Elevated levels of serum creatinine kinase induced by hyponatraemia

Ilan Goldenberg, Michael Jonas, Michael Thaler, Ehud Grossman

Summary
Elevated serum creatinine kinase levels are one of the major criteria for the diagnosis of myocardial injury. Noncardiac causes such as muscular and brain damage may also be associated with elevated serum creatinine kinase levels. Hyponatraemia may induce increased serum creatinine kinase in association with rhabdomyolysis or with hypothyroidism. A patient is described where three episodes of hyponatraemia not associated with rhabdomyolysis or hypothyroidism induced transient elevations of serum creatinine kinase levels. The association between hyponatraemia and elevated creatinine kinase levels should be emphasized to prevent erroneous diagnosis of myocardial injury.

Keywords: sodium, creatine kinase, hyponatraemia

Elevated levels of serum creatinine kinase (CK) are found in conditions where damage to muscular, brain or cardiac tissue occurs. An association between hyponatraemia and elevated CK levels has been previously described in psychiatric patients with water intoxication and rhabdomyolysis, and in hypothyroidism. However, elevated CK levels induced solely by hyponatraemia have not been described. We present a patient in whom three episodes of hyponatraemia not associated with skeletal muscle, myocardial or neurological injury, induced transient elevations of serum CK levels. Cardiac isoform CK-MB levels were increased on two occasions.

Case report
A 65-year-old woman was admitted to the Chaim Sheba Medical Center because of severe headache. Her medical history was significant for hypertension treated with captopril 12.5 mg bid and verapamil SR 240 mg once daily; chronic bronchitis treated with inhalations of ipratropium and salbutamol; and peptic ulcer treated with famotidine 40 mg/day. Three days before her admission watery diarrhoea developed, followed subsequently by headache and nausea.

Physical examination revealed a generally well-appearing patient with a temperature of 37.0°C, heart rate of 67 beats/min, and blood pressure of 160/90 mmHg. Heart, lungs, abdomen, and neurological status were normal. An electrocardiogram showed normal sinus rhythm without evidence of ischaemia, and had remained without change throughout hospitalisation. Blood chemical values revealed a serum sodium level of 123 meq/l, a potassium level of 3.5 meq/l, and CK levels of 529 U/l (normal value: <150 U/l) with an MB isoenzyme fraction of 7.4%. Other chemical and haematological blood values were within normal limits. Myoglobin was not detected in the urine, and thyroid function tests were normal. Infusion of 2000 ml of NaCl 0.9%.

Table

<table>
<thead>
<tr>
<th>Year</th>
<th>Cause</th>
<th>Sodium (meq/l)</th>
<th>CK-MB (U/l)</th>
<th>CK-MB (% of CK)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>diarrhoea</td>
<td>day 1: 115</td>
<td>233</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>day 2: 130</td>
<td>97</td>
<td>–</td>
</tr>
<tr>
<td>1992</td>
<td>diuretics</td>
<td>day 1: 114</td>
<td>332</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td></td>
<td>day 2: 132</td>
<td>143</td>
<td>–</td>
</tr>
<tr>
<td>1995</td>
<td>diarrhoea</td>
<td>day 1: 124</td>
<td>529</td>
<td>7.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>day 2: 123</td>
<td>335</td>
<td>8.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>day 3: 135</td>
<td>142</td>
<td>–</td>
</tr>
</tbody>
</table>

Normal ranges: sodium 136–148 meq/l; CK <150 U/l; CK-MB <5% of CK

over a period of 24 hours, was commenced on the second day of hospitalisation. The following day blood levels of sodium and CK had returned to normal (table).

A review of the patient’s medical chart revealed that she had been hospitalised twice before with hyponatraemia. One episode was induced by diarrhoea and the other was by thiazide diuretic intake. Both episodes were associated with transient elevation of CK levels, which had returned to normal (table). There was no evidence of a coronary event, muscular or neurological damage.

**Discussion**

Hyponatraemia associated with raised CK levels has been previously described in rare case reports of schizophrenic patients, in whom excessive water drinking caused coma and convulsions. In these patients CK elevation revealed rhabdomyolysis. The only other condition in which hyponatraemia and CK elevation both occur is hypothyroidism. In this endocrine disorder hyponatraemia is caused by decreased delivery of tubular fluid to diluting renal segments and persistent antidiuretic hormone secretion, while CK elevation is thought to be related to mild cardiac or skeletal muscle damage or decreased clearance of normal enzyme concentrations. However, CK levels in hypothyroidism usually remain persistently elevated, and are associated with raised levels of other enzymes (eg, aspartate transaminase, lactate dehydrogenase). Our patient’s thyroid function tests were normal, her urine was negative for myoglobin, and serum levels of aspartate transaminase and lactate dehydrogenase were normal. Thus, neither rhabdomyolysis nor hypothyroidism can account for the association between sodium and CK levels in this case.

Elevation of serum CK is the most sensitive enzymatic detector of acute myocardial infarction that can be used routinely. Only 15% false positive results have been described, most commonly in patients with muscle disease, skeletal muscle trauma, vigorous exercise, stroke, convulsions, intramuscular injections, and hypothyroidism. These were not present in this case. Interestingly CK-MB isoenzymes, a specific marker of acute myocardial infarction were raised twice in our patient. Although a minor coronary event or a myocardial microinfarction cannot be ruled out, the patient’s history of recurrent transient CK elevations without clinical or electrocardiographic findings makes the diagnosis unlikely. The mechanism by which serum levels of sodium affect CK levels remains to be elucidated. It could be due to subclinical myocyte damage through intracellular movement of water and swelling of cells, induced by hyponatraemia.

Whatever mechanism is responsible, we believe that the clinical importance of this finding should be emphasized as the diagnosis of acute myocardial infarction is sometimes based solely on raised CK levels.

### Summary points

- hyponatraemia may be associated with elevated levels of serum CK
- correction of serum sodium levels may lead to normalisation of serum CK levels
- the possibility of hyponatraemia should be considered in the differential diagnosis of elevated serum CK levels

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