

### Anatomy

4 total

Posterior aspect of thyroid gland

Produce and release PTH

iCal determines level of PTH secretion in body indirectly. Decreased  $Ca^{+}$  = increased PTH

PTH causes bone resorption, kidney absorption and GI absorption of  $Ca^{+}$

Principal cells secrete PTH

Half-life of PTH is 4-5 minutes

Alkalosis = decreased  $Ca^{+}$

### Calcium

50% bound to albumin

40-45% free/ionized

5-10% bound/unionized

ionized levels are regulated and affected by pH and temperature

low pH (acidotic) = increased ionized  $Ca^{+}$

high pH (alkalosis) = decreased ionized  $Ca^{+}$

Normal iCal = 4.4-5.4mg/dL

Normal total calcium = 8.9-10.1mg/dL

*Small changes in iCal leads to large changes in PTH secretion*

### Hypercalcemia Lab Values and Treatment

Normal serum  $Ca^{+}$  levels = 8.9-10.1mg/dL

Normal iCal = 4.75-5.7mg/dL; 1.19-1.33-mmol/L

Mild =  $<3$ mmol/L; 12mg/dL      hydration

Moderate to severe = 3.2-3.7 mmol/L; 13-15 mg/dL      NS and lasix

### Other treatments

Ethacrynic acid -  $Na^{+}/Ca^{+}$  diuresis

Biphosphonates - inhibit bone resorption

Calcitonin - hormone to oppose PTH (decrease  $Ca^{+}$ )

### Hypocalcemia

Airway	Neuromuscular & CNS	ECG
Recurrent laryngeal nerve damage.	Muscle cramps	negative inotropy
Unilateral (hoarseness) Bilateral (stridor, obstruction)	Parasthesias	
Bleeding - tracheal compression and edema	Chovstek's sign and Trousseau's Sign	prolonged QT
Hypocalcemic tetany - laryngospasm	Psychosis	
	Seizures	

### Hyperparathyroidism

#### HYPERCALCEMIA

Hypercalcemia =  $>10.4$  mg/dL

**Primary** - most common - due to malignancy or parathyroid malfunction. 30-40 year olds. Single gland is usually benign - 80% prevalence. **Secondary** - 15% - Hereditary and associated with MEN1 and MEN2A.

**Signs and Symptoms:** Renal -  $Ca^{+}$  deposits with recurrent stones. Skeletal - pathologic fractures, skeletal demineralization. CNS - confusion, depression. Neuromuscular - weakness, fatigue. GI - nausea, vomiting, constipation, PUD, anorexia. Cardiac - prolonged PR, short QT, HTN and Osborne J waves.

**Diagnosis:** PTH assay with  $Ca^{+}$  level. Will show increased levels of PTH and hypercalcemia.

**Treatment:** Mithramycin - inhibits osteoclasts, respiratory alkalosis, Calcitonin (stimulates osteoblasts; inhibits osteoclasts. i.e.  $Ca^{+}$  is removed from the blood and used to build bone)

*Most common cause of hypercalcemia is cancer. 25-50% of the time it is breast cancer*

**Anesthetic Considerations:** Pts will be sensitive to succinylcholine and antagonize non-depolarizing NMBs



### Surgical considerations

Arms will be tucked - IV access

NIM endotracheal tube to access nerve integrity

Consider a deep extubation

Intraop serum PTH. PTH levels should drop 20 minutes after removal

Post-op hypocalcemia

### Hypoparathyroidism

#### HYPOCALCEMIA, HYPOMAGNESEMIA and HYPERPHOSPHATEMIA

Absence of deficiency of PTH secretion or resistance of peripheral tissues to PTH

**Cause:** Iatrogenic (i.e. inadvertent removal during thyroid surgery)

**Signs and Symptoms:** neuronal irritability, muscle spasms, tetany, seizures, fatigue, stridor, apnea, CHF, hypotension, prolonged QT, decreased response to beta agonists, fatigue, Chvostek's sign, Trousseau's sign and mental status changes

**Treatment:** electrolyte replacement, avoid respiratory alkalosis (decreases  $\text{Ca}^+$  further), phosphate binders (Sevalamir). *Severe hypocalcemia:* 10-20 mL (90mg; 0.46mEq/L) of 10% Calcium Gluconate or 3-5 mL (270mg; 1.36 mEq) of Calcium Chloride followed by 1-2mg/kg/hr or Calcium infusion. *Calcium is incompatible with sodium bicarbonate*

**Anesthetic Management:** be mindful that laryngospasm can occur, seizures, prolonged QT (zofran)

