



To remain at
point of care

- **Electrolyte disturbances that are difficult to treat often indicate significant disease or coexisting ion disturbances – Seek Advice.**
- Unit-specific protocols for electrolyte disturbances take precedence over these guidelines. Dialysis patients often present unique challenges.
- Where several treatment options are provided, undertake in a stepwise fashion not concurrently. Sufficient time between interventions should elapse to ensure maximal response has occurred.
- Rapid administration of electrolytes or correction of severe derangements may result in cardiac arrhythmias – consider cardiac monitoring.
- Electrolyte solutions are incompatible with blood products, some medicines and often each other. Seek advice before mixing together in an infusion or giving simultaneously via the same IV line.
- All electrolyte solutions should be administered via a pump with dose error reduction software.
- Consider contributing factors including medicines and nutritional products. If asymptomatic consider if treatment is needed – use clinical judgement.

1. HYPOkalaemia (Mild: 3.5–3.1 mmol/L, Moderate: 3–2.5 mmol/L, Severe: less than 2.5 mmol/L)

- Plasma levels below 3.0 mmol/L may result in arrhythmias. Consider cardiac monitoring.
- May be due to Total Body Deficit (where a 1 mmol/L drop in plasma level represents a total body loss of 200–400 mmol) or trans-cellular redistribution caused by a range of conditions and drugs (e.g. metabolic acidosis, diabetic ketoacidosis, insulin and salbutamol).
- If resistant, check magnesium and replace if necessary, check for medicines which may decrease potassium (e.g. diuretics). Ensure potassium containing fluid is administered as necessary (see [Guidelines for Prescribing Intravenous Fluids for Adults](#)).

- **All potassium containing infusions must be given via an infusion pump and also a burette if greater than 10 mmol.**
- **Other drugs administered via Y-site may alter the infusion rate of potassium; consider this and incompatibilities when administering via Y-site.**

Mild hypokalaemia

- Treat with oral supplementation alone, if oral route available:
 - » Potassium chloride effervescent tablets (e.g. Chlorvescent®) 1–2 tablets (14–28 mmol) two or three times daily **OR**
 - » Potassium chloride slow release tablets 600 mg (e.g. Span K® or Duro K®) 2 tablets (16 mmol) twice daily. Up to six tablets (48 mmol) daily in divided doses may be required.

Moderate to severe hypokalaemia

- Treat with both IV **and** (where possible) oral supplementation. Patients usually require at least 60–80 mmol potassium extra in the next 24 hours; this should be added to normal daily requirements.
- Repeat plasma levels 4 hours after commencing treatment and review plan.

Maximum CONCENTRATION peripherally = 40 mmol/L to prevent phlebitis.

- **EXCEPTION:** isotonic, premixed minibags (potassium 10 mmol in 100 mL) can be given peripherally. Minibags **MUST** be given via an infusion pump.
- **If maximum peripheral concentrations are exceeded, administer through a central venous catheter.**

Maximum RATE:

- **If potassium level above 2.5 mmol/L = 10 mmol/hr**
- **With burette = 10 mmol/hr**
- **If potassium level below 2.5 mmol/L and with infusion pump = 20 mmol/hr**
- **If maximum rate (above) exceeded: cardiac monitoring, frequent blood monitoring and an infusion device are required. Administer through a large vein.**

2. HYPOmagnesaemia (Mild: 0.9–0.71 mmol/L, Moderate: 0.7–0.4 mmol/L, Severe: less than 0.4 mmol/L)

- Hypomagnesaemia is common in hospitalised patients, especially the severely ill.
- Magnesium may not be included with all electrolyte pathology requests. A specific request may be needed.
- Beware of repeated doses in renal impairment.
- IV magnesium is also used in conditions other than correction of electrolyte disturbance (e.g. seizure prevention in pre-eclampsia); check use prior to administration.

Mild or moderate hypomagnesaemia

- Treat with oral supplementation:
 - » Magnesium aspartate tablets 500 mg (e.g. Magmin®) 1–2 tablets (1.54–3.08 mmol) twice daily. Up to 6 tablets (9.24 mmol) daily in divided doses may be required. Diarrhoea is a common side effect.

Severe or symptomatic hypomagnesaemia (e.g. tremors, weakness, swallowing difficulties, cardiac arrhythmias or seizures)

- Correct with intravenous magnesium:
 - » Magnesium Sulfate – each 5 mL ampoule contains 2.47 g magnesium sulfate equivalent to 10 mmol magnesium.
 - » Administer one to two ampoules (10–20 mmol) magnesium in 100 mL 0.9% sodium chloride over 1 hour. Can be given more rapidly in emergency situations.
 - » Review plasma levels or clinical symptoms within 6 to 12 hours.

3. HYPOnatraemia (Mild: 135–131 mmol/L, Moderate: 130–120 mmol/L, Severe: less than 120 mmol/L)

- **Seek senior advice especially if severe or symptomatic** (e.g. drowsiness, headache, seizures).
- Management requires careful assessment of fluid status and biochemical indices and is dependent on whether the disturbance is of an acute or chronic nature.
- Venous blood gases are a more accurate and reliable indication of sodium and should be used for monitoring purposes.
- Overcorrection can lead to permanent neurological injury.
- Correction should occur slowly – generally no more than 8 mmol/L in 24 hours.
- Faster or slower rates may be appropriate with senior advice.
- In the event of overly rapid correction, seek specialist advice regarding the need for treatment to reverse or slow the rate of correction.

Mild or moderate hyponatraemia

- Assess fluid status:
 - » If **hypovolaemic**, correct intravascular deficit with 0.9% sodium chloride (see [Guidelines for Prescribing Intravenous Fluids for Adults](#)).

- » If **euvolaemic or hypervolaemic**, consider potential causes such as medicines (SSRIs, diuretics, antiepileptics), conditions associated with inappropriate ADH secretion or reduced effective circulating volume (cirrhosis, cardiac failure). Manage with fluid restriction.
- Monitor levels initially a minimum of twice a day; more or less frequent monitoring may be required in certain circumstances (e.g. when 3% sodium chloride is being used).

Severe or symptomatic hyponatraemia (e.g. drowsiness, headache, seizures)

- If less than 120 mmol WITHOUT symptoms consider managing as per mild or moderate.
- **Medical emergency** – consider management in an intensive care/high dependency setting. Hypertonic saline and airway management may be indicated.

3% sodium chloride (hypertonic) requires careful consideration; seek senior advice if required.

4. HYPOphosphataemia (Mild: 0.8–0.51 mmol/L, Moderate: 0.5–0.3 mmol/L, Severe: less than 0.3 mmol/L)

- Oral formulations are safe, effective and considerably cheaper than intravenous preparations.
- Phosphate does not normally need replacement until less than 0.6 mmol/L except if alcoholism/withdrawal, malnutrition, re-feeding syndrome, receiving TPN, renal phosphate wasting, recovery from diabetic ketoacidosis or respiratory failure.
- Sodium dihydrogen phosphate contains 10 mmol of phosphate and 10 mmol of sodium in a 10 mL ampoule. It contains zero potassium.

Mild to moderate hypophosphataemia

- Observe and retest or treat with **oral** supplementation:
 - » Effervescent phosphate tablets 500 mg (e.g. Phosphate Sandoz) 1–2 tablets (16.1–32.2 mmol) up to three times a day. Diarrhoea is a common side effect.
 - » **If not tolerated:** one ampoule (10 mmol) of sodium dihydrogen phosphate in 250 mL of 0.9% sodium chloride infused slowly over 2 to 6 hours into a large vein.

Severe or symptomatic hypophosphataemia (e.g. haemolysis, respiratory failure, cardiac arrhythmias, weakness)

- Correct with intravenous phosphate.
- Administer one ampoule (10 mmol) of sodium dihydrogen phosphate in 250 mL of 0.9% sodium chloride over 2 to 6 hours into a large vein.
- Monitor plasma phosphate, calcium levels and renal function every 12 to 24 hours.
- **In critically ill patients:**
 - » More concentrated solutions can be given (preferably via a central line) (e.g. one ampoule [10 mmol] of sodium dihydrogen phosphate in 100 mL of 0.9% sodium chloride). Administer at rates up to 10 mmol per hour, maximum of 40 mmol over 4 hours. Caution when giving repeat doses in renal impairment.
 - » Monitor plasma phosphate and calcium levels and renal function closely (e.g. every 1 to 2 hours). Monitor closely for clinical signs of hypocalcaemia.

5. HYPOcalcaemia (Mild: 2.15–1.91 mmol/L corrected, Moderate: 1.9–1.5 mmol/L corrected, Severe: less than 1.5 mmol/L corrected or 0.75 mmol/L IONISED)

- **REMEMBER:** Ionised calcium is the physiologically relevant component of blood calcium and is available on a blood gas. Total calcium (even corrected for albumin) is an unreliable measure of functional calcium.
- If resistant to treatment, exclude hypomagnesaemia.
- Calcium gluconate contains 2.2 mmol of calcium in 10 mL.
- Extravasation of calcium can cause significant tissue necrosis.
- IV calcium is also used in conditions other than correction of electrolyte disturbance; check use prior to administration.

Mild to moderate hypocalcaemia

- Treat with oral supplementation:
 - » Effervescent calcium tablets 1 g (Calsource®) 1–2 tablets (25–50 mmol) daily **OR**
 - » Calcium 600 mg (e.g. Caltrate) 1–2 tablets (15–30 mmol) daily. Give **with** food.

Severe or symptomatic hypocalcaemia (e.g. perioral/finger paraesthesia, seizures, tetany, positive Chvostek's/Trousseau's) or high risk of becoming symptomatic (e.g. post-parathyroidectomy)

- Correct with intravenous calcium gluconate:
 - » Administer two ampoules (4.4 mmol) in 100 mL 0.9% sodium chloride over 20 minutes.
 - » Consider central venous catheter.
 - » A continuous infusion of calcium gluconate ten (10) ampoules (22 mmol) in 900 mL 0.9% sodium chloride at 50 mL/hr (adjusted for calcium levels) should be prescribed for the next 1 to 2 days.
- Repeat plasma calcium level 4 hours after commencing treatment.

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1. HYPERkalaemia (Mild: 5.2–5.9 mmol/L, Moderate: 6.0–6.5 mmol/L, Severe: more than 6.5 mmol/L)

- Consider clinical situation, if asymptomatic confirm level. Consider possibility of sample haemolysis.
- Reducing serum potassium with insulin should only be considered if severe (more than 6.5 mmol/L) or symptomatic; hypoglycaemia may occur many hours after administration of insulin.
- Hyperkalaemia is more sinister in setting of an acute rapid rise rather than chronic renal failure and in patients with pre-existing heart failure.
- Review medicines; withhold any potassium retaining drugs (ACE inhibitors, angiotensin receptor antagonists, potassium sparing diuretics, trimethoprim, β -blockers, NSAIDs, digoxin) or potassium containing products.

Mild to moderate or asymptomatic hyperkalaemia

- Check ECG.
- Place on a low potassium diet.
- Review medicines.
- Monitor potassium levels every 12 hours (moderate) to 24 hours (mild).

Long-term management

Review for possible reversible causes of hyperkalaemia (e.g. haemolysis, acidosis, renal impairment).

Severe or symptomatic hyperkalaemia (e.g. muscular weakness and/or ECG changes [e.g. peaked T waves])

- Institute continuous ECG monitoring.
- **Seek senior advice** and consider the following points:
- **Protecting heart:**
 - » If ECG abnormalities are present – calcium gluconate one ampoule (2.2 mmol of calcium) IV via a central vein or slowly over 2 to 3 minutes into a large vein.
 - » If ECG does not normalise within 10 minutes, dose may be repeated (to a total of 0.1 mmol/kg).

Reducing serum potassium level:

- » Glucose and insulin – glucose 50% 50 mL with 5–10 units of insulin (e.g. Actrapid® or NovoRapid®) IV over 5 minutes; consider 5 units in patients under 50 kg or with chronic kidney disease (CKD stage 4 and 5).
 - At a minimum monitor BGL every hour in the first **six hours**.
 - Consider continuous glucose infusion to prevent hypoglycaemia
- AND/OR**
- » Inhaled salbutamol – nebulised salbutamol 10 mg (2 of the 5 mg/2.5 mL nebulers) OR metered dose inhaler 1200 micrograms (12 puffs) via spacer
- » If metabolic acidosis present, sodium bicarbonate 8.4% 50 mL IV over 5–15 minutes. In an emergency this can be administered by a peripheral line with caution.
- **Removing potassium from the body:**
 - » Resonium-A® – give 15–30 g orally up to four times daily or 60 g as a retention enema daily
- AND/OR**
- » Dialysis – urgent dialysis may be required.
- **Review medicines.**
- **Monitor potassium level hourly.**

2. HYPERcalcaemia (Mild: 2.55–2.9 mmol/L, Moderate: 3.0–3.2 mmol/L, Severe: more than 3.2 mmol/L corrected)

- Hypercalcaemia is most commonly due to primary hyperparathyroidism **OR** hypercalcaemia associated with malignancy.

Moderate to severe or symptomatic hypercalcaemia (e.g. lethargy, coma, ECG changes [shortened QT interval])

- Rehydration – intravenous sodium chloride 0.9%. Volume infused should be sufficient to maintain a urine output greater than 60 mL/hr. **Seek senior advice.**
- Bisphosphonate therapy with either zoledronic acid or pamidronate may be indicated. **Seek senior advice.**

Long-term management

- Review for possible causes including diet or supplements (vitamin D or calcium), sarcoidosis and other granulomatous disease; drug causes such as calcitriol excess or thiazide diuretics, and hypercalcaemia due to spinal cord injury and/or immobility.

3. HYPERnatraemia (Mild to Moderate: 145–159 mmol/L, Severe: more than 160 mmol/L)

- Seek senior advice especially if severe or symptomatic.
- Oral/enteral fluid replacement with water, is safest.
- Often due to fluid deficit; correct haemodynamic instability first with sodium chloride 0.9%.
- Intravenous fluids without added sodium (generally glucose 5%) may be needed.
- In the setting of hyperglycaemia the preferred fluid of choice is sodium chloride 0.9%.

Severe or symptomatic hypernatraemia (e.g. hyperthermia, delirium, seizures, coma)

- **Medical emergency** – consider management in an intensive care/high dependency setting.
- Serum sodium concentration should be reduced by:
 - » Not more than 0.5 mmol/L per hour.
 - » Not more than 10 mmol/L in 24 hours to prevent permanent neurological injury.
- Monitor every 4 hours in the first 24 hours.

4. HYPERmagnesaemia (Severe: more than 2.5 mmol/L)

- **May be deliberate in pregnancy.** Magnesium is used to treat/prevent eclampsia/severe pre-eclampsia. **Always** contact Obstetrician.

Severe or symptomatic hypermagnesaemia (e.g. loss of deep tendon reflexes, respiratory depression, paralysis, reduced consciousness)

- Intravenous calcium gluconate provides immediate but transient antagonism of toxic effects.
- Consider the following points:
- **Protecting heart:**
 - » One ampoule (2.2 mmol) of calcium gluconate in 0.9% sodium chloride should be administered over 5 minutes. Repeat if necessary.

Reducing serum magnesium level:

- » Kidney excretion should be promoted with intravenous sodium chloride 0.9%, aiming for a urine output of at least 60 mL per hour.
- » If this urine output can't be achieved, intravenous frusemide can be added.
- » Dialysis may be needed.
- » Review diet and medicines for antacids, enemas, supplements and lithium.