- Hyperparathyroidism = Overactive parathyroid gland(s)
  - Parathyroid gland is the thermostat for blood calcium level
  - 4 glands-usually 2 on each side, inferior and superior
  - Calcium is important for bones and muscles (heart)
  - Overactive parathyroid causes high calcium level
Causes of Hypercalcemia

- Primary hyperparathyroidism (most common cause)
  - Parathyroid adenoma, double adenoma, & 4 gland hyperplasia
- Malignancy - bone mets (second most common cause)
- Drugs - Thiazide diuretics, lithium, vitamin D toxicity
- Renal disease (secondary & tertiary hyperparathyroid - 4 gland hyperplasia)
- Granulomatous disease - sarcoid, TB
- Benign familial hypocalciuric hypercalcemia (FHH) (trick surgeons)
  - a benign autosomal dominant condition that causes chronically elevated serum calcium and reduced calcium excretion. It is typically caused by an abnormal set-point for parathyroid hormone (PTH) secretion in the calcium sensing receptor (CASR)
Types of Hyperparathyroidism (HPT)

- Primary HPT - No known cause (PTH=70-300)
  - 85% Single adenoma (one overactive gland)
  - 12% Double adenoma (two overactive glands)
  - 3% Parathyroid hyperplasia (4 overactive glands)

- Secondary/Tertiary HPT - Cause is kidney failure (PTH=2-4000)
  - Parathyroid hyperplasia (4 overactive glands)

Vitamin D helps the body absorb calcium from the gut, with low Vitamin D more PTH is needed to maintain calcium.
Symptoms of Hyperparathyroidism

• Kidney stones
• Osteoporosis/osteopenia
• Fatigue, bone/joint/muscle pain (take credit)
• Mental status changes (103 yrs old)
• Ulcers, nephrocalcinosis, pancreatitis, HTN, arrhythmias
• Mostly incidental finding on routine chemistry (normal calcium = 8.5-10; normal PTH = 10-65)
Diagnosis of Primary Hyperparathyroidism

![Graph showing blood parathyroid hormone (PTH) level and blood calcium level]

- Kidney Failure
- Gastric Bypass Surgery
- Vitamin D Deficiency
- Normal Range for Calcium & PTH
- Hypoparathyroidism
- High Calcium of Malignancy

- Primary Hyperparathyroidism: 80%
- 50%
Parathyroidectomy

Incidence of hyperparathyroidism is increasing - 2 main factors
1) Increased screening/recognition of hypercalcemia
2) Aging population in whom the disease is more prevalent, especially postmenopausal women.
Parathyroid Localization Studies

PreOp Localization

- Ultrasound
- Scintigraphy
- 4D CT, MRI
- US guided FNA
- Gamma Probe

IntraOp Localization

- Gamma Probe
- Methylene Blue
- PTH assay
- Selective Venous Sampling
Ultrasound:

- 5–15 MHz transducer
- Normal glands are not visible on ultrasound

Longitudinal/Sagittal

Axial/Transverse
Scintigraphy

- technetium 99m (\(^{99}\text{Tc}\))-sestamibi scintigraphy

- 3-dimensional single-photon emission CT (SPECT)

- hybrid SPECT/CT protocol
Axial Imaging - 4D CT
Methylene Blue

- 3.5mg/kg infused after induction of anesthesia
- Neurotoxicity in patients taking Serotonin reuptake inhibitor medications
Gamma Probe

- Inject radio tracer 90 minutes prior to incision
- Localized abnormal gland preop & intraop
- Helps confirm cure intraop
IntraOp PTH

**PTH protocol**

1. Check preop PTH prior to incision
2. Check PTH 10, 20, & 30 minutes after adenoma removed

- Predictive accuracy of 97%
- IntraOp PTH changed the operative approach in 13%
- Need for second surgery without use of intraOp PTH is 10-15%
- Goal for PTH
  - Primary - should be less than 40 (probably less than 30) - remaining normal glands should be suppressed
  - Secondary/Tertiary - goal is around 75
    - Remaining parathyroid tissue is hyperplastic
    - Don't want to over-resect
Intraoperative Internal Jugular Venous Sampling for PTH Assay

- Helps localize correct side (right or left)

- If both sides are equal, could be hyperplasia, double adenoma, or mediastinal location

- The best localization study is locating an experienced parathyroid surgeon!
Embryology of Parathyroid Glands

- 5th week gestation
- Inferior parathyroid migrates from 3rd pouch along with thymus - anterior, more variable location
- Superior parathyroid from 4th pouch - posterior, more constant location
Arterial Supply
Venous Drainage

- Superior thyroid artery
- Superior thyroid vein
- Middle thyroid vein
- Right recurrent laryngeal nerve
- Inferior thyroid vein
Nerve Supply to Larynx (Vocal Cords)
Finding the Parathyroid

- Superior Glands
  - 85% are 1cm from the cricothyroid joint (where RLN enters larynx)

- Inferior Glands
  - 61% are 1cm from the inferior pole of the thyroid gland (RLN & ITA intersection)
  - 26% are in the thyrothymic ligament
Finding the Parathyroid

- Look more, dissect less
- Blunt Kittner dissection and look for bulging tissue
- Adenoma often has dark red/dark blue color
- Superior parathyroid will be deep to RLN
- Inferior parathyroid will be superficial to RLN
- Dissect all fascia off thyroid capsule
- When preop studies are negative, it is more likely superior parathyroid within the thyroid fascia or hyperplasia
Ectopic Parathyroids

- 16-22% incidence of ectopic parathyroids
- Single adenoma (89%); double adenoma (11%)
- **Inferior** parathyroid ectopic locations - thymus (30%), anterosuperior mediastinum (22%), intrathyroidal (22%), thyrothymic ligament (17%), submandibular (17%)
- **Superior** parathyroid ectopic locations - tracheoesophageal groove (43%), retroesophageal (22%), posterior mediastinal (14%), intrathyroidal (7%), carotid sheath (7%), paraesophageal (7%)
Preop PTH = 134
10 minute PTH = 66
20 minute PTH = 67
30 minute PTH = 87
3 1/2 gland parathyroidectomy for parathyroid hyperplasia

Final PTH = 9.8
Finding the Parathyroid

Rajeev H. Mehta, MD, FACS

“The eye doesn’t see what the mind doesn’t know”

Thank you!

• Any questions?