



Surgical Endocrinology

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Thyroid Embryology

- Day 24
- Endodermal thickening on floor of pharynx (Foramen cecum in adults)
- **Thyroglossal Duct:** growth into neck ant to hyoid/thyroid cartilage
 - Disappears by Day 50
 - Thyroglossal Duct Cyst: persistence in adults
- **Pyramidal Lobe:** persistence of migration
 - 50% of adults

Thyroid Anatomy

- Two lobes, anterior to larynx / trachea
- Arterial Supply:
 - Superior thyroid a.: 1st branch of ECA
 - Inferior thyroid a.: branch of thyrocervical trunk
- Venous Drainage:
 - Superior, Middle, Inferior thyroid veins
- Muscle coverage: platysma, SCM, straps

Thyroid Physiology



- Follicular Cells
 - Capture Iodine from circulation
 - Rate-limiting step
 - Concentrate iodine to 30x
 - Oxidized by **Thyroid Peroxidase (TPO)**
 - Membrane- bound enzyme
 - Called organification
 - Makes **Thyroglobulin** & releases into follicle

Thyroid Physiology

- Follicle
 - Extracellular storage for follicular cells
 - Thyroglobulin meets Oxidized Iodine →
 - MonolodoTyrosine (MIT)
 - DilodoTyrosine (DIT)
 - Coupling of MIT/DIT form T3 & T4
 - T3, T4: storage forms of thyroid hormone

Thyroid Physiology

- TSH stimulates release of active hormone
- T3/T4 taken back by Follicular Cells
 - Endocytosis
 - Hydrolyzed & released, leaving thyroglobulin
- 80% of circulating hormone = T4
- T3 also made by peripheral conversion
 - T4 → T3
 - Most active form

Thyroid Physiology

- TSH (ant pituitary) → follicular cells
 - Stimulated T3/T4 release
 - Increase thyroglobulin synthesis
 - Increase iodine transport
- **TRH** (hypothalamus) → TSH
 - Thyrotropin-releasing hormone
 - Increases TSH release
- T3/T4 (Thyroid) → Inhibits TSH, TRH

Thyroid Physiology

- **Parafollicular Cells (C cells)**
 - From neural crest cells
 - High calcium → **Calcitonin**
 - Inhibits osteoclasts

Thyroid Nodule

- 4% of population w/ palpable nodules
- 50% solitary, 50% multiple
- H&P: local compressive sx, duration, toxicity
- Family hx: MEN, childhood hx radiation
- Labs: TSH, T4, T3
- Dx: U/S (solid vs cystic), FNA
- Tx: Benign → thyroid hormone / TSH suppression
- Intermediate/Malignant FNA → Lobectomy
- Final Path: Follicular, Medullary, Anaplastic, Most Papillary → Completion Total Thyroidectomy

Thyroid Nodule

- Dx: **FNA** → single most important study
 - Only 3% w/ benign path have CA (false neg)
 - 85% w/ malignant path have CA (true pos)
 - Follicular adenoma vs CA only dx by full path: capsular / vascular invasion (not on cytology) → must resect for dx
- Dx: **U/S** → cystic vs solid, exact size
 - If cystic → U/S FNA, if disappears, then done
 - If residual mass, FNA mass, consider OR
 - If solid → FNA → benign, indeterminate, malignant

Hyperthyroidism-Grave's

- Grave's Disease: most common
- Diffuse goiter, exophthalmos, tachycardia, tremor, heat intolerance, wt loss, young women
- Immunoglobulin G (TSAb): against TSH receptors on follicular cells
- Dx: diffusely enlarged gland, Ab positive, other Sx
- Tx:
 - Medical (1/3)
 - Iodide (Lugol's soln) blocks thyroid hormone release
 - Beta blockers (Propranolol) decr T4-T3 conversion
 - Thionamides (PTU/Methimazole) blocks hormone synthesis
 - Radioablation: Iodine-131 destroys follicular cells
 - Surgical: Thyroidectomy (esp if pregnant)

Hyperthyroidism-Toxic Adenoma

- Solitary hyperactive tumor, CA rare
- Not autoimmune w/other sx like Grave's
- High T3,T4, Low TSH
- Dx: NI Thyroid w/ palpable "hot" nodule
- Tx: Not as good w/ medical tx/radiation
 - Lobectomy

Hyperthyroidism-Toxic Multinodular Goiter

- Many hyperactive nodules → goiter
 - +/- compressive sx
- “hot” on thyroid scan
- Tx: Not as good w/ medical/radioablation
 - Total vs Subtotal Thyroidectomy

Thyroid Carcinoma

- More common in women, middle-aged
- **Papillary:** most common (70-80%)
 - Grow slowly, good prognosis, mets to LN
 - If good factors (<45yrs, <1cm)→lobectomy
 - Otherwise→total thyroidectomy
 - Postop radioablation if residual/met, >1cm
 - Lifelong thyroid replacement
 - Mets to lungs, bones
 - Poor prognosis: men, >50yrs, >4cm, invasion

Thyroid Carcinoma

- **Follicular:** 10-20%
 - May look like adenomas on FNA, only difference by invasion on path
 - Grow slowly, good prognosis if small
 - Poor prognosis: >45yrs, invasion
 - Total thyroidectomy
 - Mets to lung, bone
 - +/- Radioablation after removed

Thyroid Carcinoma

- **Medullary:** associate w/ MEN
 - Worse prognosis, elevated calcitonin
 - Total thyroidectomy w/ LN dissection
- **Anaplastic:** very aggressive, palliation
- **Lymphoma:** mass in neck & other sites
 - Differentiate from Hashimoto's w/ bx

Thyroidectomy

- Preserve **parathyroid glands**
 - Can reimplant (autograft) into muscle
 - Transient hypoparathyroidism (low Ca)
- Preserve **recurrent laryngeal nerve**
 - Paralysis of vocal cord on one side → hoarse
 - If both injured, then needs tracheostomy
- Preserve **superior laryngeal nerve**
 - Loss of voice quality & high-pitched range

Parathyroid Gland

- 90% of adults have 4 glands
- Arterial Supply: Inferior Thyroid Artery
- Venous drainage: IJ, SC, Innominate
- Usually just beneath the thyroid capsule near the recurrent laryngeal nerve
- Secretes **Parathyroid Hormone (PTH)**
 - Increases serum Calcium
 - Calcitonin by Parafollicular Thyroid Cells decreases serum Calcium

Hyperparathyroidism

- **Primary:**
 - Hyperactive gland(s) → Excess PTH
 - Adenoma (85%), Hyperplasia (15%)
- **Secondary:**
 - Renal failure w/ loss of serum calcium → PTH
 - Excess PTH by all glands
- **Tertiary:**
 - Chronically stimulated hyperplastic glands of renal failure pt starts to produce PTH on their own even after renal transplant

Hyperparathyroidism

- “stones, bones, groans, moans, & psych overtones”—from too much calcium
 - Kidney stones, bone resorption, diffuse pain / fatigue, abd pain from ulcers / pancreatitis, depression / psychosis
- Usually not symptomatic, from primary dz in oupts or malignancy in inpts
- Dx: PTH, Ca, urine Ca, Vit D

Hyperparathyroidism

- Tx: Medical for Elevated Calcium
 - Normal Saline, Diuresis w/ Lasix, bisphosphonates
- Tx: Surgical
 - Single-gland resection for adenoma
 - Subtotal (3 ½) resection for hyperplasia
 - Also for secondary & tertiary
 - Reimplant in muscle
 - **Sestamibi scan** (localizes “hot” parathyroid)
 - Intraop PTH drop after resection

Adrenal Gland

- Above the kidney (suprarenal)
- 3 Arteries: superior, middle, inferior
- 1 Vein: IVC on Right, Renal Vein on Left
- Regions: Cortex (3 zones) & Medulla
 - **Zona Glomerulosa**: aldosterone → salt
 - **Zona Fasciculata**: cortisol → sugar
 - **Zona Reticularis**: DHEA → sex steroid
 - Medulla: catecholamines (epinephrine)

Primary Hyperaldosteronism- Conn's syndrome

- Zona glomerulosa (aldosterone) → salt
- **Triad: HTN, low K, high aldosterone/low renin**
- If secondary, then volume depletion → renin → aldosterone (CHF)
- Solitary adenoma vs hyperplasia vs CA
 - Adenoma is unilateral mass on CT
 - Venous sampling for aldosterone in adrenal veins
- Tx: fix low K first, Lap adrenalectomy for adenoma → 70% BP nl
- Tx: If hyperplasia, medical tx only w/ spironolactone

Cushing's Syndrome/Disease

- Zona Fasciculata (Cortisol) → sugar
- Syndrome is the effect (usu medication)
- Disease is the cause (pituitary adenoma)
- ACTH from pituitary stimulates adrenal
- Classic: female, central obesity, HTN, DM, moon face, hirsutism
- Dx: Cortisol, ACTH, **dexamethasone suppression test**, CT/MRI
- Tx: Steroid inhibitors (mitotane), radiation
- Pituitary Adenoma: **transsphenoidal resection**
- Adrenal Adenoma: lap adrenalectomy & prednisone
- Adrenal Hyperplasia: Bilateral adrenalectomy, lifelong steroids

Adrenal Cortical Carcinoma

- Rare, usually left-sided, female
- Associated with hypersecretion (Cushing's)
- Variable production of hormones
- Large, abdominal mass
- **50% metastatic at presentation**
- Dx: CT: irregular, central necrosis
- Tx: Surgical excision w/ LN, Chemo (Mitotane) if mets/unresectable
- **Median survival = 15 months**

Incidental Adrenal Mass

- Risk of CA increases if >4cm
- Dx: hormone activity
- Must rule out pheochromocytoma
- FNA (if not pheo) to eval for mets
- Tx: all functional tumor, >6cm → excision
- Tx: If <3-4cm, nonfxnal → close f/u

Pheochromocytoma

- **Adrenal Medulla** (usually), also periaortic
→ catecholamines
- Pres: HTN (episodic), palpitations, HA, sweating, anxiety, wt loss, constipation
- Usually sporadic, also a/w MEN, others
- Dx: **serum & urine catecholamine levels**, metabolites (metanephrine, normetanephrine, VMA)
- Localize: CT vs MIBG scan
- Tx: surgical excision
- Preop w/ alpha blocker & hydration, then beta blocker
- Postop crisis (**Addisonian crisis**): low BP, N/V, high K
tx w/ IV steroids