Avoiding failed parathyroidectomy

How to avoid a failed parathyroidectomy

1. right patient
2. right operation
3. right anatomy
4. right tools

Case: primary hyperparathyroidism

- 63 yo woman with osteopenia on Fosamax, noted to have hypercalcemia, 11.3-11.7mg/dL
- PTH inappropriately elevated at 156pg/mL
- She denied kidney stones, bone pain, poor memory or concentration, abdominal pain, constipation, fatigue
- No family history of hypercalcemia, neck operations
- No history of ionizing radiation to the head, neck or chest

“the success of parathyroid surgery must lie in the ability of the surgeon to know a parathyroid gland when he sees it, to know the distribution of the glands, where they hide, and also to be delicate enough in technique to be able to make use of this knowledge”

– Edward D. Churchill, 1931
Case: primary hyperparathyroidism

- Sestamibi: persistent uptake L lower
- Ultrasound: 1.8cm hypoechoic structure

Plan for focused left parathyroidectomy

- Intraoperative ultrasound confirmed hypoechoic structure on the left, just inferior to the lower pole of the left thyroid gland
- 2.5 cm incision, to right of midline, strap muscles retracted laterally, area around left thyroid lobe explored
- NO PARATHYROID GLAND
- RLN identified, thyrothymic ligament explored, tracheoesophageal groove explored
- NOTHING

Based on the imaging studies, “blind” FNA of left thyroid lobe, inferior pole, send for PTH assay

- While waiting, ligated upper pole vessels, identified normal left upper parathyroid gland, marked with clip

PTH assay of left thyroid lobe 7,000 pg/mL

- Left lobectomy completed
- IOPTH
  - Pre 1: 234
  - Pre 2: 189
  - Post 1: 40
  - Post 2: 23
Right Patient. Does the patient have the disease?
First things first: establish a biochemical diagnosis

• Serum Ca >10.1 mg/dL
• Serum intact PTH >65 ng/L
• Urinary Ca excretion > 400 mg
• Serum phosphorous low or low-normal
• Serum chloride/phos ratio >33
• Elevated serum alkaline phosphatase, uric acid
• Serum Creatinine

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Right Patient. Does the patient need an operation?

• 2002 NIH guidelines for parathyroid surgery in asymptomatic primary hyperparathyroidism
  - Serum Ca (above upper limit normal) 1.0 mg/d
  - 24-h urinary Ca >400 mg
  - Creatinine clearance by 30%
  - BMD t-score <-2.5
  - Age <50 yrs

(Bilezikian et al, JCEM 2002;87:5353)

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Right operation

• Bilateral exploration (4 gland)
• Unilateral exploration (2 gland)
• Focused exploration (1 gland)
What is the best operation?

- **Bilateral approach**
  - Explores all 4 glands
  - “gold standard”
  - No localization studies, no IOPTH
  - Indicated for pts at high risk for multi-gland disease
    - Familial syndromes
    - Negative localization studies
  - Over 95% successful

(Paloyan E and Lawrence A, Endocrine Surgery: Operative Surgery, 1976)

What is the best operation?

- **Unilateral approach**
  - Explores 2 glands
  - Only one RLN, 2 PTH glands at risk
  - Useful for patients w/ US or Mibi suggesting disease on one side
  - Over 90% success rate


What is the best operation?

- **Focused** (1 gland)
  - Explores 1 gland
  - Only one RLN at risk
  - Indicated in patients with high probability of single-gland disease
    - US & MIBI concordant
  - 95% success rate

(Gosnell et al ANZ J Surg 2004;74:330)

Right operation. What are the critical technical aspects?

- **Bloodless field**
- **Meticulous dissection**
- **Lighting, exposure, judgement**

1-gland
- midline (lower)
- resection of adenoma
- ID of normal PTH
- preserve RLN

2-gland
- midline or lateral
- resection of adenoma
- ID of normal PTH
- IOPTH, frozen section
- preserve RLN

4-gland
- midline cervical
- ligate/divide middle thyroid veins
- ID of 4 PTH glands
- resection of enlarged PTH gland(s)
- IOPTH, frozen section
- preserve RLN
Causes of primary HPT

- Double adenoma
- Carcinoma
- Hyperplasia
- Adenoma

Incidence of multiglandular disease:
- 15-20% in earlier series (bilateral exploration)
- 5% in newer series (unilateral, focused exploration)

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Right operation? Guided by imaging studies

- Ultrasound
- Tc-sestamibi
- CT/MRI
- FNA (intrathyroidal PTH adenoma, thyroid nodules)
- Selective venous sampling

- Review the images yourself!
- Suspicious thyroid nodules should be biopsied first

Is it single-gland disease?

In patients with primary hyperparathyroidism, "when both the ultrasonography and sestamibi scans identified the same, solitary parathyroid tumor in patients with sporadic primary hyperparathyroidism, this was the only abnormal parathyroid gland in 96% of the patients. A focused parathyroidectomy could therefore be performed in such patients with an acceptable (95%) success rate" (Arici et al. Surgery 2001;129:720)

CaPTHUS (Kebebew) scoring model for predicting single-gland disease

- Serum Ca >12 mg/dL
- Serum int PTH > 2x normal upper limit
- US+ for single enlarged gland
- Sestamibi scan + for single enlarged gland
- Concordant US and sestamibi

Score >3
100% PPV for single-gland disease

(Arici et al., Arch Surg 2006;141:777)

Anatomy 101. Where do I find the diseased glands?

- Superior parathyroids
  - 4th brachial pouch
  - Associated with lateral thyroid, C-cells
  - most are located in the cricothyroid area
  - 2cm area, intersection of the inferior thyroid artery and the RLN
  - Usually posterior to the recurrent laryngeal nerve

(Paloyan E and Lawrence A, Endocrine Surgery: Operative Surgery, 1976)
Anatomy 101.
Where do I find the diseased glands?

- **Inferior parathyroids**
  - 3rd brachial pouch
  - Associated with thymus
  - Lower pole of thyroid, below and anterior to the intersection of inferior thyroid artery and the RLN, thyrothymic ligament
  - Can have a wider distribution
  - Usually **anterior** to the recurrent laryngeal nerve

(Paloyan E and Lawrence A, Endocrine Surgery: Operative Surgery, 1976)

Anatomy 101.
Where do I find the diseased glands?

- **Enlarged parathyroids**
  - Tend to become displaced into pathways of least resistance
  - **Superior PTH**
    - “PLUG” posteriorly located upper gland (Harari A. Annals Surg Oncol 2011)
    - Tracheoesophageal groove
    - Retroesophageal
    - Superior posterior mediastinum
  - **Inferior PTH**
    - Ant/Post mediastinum

(Paloyan E and Lawrence A, Endocrine Surgery: Operative Surgery, 1976)

Develop intra-operative sequence

- Have a low threshold for converting to 4-gland exploration!
- **Usual locations**
- **Tracheoesophageal groove**
- **Retroesophageal**
- **Retropharyngeal**
- **Thyrothymic ligament**
- **Bilateral exploration**
- **Carotid sheath**
- **Supernumerary glands**
- **Intrathyroidal**
- **Mediastinal**
  - 5-11% of failed cases (Conn JM Am Surgeon 1991;57:62)

Sites of 104 missing parathyroid tumors
(From Wang CA, Ann Surg 1977;186:142)
Develop intra-operative sequence

Have a low threshold for converting to 4-gland exploration!

1. Consider FNA any suspicious thyroid nodules for PTH assay
2. Explore other side, use symmetry
3. Irrigate, lighting, exposure
4. Call a friend
5. STOP.

Right tools. What surgical adjuncts should I use?

• Biopsy/Frozen section
  - Use sparingly, esp for normal glands
  - Can confirm PTH tissue
  - Cannot distinguish b/ adenoma and hyperplasia
  - Cannot distinguish b/ PTH and Hurthle cell
  - Useful as confirmation in pts with concordant imaging but no IOPTH

• Aspiration
  - Can be used to distinguish between thyroid and parathyroid tissue.

Intraoperative PTH

“works best when its needed least” (QY Duhn)
Excellent results in 85% pts with solitary adenoma
Only helpful in 50% of pts with double adenomas
>50% drop associated with successful resection (vs return to normal PTH levels)

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(Gauger et al Surgery 2001;130:1005)
(Haciyanli et al JACS 2003;197:739)

Take a break, don’t despair