Perioperative Implications

Perioperative Preparation
- Congenital heart disease: Consult experts.
- PCD: Optimize pulmonary status.
- Immunocompromised: Choice of antibiotics.
- Consider reprogramming AICD/pacemaker.

Monitoring
- ECG, defibrillator: Reverse positions
- Heterotaxy: TEE, invasive hemodynamic monitoring
- Central lines: May have abnormal anatomy

Airway
- Possible difficult mask, difficult intubation.
- Avoid nasal intubation (sinusitis).

Induction
- Congenital heart disease concerns

Maintenance
- Humidify gases (PCD)
- Congenital heart disease concerns

Extubation
- Assess cardiopulmonary reserve.

Adjuvants
- Nitric oxide if pulm Htn

Postoperative Period
- Consider ICU if PCD or heterotaxy.

Anticipated Problems/Concerns
- Dextrocardia provides periop challenges ranging from minor (unusual ECG finding) to severe (life-threatening crisis). Pts with PCD may require additional pulmonary support during the periop period. Heterotaxy pts have high periop risk. Input from appropriate experts is recommended.

Diabetes, Type I (Insulin-Dependent)

Michael F. Roizen

Risk
- Incidence in USA: 1.25 million.

Perioperative Risks
- Risk of requiring a CABG is increased 5–10 times in presence of ESRD, CHF, or autonomic neuropathy; without these conditions, the risk is 1-1½ times that of a normal person.

Worry About
- Autonomic neuropathy, gastroparesis, and sudden postop death.
- Painless myocardial ischemia.
- Atlantooccipital joint immobility.
- Tight glucose control might be indicated in pregnant pts and those difficult to wean from bypass (in ECC as well as in the case of predictable global or focal CNS ischemia).

Overview
- Endocrinopathy assoc with ESRD or ophthalmic, myocardial, and neuropathic disease
- Blood sugar control per se not associated with increased periop risk in absence of
  - Hypoglycemia
  - Hyperosmolar coma
  - Ketoacidosis
  - CNS ischemia
  - Pregnancy
  - Extracorporeal circulation
- Type I diabetes leads to deranged autoregulation of the CNS (with blood sugar at 250 mg/dL), kidney function (with blood sugar at 225 mg/dL), and function of the blood vessels (with blood sugar at 100 mg/dL and concomitant increased BP).
- Need to control BP to decrease damage to these vessels and organs.
- Check pt's glucose log for degree of control.
- Variable control may predict periop hypoglycemic episodes.
- See also Diabetic Ketoacidosis.

Etiology
- Genetic predisposition to autoimmune destruction of glucose transporter on islet cells leads to increased blood glucose, which affects proteins via nonenzymatic glycosylation.
- Swollen cells (sorbitol is oncotically active).
- Increased viscous proteins (macroglobins), which impede blood flow.
- Increased substrate for anaerobic metabolism.
- Deranged autoregulation of blood flow.

Usual Treatment
- Insulin injections, lifestyle changes including stress management, diet, and exercise.
- Pancreatic and islet cell transplantation is an option in ESRD.
- Control of BP.

Assessment Points

System	Effect	Assessment by Hx	PE	Test
HEENT	Possible atlantooccipital dislocation secondary to abnormal collagen glycosylation	Pain	Neck ROM, "prayer sign"	Usually not needed; x-rays of neck in extension
CV	Angiopathy, LV dysfunction (increased 4–10 times with Htn) Ischemic PVD	Poor exercise tolerance Angina, CHF symptoms	Two-flight climb Chest exam for signs of CHF BP lying and standing	ECG, CXR, coronary calcium score if indicated
RESP	Decreased lung elastance; decreased FEV; decreased FVC	Poor exercise tolerance		Generally not needed
GI	Gastroparesis	Early satiety		
RENAL	Nephropathy, especially with Htn	N/V, impotence; orthostatic symptoms Nonprotein foods		BUN/Cr
ENDO	Decreased insulin from islets			FBS, lytes
CNS	Autonomic dysfunction secondary to neuropathy	Early satiety, impotence, N/V, orthostatic symptoms		HRV on ECG BP change on standing
PNS	Stocking-glove neuropathy leading to infections		PNS exam, especially if regional anesthesia is planned	
MS	Impaired joint mobility secondary to nonenzymatic glycosylation of collagen	Joint mobility	Decreased ROM of joints	

Key References: Daneman D: Type 1 diabetes. *Lancet* 367(9513):847–858, 2006; Preiser JC, Devos P, Ruiz-Santana S, et al.: A prospective randomised multi-centre controlled trial on tight glucose control by intensive insulin therapy in adult intensive care units: the Glucontrol study, *Intensive Care Med* 35(10):1738–1748, 2009.

Perioperative Implications

Preoperative Preparation
- Metoclopramide (10 mg/70 kg) in pts with gastroparesis.
- Assess myocardial and volume status.

Monitoring
- Myocardial ischemia can indicate CHF if volume overload and LV dysfunction are present.
- Blood sugar.

Airway
- Atlantooccipital dislocation possible; see HEENT. Do prayer sign test; pt may have gastroparesis.

Induction
- Osmotic diuresis can lead to hypovolemia; ANS and CV dysfunction cause fluctuations in BP and HR.

Maintenance
- CV instability; volume status is key to avoiding renal and myocardial dysfunction with surgery; checking RR variation (HRV) to determine autonomic insufficiency likelihood still not widespread.

Extubation
- CV and pulm drive insufficiencies common with neuropathies.

Adjuvants
- Rx for tight control
- Regional: Diabetic nerves may be more prone to edema, especially if epinephrine has been used.

Reduce dose (e.g., lidocaine from 2.0% to 1.5%) for same effect.

Postoperative Period

- Sliding scale of insulin Rx based on blood glucose determinations every 1–3 h; tight control periop may decrease infections but side effects of hypoglycemia possibly negate benefit.

Anticipated Problems/Concerns

- Gastroparesis with presence of solid food 24 h after last meal if ANS dysfunction is present. Consider treating with metoclopramide 10 mg IM 1½ h prior to induction.
- ANS dysfunction is assoc with sudden death postop; pt can be kept in ICU/PACU overnight; vested adult who can measure blood glucose and call 911 if sent home postop.

Diabetes, Type II (Noninsulin Dependent)

Stanley H. Rosenbaum | Ranjit Deshpande

Risk

- Incidence in USA more than 25 million
- Highest prevalence: Hispanics and Native Americans
- Gender predominance: None
- Metabolic syndrome associated with obesity and sedentary lifestyle

Perioperative Risks

- Increased risk 5–10 times if end-stage renal disease, CV, CHF, or autonomic neuropathy; without renal, CV disease, or autonomic dysfunction, risk is 1–1.5 times normal.
- Metabolic abnormalities increased with perioperative insulin Rx.
- Unclear if same risks as for type I diabetes.

Worry About

- Autonomic neuropathy, gastroparesis, and sudden postop death.
- Myocardial ischemia; CV instability.
- Tight glucose control might be indicated in pregnancy (see Diabetes, Type III); difficult weaning from bypass (ECC), predictable global or focal CNS ischemia.
- Disordered autoregulation makes BP fluctuations dangerous.
- Fluid and electrolyte imbalance.
- Hyperosmolar hyperglycemic state and, less likely, diabetic ketoacidosis.

Overview

- Endocrinopathy that can cause same organ dysfunction as in diabetes type I: end-stage renal, myocardial, neuropathic disease, stiff joint syndrome, and retinopathy.
- Associated with deranged blood flow autoregulation to CNS (at blood sugar 250 mg/dL), renal (at blood sugar 200 mg/dL), and cardiac (at blood sugar 100 mg/dL) vessels.
- Ketosis is rare because there is some endogenous insulin.
- Primarily controlled by diet and/or oral agents, although insulin is more frequently used.
- Usually has high insulin levels for glucose level, but peripheral resistance to insulin effect. Can develop hyperosmolar nonketotic coma.
- Blood sugar control per se not associated with increased periop morbidity in absence of:
  - Hypoglycemia.
  - Hyperosmolar coma.
  - CNS ischemia.
  - Pregnancy.
  - Extracorporeal circulation.
- Preop HgBA1c levels (ideally <7%) indicate quality of recent blood sugar control. High levels correlate with chronic microvascular complications.

Etiology

- Familial predisposition with very high concordance in identical twins
- Autosomal dominant accentuated by conditions that increase peripheral insulin resistance (obesity, inactivity, hormones), increase glucose production or metabolic demands (glucocorticoids, pregnancy), or decrease insulin secretion (certain beta-adrenergic drugs)
- Increases nonenzymatic glycosylations
- Causes cell swelling
- Deranges autoregulation
- Increases viscous protein production
- Increases substrate for anaerobic metabolism

Usual Treatment

- Hypoglycemic agents (see oral hypoglycemic agents), diet, exercise, insulin
- BP control with ACE inhibitors being drugs of choice, especially in diabetic nephropathy

Assessment Points

System	Effect	Assessment by Hx	PE	Test
HEENT	Possible atlanto-occipital dislocation Cataracts, glaucoma, retinopathy Periodontal disease	Pain	Neck ROM, prayer sign Loose decaying teeth	
CV	Premature CAD Hypertension Peripheral arterial disease Resting tachycardia, orthostatic hypotension	Angina Claudication Symptoms of CHF	Peripheral pulses	ECG CAD-related tests, as indicated
RESP	Decreased pulm elastance	Exercise tolerance		
GI	Gastroparesis Diarrhea	Early satiety		
ENDO	Hyperglycemia Osmotic diuretic–caused hypokalemia	Polyuria		Blood glucose, K^+
HEME	Infection from decreased WBC phagocytic function		Site of infections	
RENAL	Nephropathy Type 4 RTA	Asymptomatic although often associated with neuropathy		BUN/Cr, UA for protein
CNS	Cerebrovascular disease Medication-induced hypoglycemia	TIAs, CVAs, long-acting oral hypoglycemic agents	CNS exam	
PNS	Distal sensory and motor neuropathy Autonomic neuropathy	Impotence Foot infections	PNS exam, especially prior to regional anesthetic	
MS	Impaired joint mobility		ROM of joints	

Key References: Barash PG, Cullen BF, Stoelting RK, et al, editors: *Clinical anesthesia*, ed 7, Philadelphia, PA, 2013, Lippincott Williams & Wilkins; Kadol Y: Anesthetic considerations in diabetic patients. Part I: preoperative considerations of patients with diabetes mellitus. *J Anesth* 24(5):739–747, 2010.

Perioperative Implications

Preoperative Preparation

- Metoclopramide (5–10 mg) if gastroparesis.
- Assess myocardial, autonomic function, and volume status.
- Formulate recommendations for preop insulin and long-acting hypoglycemic agents.

Monitoring

- Blood sugar and metabolic abnormalities
- Painless myocardial ischemia can cause CHF if volume overload and LV dysfunction
- Peripheral vasculature and nerves vulnerable to pressure ischemia

Airway

- Atlanto-occipital dislocation possible: See HEENT, do prayer sign test