UCSF Head & Neck Endocrine Surgery Update:
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Nothing to Disclose

Frame of Mind

• Assume multi-gland disease
• Localization studies can be wrong (multiglandular disease, revision surgery, mediastinal lesions, morbid obesity)
• Surgical Loupes
• Bloodless dissection: minimal dissection, maximum looking
Minimally Invasive Parathyroid Surgery (MIP)
- Ideal candidate single parathyroid adenoma
- Pre-op Concordant Localization studies: Sestimibi Scan and Ultrasound
- iPTH (before incision, 10 minutes after)
- iPTH (Drop to nl range (<65 pg/ml) and > 50% decrease from baseline)
- Cure rate 97.2% (Richards et al Arch Surg 2011)
- Severe hypocalcemia assoc w bilat exploration and persistent and recurrent disease no lower with bilat exploration (Tibblin Eur J Surg).

Open Minimally Invasive Parathyroid Surgery (MIP)
- MIP shorter anesthetic, smaller incision, shorter operation, shorter hospital stay.
- Complication rates are lower and cure rate comparable to Bilateral Neck Exploration
- Alternative approaches: Endoscopic, VAS, Radioguided, Robotic

Contraindications to Open MIP
- Known multi gland disease (MEN, familial hyperparathyroidism)
- Concomitant thyroid pathology
- Discordant imaging

Endoscopic Parathyroidectomy
- CO2 insufflation, steady gas flow
- 5mm endoscope through central trocar and 2 additional trocars for instruments.
- “Incisionless”
- Steep learning curve
- Require an extensive and difficult dissection
- Long operative time
- Reported Pneumomediastinitis, Air Embolism
Video Assisted Surgery (VAS)

- First reported by Miccoli (1997 J Endocrinol Invest)
- Advantages: magnification and intense illumination
- Scope and instruments can be rotated and placed in any direction.

Prades et al, Eur Arch Otorhinolaryngol (2011)

- Concordant Sestimibi & US localizing studies are ideal
- 2 cm incision, 3mm, 30 degree videoscope (Melck et al Amer Surg 2012)

Video-Assisted Parathyroidectomy (VAS)

- Bilateral approach is possible.
- Can perform associated thyroid surgery.
- Reduced operative pain, better cosmetic results and higher patient satisfaction compared to Open MIP

VAS

- Disadvantages: suboptimal depth perception, imprecise tissue manipulation, multiple assistant dependence, longer operative time (Hessman 2010 Br J Surg).
- Extraction of large adenoma (>30mm) can result in rupture
- VAS contraindicated with previous neck surgery, recurrent or persistent hyperparathyroidism, and large goiter
- BMI > 40
- Cost w multiple assistants
- Conversion to open technique can occur with failure to identify diseased gland(s).
Minimally Invasive Radioguided Parathyroidectomy (MIRP)

- Pre-op injection radiolabeled sestimibi within 4 hrs of procedure
- Hand held gamma probe
- In-vivo counts higher than 150% strongly suggest presence of parathyroid adenoma.
- Ex-vivo count > 20% of background

Minimally Invasive Radioguided Parathyroidectomy (MIRP)

- For glands below the aortic arch, a specially adapted gamma probe can be utilized via video assisted thoracoscopic surgery (VATS)
- Most useful benefit for difficult revision cases w/ scar tissue.
- Recurrent parathyroid cancer where most crucial part of treatment is calcium regulation not metastasis.

Robot Assisted Parathyroid Surgery (RATS)

- Trans-axillary (Landry et al. Surg 2011)
- Popularized in Korea where the neck is culturally prized for beauty with an emphasis on neck anatomy that exceeds what is appreciated in Western culture.

Robotic Assisted Parathyroidectomy (RAP)

- 3D view, good depth perception, 7 degrees of freedom, tremor filter
- Concordance: US, Sestimibi, SPECT

(Tolley et al Otolaryngol-Head & Neck Surg 2011)
RAP (Tolley et al Otolaryngol-Head & Neck Surg 2011) Infra-clavicular approach

- 3 Trocars: superior axillary, central axillary, periareolar
- Brachial Plexus Neuropraxia (arm raised in a flexed and internally rotated position)
- Risk if iPTH does not decline
- Longer operative time

Anesthesia Decisions

- Local anesthesia if localization studies strongly +
- G.A. allows RLN monitoring, potentially safer for limited exposure approach.

ID of PG

- Color light brown to reddish brown
- Large glands with secondary HP can be grayish.
- Obese patients have higher fat content of PG-more yellowish color.
- Fat is yellow
- Normal PG=5x4x2 mm, <60 mg
- PG has vascular pedicle

ID of PG

- PG discreet, encapsulated smooth surface, bean like
- TG more lobular, more mottled, harder, darker reddish.
- PG that are assoc w capsule of TG do not cause bleeding on dissection
- 90% of parathyroid glands within 1 cm of jxn of ITA and RLN
ID of PG

- PG characteristic gliding motion when surrounding fat manipulated.
- Positional symmetry or R & L side, 80% of time for SPG and 70% for IPG (Akerström Surgery).
- Fat floats in saline, parathyroid sinks replaced with intra-operative frozen section, that has been replaced by iPTH.
- Enlarged gland shows hypercellular parathyroid tissue with decreased fat on f.s.

Superior Parathyroid Location

- 80% of cases within 1 cm of CT membrane
- 1 cm cranial crossing RLN and ITA (less reliable)

SP dorsal to RLN

Lateral and Superior Exposure for SP

- Division of Middle Thyroid V.
- Deeper exploration expose RLN
- SP blood supply ITA or ITA and post br STA
- If division of STA necessary preserve posterior br.
Inferior Parathyroid Location

- 50%-within 1 cm lateral, inf or posterior to inf pole of thyroid
- Ventral to RLN
- Blood supply ITA
- Position more variable

Vascular Supply Dissection

- ID of STA and ITA can help find parathyroid
- Caution in dissection of distal branches

Preservation of Vascular Supply

- Dissect distal tip blood supply to hilum of PG:
  - Superio-medial for Sup PG
  - Infero-medial for Inf PG
- Sup PG pedicle lateral to RLN
- Inf PG pedicle medial to RLN

Devascularization

- Deep blackened discoloration
- Gland good color w tenuous vascular supply-not likely viable.
- It can be biopsied to see if gland has good blood supply if the cut end bleeds.
- Autotransplant-80% take (Sierra et al Surgery)
Don’t

• Don’t Remove a normal parathyroid
• Don’t Biopsy anything until you have seen everything
  a. More Biopsy=More Hypoparathyroid: (Kaplan, Surgery)
  b. Normal Glands can be read on F.S. as hypercellular.
  c. iPTH has largely replaced BX

Don’t

• Don’t empirically remove the thyroid gland-increases the risk of devascularization of remaining glands.
• Don’t rupture a parathyroid cyst-spillage can lead to multiple implants

Missing PG

Missing Sup PG
• Extended normal location
• Migration
• Ectopic Sites

Missing Inf PG
• Extended normal location
• Ectopic Sites
• Migration

Missing Superior Parathyroid Gland
1. Extended Normal Sites

• Dorsal and Lateral to RLN
• Postero-lateral aspect of upper lobe
• Retrolaryngeal/esophageal
• Above sup pole
Missing Superior Parathyroid Gland

2. Caudal Migration, more common in SPG
- Para/retro esophageal/TE groove
- Mid thyroid to Post Mediastinum
- Pre-vertebral fascia

Missing Superior Parathyroid Gland

3. Ectopic sites (rare)
- Carotid Sheath
- Scalene Fat Pad
- Intrathyroidal-rare

Missing Inf Parathyroid Gland

1. Extended Normal Locations
- Ventral to RLN
- Upper Thymus
- More lateral to inf pole
- Medial, on trachea

Missing Inf Parathyroid Gland

2. Embryological Ectopia > migration
- Anterior Mediastinum: Lower Thymus
- Undescended Inf P assoc with medial carotid sheath often at bifurcation or take off of STA
- Intra-thyroidal (more common for IPG)
Intra-thyroidal or Subcapsular Parathyroid more common w Inf PG (Ectopia)

• If 3 glands discovered and remaining gland not found is IPG
• Palpate inf pole and test for iPTH spike.
• Thyroidotomy rather than thyroid lobectomy
• Lobectomy can lead to devascularization of parathyroids and hypocalcemia
• Makes more difficult for the revision surgeon.

Missing Inf Parathyroid Gland
3. Acquired Location-Migration

• Less important compared to Sup Parathyroid Gland
• Can migrate to middle and lower thymus

Fifth Gland

• Overall 1% of cases (Palmer Can J Surg)
• Up to 15% in multiglandular disease.
• Fifth Gland if an adenoma often in mediastinal thymus

Mediastinal Adenoma

• Most are within or attached to thymus and can be removed trans-cervically
• < 1% of overall cases requires Mediastinotomy
• Adenomas below aortic arch can selectively be removed with less invasive video-assisted approaches
• Second procedure-MRI, Sestimibi w SPECT, selective venous angiography
Consideration for closure

- Normal glands should never be removed.
- Consideration for sample of inferior-most jugular venous supply for PTH.
- May help planning future dissections.

Reasons for failure in order of occurrence

- Missed gland in normal cervical location (vast majority)
- Missed dx of multiglandular disease
- Double adenoma
- Ectopic gland
- Error in diagnosis (familial hypocalciuric hypercalcemia, sarcoid, Vit D Defic, lithium Rx)

Re-operative series-Location of (Shen Arch Surg)

- Cervical Location
- Upper thymus (thyro-thymic horn)
- Para/retro esophageal
- Intrathyroidal
- Assoc w carotid sheath

Re-exploration Strategies

- Refer to experienced surgeon.
- Pre-op ID of parathyroid by US, Sestimibi, MRI, SPECT
Re-exploration

- Heightened risk of unilateral vocal cord paralysis (7-8%) and bilateral vfp (1.3%) Weber C. Surgery
- Rates of permanent hypoparathyroidism (10-39%) Brennan MF Surgery
- Reduces rate of success (60-85%) Brennan MF Surgery
- Risks of re-operation are increased with prior thyroidectomy

Radio-guided excision of parathyroid lesions in patients who had previous neck surgeries

- Prior Neck Surgery
- Parathyroid ID by US
- Direct Injection of Radio tracer into lesion
- 18/18 identified (Sari et al Int J Surg 2011)

Multiglandular Disease

- Resection should begin only after all glands identified.

Sporadic Multiglandular Disease

- Often 2 or 3 glands involved.
- Modest elevation of serum calcium
- Multiglandular disease is more difficult to treat and observation should be considered in elderly patients with only mild hypercalcemia.
MEN-1

- Parathyroid, Pancreas, Duodenum, and Pituitary tumors.
- Associated with failed parathyroid surgery.
- Markedly assymetrical multiglandular involvement.
- Individual tumors may develop assynchronously.
- Cervical Thymectomy

MEN-2A

- Parathyroid hyperplasia, MTC, Pheochromocytosis.
- Majority of MEN-2A do not have parathyroid hyperplasia
- Generally mild hypercalcemia-large hyperplastic gland and normal ones.
- Only large glands should be removed.
- Does not occur in MEN-2B

Secondary Hyperparathyroidism

- Progressive kidney disease, long-term lithium Rx
- Rarely Vit D defic, GI absorption defects.
- In patients not responsive to medical management-total parathyroidectomy w autotransplantation.
- Hypocalcemia post op expected, permanent in 10% of cases.
- 10% failure to control hypercalcemia

Multiglandular Disease Option 1:
Remove only enlarged glands

- Double adenoma
- Sporadic 3 gland hyperplasia
Multi-gland Option 2: 3.5 gland resection (subtotal parathyroidectomy)
- Sporadic 4 gland hyperplasia
- MEN 2A

Option 2: Subtotal Parathyroidectomy 3.5 gland resection
- Resect only after all 4 glands identified
- The smallest most normal appearing gland is left as remnant.
- Leave a 50 mg remnant
- Non-absorbable suture in thyroid gland.
- Selectively consider cervical thymectomy as 15% will have a 5th gland (Tominaga Biomed Pharmacother)

Multi-gland Option 3: Total parathyroidectomy w autotransplantation.
- MEN-1
- Familial hyperparathyroidism
- Secondary hyperparathyroidism

Multi-gland Option 3: Total parathyroidectomy w autotransplantation.
- Cervical thymectomy and excision of fat in central neck compartment
- Cervical thymectomy initially performed in the cervical neck followed by careful traction and ligation of veins draining the innominate v.
Total Parathyroidectomy and Autotransplantation

- Tissue slices with an estimated weight of 60-80 mg cut from smallest gland.
- 0.5-1mm slices
- Autotransplant into brachioradialis muscle or SCM and mark w surgical clip.
- Graft function 2-3 months.

Cryopreservation

- Placed on ice in saline.
- Section into 1mm slices.
- Cryovials containing culture medium (RPMI)
- Placed in freezer -70 degrees for 3 hours and stored in liquid nitrogen.
- If needed thawed in 37 degree water bath.
- Effective 60%

Cryopreservation

- Cryo-preserved parathyroid tissue functional 60%
- Auto-preserved functional 90%

Conclusions

- Assume multi-gland disease at the onset.
- Minimal dissection, maximum looking.
- Pre-op Localization studies: Sestimibi Scan and Ultrasound
- Multi-Glandular Disease-Resection should begin only after all glands identified.
- SPG-80% of cases within 1 cm of CT membrane
Conclusions

• IPG-Position more variable
• iPTH has largely replaced BX
• Vast majority of missed PG adenomas are in normal cervical location
• For multi-glandular disease tailor operation to diagnosis.