Hyperglycemia

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Risk

- Incidence in USA: Can occur in virtually any anesthetized or critically ill pt
- Race with the highest prevalence: None

Perioperative Risks

- Dehydration resulting from osmotic diuresis
- Increased likelihood of neurologic injury following brain ischemia and perhaps traumatic brain injury and spinal cord injury
- Increased infection rate
- Diminished wound healing

Worry About

- Lyte abnormalities, particularly hypokalemia, while treating hyperglycemia.
- Hypoglycemia following insulin, resulting in insult to the CV system and CNS.
- Polyuria complicates assessment of fluid balance.

Overview

- Is not a disease.
- Typically produces adverse effects by three mechanisms: Increases in plasma osmolality, increases in postischemic tissue lactic acidosis, and inhibition of white blood cell function.
- In acute setting, blood glucose concentration can be estimated using indicator-impregnated strips or other point-of-care methodologies; confirmation can be made by mechanized techniques in a reference laboratory.

Etiology

- Results from DM (both insulin-requiring and non-insulin–requiring), other endocrinopathies (Cushing syndrome, acromegaly, obesity, pheochromocytoma), physiologic stress, drug administration (particularly corticosteroids), and glucose-containing fluid infusions

Usual Treatment

- Insulin.
- Isotonic IV crystalloid solutions to treat hypovolemia and dilute existing blood glucose.
- If possible, treat underlying cause (e.g., discontinue infusion of glucose-containing solutions, discontinue corticosteroids, reduce physiologic stress to pts).

Assessment Points

System	Effect	Assessment by Hx	PE	Test
HEENT	Dehydration in extreme cases		Dry mucosa in extreme cases	
CV	Mild positive inotropic effect with mild hyperglycemia Dehydration		Tachycardia, orthostatic hypotension	
GI		Polydipsia in extreme cases		
RENAL	Osmotically induced diuresis	Polyuria, urinary frequency		Elevated urine glucose
ENDO		See Etiology		Elevated blood glucose
HEME	Diminished WBC activity; changes in serum sodium concentrations			Serum sodium concentration decreases 1.6 mEq/L for each 100 mg/dL increase in glucose concentration
CNS			Altered consciousness, neurologic deficits	Plasma osmolality

Key References: Akhtar S, Barash PG, Inzucchi SE: Scientific principles of perioperative glucose regulation and control, *Anesth Analg* 110(2):478–497, 2010; Pasternak JJ, McGregor DG, Schroeder DR, et al: Hyperglycemia in patients undergoing cerebral aneurysm surgery: its association with long-term gross neurologic and neuropsychological function, *Mayo Clin Proc* 83(4):406–417, 2008.

Perioperative Implications

Preoperative Preparation

- Glucose reduction with insulin
- Hydration
- Normalization of lytes

Monitoring

- Blood glucose concentrations in all cases
- In severe cases, blood lytes, blood osmolality, and urine output

Airway

- Abnormality typically related to DM (reduced range of motion and abnormal atlanto-occipital contractions), acromegaly (distorted anatomy), or chronic corticosteroid use or Cushing syndrome (Cushingoid signs and symptoms, friable tissues)

Maintenance

- Maintain hydration.
- Insulin therapy.
- K+ replacement.

Extubation

- No special considerations, other than those related to underlying disease

Adjuvants

- Limit attempted reduction of blood glucose concentration to approximately 75 mg/dL/h to avoid problems with osmotic injury to brain and lyte disturbances.
- Monitor ECG during correction of profound hyperglycemia.

Postoperative Period

- Variations in physiologic stress, fluid administration, and drug usage make postop blood glucose concentrations difficult to predict and control.

Anticipated Problems/Concerns

- Increases in blood glucose concentrations by a mere 40 mg/dL may worsen outcome following cerebral ischemic insult. Hyperglycemia may also harm wound healing, increase infection rates, and worsen outcomes after myocardial infarction. In contrast, hypoglycemia resulting from excessive use of insulin may result in pt morbidity and mortality from neurologic and other causes, independent of ischemic events.
- Limb hypothermia or hypoperfusion will harm the accuracy of glucose measurements from skin-prick blood samples.
- Target blood glucose should be <180 mg/dL in most pts.

Hyperglycemic Hyperosmolar State

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Risk

- Elderly pts with DM, usually type II
- Debilitated pts who cannot care for themselves
- Chronically ill diabetic pts who experience exacerbation of an underlying comorbidity
- Incidence increased in African Americans, Hispanics, and Native Americans

Perioperative Risks

- Severe hypovolemia and hemodynamic instability
- Presence of diffuse organ system damage from poor glycemic control
- Altered mental status and increased risk of pulmon aspiration
- Periop stress causing further elevations in serum glucose

Worry About

- Cause of hyperglycemic hyperosmolar state.
- Volume status and potential hemodynamic instability.
- Electrolyte and acid-base abnormalities increase the risk of cardiac arrhythmias.

Overview

- Serious metabolic condition characterized by hyperglycemia, hyperosmolarity, and dehydration
- Is one of several potentially fatal states associated with poorly controlled DM
- Requires aggressive treatment and close electrolyte and hemodynamic monitoring

Etiology

- Inadequate insulin production and increased counter-regulatory hormone production (catecholamines, glucagon, cortisol) in the setting of an acute insult leads to severe hyperglycemia, dehydration, and electrolyte abnormalities.
- Triggering event may be infection, dehydration, CVA, inadequate dosing of insulin, silent myocardial