

Hypocalcemia

Anesthetic Pearls: Anesthetic Implications & Management of Hypocalcemia

Normal *total* plasma calcium concentration is 8.5 – 10.5 mg/dl (2.1 – 2.6 mmol/L)

1. 50% in free ionized form, 40% protein-bound (mainly albumin)
2. 10% complexed with anions such as citrate and amino acids
3. **Free ionized form [Ca²⁺] is physiologically most important!**
4. Normal plasma *ionized* [Ca²⁺] is 4.5 – 5 mg/dl (2.2 – 2.5 meq/L or 1.1 – 1.25 mmol/L)
5. Changes in plasma albumin concentration affect total but **not** ionized [Ca²⁺]
6. **Corrected Calcium** (mg/dL) = measured total Ca²⁺ (mg/dL) + 0.8 (4.0 - serum albumin [g/dL]), where 4.0 represents the average albumin level in g/dL. (In other words, each 1 g/dL decrease of albumin will raise 0.8 – 1.0 mg/dL in serum [Ca²⁺])
7. Changes in plasma pH affect degree of albumin binding and therefore ionized [Ca²⁺]
-- alkalosis increases albumin binding and therefore decreases ionized [Ca²⁺]

Hypocalcemia:

- total serum Ca < 8.5 mg/dl
- **best diagnosed** based on ionized Ca: < 4 mg/dl or <1.1 mmol/L

Clinical signs & symptoms/ manifestations:

--Usually do not occur unless severe hypocalcemia (< 2.5 mg/dl or 0.8 mmol/L)

A. Neuromuscular:

laryngospasm / stridor, paresthesias, carpopedal spasm (**Trousseau's sign**: carpal spasm with 3 minutes of tourniquet ischemia), masseter spasm (**Chvostek's sign**: facial nerve irritability to percussion), focal or grand mal seizures that may be unresponsive to usual treatment, tetany, apnea, bronchospasm

B. Cardiovascular:

1. Cardiac irritability / dysrhythmias, decreased cardiac contractility, heart failure, hypotension, cardiac arrest
2. Decreased response to: digitalis, Beta-adrenergic agonists, glucagon
3. ECG signs: prolonged Q-T & S-T intervals, bradycardia, heart block, T-wave inversion

C. Psychiatric: confusion, irritability, anxiety, confusion, dementia, psychosis

Anesthetic considerations:

1. Exacerbating factors for hypocalcemia include: alkalosis, rapid transfusion of multiple units of citrate-containing blood products, large volumes of albumin solutions (theoretically)
2. Hyperventilation in hypocalcemic patient can lead to tetany.
3. Hypocalcemia potentiates the negative inotropic effects of barbiturates and volatile anesthetics
4. Response to muscle relaxants inconsistent (duration of non-depolarizing muscle relaxants may be prolonged)
5. Treatment: slow intravenous replacement (not IV push) of Calcium Chloride (central) or Calcium Gluconate (peripheral) depending on venous access.
6. **Essential:** check for hypomagnesemia