Assessment Points

System	Effect	Assessment by Hx	PE	Test
CV	LV function LVH	Exercise tolerance	Two-flight walk	ECG, CXR ECHO, MUGA Stress thallium
RESP	Pulm edema	Orthopnea Dyspnea	Rales	CXR
CNS	Stroke	Blackouts	Carotid bruit	Carotid study
RENAL	Nephropathy	Edema		BUN/Cr

Key References: James PA, Oparil S, Carter BL, et al.: 2014 evidence-based guideline for the management of high blood pressure in adults: report from the panel members appointed to the Eighth Joint National Committee (JNC 8), *J Am Med Assoc* 311(5):507–520, 2014; Mauck KF, Sundsted KK: *Update in perioperative medicine: evidence published in 2014, Ann Intern Med* 162(9):W111–W116, 2015.

Perioperative Implications

Preoperative Risks

- Continue and/or increase antihypertensive medicine.
- Short-acting vasodilators prepared, including nitroglycerin.
- Assess myocardial and volume status.
- Anxiolytics on the day before surgery.
- Correction of electrolyte imbalances if present.

Monitoring

- Arterial monitoring
- Foley catheter to monitor urine output for traumatic or long procedures or for the procedures with expected significant blood loss
- Volume status monitoring depending on LV function (e.g., CVP, possibly PA cath, TEE)

Induction

- Preintubation opiates to blunt hypertensive response to laryngoscopy and ETT placement.
- Consider administration of the high end of the dose range of the IV induction agent with uncontrolled Htn. However, with significant cardiomyopathy consider etomidate to maintain cardiac hemodynamics.
- Use of defasciculating dose of nondepolarizing neuromuscular blocker to prevent mesenteric blood mobilization during abdominal muscle contractions during acetylcholine-induced muscular fasciculations.
- Avoiding significant fluctuations in blood pressure during induction and intubation by using lidocaine, fentanyl, and esmolol.
- Rapid correction of hypotension with ephedrine or phenylephrine.
- If severely hypertensive, consider vasodilators (e.g., nitroglycerin or nitroprusside prior to induction).

Maintenance

- Careful monitoring of the depth of anesthesia to avoid light anesthesia masking intravascular volume deficit.
- Maintain euvolemia.
- Preemptive analgesia to prevent primary sensitization phenomenon.
- Consider high-dose opioids if high hemodynamic stability is needed and prolonged postop ventilation is not an issue.

Extubation

- Adequate analgesia prior to termination of anesthesia
- Short-acting vasodilator and/or beta-blockers to prevent hypertension and tachycardia

Adjuvants

- Regional: May prevent severe increases in BP. Hypotension may occur due to vasodilation.
- Continuous infusions of nitroglycerin, nitroprusside, or esmolol.
- If treated with antihypertensives preop, severe hypotension may not respond to usual doses of vasoconstrictors.
- Consider use of alpha-$_2$ adrenomimetics.
- Inhalational agents, in particular, above 1 MAC can cause dose-dependent increase in heart rate and have different hemodynamic effects.

Postoperative Period

- Restart antihypertensive medication as soon as possible in postop period.
- Patch therapy for some drugs (e.g., clonidine and fentanyl) must be started 12 h prior to allow absorption from skin.
- Effective pain control using opioids and/or NSAIDs or continuous blockade.

Anticipated Problems/Concerns

- Watch for symptoms of CNS, renal, or myocardial dysfunction.
- Preop period affords opportunity to educate pts about importance of complying with antihypertensive therapy.
- Rebound hypertension if certain medications are discontinued (e.g., clonidine).
- Discontinue ACEIs and ARBs >10 h prior to surgery. Continuation of ACEIs and ARBs has increased risk of intraop hypotension. Discontinuation not associated with increased prevalence of postop Htn.
- Periop BP lability has been reported to increase the risk for stroke, acute kidney injury, and 30-day mortality in pts undergoing cardiac surgery.
- It is generally recommended that elective surgery be delayed for severe hypertension (diastolic BP >115 mm Hg, systolic >200 mm Hg) until BP <180/110.
- Expect with anesthetics, such as propofol or any inhalational agents, to have clinically apparent vasorelaxation of excessively constricted arterioles in long-standing hypertension, resulting in hypotension post induction.
- Human physiology and the Frank-Starling Law explain the rationale for treatments, such as diuretics in congestive heart failure and cardiomyopathies.

Hyperthyroidism

Michael F. Roizen

Risk

- Incidence in USA: 300,000-500,000 individuals/y develop hyperthyroidism. In addition, 7.5% of pregnant women become hyperthyroid (highest prevalence in second trimester).
- 1:1000 females; 1:3000 males.
- Race with highest prevalence: Unknown.

Perioperative Risks

- Risk related to occurrence of thyroid storm; increased risk of storm even if pt is made euthyroid prior to surgery.
- Some increased risk of resp insufficiency.
- Progressive increased risk of hypothyroidism after surgery on thyroid, radioactive Rx of hyperthyroidism, and thyroiditis.

Worry About

- Assessing that pt is euthyroid.
- Securing airway in pt with large goiter or displaced trachea.
- Postop risks of nerve injury (immediate stridor requires immediate reintubation), surreptitious bleeding (examine wound, which can drain externally, prior to PACU discharge), and thyroid storm (uncommon without another acute illness or >3 d postop).

Overview

- Endocrinopathy with CVD: Tachycardia (commonly idiopathic if no prior Dx of hyperthyroidism has been made), CHF, dysrhythmias AFIB as major manifestations.
- Other targets: Resp and CNS (decreases drive to breathe; worsens anxiety, psychoses) and metabolic (hypermetabolism and increased protein turnover, resulting in weakened muscles and malnourishment); can present as unintentional weight loss.
- If pt is euthyroid prior to operation, risk of storm and of periop CV problems is diminished by >90%.
- If pt is not euthyroid, delay operation if possible until he or she is euthyroid.
- If emergency (life-threatening trauma, ruptured viscus), use beta-blocking agents and iodides to decrease periop effects as well as further synthesis and release of thyroid hormones; keep pt in ICU until risk of storm has passed.

Etiology

- Multinodular diffuse enlargement (Graves disease); almost never malignant; soft large gland; thought to be autoimmune (thyroid-stimulating IgGs that bind to TSH receptors on thyroid associated with goiter and ophthalmopathy)
- Pregnancy (ectopic TSH-like substance)
- Thyroiditis (autoimmune) in acute phase, often with sore neck and hoarseness
- Thyroid adenoma: Toxic multinodular goiter (firm gland) later in life and rarely (almost never) malignant; unilateral solitary nodule with autonomous function earlier in life, also almost always benign
- Choriocarcinoma
- TSH-secreting pituitary adenoma
- Surreptitious ingestion of T_4 or T_3

Usual Treatment

- Antithyroid drugs for 2–6 mo; if hyperthyroidism recurs, retreat; if recurs again, consider surgery or radioiodine Rx.

Assessment Points

System	Effect	Assessment by Hx	PE	Test
HEENT	Weakened tracheal rings, distorted/displaced trachea Ophthalmopathy	Snoring, hoarseness, neck pain	Ask pt to vocalize "e," examine airway and neck, look at the eyes, test for diplopia, note change over time in measure of eye protrusion	Check CXR (PA and lateral), lateral neck films; CT scan or US of neck
CV	Dysrhythmias, AFIB, sinus tachycardia, mitral valve prolapse CHF, cardiomyopathies	Palpitations; increased HR during sleep, DOE, orthostatic SOB	Standard exam	Rhythm strip or full ECG CV system is involved in either Hx or PE
GI	Weight loss, diarrhea, dehydration Hepatic enzyme abnormality due to medications	Dizziness on arising; Hx of diarrhea, constipation	Skin turgor; other measures of volume status such as orthostatic vital signs	Increased serum alkaline phosphatase
HEME	Mild anemia, thrombocytopenia; agranulocytosis secondary to propylthiouracil or methimazole		Skin/mucous membranes for infection/petechiae	CBC with platelet count and differential
CNS		Shaking, anxiety, emotional lability	Reflex speed, tremor, nervousness, mental status	
METAB	Need to assess if euthyroid and/or malnourished	Refer to all other systems, especially reflex speed, tremor, heat intolerance, fatigue, weakness, weight loss, anorexia, increased appetite	Reflex speed; HR	Free T_4

Key Reference: Roizen MF, Fleisher L: Anesthetic implications of concurrent diseases. In Miller RD et al, editors: *Anesthesia,* ed 7, New York, 2010, Elsevier, pp 1077–1080.

Perioperative Implications

- See Thyroidectomy, Subtotal.

Preoperative Preparation
- Assess if euthyroid.
- Assess for associated autoimmune diseases.

Preinduction/Induction
- Prehydrate liberally if CV status will tolerate it.
- Check and protect eyes.

Anesthetic Technique
- No one technique has proved superior.
- Hyperthyroidism is an associated risk factor for halothane hepatitis.

Monitoring
- Temperature. (Also place cooling blanket on OR table for possible treatment of thyroid storm.)
- Consider invasive monitoring if pt has dilated cardiomyopathy/thyroid storm/severe dysrhythmia.
- If head-up position is utilized, consider air embolus monitoring and therapy.

Airway
- Consider awake fiberoptic intubation if there are questions regarding adequacy of airway or distortion/involvement of the trachea.
- Consider armored tube or equivalent if tracheal rings are affected.

Induction/Maintenance
- Routine

Adjuvants
- Usually no requirement for muscle relaxants

Anticipated Problems/Concerns

- Thyroid storm is a life-threatening condition if hyperthyroidism has been severely exacerbated by illness or operation. Manifested by hyperpyrexia, tachycardia, and striking alterations in consciousness. Early signs include delirium, confusion, mania, excitement. Differential Dx: Malignant hyperthermia, pheochromocytoma crisis, NMS.
- Rx includes supportive care, methimazole or propylthiouracil followed in 1 h by iodides and propranolol or atenolol; these decrease conversion of the less active T_3 to the more active T_4.
- Surreptitious bleeding behind neck bandages or into chest if minimally invasive technique is used from axilla, can suddenly compromise airway function or result in CV collapse.
- Injuries to the recurrent laryngeal nerve after thyroidectomy usually result in damage to abductor fibers, resulting in hoarseness.
- Bullous glottic edema can require immediate reintubation.
- Occasionally late tetany (usually 2–3 d after thyroidectomy) can occur from accidental removal of or damage to parathyroid glands.

Hypertriglyceridemia

Andrew Bowdle

Risk

- Prolonged propofol infusion due to lipid vehicle
- Genetic defects in triglyceride metabolism
- Component of the metabolic syndrome (obesity, hypertriglyceridemia, low HDL, Htn, diabetes)

Perioperative Risks

- Associated with atherosclerosis, coronary, and cerebrovascular disease.
- Hyperglycemia (metabolic syndrome) increases risk of surgical wound infection.
- Severe hypertriglyceridemia may cause acute pancreatitis.

Worry About

- Coronary and cerebrovascular disease
- Pancreatitis
- Blood sugar control in metabolic syndrome
- Propofol infusion syndrome if hypertriglyceridemia is due to prolonged propofol infusion (hypertriglyceridemia due to propofol may occur with or without other features of propofol infusion syndrome, including rapidly progressive myocardial failure, bradycardia, ECG changes resembling Brugada syndrome, lactic acidosis, rhabdomyolysis, elevated serum creatine kinase, urea and potassium, elevated liver enzymes, hepatomegaly, and lipemic blood)

Overview

- High triglycerides are strongly associated with coronary artery atherosclerosis.
- Normal <150 mg/dL, borderline high 150–199 mg/dL, high 200–499 mg/dL, very high >500.
- >1000 mg/dL: Severe hypertriglyceridemia may cause acute pancreatitis.
- Prolonged and/or high-dose propofol infusion may produce hypertriglyceridemia.

Etiology

- Primary hypertriglyceridemia is caused by a variety of disorders of triglyceride metabolism.
- Secondary hypertriglyceridemia is caused primarily by obesity, diabetes, nephrotic syndrome, hypothyroidism, pregnancy, restrogen replacement, tamoxifen, beta-blockers, immunosuppressive medications, HIV antiretroviral agents, and retinoids.

Usual Treatment

- Diet and weight loss if due to obesity
- Lipid-lowering drugs: Statins for triglycerides <500 mg/dL (mainly to reduce risk of coronary artery atherosclerosis), fibrates for triglycerides >500 mg/dL
- If due to propofol infusion, discontinue or reduce infusion