

## Parathyroid

Glands secrete PTH which is responsible for Calcium and Phosphorus homeostasis. PTH causes Calcium levels to rise and Phosphorus levels to fall.

*Mnemonic: PTH = Phosphorus Trashing Hormone - → decreases phosphorus*

### Hyperparathyroidism (Hypercalcemia)

- Primary → loss of Calcium/PTH feedback mechanism
  - +Usually results from over secretion of PTH by an Adenoma
    - Tx.: Surgically by removal of the adenoma
  - +Another major cause is malignancy via either PTHrP release or Cytokine release which leads to osteolytic states
    - Tx: Symptomatic or tx the underlying malignancy
- Secondary → feedback mechanism is intact and PTH is increased appropriately due to low calcium or high phosphate secondary to kidney failure or Vit. D deficiency.
- Tertiary → PTH hypersecretion persists even though the secondary cause has been corrected. The parathyroid glands become autonomous at this point and the disease is similar to primary hyperparathyroidism

### Hypercalcemia treatment:

- Hydration
- Loop diuretics. *Mnemonic: Loops Loose Calcium.*
- Bisphosphonates: act mostly on osteoclasts to inhibit bone resorption. Side effects for all are similar and might include mild and transient flu-like symptoms and creatinine elevations in a small number of patients. Also GI upset and esophageal irritation for the oral ones (take with full glass of water and remain upright for 30 mins.)
  - Pamidronate (Aredia) - IV
  - Zoledronic acid (Zometa) – IV, more potent, faster infusion time
  - Alendronate (Fosomax) – Oral, osteoporosis
  - Risedronate (Actonel) – Oral, osteoporosis
- Calcitonin – a natural hormone secreted by thyroid gland which inhibits bone resorption through action on osteoclasts and also increases calcium excretion in the kidney. Plays a very minor role in calcium homeostasis and continuous administration can lead to tachyphylaxis due to down regulation of calcitonin receptors on osteoclasts. Can be useful as an adjunct in the acute tx of hypercalcemia.
- Corticosteroids – inhibit vitamin D production
- Dialysis as last resort

### Hypocalcemia

- Sx: Chvostek's sign, Trousseau's sign, tetany, prolonged QT, muscle cramps, laryngospasm
- Causes:

- +Renal Failure → can lead to secondary hyperparathyroidism and hypercalcemia
- + Hypoparathyroidism
  - Primary (Low PTH) → agenesis (DiGeorge's) or surgical removal
  - Secondary (High PTH) → a.k.a. pseudohypoparathyroidism due to PTH insensitivity.
- +Vitamin D deficiency (rickets)
- Tx: Replace calcium, Vitamin D analogues (calcitriol, paracalcitol, doxercalciferol) Phosphate binders (Calcium carbonate, Calcium acetate, sevelamer). New agent Cinacalcet increases parathyroid sensitivity to calcium.

Hypomagnesemia: Influences PTH secretion in manner similar to Calcium. Must replete Mg before repleting K and Ca otherwise you will not see results.

Osteoporosis: Decreased bone mineral density, occurs more often in women due to menopause.

- Tx:
  - + Bisphosphonates – also used for OI and Paget's
  - + Selective Estrogen Receptor Modulators (SERMs) (tamoxifen, raloxifene)
    - actions similar to estrogen on bone but without negative actions on breast.
    - Side effects: Hot flashes, increased DVT risk.
  - + Calcitonin – nasal preparation available. Rarely used.
  - + Teriparatide – PTH analogue. Given in bursts to prevent hyperparathyroid like symptoms. Has been shown to cause increase osteosarcoma in rats.

## **Thyroid**

Gland secretes Thyroid Hormones (T4/T3) which are responsible for controlling the metabolic rate.

Thyroid synthesis: Symporter (site of Hashimoto's antibody attack) → Oxidation → Iodination → Coupling → Proteolysis → Release

### Hypothyroidism

- Sx: Fatigue, Depression, Cold intolerance, Weight gain, weakness, brittle hair, coarse skin, constipation, cramps, goiter, risk of miscarriage
- Causes: Hashimoto (autoimmune), Myxedema (severe form in adults), Iodide deficiency (goiter), Thyroid ablation, Secondary (due to decreased TSH or TRH), drug induced
- Can lead to cretinism (mental retardation) in kids

Tx: Replace Thyroid hormone

- + Levothyroxine (Synthroid, Levoxyl, Levothroid) – most commonly used, contains only T4 therefore longer half-life but longer to peak effect
- + Levothyronine (Cytomel, Triostat) contains T3 only, more rapid action but shorter half-life, usually reserved for acute treatment of life-threatening conditions such as myxedema coma.
- + Side Effects of both are the effects of hyperthyroidism. Careful in patients with cardiac or vascular conditions.

### Hyperthyroidism:

- Sx: Nervousness, increased heart rate, weight loss, heat intolerance, diarrhea, tremors, decreased sleep, excessive sweating, (exophthalmos), a-fib
- Causes: Graves (autoimmune), nodular goiter (thyroid nodule), Thyroiditis (inflammatory, viral?) Thyroid cancer
- Tx: Do not use radiation in pregnancy/lactation, use PTU instead
  - + Surgical removal of part of gland or radioiodine ablation. Both are followed by T4 replacement.
  - + Thyroid Peroxidase inhibitors (prevent formation of T4) All can cause lupus-like syndrome, hepatitis and agranulocytosis
    - Propylthiouracil – shorter half life, safer in pregnancy and lactation, but increased risk of agranulocytosis
    - Methimazole – longer half life, less safe in pregnancy/lactation, less risk of agranulocytosis
    - Carbimazole – Precursor to Methimazole, not used in U.S.
  - + Symptomatic treatment through sympathetic blockade.
    - Beta adrenergic blockers