Life-threatening hyponatraemia and hyperkalaemia after enteral tube feeding

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ABSTRACT
An 83-year-old woman with oropharyngeal dysphagia was prescribed enteral tube feeding with Isocal 1200 mL and water 200 mL by a dietician. After 8 weeks, she presented with hypotension, dehydration, and altered conscious state. Blood tests showed severe hyponatraemia (serum sodium, 95 mmol/L) and hyperkalaemia (serum potassium, 6.3 mmol/L). Her daily intake of sodium and potassium was reviewed and found to be low (26.4 and 38.4 mmol, respectively). The formula was replaced with Isocal HN and sodium chloride tablets were added. The total daily intake of sodium and potassium was increased to 78 and 49.2 mmol, respectively. Both hyponatraemia and hyperkalaemia were corrected and her serum electrolyte remained normal at the 1-year follow-up.

Key words: Enteral nutrition; Hyperkalemia; Hyponatremia

INTRODUCTION
Enteral feeding is common for elderly patients with feeding and swallowing disorders, and should be supervised by physicians.1 Hyper/hyponatraemia and hyper/hypokalaemia are possible electrolyte disturbances after enteral tube feeding.2 Hyperkalaemia and azotaemia are the most common metabolic disorders associated with enteral tube feeding.3

This report describes an elderly woman with oropharyngeal dysphagia who was prescribed enteral tube feeding by a dietician and developed hypotension, dehydration, and altered consciousness secondary to hyponatraemia and hyperkalaemia.

CASE REPORT
In March 2011, an 83-year-old woman with recurrent stroke and vascular dementia presented with poor oral intake. Her body weight was 27.6 kg and her body mass index was 13 kg/m². She was diagnosed to have oropharyngeal dysphagia and was prescribed enteral tube feeding with Isocal 1200 mL and water 200 mL by a dietician. At discharge from hospital, her serum electrolyte levels were normal, and her usual medication, citalopram 20 mg daily, was continued.

After 8 weeks, the patient was re-admitted with hypotension, dehydration, and altered conscious state. She had no evidence of sepsis or other serious illness. She had severe hyponatraemia (serum sodium, 95 mmol/L) [reference range, 136-142 mmol/L] and hyperkalaemia (serum potassium, 6.3 mmol/L) [reference range, 3.5-5.0 mmol/L]. Other serum results were as follows: urea, 7.1 (reference range, 2.5-6.7) mmol/L; creatinine, 21 (reference range, 53-106) µmol/L; osmolality, 181 (reference range, 275-295) mmol/kg H₂O; bicarbonate, 25.9 (reference range, 21-28) mmol/L; and chloride, 60 (reference range, 96-106) mmol/L. Complete blood count and liver function test results were within normal limits. Urine sodium was 11 (reference range, <20) mmol/L and urine osmolality was 336 (reference range, 250-900) mmol/kg H₂O. The calculated transtubular...
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The patient was treated empirically for adrenal crisis and dehydration with hydrocortisone replacement and normal saline resuscitation. Her serum sodium and potassium levels were normalised a few days later. However, her spot cortisol level was elevated to 1443 (reference range, 140-690) nmol/L, which showed an adequate adrenal response to the acute illness. Hydrocortisone replacement was therefore stopped.

Her daily intake of sodium and potassium was reviewed to ascertain the cause of the severe electrolyte disturbance. She had been prescribed Isocal 1200 mL daily since her previous hospitalisation, and her daily intake of sodium and potassium were low (26.4 and 38.4 mmol, respectively). After replacing the formula with Isocal HN and additional sodium chloride tablets, her total daily intake of sodium was increased to 78 mmol, potassium to 49.2 mmol, and fluid intake remained at 1400 mL. Both hyponatraemia and hyperkalaemia were corrected and her serum electrolyte levels remained normal at the 1-year follow-up.

**DISCUSSION**

This patient presented with hypotension, dehydration, decreased sensorium, hyponatraemia, and hyperkalaemia. The initial picture was suggestive of adrenal crisis. However, the patient’s elevated spot serum cortisol level excluded an adrenal cause. The high normal transtubular potassium gradient level refuted the likelihood of hypoaldosteronism. The syndrome of inappropriate anti-diuretic hormone secretion was also unlikely as she had hypovolaemia; her serum potassium was grossly elevated and urine sodium was <20 mmol/L. Hence, the diagnosis was chronically low sodium intake, leading to severe hyponatraemia and impairing potassium excretion from the distal renal tubules.

Most of the standardised enteral feeding formulas are isotonic and provide 1 kcal/mL. However, different enteral formulae can have different sodium and potassium compositions (**Table**). The type and daily amount of enteral formulae for an individual is usually based on the daily requirement of calories and protein. For this patient with a body weight of 27.6 kg, the enteral formula she was taking could well have provided adequate calories and protein. However, this formula could only provide 26 mmol of sodium and 38 mmol of potassium, which was much lower than the usual daily requirements of 60 to 90 mmol and 60 mmol, respectively, for her body weight.

The theoretical minimum daily requirement of sodium for a healthy adult is 22 mmol, which is based on the amount needed to replace the requisite loss of sodium. However, electrolyte disorders may occur in susceptible patients if the renal compensatory mechanism does not work efficiently. Epidemiological data indicate that the usual sodium intake in developed countries ranges from 100 to 225 mmol per day.

Low sodium intake can cause hyperkalaemia in addition to hyponatraemia. The distal tubules of the kidneys regulate and excrete potassium in the body. To achieve adequate potassium excretion, sodium delivery to this site must be adequate, together with the normal function of aldosterone to facilitate the sodium-potassium exchange in the distal tubules. With extremely low sodium intake, as in this patient, sodium delivery to the distal tubules was inadequate.

<table>
<thead>
<tr>
<th>Formula</th>
<th>Calorie (Kcal/L)</th>
<th>Protein (g/L)</th>
<th>Sodium (mmol/L) [mg/L]</th>
<th>Potassium (mmol/L) [mg/L]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isocal</td>
<td>1000</td>
<td>32.5</td>
<td>22 (500)</td>
<td>32 (1250)</td>
</tr>
<tr>
<td>Osmolite</td>
<td>1060</td>
<td>37.1</td>
<td>28 (640)</td>
<td>26 (1020)</td>
</tr>
<tr>
<td>Isocal HN</td>
<td>1060</td>
<td>41.6</td>
<td>41 (938)</td>
<td>41 (1615)</td>
</tr>
<tr>
<td>Osmolite HN</td>
<td>1060</td>
<td>44.3</td>
<td>40 (930)</td>
<td>40 (1570)</td>
</tr>
<tr>
<td>Jevity</td>
<td>1060</td>
<td>44.3</td>
<td>40 (930)</td>
<td>40 (1570)</td>
</tr>
<tr>
<td>Glucerna</td>
<td>1000</td>
<td>41.8</td>
<td>41 (935)</td>
<td>40 (1573)</td>
</tr>
<tr>
<td>Ultracal</td>
<td>1060</td>
<td>45.6</td>
<td>59 (1357)</td>
<td>48 (1855)</td>
</tr>
</tbody>
</table>
for adequate potassium excretion in the distal tubules. After increasing the daily sodium intake from 26 to 78 mmol, her hyponatraemia was corrected and potassium excretion returned to normal.

In conclusion, physicians should be aware of the daily requirements of calories, protein, sodium, and potassium of patients when prescribing enteral formulae, and work closely with the dietician. Monitoring of patients' clinical status and electrolytes after commencement or changing of the enteral feeding regimen is necessary.

REFERENCES