Reminder of important clinical lesson

Life-threatening hyperkalemia – an overlooked acute kidney injury with a serum creatinine rise in the ‘normal’ range

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Correspondence to Dr Joerg Latus, Joerg.latus@rbk.de**Summary**

A 76-year-old woman (51 kg, 158 cm, body mass index 20.5) was admitted to the hospital because of an acute kidney injury with hyperkalemia. On admission, she reported progredient muscle weakness of all limbs for several days. Serum potassium level was dramatically elevated and ECG showed QRS with a ‘sine-wave’ pattern and haemodialysis was started. 45 days ago, Hartmann’s operation was done because of stenosing sigmoid diverticulitis. At this time, the serum creatinine was 0.4 mg/dl (‘normal’ 0.5–1.2). Thereafter, she got severe ‘high output-ileostoma’ with severe intestinal fluid losses and treatment with potassium supplementation and spironolactone was started by the surgeons. She was discharged with elevated serum potassium levels and serum creatinine of 1.0 mg/dl (‘normal’ range (0.5–1.2 mg/dl)). This case illustrates impressively the lack of serum creatinine as an ideal kidney function test, because it is depending on muscle mass and there is no interindividual normal range.

BACKGROUND

Measurement of serum creatinine is the most used kidney function test in the medical community. Usually, rising serum creatinine implies renal impairment and falling levels indicate improvement. But there are important limitations with serum creatinine: variation in creatinine production differs among and within people over time and depends on muscle mass. There is no linear relationship between the biomarker serum creatinine and the glomerular filtration rate and an initial small rise in serum creatinine reflects a marked fall in glomerular filtration rate.

CASE PRESENTATION

A 76-year-old woman (51 kg, 158 cm, body mass index 20.5) was admitted to the hospital due to progredient muscle weakness of all limbs, mainly the lower extremity for several days. Serum potassium level was 9.5 mmol/l and there was an acute kidney failure due to prerenal azotemia with a serum creatinine of 3.2 mg/dl ($\text{eGFR}_{\text{MDRD}}=15$ ml/min). The first ECG in the emergency department (figure 1B) showed QRS with a ‘sine-wave’ pattern.

One week before she was discharged from the surgical unit after she had surgical repair because of a complicated sigmoid diverticulitis. The surgeon established a double lumen stoma. Thereafter, she got severe ‘high output-ileostoma’ with severe intestinal fluid losses and as a sequel chloride-depletion metabolic alkalosis with serum bicarbonate of 37 mmol/l and hypokalemia of 2.5 mmol/l (normal 3.6–5.0). The hypokalemia was treated with potassium supplementation (40 mmol intravenous twice a day) and therapy with spironolactone (50 mg by mouth twice a day) was started by the surgeons. At that time point, the serum creatinine was 0.4 mg/dl (‘normal’ 0.5–1.2) and the ECG showed no pathological findings (figure 1A). Forty five days after surgery, she was discharged with a serum potassium level of 6.6 mmol/l, no nephrologist was contacted and there were no concerns

of an ongoing hyperkalemia after stopping the supplementation because of a serum creatinine of 1.0 mg/dl within the ‘normal’ range (0.5–1.2 mg/dl).

TREATMENT

The patient was admitted to the intensive care unit and haemodialysis was started immediately.

OUTCOME AND FOLLOW-UP

During the haemodialysis the serum potassium dropped to 8.5 mmol/l (figure 1C) and the ECG improved: QRS complexes and T-waves could be differentiated (figure 1D). With ongoing haemodialysis the potassium dropped to 5.8 mmol/l and the ECG only showed discrete peaked T waves (figure 1E). After normalisation of the serum potassium the ECG showed no pathological findings (figure 1F). After intravenous saline infusion the serum creatinine decreased and there was no necessity for chronic haemodialysis.

DISCUSSION

This case illustrates impressively the lack of serum creatinine as an ideal kidney function test, because it is depending on muscle mass and there is no interindividual normal range. The serum creatinine in our patient almost tripled in value, but was still in the ‘normal’ range. Production of creatinine differs among and within people over time. Individuals with reduced muscle mass and low body mass index (eg, chronic disease, amputation, malnutrition, muscle wasting) produce less creatinine than the general population. The commonly used estimation equations (MDRD, Cockcroft-Gault equation) are less accurate in those populations and especially those individuals are at risk for severe dehydration and measurement of serum creatinine can be misleading. Therefore, it is necessary to pay attention on rises in serum creatinine levels within the normal range to detect renal impairment, especially in individuals

Figure 1 (A) ECG on first admission (potassium 2.5 mmol/l). (B) Potassium 9.5 mmol/l. (C and D) During haemodialysis (potassium dropped to 5.8 mmol/l). (E) Potassium 5.1 mmol/l. (F) Potassium levels in normal range.

with reduced muscle mass and low baseline creatinine like in our case.

Learning points

- ▶ Patients with reduced muscle mass and low baseline creatinine (eg, chronic disease, anorexia...) are at risk for severe dehydration and routine blood tests can be misleading.
- ▶ When serum creatinine concentration doubles or triples in value within the normal range be aware that the patient is developing renal impairment.
- ▶ Close observation is warranted until renal biomarkers improve in the above mentioned patient group.

Competing interests None.

Patient consent Obtained.

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