MONOGRAPH

CALCIUM

Scope (Staff):	Medical, Pharmacy, Nursing, Anaesthetic Technicians
Scope (Area):	All Clinical Areas

Child Safe Organisation Statement of Commitment

CAHS commits to being a child safe organisation by applying the National Principles for Child Safe Organisations. This is a commitment to a strong culture supported by robust policies and procedures to reduce the likelihood of harm to children and young people.

This document should be read in conjunction with this DISCLAIMER

⚠ HIGH RISK MEDICINE ⚠

QUICKLINKS

INTRAVENOUS Dosage-Administration	ENTERAL Dosage-Administration	Compatibility	Monitoring

DRUG CLASS

Electrolyte[1].

Calcium is a High Risk Medicine.

INDICATIONS AND RESTRICTIONS

Calcium gluconate/chloride (IV)

Calcium **gluconate** is preferred in non-emergency situations.

- Cardiac arrest in the presence of hyperkalaemia, hypocalcaemia, hypermagnesaemia or calcium channel blocker toxicity (**NOT** due to digoxin toxicity).[2]
- Acute hypocalcaemia.[2, 3]
- Severe hyperkalaemia (**NOT** due to digoxin toxicity).[3]
- Calcium homeostasis (e.g. plasma-exchange, cardiac output optimisation in patients with low cardiac output syndrome).[2-4]
- Citrate-based continuous renal replacement therapy – *calcium gluconate*.[3]

Calcium carbonate (Enteral)

- Nutritional supplementation when calcium intake is inadequate (e.g. osteoporosis, osteomalacia, rickets, eating disorder).[5]

- Hypocalcaemia.[5]
- Adjunctive treatment with bisphosphonates.[6]
- Hyperphosphataemia in renal disease.[5]

Calcium polystyrene sulfonate (Calcium Resonium®) (Enteral/Rectal)

- Hyperkalaemia.[5]

CONTRAINDICATIONS

- Hypersensitivity to calcium or any component of the formulation.
- Hypercalcaemia.[1]
- Cardiac arrest or hyperkalaemia caused by digoxin toxicity.[1]

PRECAUTIONS

- Hypercalciuria, history of nephrolithiasis (renal calculi).[1]
- Concurrent use with digoxin – may cause arrhythmias.[1]
- Rapid IV administration may cause vasodilation, bradycardia, hypotension, cardiac arrhythmias, and cardiac arrest.[7]
- IV: Highly irritant. Administer with caution to avoid extravasation. Use calcium gluconate in preference over calcium chloride in the absence of central venous access.[1]

FORMULATIONS

Listed below are products available at PCH, other formulations may be available, check with pharmacy if required[8]:

Calcium gluconate injection

- 10% vials (93 mg/mL): 0.22 mmol/mL elemental calcium.

Calcium chloride injection

- 10% vials (100 mg/mL): 0.68 mmol/mL elemental calcium.

Calcium carbonate

- Suspension (Auspman®): 100 mg/mL (40 mg/mL elemental calcium).
- Tablet: 1.5 g (600 mg elemental calcium); also available in combination with colecalciferol 500 units.
- Chewable tablet: 1.25 g (500 mg elemental calcium).
- 40 mg elemental calcium = 1 mmol.[5]

Calcium polystyrene sulfonate (Calcium Resonium®)

- Powder: 15 g calcium polystyrene sulfonate per (supplied) scoop.

Imprest location: Formulary One

INTRAVENOUS – DOSAGE & ADMINISTRATION

Calcium **chloride** 10% contains **THREE TIMES MORE** calcium than calcium **gluconate** 10%.

Intended calcium salt (calcium **CHLORIDE** or calcium **GLUCONATE**) **must be specified**

- Doses below are expressed as elemental calcium.
- Calcium **gluconate** 10%: 0.22 mmol/mL elemental calcium. Solution is prone to precipitation; discard if solution is cloudy or contains particles.[7]
- Calcium **chloride** 10%: 0.68 mmol/mL elemental calcium.[7]
- **Bolus** IV injection in emergency situations or non-urgent **intermittent** IV doses:
  - ✓ Prescribe on "ONCE ONLY MEDICINES" section on Paediatric Hospital Medication Chart (pHMC).
  - ✓ Dose must be prescribed as **"mL"** and **"mmol"**.
  - ✓ Rate of administration must be specified.
- **Continuous** IV Infusion:
  - ✓ Prescribe IV infusion on Variable Rate IV Infusion Chart (PCC only) or IV Fluid Therapy Order Chart (all other clinical areas).
  - ✓ Rate of infusion must be prescribed in **mL/hour** and **mmol/kg/hour** of elemental calcium.
- Administration via a CVAD is highly recommended. If central access if not available in emergency situations, administer into large peripheral vein using a small needle.
- **Do not** administer via IM, subcutaneous, or scalp/foot veins.[9]

All ages:

Cardiac arrest in presence of hypocalcaemia, calcium channel blocker toxicity, hyperkalaemia, or hypermagnesaemia**:**

- Calcium **chloride** is preferred over calcium gluconate for this indication as it is present in the ionised form, resulting in a greater increase in ionised calcium.[10]
- Calcium **chloride** 10%: 0.2 mL/kg (0.1 mmol/kg, max 6.8 mmol/10 mL).[5, 11, 12]
- Calcium **gluconate** 10%: 0.5 mL/kg (0.1 mmol/kg, max 6.6 mmol/30 mL).[5, 11, 12]
- May be administered undiluted over 10 – 20 seconds, via a CVAD or large peripheral vein.[7, 9]

Acute hypocalcaemia or severe hyperkalaemia not due to digoxin toxicity[11]**:**

Calcium **gluconate** 10%

- 0.5 mL/kg (0.1 mmol/kg, max 4.4 mmol/20 mL).[9]
- Dilute to 0.1 mmol/mL or weaker. Administer via a CVAD (preferred) or large peripheral vein over 10 – 60 minutes.[9]

- May be administered undiluted over 2 – 5 minutes via a CVAD in emergency situations.[9]
- Repeat 4 – 6 hourly or consider maintenance continuous infusion if necessary.[5]

Continuous infusion for calcium homeostasis (e.g. maintenance infusion in severe hypocalcaemia, patients with low cardiac output syndrome or requiring plasma-exchange therapy)**:**

Calcium **gluconate** 10%

- 0.02 – 0.08 mmol/kg/hour; equivalent to 0.5 – 2 mmol/kg/**DAY**, titrate to target calcium levels.
- Undiluted calcium gluconate 10% must be administered via a **CVAD**.
- If a CVAD is not available and continuous infusion via peripheral access is warranted:
  - Administer into a large peripheral vein using a small needle and monitor infusion site closely (at least every 30 minutes) for signs of extravasation.
  - Add 11 mmol (50 mL of calcium gluconate 10%) to a 500 mL bag of compatible fluid (final concentration 0.02 mmol/mL).

Replacement in Continuous Renal Replacement Therapy (CRRT) - Citrate:

Refer to PCC CRRT-Citrate Guideline.

ENTERAL – DOSAGE & ADMINISTRATION

Neonates: Refer to Neonatal Medication Protocols

Calcium Carbonate

****Dose must be expressed as elemental calcium****

Mild hypocalcaemia (enteral)[5, 10, 13]:

- 1 month – 11 years: Initially 10 – 20 mg/kg of elemental calcium up to 4 times daily (max 2 g/DAY).
- 12 – 18 years: Initially 1 – 2 g of elemental calcium daily in 3 to 4 divided doses.
- Titrate dose to target calcium levels and symptom control.

Recommended daily intake (RDI) of elemental calcium[14]:

Elemental calcium 100 mg = 2.5 mmol (40 mg = 1 mmol)

Infants

AGE	Adequate intake
0 – 6 months	210 mg/day
7 – 12 months	270 mg/day

Children & adolescents

AGE	RDI
1 – 3 years	500 mg/day
4 – 8 years	700 mg/day
9 – 11 years	1000 mg/day
12 – 18 years	1300 mg/day

Hyperphosphataemia in renal disease (enteral)[5]:

Phosphate-binder; administer with feeds or meals.

- 1 – 12 months: 50 mg of elemental calcium 3 to 4 times daily.
- 1 – 5 years: 120 mg of elemental calcium 3 to 4 times daily.
- 6 – 11 years: 240 mg of elemental calcium 3 to 4 times daily.
- 12 – 18 years: 500 – 600 mg of elemental calcium 3 to 4 times daily.

Supplementation in eating disorder (enteral):

- 600 mg of elemental calcium daily (500 mg if patient prefers chewable tablet).

Adjunctive treatment with bisphosphonates (enteral):

Refer to pamidronate or zoledronic acid monograph.

Calcium Resonium

Refer to AMH – Children's Dosing Companion.

DOSAGE ADJUSTMENTS

Renal impairment[3, 13]:

- No initial dosage adjustments necessary.
- Accumulation may occur; adjust according to serum calcium concentrations.

Hepatic impairment[3, 13]:

- No initial dosage adjustment necessary; adjust according to serum calcium concentrations.

COMPATIBILITY *(LIST IS NOT EXHAUSTIVE)*

Compatible fluids[7]:

Sodium chloride 0.9%, glucose 5%, glucose 5% in sodium chloride 0.9%, Hartmann's, Plasma-Lyte-148.

Only commonly used drugs are listed below. This is not a complete list of incompatible drugs. Compatibilities of IV drugs must be checked when two or more drugs are given concurrently.

Compatible at Y-site[10]:

Calcium **gluconate** – argipressin, aciclovir, adrenaline, ascorbic acid, atropine, azithromycin, cefazolin, cefepime, cefotaxime, clindamycin, dexmedetomidine, digoxin, dobutamine, dopamine, fentanyl, furosemide, gentamicin, glycopyrronium, heparin sodium, hydromorphone, ketamine, magnesium sulfate, metaraminol, metoclopramide, midazolam, milrinone, morphine, sodium nitroprusside, noradrenaline, phenobarbital, piperacillin/tazobactam, potassium chloride, propofol, vancomycin, vecuronium.

Calcium **chloride** – aciclovir, adrenaline, amiodarone, ascorbic acid, atropine, clindamycin, dexmedetomidine, digoxin, dobutamine, dopamine, fentanyl, glycopyrronium, heparin sodium, noradrenaline.

INCOMPATIBLE drugs[10]:

Calcium **gluconate** – amphotericin B (conventional & liposomal), ceftriaxone, dantrolene, diazepam, methylprednisolone sodium succinate, pantoprazole, phosphate, sodium bicarbonate, sulfamethoxazole/trimethoprim.

Calcium **chloride** – amphotericin B (conventional & liposomal), cefazolin, ceftriaxone, dantrolene, magnesium sulfate, sodium bicarbonate, phosphate.

MONITORING

- Continuous cardiac monitoring if treating severe hyperkalaemia[7].

- Other monitoring requirements depending on indication(s)[2, 3]:
  ECG, vitals, serum calcium, ionised calcium, phosphate, albumin, infusion site.
- Monitoring parameters and frequency to be determined by treating team.
- Suggested calcium level monitoring frequency for IV therapy[2, 3]:
  - Intermittent IV doses – 4 to 6-hourly
  - Continuous IV infusion – 1 to 4-hourly
  - Monitor more frequently in patients with renal impairment.
- Albumin-adjusted serum calcium level or ionised calcium should be used if patient has low albumin.[2, 3]

ADVERSE EFFECTS

Calcium gluconate/chloride:
Hypercalcaemia, skin necrosis (resulting from extravasation), infusion site irritation, cutaneous calcification, vasodilation, arrhythmia, bradycardia, hypertension/hypotension, syncope, anxiety, tingling sensation, hot flush, cardiac arrest, nephrolithiasis (renal calculi).[3, 13]

Calcium carbonate:
Hypercalcaemia, hypophosphataemia, abdominal pain/distension, constipation, flatulence, burping, milk-alkali syndrome, nephrolithiasis (renal calculi).[1]

Calcium polystyrene sulfonate:
Constipation, faecal impaction, electrolyte disturbances including hypercalcaemia, diarrhoea, nausea, vomiting ischaemic colitis, gastrointestinal obstruction, ulceration, perforation, or necrosis.[1]

STORAGE

- Store below 25°C.[7]
- Do not refrigerate calcium gluconate injection.[7]

INTERACTIONS

This medication may interact with other medications; consult PCH approved references (e.g. Clinical Pharmacology), a clinical pharmacist or PCH Medicines Information Service on extension 63546 for more information.

Please note: The information contained in this guideline is to assist with the preparation and administration of **calcium**. Any variations to the doses recommended should be clarified with the prescriber prior to administration

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Document Owner:	Chief Pharmacist		
Reviewer / Team:	Senior Pharmacist, Paediatric Intensivist, PCC CNS, Endocrinologist, Nephrologist, ED Consultant, Adoslescent Medicine Consultant		
Date First Issued:	Aug 2016	**Last Reviewed:**	Apr 2024
Amendment Dates:	May 2020	**Next Review Date:**	Apr 2027
Approved by:	Medication Safety Committee	**Date:**	Apr 2024
Endorsed by:	Drugs and Therapeutics Committee	**Date:**	May 2024
Standards Applicable:	NSQHS Standards: NSMHS: N/A Child Safe Standards: N/A		

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