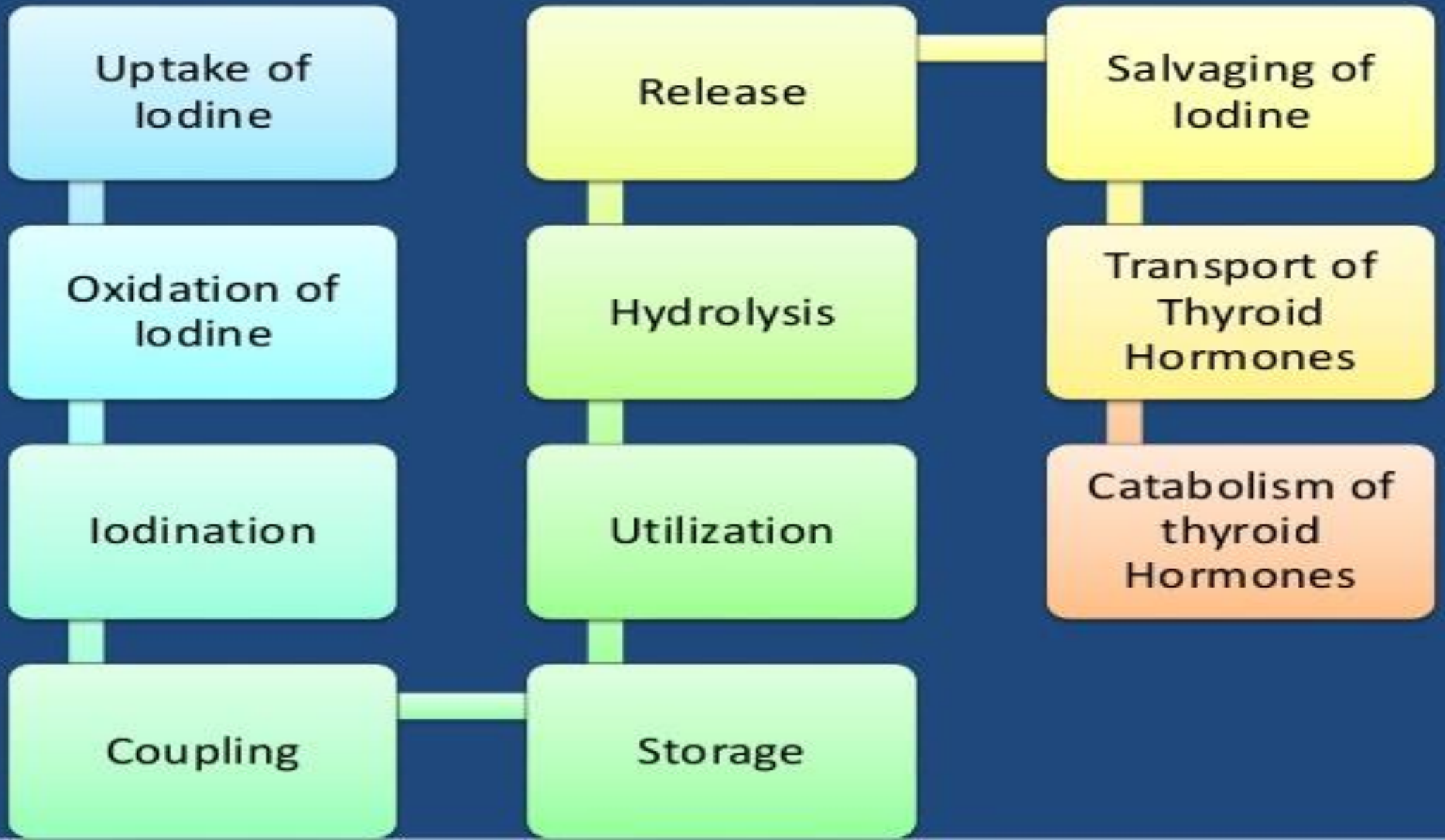
Thyroid Hormone

- Secreted by the thyroid gland
- Gland secret major hormone;
  - Thyroxine (T4)
  - Triiodothyronine (T3)
- Controlled by the primarily TSH (Thyroid stimulating hormone) secreted by the ant Pituitary gland.
- Gland also secrete calcitonin (imp hormone in calcium metabolism).

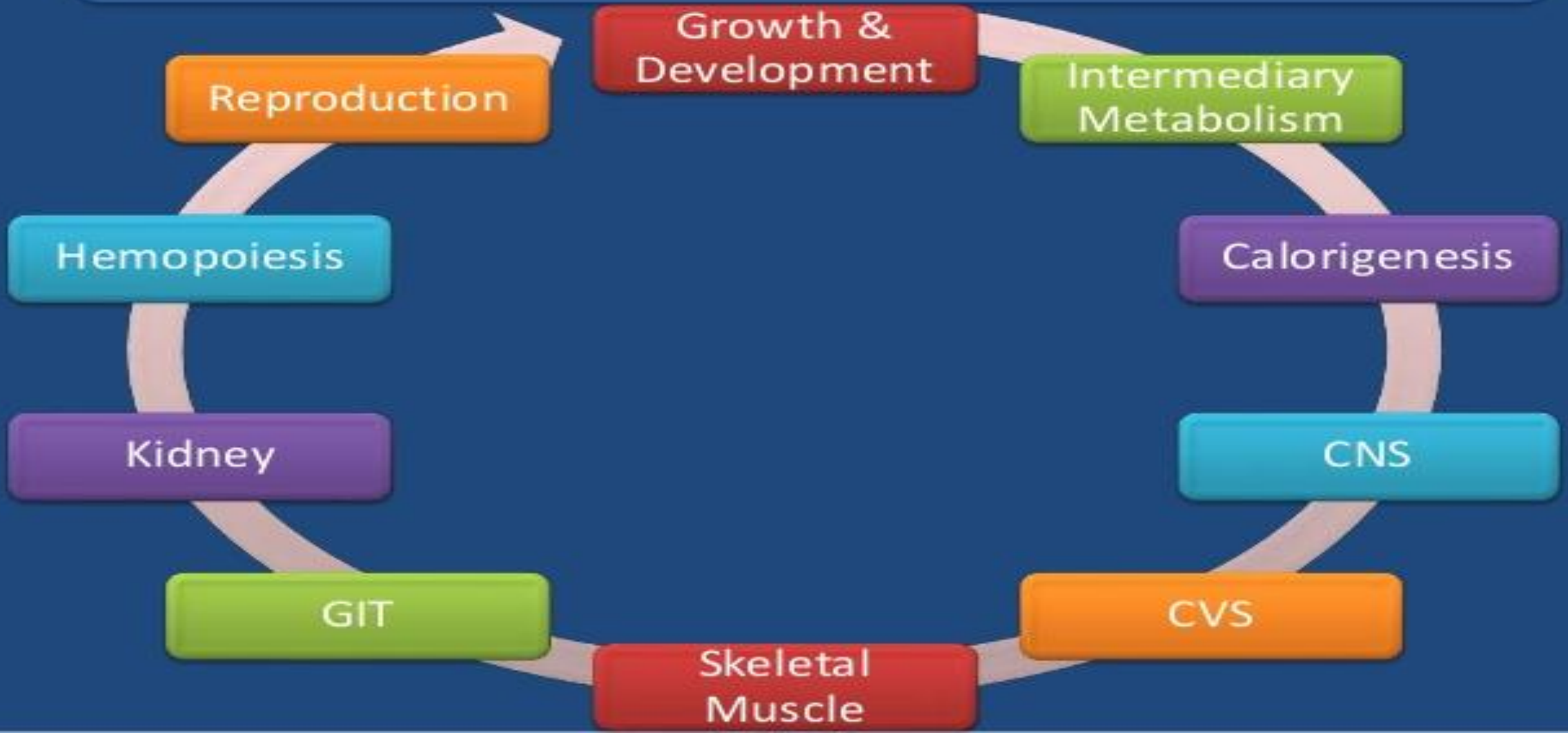
Iodine metabolism

- Iodine is required for the formation of thyroid (150-200µg/day) (sr 5-10 µg/dL)
- About 80% is stored in Thyroid gland.
- Ingredients which prevent the utilization of Iodine are called as Goitrogens.

Synthesis & secretion of Thyroxin



Effect of Thyroid Hormones



Effect of Thyroid Hormones

Lipid metabolism

- Fat mobilization.
- Oxidation of FA
- Inversely related to hormone levels.

Carbohydrate metabolism

- Enhance insulin dependent glucose entry
- Increased gluconeogenesis & glycogenolysis.

Growth

- For normal growth.

Development

- Physical and mental development in fetal, neonatal, young and adult.

Other effect

- Cardiovascular
- Central nervous system
- Reproductive system
- Hemopoiesis
- Skeletal, GIT, Kidney

Thyroid Disorders

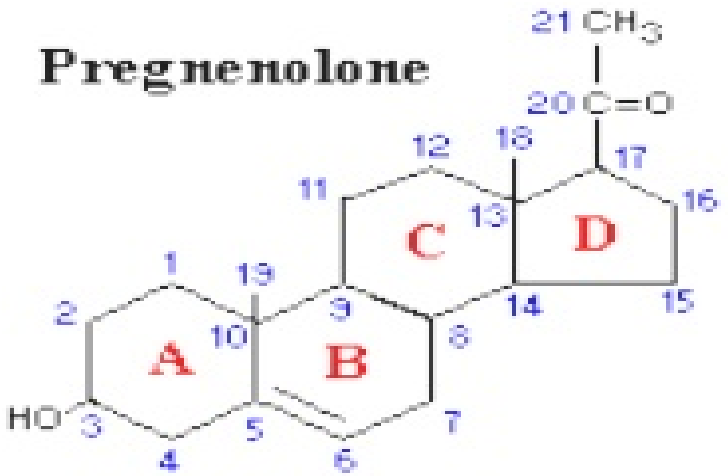
- Cretinism
- Hyperthyroidism
- Hypothyroidism
- Euthyroid Goiter

Steroid Hormones

- Steroid hormones: produced in the adrenal cortex, testis, ovary, and some peripheral tissues (adipose tissue, the brain!)
- All steroid hormones share a typical (but not identical) ring structure.

Steroid hormones

- All steroid hormones are derived from cholesterol and differ only in the ring structure and side chains attached to it.
- All steroid hormones are lipid soluble



Types of steroid hormones

- **Glucocorticoids**; cortisol is the major representative in most mammals
- **Mineralocorticoids**; aldosterone being most prominent
- **Androgens** such as testosterone
- **Estrogens**, including estradiol and estrone
- **Progestogens** (also known a progestins) such as progesterone

Steroid hormones

- Steroid hormones are not water soluble so have to be carried in the blood complexed to specific binding globulins.
- Corticosteroid binding globulin carries cortisol
- Sex steroid binding globulin carries testosterone and estradiol
- In some cases a steroid is secreted by one cell and is converted to the active steroid by the target cell: an example is androgen which secreted by the gonad and converted into estrogen in the brain

Functions of Steroid Hormones

- Steroid hormones play important roles in:
  - carbohydrate regulation (glucocorticoids)
  - mineral balance (mineralocorticoids)
  - reproductive functions (gonadal steroids)

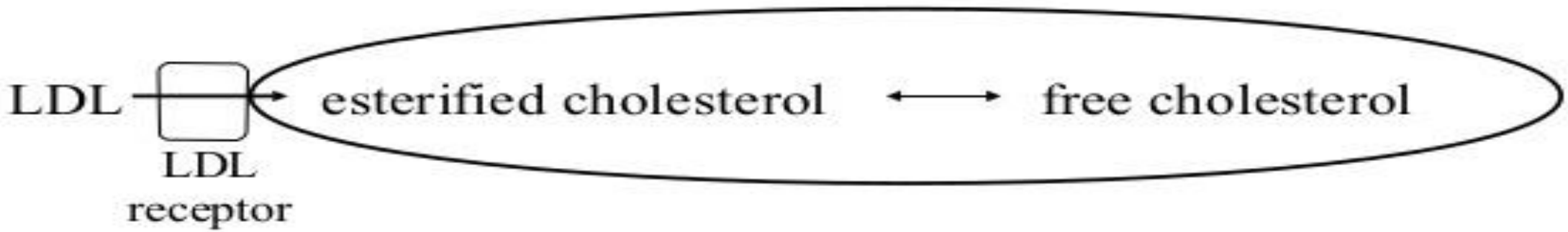
- Steroids also play roles in inflammatory responses, stress responses, bone metabolism, cardiovascular fitness, behavior, cognition, and mood.

Sources of Cholesterol for Steroid Synthesis

- Cholesterol is also taken up by the cell in the form of low density lipoprotein (LDL).

  - LDL is a complex composed of cholesterol, phospholipids, triglycerides, and proteins (proteins and phospholipids make LDL soluble in blood).

  - LDL is taken into cells via LDL receptors, and broken down into esterified cholesterol, and then free cholesterol:



Adrenal Steroids

- The adrenal glands are located immediately superior to the kidneys.
- There are three classes of adrenal steroids:
  - mineralocorticoids,
  - glucocorticoids, and
  - androgens

Parathyroid Hormone

- provides a powerful mechanism for controlling extracellular calcium and phosphate concentrations by regulating:

- ✓ intestinal reabsorption
- ✓ renal excretion
- ✓ exchange between the extracellular fluid and bone of these ions.

- **Excess activity** of the parathyroid gland causes rapid **absorption of calcium salts** from the bones, with resultant **hypercalcemia** in the extracellular fluid;

- conversely, **hypofunction** of the parathyroid glands causes **hypocalcemia**, often with resultant **tetany**.

Chemistry of Parathyroid Hormone

- synthesized in the form of a **preprohormone**
- cleaved to a **prohormone**
- then to the **hormone itself with 84 amino acids** by the endoplasmic reticulum and Golgi apparatus
- finally is **packaged in secretory granules** in the cytoplasm of the cells.

Effect on Ca^+ and Phosphate Concentrations in the ECF

- suddenly infusing PTH

- ✓ **calcium** ion concentration begins to **rise** and reaches a plateau in about 4 hours.

- ✓ the **phosphate** concentration, however, **falls** more rapidly than the calcium rises and reaches a depressed level within 1-2 hours.

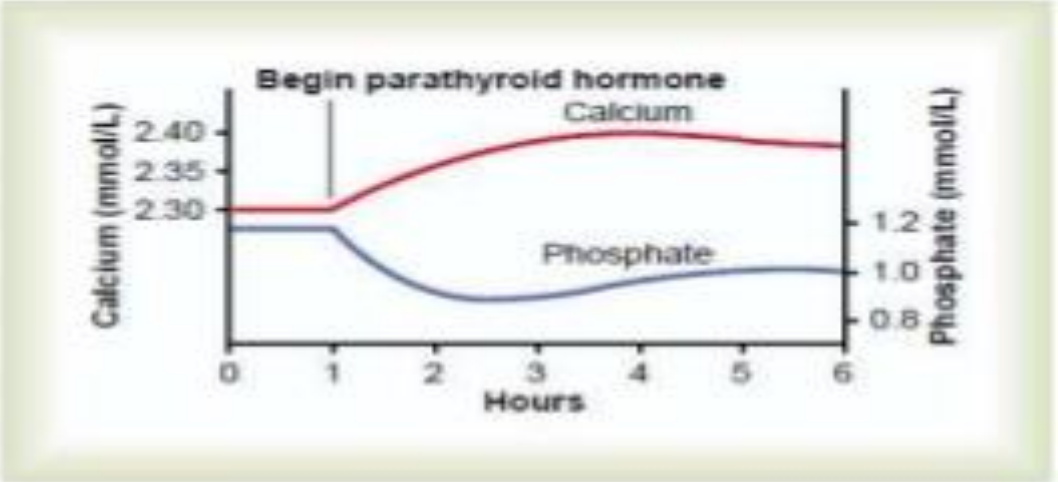


Figure 79–10

Approximate changes in calcium and phosphate concentrations during the first 5 hours of parathyroid hormone infusion at a moderate rate.

- PTH ↑calcium and phosphate absorption from the bone
- PTH ↓excretion of calcium by the kidneys.
- PTH ↑renal phosphate excretion **

** an effect that is usually great enough to override increased phosphate absorption from the bone.

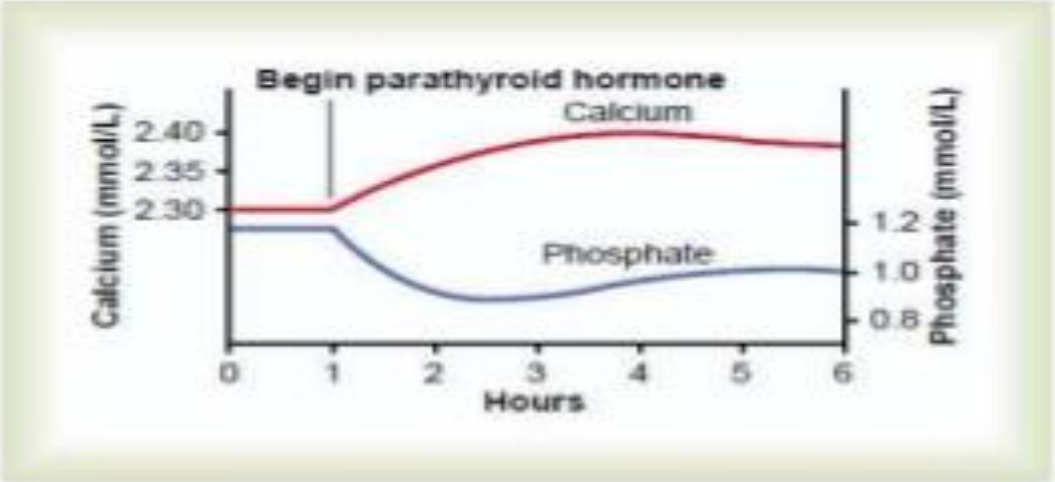


Figure 79–10

Approximate changes in calcium and phosphate concentrations during the first 5 hours of parathyroid hormone infusion at a moderate rate.

PTH ↑calcium and phosphate absorption from the bone

First phase	Second phase
rapid	**slow**
Minutes-hours	Days-weeks
Activation of already existing **osteocytes /osteoblasts**	Proliferation of **osteoclasts**
Receptor protiens on octeocytes/osteoblasts that bind PTH and activate calcium pump	Activated osteocytes/osteoblasts send **secondary signals** to osteoclasts
Promote **calcium and phosphate** absorption	Osteoclastic absorption of **bone** itself

Disorders of PTH

- hypoparathyroidism
- Primary hyperparathyroidism
- Secondary hyperparathyroidism

Hypoparathyroidism

- ↓PTH→↓Ca^+ reabsorption from bone→↓ Ca^+ level in body fluids

- Bone remains strong

- If parathyroid glands are suddenly removed:
  - ✓ Ca^+ levels fall from 9.4mg/dl to 6-7 within few days
  - ✓ **Phosphate** concentration may **double**
  - ✓ **↓Ca^+→tetany**

- **Laryngeal muscles tetany**→obstructs respiration →death

Hypoparathyroidism

- Treatment

- ✓ hypoparathyroidism is usually **not treated with PTH** administration.
- ✓ large quantities of **vitamin D** daily
- ✓ 1-2 grams of **Calcium**
- ✓ **1,25-dihydroxycholecalciferol**

Primary Hyperparathyroidism

- **Osteoblastic activity** in the bones also **increases** greatly in attempt to make up for the old bone absorbed by the osteoclastic activity.

- When the osteoblasts become active, they secrete large quantities of **alkaline phosphatase**. Therefore, one of the important diagnostic findings in hyperparathyroidism is a high level of plasma alkaline phosphatase.

Primary Hypeparathyroidism

- **Tumor in parathyroid glands** (females mainly)→ excess PTH → **↑Ca concentration in ECF. ↓Phosphate**
- In severe hyperparathyroidism the bone may be eaten away entirely.
- Indeed, the reason a hyperparathyroid person seeks medical attention is often a broken bone.

Kidney stones

- **Mild hyperparathyroidism** leads to formation of kidney stones(calcium phosphate, calcium oxalate stones)

- Kidney stones are more common in alkaline urine(low solubility in alkaline media)→**treatment include acidotic diet & acidic drugs.**

Secondary hyperparathyroidism

- high levels of PTH occur as a compensation for **hypocalcemia**
- this contrasts with primary hyperparathyroidism, which is associated with hypercalcemia.
- caused by **vitamin D deficiency** or **chronic renal disease** in which the damaged kidneys are unable to produce sufficient amounts of the active form of vitamin D