Managing Perioperative Endocrine Dysfunction

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UCHealth System- University of Colorado Hospital- Metro Denver

- University of Colorado hospital- Denver
- Poudre Valley Hospital and Medical Center of the Rockies- Northern Colorado
- Memorial Hospitals- Southern Colorado
- Yampa Valley Medical Center- Western Colorado

https://www.uchealth.org/about/

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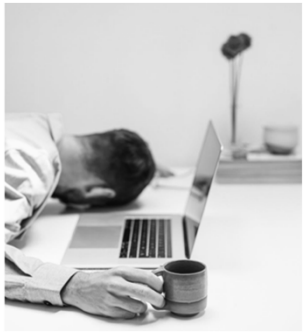

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ENDOCRINE SYSTEM

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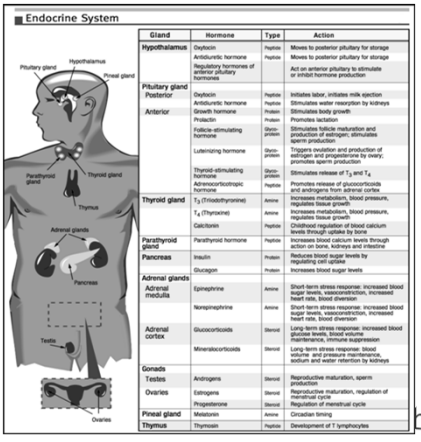
Endocrine Anatomy



Gland	Hormone	Type	Action
Hypothalamus	Oxytocin	Peptide	Moves to posterior pituitary for storage
	Antidiuretic hormone	Peptide	Moves to posterior pituitary for storage
	Regulatory hormones of anterior pituitary hormones		Act on anterior pituitary to stimulate or inhibit hormone production
Pituitary gland			
Posterior	Oxytocin	Peptide	Initiates labor, initiates milk ejection
	Antidiuretic hormone	Peptide	Stimulates water resorption by kidneys
Anterior	Growth hormone	Protein	Stimulates body growth
	Prolactin	Protein	Promotes lactation
	Follicle-stimulating hormone	Glycoprotein	Stimulates follicle maturation and production of estrogen; stimulates sperm production
	Luteinizing hormone	Glycoprotein	Triggers ovulation and production of estrogen and progesterone by ovary; promotes sperm production
	Thyroid-stimulating hormone	Glycoprotein	Stimulates release of T_3 and T_4
	Adrenocorticotropic hormone	Peptide	Promotes release of glucocorticoids and androgens from adrenal cortex
Thyroid gland	T_3 (Triiodothyronine)	Amine	Increases metabolism, blood pressure, regulates tissue growth
	T_4 (Thyroxine)	Amine	Increases metabolism, blood pressure, regulates tissue growth
	Calcitonin	Peptide	Childhood regulation of blood calcium levels through uptake by bone
Parathyroid gland	Parathyroid hormone	Peptide	Increases blood calcium levels through action on bone, kidneys and intestine
Pancreas	Insulin	Protein	Reduces blood sugar levels by regulating cell uptake
	Glucagon	Protein	Increases blood sugar levels
Adrenal glands			
Adrenal medulla	Epinephrine	Amine	Short-term stress response: increased blood sugar levels, vasoconstriction, increased heart rate, blood diversion
	Norepinephrine	Amine	Short-term stress response: increased blood sugar levels, vasoconstriction, increased heart rate, blood diversion
Adrenal cortex	Glucocorticoids	Steroid	Long-term stress response: increased blood glucose levels, blood volume maintenance, immune suppression
	Mineralocorticoids	Steroid	Long-term stress response: blood volume and pressure maintenance, sodium and water retention by kidneys
Gonads			
Testes	Androgens	Steroid	Reproductive maturation, sperm production
Ovaries	Estrogens	Steroid	Reproductive maturation, regulation of menstrual cycle
	Progesterone	Steroid	Regulation of menstrual cycle
Pineal gland	Melatonin	Amine	Circadian timing
Thymus	Thymosin	Peptide	Development of T lymphocytes

https://meducation.net/resources/1735986-Endocrine-System-Chart

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Perioperative and Endocrine System

- Perioperative stress can exacerbate endocrine disorders
- Complicates surgical outcome, anesthesia recovery and healing
- Autonomic dysfunction
- Hypothalamic-pituitary-adrenal (HPA) axis is central to a patient's ability to generate a surgical stress response
- Anesthetic agents can suppress cortisol release

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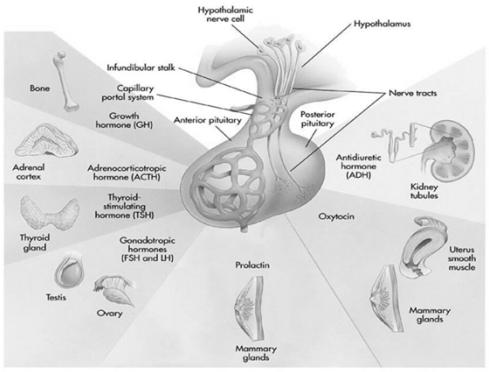
Pituitary Gland- Powerhouse



From Thibodeau GA, Patton KT: *The human body in health and disease*, ed 3, St. Louis, 2002, Mosby.

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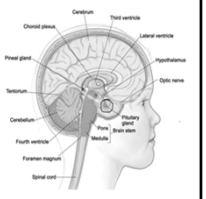
Pituitary Gland

Hormone	Target Organ or Tissue
Adrenocorticotropic hormone(ACTH)	Adrenal glands
Beta-melanocyte–stimulating hormone	Skin
Endorphins	Brain and immune system
Enkephalins	Brain
Follicle-stimulating hormone	Ovaries or testes
Growth hormone	Muscles and bones
Luteinizing hormone	Ovaries or testes
Oxytocin*	Uterus and mammary glands
Prolactin	Mammary glands
Thyroid-stimulating hormone	Thyroid gland
Vasopressin (antidiuretic hormone)*	Kidneys



https://www.merckmanuals.com/home/hormonal-and-metabolic-disorders/pituitary-gland-disorders/overview-of-the-pituitary-gland

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Pituitary Gland- Hyperfunction

- Pituitary adenoma
  - Space occupying lesion
  - Hormone secreting tumors
    - Growth hormone
    - Prolactin
- Craniopharyngioma
  - Benign
  - ↑ ICP
  - PreOp hydrocortisone
  - Avoid sympathomimetic drugs
  - Monitor u/o
  - Desmopressin (DDAVP)- antiduretic

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Acromegaly- Periop Consideration

- Preop Evaluation
  - endocrinopathies and cardiac diseases
  - difficult airway
  - OSA –risk high
  - poor collateral circulation
- Serum glucose
- Muscle relaxants titrated using peripheral nerve stimulator
- Positioning should be done meticulously

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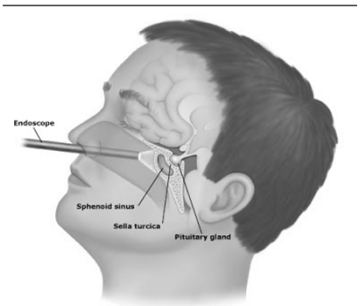
Transphenoidal Hypophysectomy



https://cushingsmoxie.blogspot.com/2008/06/pituitary-surgery-faqs.html

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Transphenoidal Hypophysectomy- Complications

- Nosebleed- check dressing
- Intracranial hemorrhage- headaches
- CSF leak- lumbar drain placement
- Diabetes Insipidus
  - vasopressin-
  - thirst and excessive urine output
  - hormone replacement therapy
- Hypopituitarism
  - damage from surgery
  - hormone replacement therapy
- Injury to carotid arteries- stroke
- Worsening of vision- optic nerve pressure

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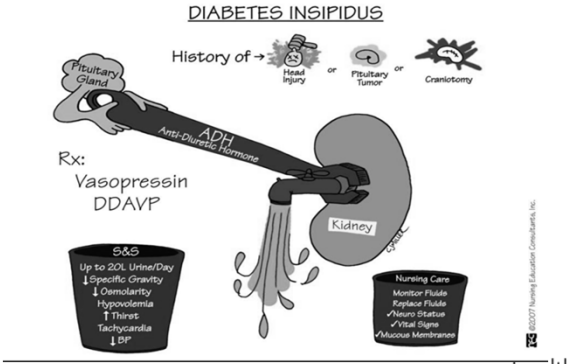
Diabetes Insipidus



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Pituitary Gland- Hypofunction

- Anterior Pituitary
  - Adrenal insufficiency
  - Hypothyroidism
- Posterior Pituitary
  - Diabetes insipidus
  - SIADH
- Causes: tumor, sarcoidosis, infection, steroid, sx
- Management:
  - Steroid Replacement
  - Fluid management
  - Electrolyte correction

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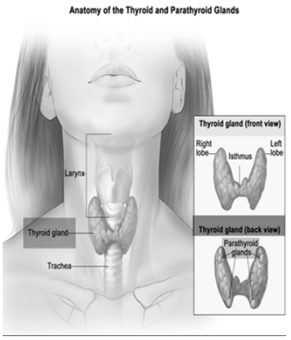
Thyroid Gland

- Dark red- highly vascular
- Values:
  - Thyroid stimulating hormone-(TSH) (0.5-6 uU/ml)
    - High- not making enough thyroid hormone
    - Low- too much thyroid hormone
  - Thyroxine-(T4) – circulating in blood (4.6-12 ug/dl)
  - Triiodothyronine-T3- active thyroid hormone (80-180ng/dl); *useful to diagnosis hyperthyroidism*



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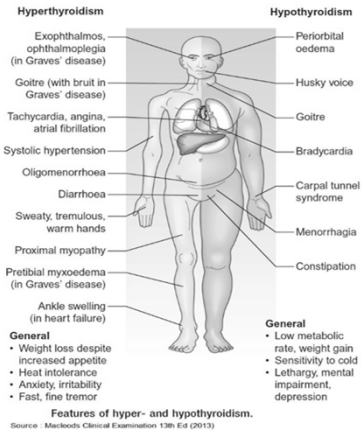

Features of hyper- and hypothyroidism.
Source : Macleods Clinical Examination 13th Ed (2013)

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Hypothyroidism

- Cardiac- hemodynamic instability or myocardial ischemia
  - bradycardia
  - hypotension- diminished response to adrenergic agents*
  - diastolic dysfunction, ↑ SVR
  - impaired venous return
  - nonspecific ST changes, atrial fibrillation
  - diminished cardiac output of 30% to 50%

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Hypothyroidism

- Respiratory/ventilation
  - respiratory muscle weakness
  - hypoventilation- impaired ventilatory drive and respiratory muscle weakness
  - pleural effusion
  - OSA*
  - delayed emergence

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Hypothyroidism

- GI effects
  - decreased GI motility- postop ileus
  - compounded with opioids
  - hypoglycemia
- Renal effects
  - Increased Antidiuretic hormones (ADH)- Hyponatremia
  - ↑ Creatinine - decreased medication clearance
  - increased susceptibility to anesthetics, tranquilizers, and narcotics

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Hypothyroidism

- Hematologic
  - normochromic, normocytic anemia
  - decrease in factor VIII activity, prolonged partial thromboplastin time, and von Willebrand disease
  - prolonged half-life of multiple coagulation factors
- Hypothermia

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Hypothyroidism- Myxedema Coma

- Rare-mortality as high as 80%
- Symptoms:
  - altered mental status-coma or seizure
  - Hypothermia- <69 F
  - bradycardia
  - hyponatremia
  - pericardial effusions or heart failure
  - hypopnea
  - thyroxine (<1 µg/dL)
- Precipitated by surgery, infection, cold exposure, and administration of sedatives

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Hypothyroidism- Periop Consideration

- History
  - Last diagnosed, TSH levels, adjust dosage
  - drink medication regularly
  - yearly endocrinology visits
- No history
  - routine preop screening not recommended
  - unexplained weight changes, palpitations, tremor or changes in bowel habits, skin, hair, or eyes that suggest thyroid dysfunction
  - presence of exophthalmos, goiter, abnormal reflexes, hair or skin abnormalities, or tachycardia or bradycardia
  - *Full evaluation and treatment depends on severity and surgery magnitude*

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Hypothyroidism- Periop Consideration

- Hypotension- hypovolemia and blunted baroreceptor reflexes
- Aspiration risk- enlarged tongue, relaxed oropharyngeal tissues, goiter and poor gastric emptying
- Carbon dioxide insensitivity and increased sensitivity to CNS depressant drugs and paralytic medications
- *Postponement of elective surgery- severe*

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Hypothyroidism- Periop Consideration

- Preop Instructions- take meds morning of surgery
  - Continue medication up to morning of surgery
  - Levothyroxine- Long half life- 7 days if NPO
- Postop- resume PO or start IV after 5 days
  - Levothyroxine loading dose: 200 to 500 µg followed by 50 to 100 µg IV daily
- *Caution: Cardiac dse with angina– WHY?*

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Hyperthyroidism

- State of excess thyroid gland function
- Cardiac
  - Tachycardia, atrial fib, coronary spasm, cardiomyopathy
  - ↑ circulating blood volume- ↑ sodium and water retention- renin-angiotensin-aldosterone system
  - ↑ cardiac output by 50% to 300%
  - enhanced diastolic relaxation
  - ↓ SVR
- Respiratory
  - Muscle weakness- need for ventilator support*
- Anesthesia
  - ↑ anesthetic medications due to elevated cardiac output and to control BP and HR

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Hyperthyroidism- Periop Consideration

- Airway assessment- ultrasound, fiberoptic, dysphagia, lay flat
- Resting HR <100- beta blockers, reduce anxiety
- Avoid sympathetic stimulation (pain, ketamine), pancuronium, and local anesthetics with epinephrine
- Regional anesthesia
- Barbiturates – induction
- Opioids, Dextomedetomide and propofol
- Thrombocytopenia- checking platelet count before initiating regional anesthesia
- Hypovolemia
- Exopthalmos protection/positioning
- Neuromuscular blockade
- Temperature monitoring

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Hyperthyroidism- Periop Consideration

- Preop and Post Op
  - Mild or moderate- Betablockers
  - Severe- Hemodynamic monitoring for unstable or with cardiopulmonary dse
- Antithyroid drugs- Thionamides and Methimaziole
  - Stop if patient is having Thyroidectomy
- Inorganic iodide
- Glucocorticoids- decrease the conversion of thyroxine to triiodothyronine
  - Hydrocortisone, Dexamethasone, Betamethasone
- Cholestyramine-decreases circulating hormone levels by binding thyroid hormone in the intestine and decreasing its reabsorption
- Lithium

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Thyroid surgery

- Assessment of thyroid function- status
- Mobility of vocal cords- laryneal monitoring
- Postoperative complications of thyroid surgery
  - Recurrent laryngeal nerve palsy/paralysis
  - Hypothyroidism
  - Hypocalcemia- prolong QT
  - Phrenic nerve injury
  - Pneumothorax
  - Thyroid storm
  - Airway obstruction

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Hyperparthyroidism- Thyrotoxicosis/Thyroid storm

- Emergency situation (mortality= 20%), consider endocrinology consult
- Hydration- IV fluid
- Cool (blankets, IV solution, acetaminophen)
- Control hemodynamics:
  - Esmolol 0.25-0.5 mg/kg bolus or 50-200 mcg/kg/min infusion
  - Propranolol 10-40 mg PO or up to 1 mg/min IV
- Stop conversion of T4 to T3:
  - PTU 200-400 mg PO/NG/PR q6h
  - Hydrocortisone 100-200 mg IV q8h
- Stop synthesis & release of new hormone:
  - Potassium iodide 5 gtts PO/NG q6h or sodium iodide 0.25 g IV q6h (1 hr after PTU)

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Hyperparthyroidism- Thyrotoxicosis/Thyroid storm

- Look for & treat complications:
  - CVA, loss of consciousness
  - Myocardial infarction, atrial fibrillation (avoid amiodarone because of iodide content; use digoxin instead) or congestive heart failure
  - Hypoventilation & hypercarbia
  - Electrolyte abnormalities
- Consider differential diagnosis for hypermetabolic state
  - *What intraoperative conditions manifest similar presentation with Thyroid Storm*?
  - Malignant Hyperthermia- difficult to differentiate
  - CO2, jaw rigidity
- Consider last ditch treatments: plasmapheresis, dantrolene, lithium, neuraxial blockade to T4

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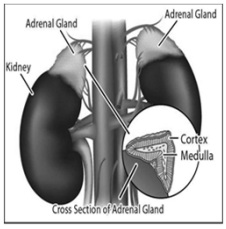
Adrenal Gland



- Secretes compounds
  - cortisone and adrenaline
- Regulates metabolic processes, water balance, blood pressure
- Outer- Adrenal Cortex
- Cortex- 3 layers- G.F.R.
  - Zona Glomerulosa- mineralocorticoids- aldosterone
  - Zona Fasciculata- glucocorticoids- cortisol, corticosterone, and cortisone
  - Zona Reticularis- androgens- DHEA & DHEAS
- Inner- Adrenal Medulla
- Medulla- produces epinephrine & norepinephrine

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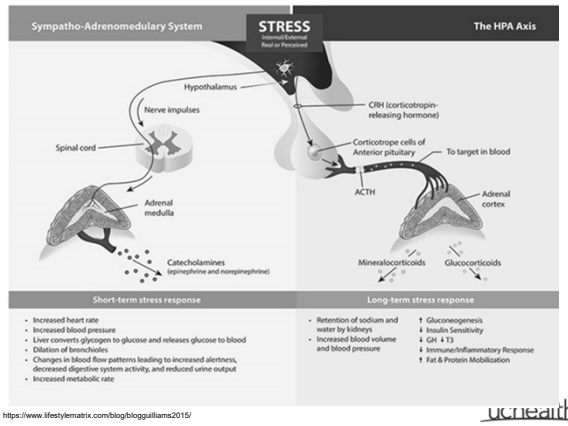

https://www.lifestylematrix.com/blog/blogguilliams2015/

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Adrenal Cortex

- Cortisol
  - Secretion regulated by stress & ACTH-negative feedback
  - Free cortisol is active fraction
  - Regulates intermediary metabolism of nutrients to increase blood glucose
  - Promotes anti-inflammatory & fluid retention
- Aldosterone
  - Secretion regulated by renin-angiotensin system, K, ACTH
  - Regulates extracellular volume & K, acting on DCT of kidney
- Androgen
  - Regulates male secondary sexual characteristics

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Adrenal Cortex- Hyperfunction Cushing's Syndrome

- Excess cortisol
  - ACTH-dependent disease
- Causes
  - endogenous increased production and secretion of cortisol or ACTH
    - pituitary tumors
    - paraneoplasm- small call pulmonary carcinoma
    - alcohol consumption
  - long term use
    - prescription steroids

https://columbiasurgery.org/conditions-and-treatments/cushings-syndrome

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Adrenal Cortex- Cushing's Syndrome

- Diagnosis
  - 24 hour urine cortisol level
  - Salivary cortisol
  - dexamethasone suppression test
- Laparoscopic adrenalectomy
- One hyperactive adrenal gland- ***careful!***
- Bilateral- post-op lifelong administration of glucocorticoids
- Inoperable adrenal cortex carcinomas or paraneoplastic ACTH syndromes- blockage of cortisol production

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Cushing's Syndrome- Periop Consideration

- Respiratory:
  - Possible difficult airway: obesity, obstructive sleep apnea (OSA)
- Cardiovascular:
  - Left ventricular hypertrophy, pulmonary hypertension/right ventricular failure, systolic & diastolic dysfunction
  - Hypertension, volume overload (↑ renin & glucocorticoid vascular reactivity)
  - Treat with Betablockers, ARBS, diuretics
- Metabolic:
  - Hypokalemic metabolic alkalosis: mineralcorticoid effect of glucocorticoids
  - Diabetes: insulin deficiency- Hold oral, start insulin
  - Osteoporosis: need for careful positioning

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Cushing's Syndrome- Periop Consideration

- Pharmacologic considerations:
  - Perioperative steroid replacement (stress dose & post-operative replacement)
  - Sensitivity to neuromuscular blockers (due to possible muscle weakness, hypokalemia, catecholamines)
  - Avoid etomidate for induction
- CNS:
  - Psychosis

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Adrenal Cortex- Hyperaldosteronism (Conn's Syndrome)

- Excess mineralocorticoid- aldosterone
- Primary
  - Overproduction of aldosterone
  - Adenoma- Conn's, hyperplasia, adrenal carcinoma
  - ↑ Aldo → ↓ Renin
  - **HYPERTENSION- uncontrolled**
  - Hypokalemia, Alkalosis
  - Headache, dizziness, vision changes, chest pain, SOB
- Secondary
  - Overstimulation of renin-angiotensin-aldosterone system (RAAS)
  - ↑ Renin → Aldo
  - Caused by reduced blood flow to your kidneys
  - Edema, HTN, Low K, Alkalosis

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Adrenal Cortex- Hyperaldosteronism- Conn's Syndrome

- Diagnosis:
  - Aldosterone and Renin test
  - Captopril challenge
  - Salt-loading test
  - Fludrocortisone suppression test
  - CT or MRI scans of the abdomen
  - Adrenal vein sample
- Treatment:
  - Medication- mineralocorticoid receptor antagonist- Spironolactone
  - Surgery- adrenalectomy
  - Lifestyle changes- DASH diet, exercise, ETOH and caffeine reduction, quit smoking

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Hyperaldosteronism- Conn's Syndrome Periop Consideration

- Hypertension & end-organ dysfunction
  - Cardiomyopathy
  - Cerebrovascular disease
  - Chronic kidney disease
- Fluid & electrolyte abnormalities
  - Hypokalemia (weakness, potentiates non-depolarizing muscle relaxation
  - Metabolic alkalosis
  - Volume depletion
  - Hypomagnesemia

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Hyperaldosteronism- Conn's Syndrome Periop Consideration

- Associated endocrine disorders
  - Acromegaly
  - Pheochromocytoma
  - Primary hyperparathyroidism
  - Medications such as spironolactone
- Adrenalectomy
  - Bilateral? Need steroids
  - Laparascopic vs. open (pain & disposition)
  - Retroperitoneal approach
- Optimization
  - Antihypertensive therapy
  - Correction of electrolyte abnormalities
- https://www.youtube.com/watch?v=aV2cL5z1IWo

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Adrenal Cortex- Hypofunction- Mineralocorticoid

- Primary
  - Addison's disease- autoimmune reaction with the destruction of the adrenal cortex tissue
  - Carcinomic metastases- pulmo, melanoma, renal
  - Infectious disease : TB
  - Infarction/bleeding/trauma: Waterhouse-Friedrichsen syndrome -meningococcal infection
- Secondary
  - ACTH deficiency
  - long-term treatment with corticosteroids

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Adrenal Cortex- Hypofunction- Mineralocorticoid

- Cardiovascular
  - Hyperkalemia
  - Hyponatremia (↓ level of consciousness, seizures
  - Hypoglycemia (↓ level of consciousness, seizures)
- Volume status: dehydration can occur (2-3 L)
- Electrolyte imbalance
  - Hyperkalemia
  - Hyponatremia (↓ level of consciousness, seizures)
  - Hypoglycemia (↓ level of consciousness, seizures)
- Symptoms:
  - Weakness, pigmentation, weight loss, dehydration, and hypotonia

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https://www.anesthesiaconsiderations.com/adrenocortical-insufficiency-

Adrenal Cortex Hypofunction Periop Consideration

- Adrenal crisis- attenuated ability to mount a cortisol response
- Altered mental status, abdominal pain, nausea/vomiting, weakness, and hypotension are blunted due to anesthesia meds
- Prevent perioperative cardiovascular collapse:
  - Steroid supplementation
  - Volume resuscitation
  - Correction of electrolyte abnormalities
- Pharmacologic concerns:
  - ↓ circulating catecholamines (consider vasopressin for hypotension)
  - Succinylcholine-induced hyperkalemia
- Postoperatively, steroids should be continued until the stress response diminishes (usually 48 hours)

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Addisonian Crisis

- Acute condition
- autoimmune disorders, infections, sudden withdrawal of adrenal replacement therapy, hemorrhage
- Severe, persistent hypotension that is poorly responsive to fluid and vasopressor therapy
- Hypotension or shock
- Associated with hyponatremia and hyperkalemia
- Management:
  - Hydrocortisone 75–100 mg given every 6–8 hourly or dexamethasone 3–4 mg every 6–8 hourly
  - Fluid and electrolyte* and glucose replacement
  - Hemodynamic monitoring- bleeding

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Perioperative Steroid Dosing

Table 2. Surgical Stress by Procedure and Recommended Steroid Dosing

Surgery Type	Endogenous Cortisol Secretion Rate	Examples	Recommended Steroid Dosing
Superficial	8–10 mg per day (baseline)	Dental surgery Biopsy	Usual daily dose
Minor	50 mg per day	Inguinal hernia repair Colonoscopy Uterine curettage Hand surgery	Usual daily dose *plus* Hydrocortisone 50 mg IV before incision Hydrocortisone 25 mg IV every 8 h × 24 h Then usual daily dose
Moderate	75–150 mg per day	Lower extremity revascularization Total joint replacement Cholecystectomy Colon resection Abdominal hysterectomy	Usual daily dose *plus* Hydrocortisone 50 mg IV before incision Hydrocortisone 25 mg IV every 8 h × 24 h Then usual daily dose
Major	75–150 mg per day	Esophagectomy Total proctocolectomy Major cardiac/vascular Hepaticojejunostomy Delivery Trauma	Usual daily dose *plus* Hydrocortisone 100 mg IV before incision Followed by continuous IV infusion of 200 mg of hydrocortisone more than 24 h *or* Hydrocortisone 50 mg IV every 8 h × 24 h Taper dose by half per day until usual daily dose reached *plus* Continuous IV fluids with 5% dextrose and 0.2–0.45% NaCl (based on degree of hypoglycemia)

Data from Axelrod,[4] Salem *et al.*,[13] and Bornstein *et al.*[6]
IV = intravenous.

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Adrenal Medulla- Pheochromocytoma

- Rare neuroendocrine tumors- adrenal medulla
- Synthesize and secrete norepinephrine
- Symptoms:
  - Periodic flushing, palpitations, sweating, headaches, and hypertension
- Catecholamine crisis during routine surgery

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Adrenal Medulla- Pheochromocytoma

- Diagnosis:
  - plasma-free metanephrines and urinary vanillylmandelic acid (VMA) levels
  - radiographic imaging studies: MRI or nuclear imaging to locate
- Cardiovascular:
  - Echocardiography- detects overall systolic and diastolic function
  - Hypertension, abnormal ECG, LVH, LVD
  - Hypertrophic cardiomyopathy secondary to norepinephrine-induced hypertension
- Resolved with surgery

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Pheochromocytoma- Periop Consideration

- Preoperative optimization
  - adequate a- and b-adrenergic blockade- 3 to 5 days before surgery
  - Phenoxybenzamine (Dibenzyline)- 1 to 2 weeks preoperatively- ↓ BP
- Hemodynamic lability & potential for pheochromocytoma crises:
  - Hypertension, tachycardia, arrhythmia, myocardial ischemia
  - Need for invasive hemodynamic monitoring- avoid fluctuations
  - Avoid sympathetic response- Alpha blockers to induction, intubation, pneumoperitonium and surgical stimulation
  - Large bore IV- Rapid infusion of fluids or plasma expanders after vascular ligation
  - Serial Hematocrit- Adequacy of intravascular fluid

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Pheochromocytoma- Periop Consideration

- Avoid Ketamine and Ephedrine- increase catecholamine levels
- Morphine (which causes histamine release can trigger of pheochromocytoma crisis
- Meperidine and droperidol have been associated with severe hypertension
- Intraoperative HTN crises are best treated with rapid acting direct vasodilators (eg, nitroprusside, nitroglycerine, nicardipine).
- Bilateral adrenalectomy- glucocorticoid and mineralocorticoid replacement therapy
- Clevidipine butyrate- hypertensive crisis

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Pheochromocytoma- Periop Consideration

- Postoperative complications:
  - Hypotension
  - Hypertension- 1 week- increased catecholamine levels in adrenergic nerve endings
  - Hypoglycemia
  - Hypoadrenalism
  - ICU monitoring

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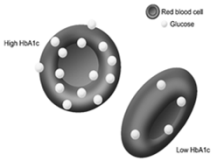
Pancreas- Diabetes

- Syndrome of abnormal carbohydrate metabolism- hyperglycemia
- Diabetes Type I- 10%, DM Type II- 90%
- Neuropathy, retinopathy, nephropathy and vasculopathy
- Preop labs
  - Glycosylated hemoglobin (HbA1C)
  - goal is less than 7%
  - 8%= more than 180 mg/dL
  - Renal function
  - DM with renal insufficiency are at greater risk for hypoglycemia given the prolonged half-life of insulin and sulfonylureas



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Pancreas- Diabetes

Type I
- absolute deficiency of insulin
- destruction and loss of pancreatic b cells (insulin producing)
- requires exogenous insulin
- prone to ketosis
- surgical stress response- pt less able to counteract the effects of the gluconeogenic and glycolytic hormones (ie, cortisol, epinephrine, glucagon, growth hormone

Type II
- insulin resistant
- relative deficiency of insulin
- peripheral resistance to insulin
- excessive hepatic glucose release
- prone to hyperosmolar hyperglycemic state (HHS)
- interaction of genetic and environmental factors (stress, diet, and amount of exercise)
- Secondary: pancreatic or adrenal dse

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Pancreas- Diabetes/Anesthesia

- Cardiovascular
  - increased risk for hypertension, CAD, CHF, diastolic dysfunction, CV, renovascular and PVD
  - clinically silent myocardial, ischemia or infarction- *WHY?*
  - preoperative cardiac testing – DM is one of the risk factors
  - ß-adrenergic blockers
- Neuropathies
  - cardiovascular autonomic neuropathy- arrhythmias, orthostatic hypotension
  - silent ischemia- angina with no pain- dyspnea, hypotension
  - cystopathy- voiding
  - asymptomatic hypoglycemia
  - peripheral sensory- heel pads, avoid heating pads
  - gastroperesis- slow gasric emptying, GERD, PONV

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Pancreas- Diabetes/Anesthesia

- Renal
  - avoid nephrotoxic drugs
  - maintain normovolemia
  - control of hyperglycemia and/or hypertension
  - and preservation of renal blood flow
- Musculoskeletal
  - difficulties with laryngoscopy and endotracheal intubation
  - Prayer sign- stiff joint- TMJ, C spine
- Obesity- OSA
- Hyporenin, hypaldosterone state – hyperkalemia, avoid hypotension
- Macrophages dysfunction - ↑ risk of infection, delay wound healing
- Hyperlipidemia and Hypertension

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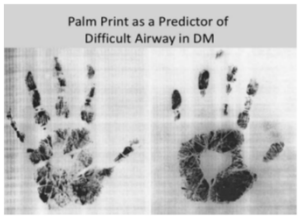
Diabetes and Joint rigidity test



Airway concerns- TMJ and C spine

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Diabetes and Surgery

- Dehydration- glycosuria
- Acidemia- ketones
- Dyselectrolytemia
- Hyperviscosity
- Multi-origan ischemic changes
- Disruption of immune system mechanism
- Neuropathic involvement

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Diabetic Ketoacidosis (DKA)

- Diabetic ketoacidotic coma- DKA (Type I- due to absolute insulin deficiency)
  - catabolism of free fatty acids into ketone bodies
  - hyperglycemia
  - dehydration
  - hyperosmolarity
  - high anion-gap metabolic acidosis
- Causes
  - infection, surgical stress, trauma or lack of insulin
  - tachypnea, abdominal pain, nausea and vomiting, change in sensorium

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Diabetic Ketoacidosis (DKA)

"Help."

- Treatment
  - Identifying and treating the precipitating factors
  - Fluid resuscitation
  - Glycometabolic control
  - Electrolyte replacement

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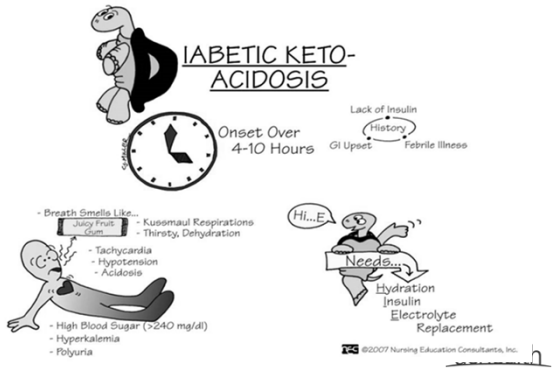
Diabetic Ketoacidosis (DKA)



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Hyperosmolar Hyperglycemic (HHS) state

- Occur predominantly in type 2 DM
- Non-ketotic Hyperosmolar state (NKHS)
  - more dehydrated, hyperosmolar and hyperglycemic
  - leading to lactic acidosis- hypotension
- Ketoacidosis is not a feature - availability of insulin prevent ketone body formation
- Neurologic changes: confusion, coma, seizures and/or focal neurological deficits, risk of developing cerebral edema
  Why?
  Hyperosmolality (frequently exceeding 360 mOsm/L)- induces dehydration of neurons
- Risks for thromboembolic events- hypovolemia, hypotension and hyperviscosity
- Treatment
  - Fluid resuscitation (0.9 Saline)

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Diabetes - Hypoglycemia

- Hypoglycemia - plasma glucoses less than 50 mg/dL
- Absolute or relative excess of insulin versus carbohydrate intake and exercise.
- Causes of hypoglycemia:
  - residual effects of long acting drugs
  - overaggressive antidiabetic treatment
  - decreased caloric intake

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Diabetes - Hypoglycemia

- Diagnosis
  - altered mental status up to coma and death.
  - physiologic responses to increased catecholamines
  - compromised when under anesthesia
- Unable to counter hypoglycemia despite secreting glucagon or epinephrine (counter-regulatory failure)
- Treatment
  - Dextrose administration, Oral or IV
  - Correcting the precipitating causes

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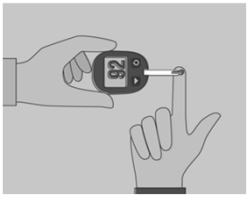
Diabetes- Periop Management

- Patient risk factors:
  - type of diabetes
  - patient medications
  - end-organ changes
  - nature of surgery
  - urgency of surgery
  - level of glycemic control



- Perioperative risk factors:
  - stress response to surgery
  - dietary changes pre and post surgery
  - anesthesia medications
  - circulatory instability

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Diabetes- Periop Management

- PreOp evaluation
  - H&P
  - Anesthetic records
  - Laboratory tests
  - HA1C
  - Risk for perioperative adverse outcomes
  - EKG
  - Chest radiograph

  Perioperative morbidity of diabetic patients is related to their preexisting end-organ damage

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Diabetes- Periop Management

- Goals:
  - avoid furthur damage to pre existing organ disease
  - optimize electrolyte imbalances
  - reesume preoperative glycemic control state
- Continuous monitoring plasma glucose levels
- Recommend IV insulin before, during and after esp with major surgery
- Oral hypoglycemic agent drug can be continued except morning of surgery if with dietary restrictions
  - Sulfonylureas and metformin have long half lives
    - discontinue 24–48hrs
    - resume post op
  - Metformin – functional renal and hepatic
  - Long acting sulphonylureas - stopped 3 days, convert to shorter acting drugs, or insulin for major surgery

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Diabetes- Periop Management

- First case in the morning
- Caution: local anesthesia with epinephrine- nerve injury
- Document neuropathies
- Regional anesthesia
  - blunts the increases in coritcol, glucagon, and glucose
  - autonomic neuropathy is present, profound hypotension may occur
  - infections and vascular complications- epidural abscess
- Insulin response to hyperglycemia
  - high thoracic (T1-T6) blockade → ? Inhibited
  - low blockade, (T9 - T12) → no effect

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Summary

- Perioperative optimization of endocrine dysfunction is important
- Attempt to normalize hormone levels prior to surgical intervention whenever possible
- Use measures that will maximize hemodynamic stability and prevent decompensation

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Questions

1. Why is there a need to be cautious in replacing thyroid hormones when patients have a history of angina?
   a. Increase cardiac ischemia
   b. Stimulate hyperglycemia
   c. Induce stroke
   d. Cause bradycardia
2. Patients with diabetic neuropathies can have silent myocardial infarction?
   a. True
   b. False
3. In Hyperosmolar Hyperglycemic (HHS) state, why do patients develop seizures?
   a. Dehydration of neurons
   b. Low fat diet
   c. Allergic Reaction
   d. Hypoglycemia

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https://www.reddit.com/r/natureporn/comments/1f8rbx/flatiron_mountains_colorado_1968x1310/

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