Primary Hyperparathyroidism (PHPT)

• Inappropriate PTH secretion (relative to the plasma Ca\(^{++}\) levels) by adenoma(s), hyperplasia, or carcinoma (rare).
• Some genetic determinant (MEN 1 and 2, FHH, HPT-JT, familial isolated HPT).
• Disregulation of CaR (Ca\(^{++}\) “sensor”) and of VDR (Vit D receptor).
• PHPT also linked to ionizing radiation.

Secondary Hyperparathyroidism

- Increased PTH secretion in response to reduced levels of Ca++ in the plasma.
- Most common cause: chronic renal failure (phosphor retention, reduced calcitriol levels, bone resistance to the calcium-mobilizing activity of PTH, increased calcitonine levels).
Tertiary Hyperparathyroidism

• Persistence of hyperparathyroidism after correcting the cause of secondary HPT (e.g., successful kidney transplantation).

• Autonomy developing after prolonged secondary HPT, with hypercalcemia.

Persistent/Recurring HPT

Persistent HPT

• Persistent abnormal plasma Ca++ levels immediately after surgery for PHPT.

Recurring HPT

• Relapse of signs/symptoms of HPT after more than 6 months from normalization induced by surgery.
Diagnostic Imaging

• Virtually no role in primary differential diagnosis (complementary only).

• Important, crucial role for pre-operative localization, especially when planning mini-invasive surgery.
Morphologic Imaging

- Ultrasound
- CT
- MR

Morphofunctional Imaging

- Scintigraphy

**Ultrasound**

**Pros:**
- low cost
- non-ionizing radiation

**Cons:**
- inter-operator variability
- variable sensitivity according to location (ectopic)
- does not explore mediastinum

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**CT or MR**

- **CT sensitivity:** 46%-80% (contrast)
  - 46-58% post-surgery.

- **MR sensitivity:** similar as scintigraphy, but wide variability
  - best employed in combination with scintigraphy (as for US)
Parathyroid Scintigraphy

• There is no radiopharmaceutical that specifically accumulates in parathyroid tissue.

• Dual-tracer procedures were originally developed to take advantage of different uptake in the thyroid and in parathyroid (\(^{75}\text{Se}-\text{methionine-}^{131}\text{I}, \ 201\text{Tl-}^{99m}\text{TcO}_4^-/^{123}\text{I})

Parathyroid Scintigraphy

• \(^{99m}\text{Tc-Sestamibi: after rapid uptake in both the thyroid and parathyroid tissue, it exhibits different retention/washout times (early and delayed acquisitions).}

• Adding a second tracer that solely accumulates in the thyroid (\(^{99m}\text{TcO}_4^-\) or \(^{123}\text{I-iodide}) facilitates interpretation of the scintigraphic patterns.
99mTc-Sestamibi 15 min

99mTc-Sestamibi 2.5 hr

99mTcO₄⁻ - 99mTc-Sestamibi subtraction

99mTcO₄⁻ - 99mTc-Sestamibi subtraction
99mTc-Sestamibi 15 min

99mTc-Sestamibi 2.5 hr

99mTcO₄⁻ subtracted from delayed 99mTc-Sestamibi

Delayed 99mTc-Sestamibi with 99mTcO₄⁻ profile
SPECT/CT with $^{99m}$Tc-Sestamibi in patient with recurrent PHPT

Ectopic adenoma in upper mediastinum
Debate on Radioguided Surgery

• Preoperative radioguidance only?
• Intraoperative radioguidance?
• Quick intraoperative PTH assay?
• Intraoperative ultrasound?
• “Single-day” high-dose protocol?
• Separate-day low-dose protocol?