Pituitary Tumors and Surgery

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The Case

- 37 yo female with known pituitary mass.
- 2-3 years ago went camping developed cold, fever, and headache.
- Pituitary mass was discovered during the workup. Diagnosed adenoma.
- Saw endocrinologist and neurologist outside hospital. No notes on these visits. Pt does not recall the results or discussions at that time.

Radiographic imaging

Consistent with adenoma

- Most pituitary tumors are noncancerous, nonspreading adenomas.
- Adenomas remain confined to the pituitary gland or surrounding tissues and do not metastasize.
- Generally adenomas divided into two groups:
  - Functional (secrets prolactin, ACTH, Growth Hormone, or rarely: TSH, LH, or FSH)
  - Nonfunctional (symptoms will be caused by mass effect)

Is this worrisome?

- No. Not by itself.
- Pituitary adenomas are exceedingly common at autopsy and on pituitary imaging, with a prevalence of 15-25%.
- In 2006, Buurman and Saeger reported 334 pituitary adenomas in 3048 autopsy cases and the mean adenoma diameter was only 1.97 mm.
- The majority of these will have no clinical relevance.
- However if the patient presents with symptoms it is a different matter.
Epidemiology
- Pituitary tumors account for 10-15% of all primary brain tumors
- Highest incidence between the 3rd and 6th decade
- More common in women
- Genetic predisposition seen only in MEN-1.

Back to the patient...
- Did she present with symptoms?
- Following complaints were noted at the first visit in July:
  - baseline headache
  - weight gain of 30-40 lb over the last 6 months
  - cold intolerance
  - intermittent visual blurriness
  - easily fatigued
  - daytime sleepiness
- These are all consistent with secreting adenoma
  - symptoms can be secondary to ACTH secretion.
  - Except the visual blurriness, which might be due to a mass effect on the optic chiasm. This is however not likely as the optic deficits would present as field deficits.

Endocrinologic evaluation
- Laboratory Results
  - Notable for low prolactin of 55
  - Consistent with stalk compression
  - LH < 1
  - FSH 3
  - TSH 1.6
  - T4 0.96
  - Cortisol 4.2
- ACTH stimulation test: normal at 9.8 mcg/24h
- “consistent with a non-secretory pituitary macroadenoma”

Surgery
- Clinically nonfunctioning pituitary macroadenoma
- Visual field deficits or tumor compressing the optic chiasm
- Transphenoidal surgery
- MRI 4 months postoperatively
- Remnant present?
- No
- Expectant approach
  - 1. Expectant approach with MRI every 1-2 years
  - 2. Consider radiotherapy in selected cases
- Transphenoidal surgery
- Visual field and MRI assessments every 6-12 months
- Visual field deficits or tumor appreciating the optic chiasm
- No
- Expectant approach
- Transphenoidal surgery

Functioning Tumors
- Microadenomas=no mass effects
  - Excessive hormone production
    - GH secreting
      - gigantism (prepuberty)
      - acromegaly (postpuberty)
    - ACTH secreting
      - Cushing's, bilateral adrenal hyperplasia
    - Prolactinomas
      - amenorrhea/galactorrhea syndrome (fem); impotence, decreased libido(male)
  - CT scan and MRI will eval ICP
  - Perioperative short term steroids
  - Visual exam to evaluate optic chiasm
### Prolactinoma
- 20~30% of pituitary tumors
- Prolactin levels > 200 ng/ml (if less worry about stalk effect)
  - women
    - amenorrhea, galactorrhea, loss of libido, infertility
  - men
    - decreased libido, impotence, premature ejaculation, erectile dysfunction, oligospermia
- microadenoma: 20:1 female predominance
- macroadenoma: 1:1
- 90% response to medical therapy
  - bromocriptine

### Growth Hormone Secreting Tumor
- Most commonly macroadenoma
- Occur in the 4th and 5th decade
- 50% death before 50 years
- GH level > 5 ng/ml
- Initial treatment is surgery

### Acromegaly - Excess GH (somatotropin)
- Enlargement hands and feet (bone)
- HTN, diabetes, heart disease
- Cardiomyopathy, CHF
- Obstructive Sleep Apnea
- Enlarged soft tissue
  - Lips, tongue, epiglottis, vocal cords
  - Connective tissue overgrowth leads to recurrent laryngeal nerve paralysis
  - Subglottic tracheal narrowing
  - Peripheral nerve/artery entrapment
- Enlarged membranous bones
  - Cranium, nose, supraorbital ridges, lower jaw, kyphosis

### Corticotroph Secreting Adenomas
- 8-10% of pituitary tumors
- Cushing’s Disease
  - Hypercortisolemia
  - ACTH-secreting pituitary tumor.
  - Weight gain, truncal obesity, buffalo hump
  - Free cortisol level
    - no cortisol suppression on low-dose dexamethasone testing, cortisol suppression on high-dose dexamethasone testing, and moderately elevated ACTH levels
- Surgery is best option

### Clinical Features Of Acromegaly

Smith M, and Hirsch N P Br. J. Anaesth. 2000;85:3-14  
©2000 by Oxford University Press
Clinical Features Of Cushing’s Syndrome

| Appearance | Redistribution of body fat; ‘moon’ face; truncal or ‘buffalo’ obesity |
| Musculoskeletal | Proximal myopathy; vertebral collapse; osteoporosis and pathologic fractures - caution during positioning |
| Skin | Purple striae on abdomen, buttocks, thighs; easy bruising and fragile skin; hirsutism; acne |
| Endocrine | Impaired glucose tolerance; diabetes |
| Cardiovascular | Hypertension; ECG abnormalities; left ventricular hypertrophy |
| Metabolic | Hypernatremia; hypokalemia; alkalosis |
| Other | Sleep apnea; gastrointestinal reflux; renal stones; masculinization; mental disturbance |

Thyrotropic (TSH-Producing) Adenoma

- Less than 1-2% of pituitary adenomas
- Pituitary hyperthyroidism
  - High TSH with high Free T4
- Can be quite large upon diagnosis
  - >60% locally invasive: risk of blood loss
  - propylthiouracil or octreotide
- Surgery is usually first option

Pituitary Dwarfism

- Presentation:
  - Slow growth before age 5
  - Short stature (child <5th%ile, adult <5 ft)
  - Absent/delayed sex develop (adolescent)
  - Excessive thirst & increased urine volume (DI)
- Associated with deficiencies in
  - Thyrotropin
  - Vasopressin
  - Gonadotropin
  - ACTH
- Facial development abnormalities (cleft palate/lip)

Pituitary Apoplexy

- Sudden hemorrhage into or infarct of pituitary
- LIFE THREATENING
- Leads to
  - Rapid development of acute neurological deficits
  - Rapid decline in pituitary function
- RX
  - Corticosteroids
  - Emergency decompression

Preoperative Evaluation

- Imaging:
  - MRI brain with and without IV contrast (include thin cuts through pituitary)
  - Tumor enhances less than gland
  - Vasculature is black
- Labs:
  - Prolactin, FSH, LH, GH, ACTH, testosterone, GH, cortisol, IGF-1 (insulin like growth factor)
  - CBC, electrolytes, glucose
- Visual Fields:
  - Performed by an ophthalmologist

Perioperative Management of Patients Undergoing Transsphenoidal Pituitary Surgery
Pituitary Dwarfism and Anesthesia
- Small airway
- No anatomic abnormalities
- Tracheal tree is similar to pediatric patient of similar size
- Replacement Rx with appropriate hormones
  - Euthyroid
  - Steroids
  - Vasopressin
  - All hormones prep to optimize

Pituitary Apoplexy and Anesthesia
- Surgical indications:
  - The abrupt and catastrophic acute hemorrhagic infarction of a pituitary adenoma
  - Present with acute headache, meningismus, visual impairment, ophthalmoplegia, and alteration in consciousness
  - Glucocorticoid replacement
  - adrenal insufficiency
  - Urgent surgical decompression

Acromegaly and Anesthesia
- Airway issues
  - Difficult mask fit / ventilation
  - May be difficult intubation
    - Bone growth
    - Soft tissue
    - Prone to subglottic stenosis
  - May require awake FOB
- Monitor glucose
- Titrate muscle relax if skeletal muscle weakness
- Consider HTN, Cardiac Disease/Dysfunction, Sleep Apnea

Cushings Perioperative Corticosteroid Administration
- Stress dose
  - 50-100mg hydrocortisone
  - 6-8hr for several days
  - Rarely required beyond 24hrs
- Dexamethasone: use in Cushing's disease
  - no interference with postop. serum cortisol assay
  - Postop 6hr serum cortisol
  - rapid lab

Surgical Approaches to Pituitary Tumors
- Transsphenoidal
  - Endoscopic
  - Endonasal microscopic
  - Sublabial transseptal
- Transcranial
  - Pterional
  - Subtemporal
  - Supraorbital

Pituitary Surgery - Transcranial
- Large invasive tumors or tumors with significant suprasellar extension
  - Direct visualization of suprasellar structures
    - Vascular
    - Optic chiasm
    - Hypothalamus
    - Pituitary stalk
  - Disadvantages are potential damage to:
    - olfactory nerve, frontal lobe, vasculature, optic nerve & chiasm.
    - Increased incidence of permanent DI & ant pituitary deficiency
**Pituitary Surgery - Transcranial**

- Basic considerations of neuroanesthesia
  - Control of ICP
  - Mannitol, ETCO₂
  - Possibility of large amount blood loss
  - A-line
  - Smooth extubation

**Pituitary Surgery - Transsphenoidal**

- Advantages
  - Lower incidence of DI
  - Eliminates frontal retraction and scars
  - Tissue sparing
  - Less transfusions
  - Shorter hospitalization

- Disadvantages
  - CSF leak & meningitis
  - Less visualization of sella
  - Possibility of bleeding
    - cavernous sinus or carotid artery
    - intracranial hemorrhage
    - brain stem compression

**Pituitary Surgery - Transsphenoidal**

- Did the pt have a pneumoencephalogram?
- Head pinned with 30-40° head up (risk of VAE minimal)
- Make room for the C-arm, table turned, away arm tucked
- Leg prepped for fat pad
- Lumbar intrathecal catheter
  - inject saline or remove CSF
  - inject intrathecal air
  - push the tumor down
  - outline a tumor
  - discontinue nitrous oxide
- ENT surgeon starts (maybe)
  - Vasoconstricting locals!
  - Prepares the way for the neurosurgeon

**Intraoperative Management**

- Monitoring – routine, a-line rarely used
- Rapidly cleared drug or anesthetics
  - propofol, remifentanil, desflurane
- Proximity of ICA : risk of hemorrhage
- Cushing's disease: difficult IV, avoid steroids
- Acromegaly
  - prone to upper airway obstruction
  - extubation in a semi-seated position

**Transsphenoidal**

- Dysrhythmias & severe HTN b/o epi in local
- Air embolism (rare)
- DI is a postop concern
- Smooth emergence
  - Minimize coughing and bucking
- Blood in airway
  - EBL usually <500 cc
  - Pain not a major factor
The Fully Endoscopic Endonasal Approach

Early Post-operative Remission Rates
Endoscopic vs. Microscopic Results

<table>
<thead>
<tr>
<th>Hormonally Active Adenomas</th>
<th>Non-functioning Adenomas</th>
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</thead>
<tbody>
<tr>
<td>ACTH</td>
<td>PRL</td>
</tr>
<tr>
<td>Endoscopic Series</td>
<td>84%</td>
</tr>
<tr>
<td>Microscopic Series</td>
<td>81%</td>
</tr>
</tbody>
</table>

* Calculated from several published microscopic series

COMPLICATION RATES

<table>
<thead>
<tr>
<th>Complication (%)</th>
<th>Endoscopic</th>
<th>Microscopic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ant. Pit. Insufficiency</td>
<td>2.1</td>
<td>19.4</td>
</tr>
<tr>
<td>Diabetes Insipidus</td>
<td>2.5</td>
<td>17.8</td>
</tr>
<tr>
<td>Carotid Injury</td>
<td>0</td>
<td>1.1</td>
</tr>
<tr>
<td>CN Injury</td>
<td>0</td>
<td>1.6</td>
</tr>
<tr>
<td>Intraseptal Hemorrhage</td>
<td>0.4</td>
<td>2.9</td>
</tr>
<tr>
<td>Cerebrospinal Fluid Leak</td>
<td>0.7</td>
<td>3.9</td>
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<tr>
<td>Postoperative epistaxis</td>
<td>0.6</td>
<td>10</td>
</tr>
<tr>
<td>Meningitis</td>
<td>0</td>
<td>1.3</td>
</tr>
</tbody>
</table>

Pituitary Surgery
Post-Operative Complications

- Diabetes Insipidus
  - Follow urine output and Na levels
- SIADH
  - CSF leak
    - Check for rhinorrhea
- Hemorrhage/Apoplexy
  - Worsening vision

Diabetes Insipidus (DI)

- Presentation
  - Polydipsia
  - Polyuria
  - Poorly concentrated urine despite high plasma osmolality
- Typically manifests 24-48h after surgery
- Posterior pituitary-vasopressin deficiency
- Careful monitoring urine, urine & plasma osmolality
  - Isotonic fluids until osmolality >290
  - Osmolarity >290 then hypotonic fluids
  - Desmopressin: 0.1mg by orally or 1ug SQ

SIADH

- Syndrome of inappropriate antidiuretic hormone
- Characterized by hyponatremia
  - H₂O retention
  - Serum: low Na, low osmolality
  - Urine: high osmolality (concentrated)
- HALLMARK: hyponatremia in presence of high urinary osmolality
- Fluid restriction: important therapy (0.5 to 1.5 L/day)
- Severe Hyponatremia (<120 meq/L)
  - 3% NaCl
  - Lasix
Hypopituitarism
• Should be screened for signs of hypopituitarism
• Corticosteroid supplement after discharge
• Rapid wean and assay morning cortisol on a daily basis

Thank you
QUESTIONS???