Alert

Multiple forms of calcium exist with varying amounts of elemental calcium expressed in varying units. Therefore careful attention is required in prescription and administration of calcium to avoid over- or under-dosing. Conversion factor for elemental Ca: 1mg = 0.02 mmol = 0.05 mEq. High-risk medication: Fatal in overdose. Rapid IV administration can cause severe bradycardia. Calcium chloride 10% is preferred over calcium gluconate 10% for IV administration due to smaller volumes and minimal aluminium content.

Indication

Asymptomatic or symptomatic hypocalcaemia
Hyperkalaemia
Exchange transfusion
Magnesium toxicity.
Supplementation in parenteral nutrition (beyond the scope of this guideline).

Action

Calcium is essential for the functional integrity of the nervous, muscular, skeletal and cardiac systems and for clotting function. It antagonises the cardiotoxic effects (arrhythmias) of hyperkalaemia and hypermagnesaemia.

Drug Type

Mineral.

Trade Name

Calcium Gluconate Injection [Phebra] 10% injection (calcium 0.22 mmol/mL)

Maximum Dose

IV – 4 mmol/kg/dose

Presentation

Calcium gluconate 10% 10 mL vial contains 0.22 mmol/mL of elemental calcium.

Dosage/Interval

Hypocalcemia, hyperkalaemia, magnesium toxicity
IV: Elemental calcium 0.5 mmol/kg (0.4–2 mmol/kg) every 6 hours PRN.
This equates to:
Calcium gluconate 10% IV 2.3 mL/kg (1.8–9 mL/kg) every 6 hours PRN

Cardiac arrest secondary to hypocalcaemia, hyperkalaemia, magnesium toxicity
IV or intraosseous: Elemental calcium 2 mmol/kg over 5-10 minutes. May repeat in 10 minutes.
This equates to:
Calcium gluconate 10% IV 9 mL/kg. May repeat in 10 minutes.

Exchange transfusion
Option 1: Administer if hypocalcaemia:
IV: Elemental calcium 0.23–0.46 mmol/kg
Calcium gluconate 10% IV 1–2.1 mL/kg.
Option 2: Administer 0.18 mmol elemental calcium for every 100 mL blood transfused:
Calcium gluconate 10% IV 0.8 mL/kg.

Route

IV (via a central line where possible). Oral (see separate guideline ‘Calcium- ORAL’)

Preparation/Dilution

Calcium gluconate – IV intermittent
Draw up 5 mL (1.1 mmol) and add 5 mL of sodium chloride 0.9%, glucose 5% or glucose 10% to make a final volume of 10 mL with a concentration of 0.11 mmol/mL. Infuse dose over 10–60 minutes via a central line (if possible).

Calcium gluconate – cardiac arrest
Infuse undiluted over 5 – 10 minutes via a central line (if possible).

Administration

Calcium gluconate – IV intermittent
Infuse dose over 10–60 minutes (5-10 minutes in cardiac arrest) via a central line (if possible and compatibilities permit). If NO central access is available, consult the Neonatologist on service before administering via peripheral route. If administering peripherally give via a large vein. In poorly perfused patients, consider diluting the infusion further (two-fold) and infuse over at least TWO hours.
MUST NOT be injected intra-arterially, intramuscularly or subcutaneously.

Monitoring

Continuous ECG monitoring to monitor heart rate and rhythm (stop infusion if HR < 100 bpm). Measurement of ionised calcium preferred over total calcium. Blood gas machines measure ionised calcium directly and are more accurate than the main pathology laboratory which calculates the ionised calcium from a complex formula. Observe IV tubing for precipitates.
Observe IV insertion site for extravasation.
Correct hypomagnesaemia if present.

**Contraindications**
Caution in patients with renal or cardiac impairment.

**Precautions**
Ensure IV calcium is administered at a different time to phosphates, carbonates, sulfates or tartrates (precipitates can occur).

**Drug Interactions**
Ceftriaxone (may cause insoluble precipitates and can be fatal), digoxin (serious risk of arrhythmia and cardiovascular collapse), thiazide diuretics (increased risk of hypercalcaemia), ketoconazole (decreased ketoconazole effect).

**Adverse Reactions**
Rapid administration is associated with bradycardia or asystole.
Rash, pain, burning at injection site, cutaneous necrosis with extravasation (give via central line unless otherwise instructed by a neonatologist)
Nephrolithiasis with long-term use.
Gastric irritation, diarrhoea and NEC have occurred during oral therapy with hyperosmolar preparations (must be diluted if used orally. See separate guideline Calcium - ORAL)

**Compatibility**
Fluids: Glucose 5%, glucose 10%, Hartmann’s, sodium chloride 0.9%
Y-site: Amifostine, amiodarone, aztreonam, bivalirudin, ceftaroline fosamol, cisatracurium, dexametomidine, doripenem, filgrastim, granisetron, heparin sodium, hydrocortisone sodium succinate, isoflurane, linezolid, midazolam, milrinone, piperacillin-tazobactam (EDTA-free), potassium chloride, remifentanil.

**Incompatibility**
Fluids: Fat emulsion
Y-site: Adrenaline (epinephrine) hydrochloride, cefalotin, ceftriaxone, clindamycin, dexamethasone, dobutamine, fluclouacillin, fluconazole, foscarinet, indomethacin, methylprednisolone sodium succinate, metoclopramide, mycophenolate mofetil, sodium bicarbonate, thiopentone, carbonate, phosphate and sulfate salts.

**Stability**
Calcium gluconate is a supersaturated solution and may precipitate in the vial at room temperature. Inspect the vial before use.
IV diluted solution: Do not use if discoloured, cloudy, turbid or if a precipitate is present. Discard remaining solution after use.

**Storage**
Ampoule: Store below 25°C.

**Special Comments**
Consider use of hyaluronidase for treatment of extravasation injuries

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<th>Elemental Ca</th>
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<tr>
<td>Calcium acetate 1 g</td>
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<tr>
<td>Calcium carbonate 1 g</td>
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<td>Calcium chloride 10% 1 mL</td>
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<tr>
<td>Calcium gluconate 10% 1 mL</td>
<td>9.3 mg</td>
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**Evidence summary**
Blood gas machines measure ionised calcium directly and are more accurate than the main pathology laboratory which calculates the ionised calcium from a complex formula. Corrected calcium is calculated (when albumin < 40 or > 45) by the formula:

\[ \text{Measured Ca (mmol/L)} + (40 – \text{albumin (g/L)} \times 0.025) \]

A randomised trial of calcium chloride vs calcium gluconate in children showed equal effect of equal amounts of elemental calcium on calcium concentrations in a eucalcaemic state.\(^1\)

MHRA Public assessment reports significant levels of aluminium in calcium gluconate stored in glass containers and recommends it not be used in preterm infants. Calcium gluconate stored in plastic containers does not have this issue.\(^2\)
Exchange transfusion with blood stored in acid-citrate-dextrose (ACD) causes a profound fall in ionised calcium concentration. However, ionised concentrations could not be correlated with infant’s condition. Injection of calcium raised total calcium during exchange transfusion and caused no a brief rise in ionised calcium. Current additive used in whole blood is citrate phosphate dextrose (CPD). In a recent retrospective review on the complications of neonatal exchange transfusion using citrated blood, hypocalcaemia was found in 22% and 13% of them required calcium supplementation. No recommendation can be made about routine supplementation during exchange transfusion but close monitoring of serum calcium is required during exchange transfusion.

Calcium concentrations decrease transiently after birth. Of preterm infants, 30-57% will have calcium < 1.75 mmol/L or ionised Ca < 0.9 mmol/L in the first few days. This is usually asymptomatic and typically recovers in 7–10 days. No short- or long-term benefit of early calcium treatment has been demonstrated other than acute rise in calcium concentration.

References

2. MHRA Public Assessment Report. Calcium gluconate injection 10% in 10 ml glass containers: risk of aluminium exposure. September 2010

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<tr>
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<th>Author: NMF Consensus Group</th>
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