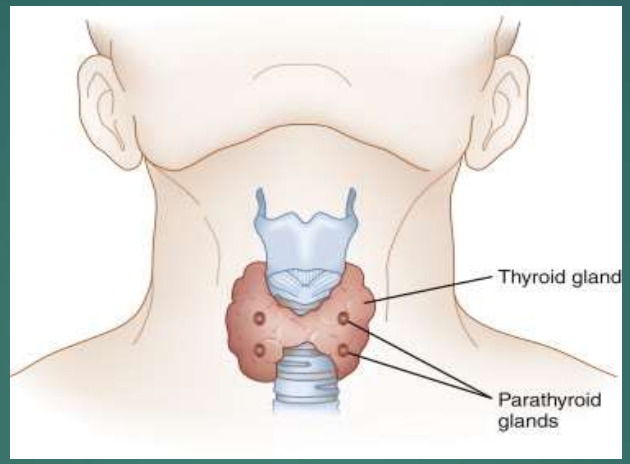
PARATHYROID GLAND



- The parathyroid glands are small pea-sized glands located in the neck just behind the butterfly-shaped thyroid gland.
- Most people have four parathyroid glands, with two parathyroid glands lying behind each 'wing' of the thyroid gland.
- The parathyroid glands produce a hormone called **parathyroid hormone (PTH)**.

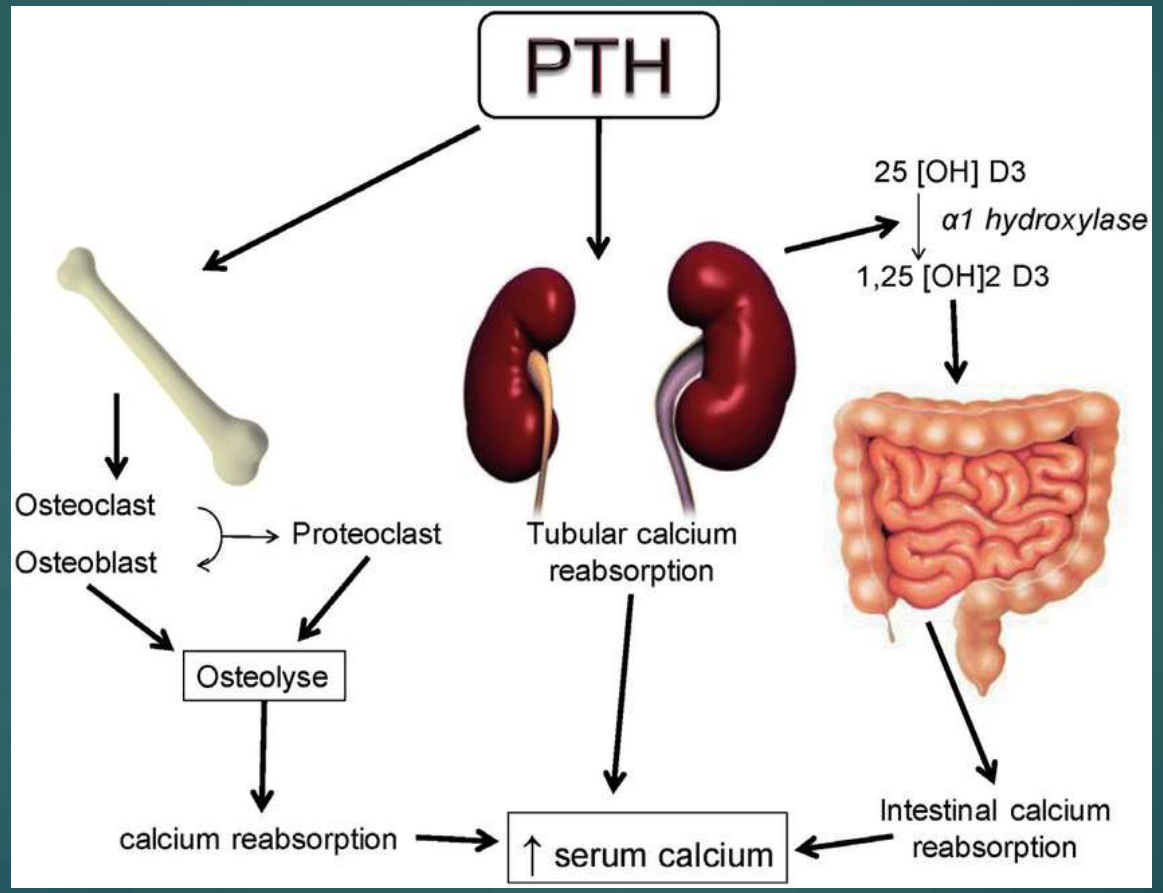
PARATHYROID HORMONE

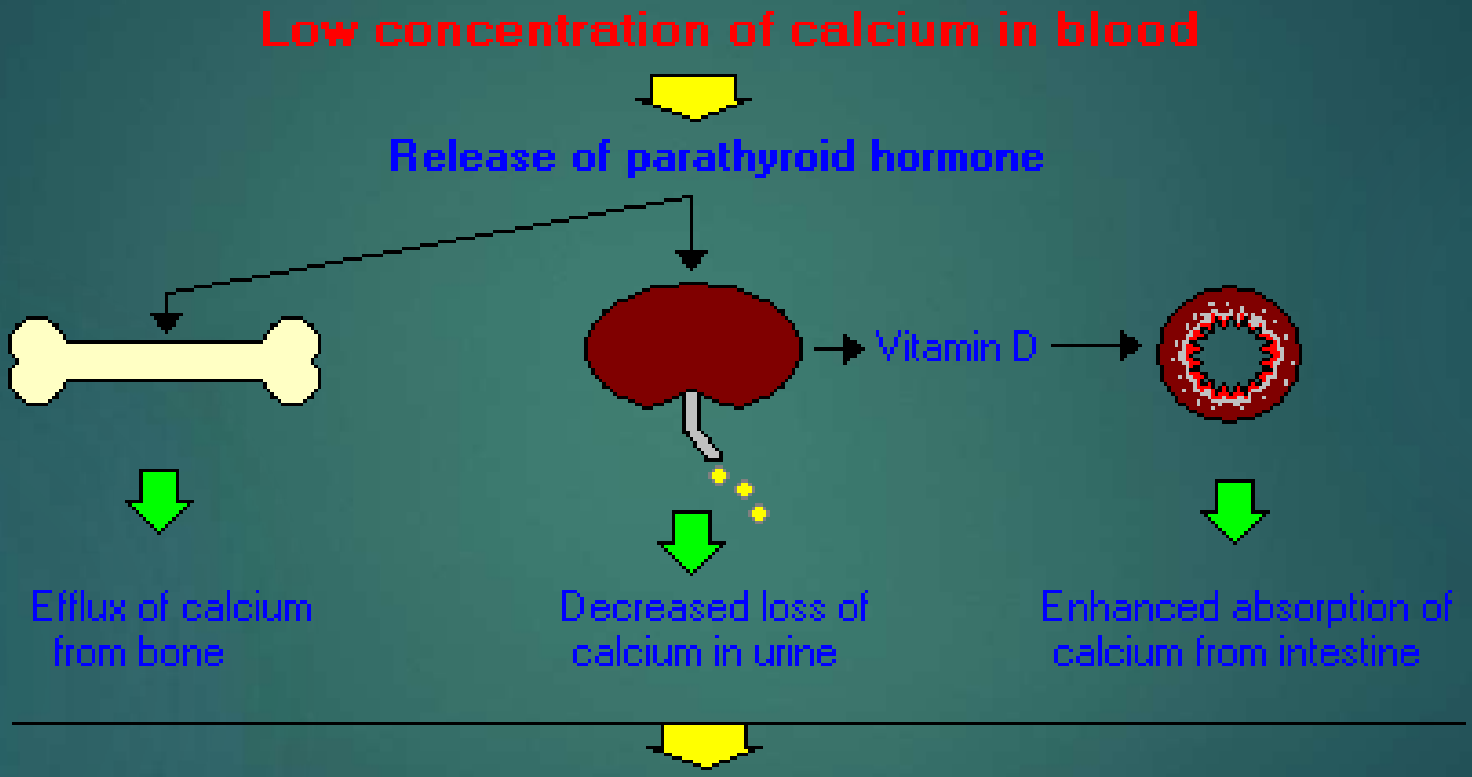
- PTH is a major systemic regulator of the concentrations of calcium, phosphate, and active vitamin D metabolites in blood and of cellular activity in bone.
- This hormone is secreted from cells of the parathyroid glands and finds its major target cells. Another hormone, parathyroid hormone-related protein, binds to the same receptor as parathyroid hormone and has major effects on development.
- 3 organs that are targeted by PTH are:
  i. Bones
  ii. Kidneys
  iii. Intestine

Physiologic Effects of Parathyroid Hormone

- Parathyroid hormone is mainly controlled by the negative feedback of calcium levels in the blood to the parathyroid glands.
- Low calcium levels in the blood stimulate parathyroid hormone secretion. In conjunction with increasing calcium concentration, the concentration of phosphate ion in blood is reduced.
- High calcium levels in the blood prevent the release of parathyroid hormone

Mechanism of action of Parathyroid Hormone




Low concentration of calcium in blood
Release of parathyroid hormone
Vitamin D
Efflux of calcium from bone
Decreased loss of calcium in urine
Enhanced absorption of calcium from intestine
Increased concentration of calcium in blood

Mechanism of action of Parathyroid Hormone

- Mobilization of calcium from bone
  - Although the mechanisms remain obscure, a well-documented effect of parathyroid hormone is to stimulate osteoclasts to reabsorb bone mineral, liberating calcium into blood.
- Enhancing absorption of calcium from the small intestine
  - Facilitating calcium absorption from the small intestine would clearly serve to elevate blood levels of calcium. Parathyroid hormone stimulates this process, but indirectly by stimulating production of the active form of vitamin D in the kidney. Vitamin D induces synthesis of a calcium-binding protein in intestinal epithelial cells that facilitates efficient absorption of calcium into blood.

- Suppression of calcium loss in urine
  - In addition to stimulating fluxes of calcium into blood from bone and intestine, parathyroid hormone puts a brake on excretion of calcium in urine, thus conserving calcium in blood.
  - This effect is mediated by stimulating tubular reabsorption of calcium. Another effect of parathyroid hormone on the kidney is to stimulate loss of phosphate ions in urine.

HIGH PARATHYROID LEVEL

- Having too much of the hormone can cause a condition known as **hypercalcaemia**, which increases blood calcium levels.
- This condition does not cause obvious symptoms in mild cases, but if levels rise too high, it can cause digestive upset, constipation, depression, lethargy, weakness, joint pain, and excessive thirst
- Hypercalcaemia can further dividend into:
  i. primary hyperparathyroidism
  ii. secondary hyperparathyroidism
  iii. tertiary hyperparathyroidism

- Primary hyperparathyroidism

  - It is the condition where high PTH level causes raised in calcium level in blood.
  - The most common cause of primary hyperparathyroidism (75–85% of cases) is a single benign growth or nodule (adenoma) in one parathyroid gland.
  - Others are caused by growths in two glands (2-12%), in 1–2% there are growths in three glands, and in 1–15% of cases there are growths in all four glands.

- There are some rare genetic causes of primary hyperparathyroidism which cause generalised overgrowth of all four glands.

- In a rare cases, cancer of parathyroid gland can also cause hyperparathyroidism.

- Secondary hyperparathyroidism
  - It occurs in response to low blood calcium levels and is caused by other mechanisms, for example, kidney disease and vitamin D deficiency.
  - Vitamin D is necessary to absorb dietary calcium from the gut. In vitamin D deficiency, less calcium from food is absorbed in the gut, so blood calcium levels are low and this causes more parathyroid hormone to be produced
  - In chronic kidney disease, several factors contribute to increase parathyroid hormone production. The kidney's ability to control blood calcium levels is reduced. Also, vitamin D is activated in the kidney, so kidney disease reduces the effectiveness of vitamin D

- Tertiary hyperparathyroidism
  - The most common cause of tertiary hyperparathyroidism is chronic kidney disease.
  - It can continue even after a kidney transplant. High phosphate levels, low levels of active vitamin D and hypocalcaemia, all typical symptoms of kidney disease, cause long-term high parathyroid hormone and overgrowth of the parathyroid glands.

- Tertiary hyperparathyroidism can also occur in people who need to take phosphate treatment; for example, in a rare inherited disease called hypophosphataemic rickets. It often affects all four parathyroid glands, but sometimes just one or two glands.

LOW PARATHYROID LEVEL

- Too little parathyroid hormone or also known as hypoparathyroidism, is a rare medical condition. It can result in low levels of calcium in the blood hypocalcaemia.
- Hypoparathyroidism is caused by damage to parathyroid glands. In particularly rare cases, the parathyroid glands are destroyed by autoimmune attack or by radiation, usually as a result of treatment of a tumour, or rare diseases that attack the parathyroid glands.
- Some people are born with hypoparathyroidism (congenital); a genetic basis of the disease is increasingly being recognised in those without surgery-induced hypoparathyroidism

- Sign and symptoms of hypoparathyroidism
  i. Tiredness
  ii. irritability, mood swings and brain fog anxiety
  iii. muscle pains, abdominal pain
  iv. contraction or tightening of the muscles of the hands and feet, fits, fainting
  v. confusion, headaches, brittle nails, dry skin and hair, and uncontrolled spasms that cause muscle cramps.
- When calcium levels fall very fast or become very low, there may be fits (seizures) or spasm of the muscles in the airways causing noisy and difficult breathing

THANK YOU