### 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
<table>
<thead>
<tr>
<th>Indication</th>
<th>Details</th>
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<tbody>
<tr>
<td>Asymptomatic or symptomatic hypocalcaemia</td>
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<tr>
<td>Hyperkalaemia</td>
<td></td>
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<tr>
<td>Exchange transfusion</td>
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<tr>
<td>Magnesium toxicity</td>
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<tr>
<td>Supplementation in parenteral nutrition</td>
<td>(beyond the scope of this guideline)</td>
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</tbody>
</table>

### 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).
Calcium Gluconate
Newborn Use Only

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 fosamil, cisatracurium, dexametomidine, doripenem, filgrastim, granisetron, heparin sodium, hydrocortisone sodium succinate, labetalol, linezolid, midazolam, milrinone, piperacillin-tazobactam (EDTA-free), potassium chloride, remifentanil.

Incompatibility
Fluids: Fat emulsion

Y-site: Adrenaline (epinephrine) hydrochloride, cefalotin, ceftriaxone, clindamycin, dexamethasone, dobutamine, flucloxacinil, fluconazole, foscarnet, indometacin, methylprednisolone sodium succinate, metoclopramide, mycophenolate mofetil, sodium bicarbonate, thiopentone, carbonate, phosphate and sulfate salts.

Do not mix with any medication that contains phosphates, carbonates, sulfates or tartrates.

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
Calcium salt equivalents of elemental calcium

<table>
<thead>
<tr>
<th>Salt</th>
<th>Elemental Ca</th>
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<tbody>
<tr>
<td>Calcium acetate 1 g</td>
<td>253 mg</td>
</tr>
<tr>
<td>Calcium carbonate 1 g</td>
<td>400 mg</td>
</tr>
<tr>
<td>Calcium citrate 1 g</td>
<td>211 mg</td>
</tr>
<tr>
<td>Calcium chloride 1 g</td>
<td>273 mg</td>
</tr>
<tr>
<td>Calcium gluconate 1 g</td>
<td>66 mg</td>
</tr>
<tr>
<td>Calcium gluceptate 1 g</td>
<td>82 mg</td>
</tr>
<tr>
<td>Calcium gluconate 1 g</td>
<td>93 mg</td>
</tr>
<tr>
<td>Calcium chloride 10% 1 mL</td>
<td>27.3 mg</td>
</tr>
<tr>
<td>Calcium gluconate 10% 1 mL</td>
<td>9.3 mg</td>
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</tbody>
</table>

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:
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.\(^3\) Injection of calcium raised total calcium during exchange transfusion and caused no a brief rise in ionised calcium.\(^4,5\) 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.\(^6,7\)

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 supplementation has been demonstrated other than acute rise in calcium concentration.\(^5,7,9\)

### 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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