Pituitary Disorders

The pituitary gland is located in the sella turcica at the base of the brain, and consists of anterior and posterior components. The anterior pituitary secretes hormones (ACTH, FSH, LH, GH, TSH, PRL) under the control of the hypothalamus (HPA axis) while the posterior pituitary is responsible for the storage and release of vasopressin and oxytocin, which are secreted by the hypothalamus. Dysfunction of the pituitary gland may be related to mass effects and/or hormone effects.

ANESTHETIC CONSIDERATIONS:

- Altered Pituitary function
  - Hyperpituitarism
    - Hormone secreting – PRL (prolactinoma) >ACTH (Cushing's)> GH (acromegaly)> FSH/LH > TSH (hyperthyroidism)
  - Hypopituitarism
    - Non-secretory –panhypopituitarism more common than isolated deficiency of pituitary hormone
  - Mass effect with macroadenoma
- Increased ICP with risk of herniation
- Surgical Approach:
  - Transsphenoidal vs. craniotomy
- Intraoperative complications – hemorrhage, CN palsy (II-VI), CSF leak, VAE
- Postoperative fluid and electrolyte disturbances – DI/SIADH

ANESTHETIC GOALS:

- Medical management of endocrine disorders in perioperative period
- Preoperative ICP optimization
  - Steroids, mannitol, diuretics, acute hyperventilation as indicated
  - Avoid further ↑ing ICP and employ intraoperative techniques to ↓ICP as indicated
- Smooth rapid emergence for postoperative neurological assessment
- Monitor for postoperative complications

HISTORY

- Sx of intracranial mass
  - ↑ICP – headache, N/V, blurred vision, gait disturbance, neurological deficits, altered mental status, seizures
  - Compression of optic chiasm – visual field defects
  - Rhinorrhea
- Endocrine Sx
  - Panhypopituitarism
    - Anterior pituitary
      - Growth hormone deficiency, hypothyroidism, hypoadrenalism, hypogonadism
    - Posterior pituitary
      - Diabetes insipidus
  - Secretory tumors
    - Prolactin – prolactinoma
    - Growth hormone – gigantism (peds), acromegaly (adult)
    - ACTH – Cushing's disease
    - Thyroid hormone – hyperthyroidism

PHYSICAL

- Vital signs (HT/bradycardia with ↑ICP), including orthostatic VS (DI)
- Assessment of volume status (DI)
- Airway exam
- Cardiac
- Respiratory

INVESTIGATIONS

- **Labs**
  - CBC (anemia with malignancy)
  - Lytes, urea, Cr (DI)
  - Ca (MEN type I)
  - Glucose
  - INR, PTT
  - TSH, cortisol, ACTH, IGF-1, testosterone, LH, FSH, prolactin
- **Imaging**
  - CT/MRI brain
- **Other**
  - EKG

OPTIMIZATION

- Consult Endocrinology
- Intracranial mass
  - Chemo/radiation to shrink mass preop, corticosteroids to ↓cerebral edema, anticonvulsant prophylaxis
- ICP management
- Control hypersecretory endocrine disorders
  - Acromegaly – management of cardiac manifestations
  - Hyperthyroidism – antithyroid medication, somatostatin analogs; euthyroid state prior to elective surgery

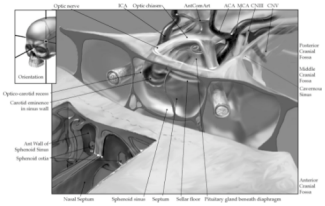
- Hormone replacement for panhypopituitarism
    - Hypocortisolism – correct fluid deficits and hyponatremia; stress-dose steroids
    - Hypothyroidism – replace levothyroxine (hypothyroid pts have ↓tolerance to cardiovascular depressant effects of anesthetic agents)
    - DI – replace DDAVP

ANESTHETIC OPTIONS

- **Local**
- **Regional**
- **General** – only reasonable option for transsphenoidal resection or craniotomy

ANESTHETIC SETUP

- **Drugs**
    - Standard emergency drugs
    - Vasodilators
- **Monitors**
    - Standard CAS monitors
    - Consider artline (helpful for monitoring for HTN and lytes)
    - Large bore iv (potential for massive hemorrhage if internal carotid artery or cavernous sinus)



MANAGEMENT OF ANESTHESIA (FOR TRANSSPHENOIDAL RESECTION OF PITUITARY)

- **Induction**
    - Consider regular ETT vs RAE tube
        - Difficult intubation in acromegaly and conditions associated w/ Cushing's disease (OSA, obesity)
        - RSI in Cushing's disease (gastroparesis w/ DM)
    - Pharyngeal pack to avoid accumulation of blood in stomach (vomiting) or in glottis (prevent coughing/laryngospasm post-extubation)
- **Maintenance**
    - Position supine with head slightly raised to avoid venous engorgement – monitor for VAE
    - Limited access to head and arms intraop – nerve stimulator on lower extremity
    - Maintain muscle relaxation (any movement during surgery could lead to complications – see below)
    - Endoscopic surgical approach guided by fluoroscopy or stereotactic technology
    - Surgical access via nasal cavity, infiltration w/ LA + epi – monitor for arrhythmias, HT, cardiac ischemia
    - Nasal surgery stimulating; risk of sudden HTN – adequate depth of anesthesia, vasodilators as indicated
    - Ventilate to surgical preference for CO_2 management
        - Hypocapnia to ↓brain volume and minimize bulging of arachnoid into sella (want to avoid opening of arachnoid mb; CSF leak ↑s risk of meningitis)
        - Normo- or hypercapnia if tumor extends suprasellar to deliver lesion into sella for excision (or surgeon may pump saline/air into lumbar CSF)
            - Avoid N_2O if intrathecal air injected
    - Valsalva to test for CSF leak after tumor resection; if significant leak, sella packed with autologous fat
- **Emergence**
    - Goals
        - Smooth emergence (no coughing/bucking/vomiting), especially if CSF space opened intraop
        - Relatively rapid emergence for neuro assessment
    - PONV prophylaxis to avoid ↑ICP from vomiting
    - Suction airway, remove pharyngeal pack
    - Nasal packing makes breathing through nose impossible

DISPOSITION & MONITORING

- **Monitoring**
    - Monitor for DI/SIADH – intravascular volume status, urine output, electrolytes
    - Taper corticosteroids after 24h postop
    - Monitor for panhypopituitarism

COMPLICATIONS (FOR TRANSSPHENOIDAL RESECTION OF PITUITARY)

Table 2. Complications of Transsphenoidal Surgery

Complications	Incidence (%)
Mortality	<0.5
Major complications (cerebrospinal fluid leak, meningitis, ischemic stroke, vascular injury, intracranial hemorrhage, new cranial nerve palsy, and visual loss)	1.5
Minor complications (sinus disease, septal perforation, epistaxis, wound infections, and hematomas)	6.5

1. INTRAOPERATIVE

- **Hemorrhage**
  - From internal carotid arteries or cavernous sinus
- **Venous air embolism**
  - Intraop positioning in reverse Trendelenberg predisposes to VAE
- **CSF leakage**
  - From inadvertent opening of arachnoid mater intraop; fluid positive for τ-transferrin
  - ↑Risk meningitis
  - Defect resealed with fibrin glue or packing of sphenoid space with fat/muscle
  - If persistent CSF leak a concern, surgeon may place lumbar CSF drain to maintain decompression postop
- **Cranial nerve damage**
  - CN II – VI in close proximity to pituitary gland and may be damaged → cranial nerve palsy
  - VEP monitoring not practical intraop (extreme sensitivity to anesthetics → frequent false positives)
  - If evidence of new CN palsy postop - immediate CT/MRI or surgical reexploration

2. POSTOPERATIVE

- **Headache**
  - Most common complaint after transsphenoidal surgery
  - Manage with opioids, NSAIDs, acetaminophen
- **Hyponatremia (21-35%)**
  - Numerous potential etiologies
    a) As SIADH component of classic triphasic response post-pituitary resection
       - Posterior pituitary often spared during transsphenoidal resection of anterior pituitary; even if excised, water homeostasis commonly normalizes as ADH released from cut end of hypophyseal tract; however, transient or permanent DI can occur
       - Initial DI (onset 4-8h postop) followed by transient SIADH (most severe POD 6-7), and then either recovery or, in severe cases, permanent central DI
    b) Cerebral salt wasting
    c) Relative cortisol deficiency
- **Hypernatremia**
  - DI
- **Hormone Deficiencies**
  - **Hypogonadism:** typically 1st manifestation
  - **Hypocortisolism** : 4-14d after hypophysectomy
  - **Hypothyroidism**: does not manifest before 4 weeks after hypophysectomy

PATHOPHYSIOLOGY

ANATOMY

- Pituitary gland – located in sella turcica at base of skull
- Pituitary stalk
- Hypophyseal portal venous system – connects hypothalamus and anterior pituitary gland
- Anterior pituitary (adenohypophysis) synthesizes and secretes hormones under control of hypothalamus
  - Regulating hormones produced by hypothalamus are secreted into hypophyseal portal veins connecting hypothalamus to anterior pituitary gland, and regulate synthesis of anterior pituitary hormones
- Posterior pituitary (neurohypophysis) stores and secretes hormones synthesized by hypothalamus
  - Vasopressin and oxytocin synthesized in hypothalamus (supraoptic and paraventricular nuclei), then transported along hypothalamic neuronal axons to posterior pituitary gland, where they are stored and released

ETIOLOGY OF PANHYPOPITUITARISM

- Malignancy – tumor destroys pituitary by compressing gland against bony confines of sella turcica
  - Primary
    - Benign – adenoma, meningioma, craniopharyngioma
    - Malignancy – adenoma, germ cell tumor, lymphoma
  - Metastatic – breast CA, lung CA
- Infarction
  - Sheehan's syndrome – postpartum hemorrhagic shock resulting in necrosis of anterior pituitary gland
- Iatrogenic
  - Radiation, pituitary resection

PATHOPHYSIOLOGY

- Pituitary tumors
  - Most common lesions – prolactin-secreting microadenoma, non-secreting macroadenoma
- Macroadenoma (>1cm) vs microadenoma (<1cm)
- Functional
  - Usually composed of single cell type and produce a single predominant hormone

Clinical disease	Hormone produced by tumor	Estimated frequency (%)	Medical therapy
Acromegaly	Growth hormone	5–10	Somatostatin analog (octreotide) Growth hormone receptor blocker
Cushing's disease	ACTH	10–15	Ketoconazole (blocks cortisol synthesis)
Gonadotroph	FSH, LH	5	None
Prolactinoma	Prolactin	20–30	Dopamine agonist (bromocriptine, cabergoline, pergolide)
Null cell	None	20–25	None
Thyrotropic	TSH	<3	Somatostatin analog (octreotide) Propylthiouracil
Other (including mixed cell adenomas)	None	20	None

- Non-functional (null cell)
  - Most commonly macroadenoma
  - Clinical presentation
    - Sx of ↑ICP (directly from tumor or indirectly from obstruction of 3rd ventricle w/ hydrocephalus)
    - Panhypopituitarism (intrasellar growth with pituitary compression and dysfunction)
  - Order of loss of hormonal function – gonadotropins → GH → ACTH → TSH
- Hyperprolactinemia can result from any tumor 2° to loss of tonic inhibition of prolactin secretion
- Cavernous venous sinus is lateral to pituitary – risk of hemorrhage with tumor invasion or surgical access
- Tumors with suprasellar extension can cause hydrocephalus

CLINICAL PRESENTATION

- Endocrine features depend on rate at which deficiency develops and pt age

Tumors of the Pituitary Region (Miller Table 63-13)

Location	Hormone Secreted	Clinical Presentation	Comment
Anterior pituitary	Prolactin	Galactorrhea, amenorrhea, hypogonadism, infertility	Bromocriptine sensitive
	Adrenocorticotropin	Cushing's disease (hypercortisolism)	Basophilic adenoma; centripetal obesity; diabetes mellitus; friable tissues
	Growth hormone	Acromegaly/gigantism, glucose intolerance	Eosinophilic adenoma; difficult airway; thick skin (difficult cannulation); hypertension/cardiomyopathy
	Nonsecretory	Mass effect, panhypopituitarism	Chromophobic adenoma; consider preoperative hormone replacement
Suprasellar	Nonsecretory	Panhypopituitarism, SIADH, visual symptoms, hydrocephalus	Craniopharyngioma, Rathke cleft cyst, or suprasellar extension of pituitary lesion

- Following pituitary resection, the following hormone deficiencies occur:
  - Gonadotropin deficiency (amenorrhea, impotence) typically 1st manifestation of panhypopituitarism
  - Hypocortisolism occurs 4-14 days post-hypophysectomy
  - Hypothyroidism occurs 4 weeks post-hypophysectomy

MANAGEMENT

- Tx endocrinopathy – hormone replacement (panhypopituitarism) vs suppression (secretory tumors)
- Small pituitary tumors – transsphenoidal resection
- Large pituitary tumors – craniotomy

REFERENCES

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- Nemergut EC et al. Perioperative management of patients undergoing transsphenoidal pituitary surgery. Anesthesia and Analgesia 2005;101:1170-1181