Chapter 7 / Capítulo 7

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Hypocalcemia in Emergency Care

Hipocalcemia en emergencia

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INTRODUCTION

Hypocalcemia may be associated with clinical manifestations ranging from few (or no) symptoms, when hypocalcemia is mild, to potentially life-threatening seizures, refractory heart failure, or laryngospasm when severe. In addition to severity, the rate of development and chronicity of hypocalcemia determine the clinical presentation.

Clinical manifestations

The signs and symptoms of acute hypocalcemia are similar regardless of the etiology. The distinctive symptom of acute hypocalcemia is tetany, characterized by neuromuscular irritability. Symptoms range from mild paresthesias to carpopedal spasms and seizures.

Table 7.1. Clinical manifestations

Acute	Chronic
• Neuromuscular irritability (tetany) • Paresthesias (perioral, extremities) • Muscle spasms • Carpopedal spasm • Trousseau's sign • Chvostek's sign • Seizures • Laryngospasm • Bronchospasm • Prolonged QT interval • Hypotension • Heart failure • Arrhythmia • Papilledema	• Extrapyramidal signs • Parkinsonism • Dementia • Subcapsular cataracts • Abnormal dentition • Dry skin

Source: Own elaboration

The hallmark of acute hypocalcemia is tetany, characterized by neuromuscular irritability. When measured electromyographically, tetany consists of repetitive high-frequency discharges following a single stimulus. Hyperexcitability of peripheral neurons is probably the most important pathophysiological effect of hypocalcemia, but hyperexcitability occurs at all levels of the nervous system, including motor end plates, spinal reflexes, and the central nervous system.

Tetany

Acute hypocalcemia directly increases peripheral neuromuscular irritability. Symptoms of

tetany may be mild (perioral numbness, paresthesias of the hands and feet, muscle cramps) or severe (carpopedal spasm, laryngospasm, and focal or generalized seizures, which must be distinguished from generalized tonic muscle contractions that occur in severe tetany). Other patients may present with less specific symptoms (such as fatigue, hyperirritability, anxiety, and depression), and some patients, even with severe hypocalcemia, may have no neuromuscular symptoms.

The classic physical findings in patients with neuromuscular irritability due to latent tetany are Trousseau's sign and Chvostek's sign.

Tetany is uncommon unless the serum ionized calcium concentration falls below 4,3 mg/dL (1,1 mmol/L), which usually corresponds to a total serum calcium concentration of 7,0 to 7,5 mg/dL (1,8 to 1,9 mmol/L). Patients with gradually developing hypocalcemia tend to present fewer symptoms at the same serum calcium concentration. Other factors that determine variation in the frequency and severity of symptoms include acid–base status, hypomagnesemia, and potassium balance.

Seizures

In hypocalcemia, generalized tonic–clonic seizures, generalized absence seizures, and focal seizures may occur, and they can be the sole presenting symptom, though not a direct manifestation of tetany. In patients with seizures caused by hypocalcemia, the electroencephalogram (EEG) shows both spikes ("convulsive effect") and bursts of high-voltage paroxysmal slow waves.

Cardiovascular

Hypotension may complicate acute hypocalcemia, particularly when it is rapidly induced by ethylenediaminetetraacetic acid (EDTA), transfusion of citrated blood, or the use of low-calcium dialysate in patients undergoing renal replacement therapy. In addition, decreased myocardial performance and even congestive heart failure (with or without hypotension) have been described.

Papilledema

Papilledema may occur in patients with hypocalcemia of any cause. It appears only when hypocalcemia is severe and usually improves with correction of hypocalcemia. It may or may not be accompanied by benign intracranial hypertension (idiopathic intracranial hypertension).

Psychiatric manifestations

Hypocalcemia may cause psychological symptoms, particularly emotional instability, anxiety, and depression. Less common are states of confusion, hallucinations, and overt psychosis. All are reversible with treatment.

Diagnosis

A 54-year-old woman, recently subjected to a total thyroidectomy, went to consultation due to a seizure. The patient is awake and presents generalized seizures. The ECG shows prolonged PR and QT intervals (due to ST-segment prolongation).

Anamnesis

- Ask about abdominal pain and vomiting.
- Severe pancreatitis can cause hypocalcemia.
- Consider symptoms or risk factors for rhabdomyolysis as an underlying cause of hypocalcemia.
- Ask about any history of thyroid or parathyroid surgery.
- These are common causes of parathyroid dysfunction leading to hypocalcemia.

Pearls

Consider the evaluation and treatment of hypocalcemia in severely injured adult and pediatric trauma patients. Retrospective evidence has shown an association between severe hypocalcemia and increased transfusion requirements as well as higher mortality.

Physical Examination

Look for Trousseau's sign (carpal spasm with the inflation of a blood pressure cuff) and Chvostek's sign (facial muscle spasm with tapping over the facial nerve). These examination findings are associated with hypocalcemia.

Diagnostic tests

Standard orders:

- Conduct a complete blood count to assess for anemia.
- Conduct a comprehensive metabolic panel to measure total serum calcium levels, assess renal function, and obtain the albumin level to correct the serum calcium value.
- Check magnesium and phosphorus levels, as these are common coexisting electrolyte disturbances.
- ECG: evaluate for QT interval prolongation or cardiac dysrhythmia.

Additional tests to consider:

If possible, obtain serum ionized calcium levels as a direct measurement of the biologically active free ionized calcium concentration.

- Evaluate serum phosphate and uric acid levels as indicators of tumor lysis syndrome.
- Obtain a serum creatine kinase level if rhabdomyolysis is suspected.
- Evaluate lipase levels, which are associated with pancreatitis in patients presenting with abdominal pain/vomiting.
- Measure parathyroid hormone levels to assess for possible hypoparathyroidism.
- Perform a head computed tomography to evaluate intracranial pathology in patients presenting with seizures.

Treatment

There are two forms of parenteral calcium. Calcium gluconate can be administered through a peripheral intravenous catheter. Calcium chloride contains approximately three times the amount of elemental calcium compared with an identical dose of calcium gluconate, and it is ideally administered through a central venous catheter, except in code/periarrest situations.

The dose and rate of calcium replacement are guided by the severity of symptoms and by the corrected serum calcium level.

Choose 1 of the following 2 regimens:

Regimen 1: Calcium gluconate (preferred for peripheral intravenous administration)

Dosing is based on symptoms and the degree of hipocalcemia.

- Mild (corrected serum calcium level 8,5–10,4 mg/dL [2,1–2,6 mmol/L] or ionized serum calcium level 4–5 mg/dL [1–1,2 mmol/L]): 1000–2000 mg as an intravenous infusion over 2 hours.
- Moderate (corrected serum calcium level 7,6–8,5 mg/dL [1,9–2,0 mmol/L] or ionized serum calcium level 3,6–4 mg/dL [0,9–1 mmol/L]): 4000 mg as an intravenous infusion over 4 hours.
- Severe, symptomatic (corrected serum calcium level <7,5 mg/dL [<1,9 mmol/L] or ionized serum calcium level <3,6 mg/dL [<0,9 mmol/L], seizures or tetany): 1000–2000 mg as an intravenous infusion over 10 minutes. The dose should be repeated every hour,

monitoring calcium levels until symptom resolution.

Regimen 2: Calcium chloride (central venous administration or code/peripartum)

Dosing is based on symptoms and the degree of hypocalcemia.

- Mild (corrected serum calcium level 8,5–10,4 mg/dL [2,1–2,6 mmol/L] or ionized serum calcium level 4–5 mg/dL [1–1,2 mmol/L]): 670 mg as an intravenous infusion over 2 hours.
- Moderate (corrected serum calcium level 7,6–8,5 mg/dL [1,9–2,0 mmol/L] or ionized serum calcium level 3,6–4 mg/dL [0,9–1 mmol/L]): 1300 mg as an intravenous infusion over 4 hours.
- Severe, symptomatic (corrected serum calcium level <7,5 mg/dL [<1,9 mmol/L] or ionized serum calcium level <3,6 mg/dL [<0,9 mmol/L], seizures or tetany): 1000 mg as an intravenous infusion over 10 minutes. The dose may be repeated every hour until symptom resolution.

In patients with mild symptoms and a corrected total serum calcium level >7,5 mg/dL (1,9 mmol/L), oral calcium administration may be preferable.

Choose one of the following options (in alphabetical order):

- Calcium carbonate: 1 g of elemental calcium orally every 12 hours.
- Calcium carbonate 1500 mg = 600 mg of elemental calcium.
- Calcium citrate: 1 g of elemental calcium orally every 12 hours.
- Calcium citrate 1040 mg = 250 mg of elemental calcium

Tips

Calcium discontinuation is no longer justified in patients taking digoxin due to increased cardiac sensitivity and the development of arrhythmias; calcium administration to these patients is no longer contraindicated.

Perspectives

Make sure to treat concomitant hypomagnesemia.

Medication dosing for special populations

For pediatric patients, it is recommended to use one of the following 2 regimens:

Regimen 1: Calcium gluconate (preferable for peripheral intravenous administration)

- Mild to moderate: 29–60 mg/kg intravenously every 6 hours or as a continuous infusion at a rate of 8–13 mg/kg/hour.
- Severe: 100–200 mg/kg intravenously over 5 to 10 minutes (maximum 2000 mg).

The dose may be repeated as needed, or a continuous infusion at a rate of 8 to 13 mg/kg/hour may be considered.

Regimen 2: Calcium chloride (central venous administration or code/peripartum)

- Severe: 10–20 mg/kg intravenously over 5–10 minutes (maximum 1000 mg)
- The dose may be repeated every 4 to 6 hours as needed.

Trauma

Patients undergoing large-volume transfusions are at particularly high risk of severe hypocalcemia due to the calcium-binding effects of citrate, the anticoagulant used in packed red blood cells (PRBCs).

There is a lack of high-quality evidence to guide care. Recommendations for the management

of patients undergoing massive transfusions range from monitoring with frequent laboratory tests and cardiac monitoring to empirical treatment. An empirical treatment recommendation is presented below; choose one of the following two regimens:

- Regimen 1 (central venous access) Calcium chloride 1 g intravenously for patients in hemorrhagic shock with the first unit of blood, followed by an additional 1 g intravenously with every 4 units of packed red blood cells.
- Regimen 2 (peripheral venous access) Calcium gluconate 3 g intravenously for patients in hemorrhagic shock with the first unit of blood, followed by an additional 1 g intravenously with every 4 units of packed red blood cells.

Pregnancy

Calcium preparations cross the placenta. Calcium should be administered in emergency situations, as the benefit generally outweighs the risk. We recommend consulting an obstetrician for any patient who requires parenteral calcium treatment.

Disposition

- The disposition of patients with hypocalcemia will depend primarily on their corrected serum calcium level and their symptoms.
- Asymptomatic patients can generally be safely discharged with close follow-up.
- Patients who receive intravenous calcium, have persistent symptoms, or show any evidence of cardiac involvement should be admitted for further cardiac monitoring and symptom treatment.

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