Calcium chloride.

- Although there are no clinical studies assessing the efficacy of calcium salts in the emergency management of hyperkalaemia, there remains little doubt of their importance in emergency management even in patients with normal serum calcium.
- Both calcium salts, calcium chloride and calcium gluconate, antagonise the cardiac membrane excitability and have been widely recommended for the treatment and prophylaxis of arrhythmias due to hyperkalaemia when life-threatening ECG changes (absent P waves, wide QRS, sine-wave pattern) are present or when cardiac arrest occurs.
- The decision of which calcium salt should be used, chloride or gluconate, is largely guided by practicalities such as availability and local practice.

Exchange resins.

- Cation exchange resins are cross-linked polymers with negatively charged structural units which exchange calcium (calcium resonium) or sodium (sodium polyacrylate sulfonate; Kayexalate) for potassium across the intestinal wall.
- Efficacy: resins do not appear to increase faecal potassium excretion above the effect of induction of diarrhoea with laxatives. Studies have reported no reduction in serum potassium at 4 h.
- Cautions: slow acting, therefore unsuitable for urgent management of hyperkalaemia. Coadministration of laxative is recommended.

Adverse effects: constipation, intestinal necrosis.

Intravenous fluids.

- The theoretical basis for the use of diuretics in the treatment of hyperkalaemia is to enhance urinary potassium excretion. However, there are no clinical trials to support their use in the treatment of hyperkalaemia.

Dialysis.

- The principle mechanism of action is the diffusion of potassium across the transmembrane gradient. Haemodialysis can remove 25-40 mmol/l of potassium and is more effective than peritoneal dialysis.
- The typical decline in serum potassium is 1 mmol/l in the first 60 min, followed by 1 mmol/l over the next 2 h. The efficacy of haemodialysis is lower potassium concentration in the dialysate, a high blood flow rate or a high dialysate bicarbonate concentration.

Summary of medications used

<table>
<thead>
<tr>
<th>Therapy</th>
<th>Dose</th>
<th>Mechanism</th>
<th>Onset (min)</th>
<th>Duration (h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium chloride</td>
<td>10 mmol/10 IV</td>
<td>Antagonise</td>
<td>1-1</td>
<td>0.5-1</td>
</tr>
<tr>
<td>Insulin/glucose</td>
<td>10 units/35g IV</td>
<td>Shift</td>
<td>15-30</td>
<td>4-6</td>
</tr>
<tr>
<td>Sodium bicarbonate</td>
<td>1 mmol/10 IV</td>
<td>Shift</td>
<td>15-30</td>
<td>4-6</td>
</tr>
<tr>
<td>Calcium resonium</td>
<td>15-30 PO/PR</td>
<td>Variable</td>
<td>15-30</td>
<td>4-6</td>
</tr>
</tbody>
</table>

- When hyperkalaemia is suspected to be the primary precipitant of cardiac arrest, resuscitation should not be terminated until serum potassium is controlled, by any means necessary, unless there are extenuating circumstances.
- Hyperkalaemia may also arise during the resuscitation attempt as a result of metabolic changes and hypoxia but does not usually require specific intervention.
- During CPR, adrenaline (epinephrine) should be the first drug to be administered irrespective of the cause of cardiac arrest. Adrenaline is a powerful sympathomimetic amine with both alpha- and beta adrenergic activity which helps to drive potassium into cells, thereby lowering serum potassium.
- Next, calcium chloride should be administered to antagonise the toxic effects of hyperkalaemia.
- Sodium bicarbonate should be considered in the context of a metabolic acidosis.
- Insulin-glucose is thought to be ineffective during CPR, however it is unlikely to cause harm and should begin to have effect within minutes of return of spontaneous circulation.
- There is no literature available on the use of intravenous salbutamol in this scenario.

Opertimising ventilation during CPR can avoid compounding acidosis and further extracellular shift of potassium.

Hyponatraemia.

- There are several reports of patients treated successfully with dialysis during CPR for cardiac arrest secondary to hyperkalaemia. In many of these reports, resuscitation combined with dialysis has been successful even after prolonged CPR (in excess of 90 min) with no neurological sequelae. The dialysis mode used was dependent on local availability and practice, but success has been reported with haemodialysis, veno-venous haemofiltration or veno-venous haemodiafiltration, and also with peritoneal dialysis.
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