Sine-wave electrocardiogram rhythm in a patient on haemodialysis presenting with severe weakness and hyperkalaemia

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DESCRIPTION

A man in his 60s with a history of end-stage renal disease on haemodialysis, hypertension, chronic obstructive pulmonary disease, HIV and peripheral artery disease arrived at the emergency department having generalised weakness. The patient was unable to ambulate, and his family found him unable to get himself off the floor. The patient was slightly drowsy, but he confirmed that he regularly misses haemodialysis, and he missed his last two treatments.

On arrival to the emergency department, vital signs were blood pressure 117/71 mm Hg, respiratory rate 15 per minute, heart rate 80 beats per minute and oxygen saturation 100% on ambient air. In the physical examination, the patient was slightly drowsy but was able to answer questions. Cardiopulmonary and abdominal examination were normal. Laboratory data revealed blood urea nitrogen 61 mg/dL (normal range (NR) 9–20), creatinine 15.5 mg/dL (NR 0.66–1.25), phosphorus 5.9 mg/dL (NR 2.5–4.5), potassium 8.8 mmol/L (NR 3.6–5.0), glycaemia 10.8 mmol/L (NR<7.8), haemoglobin 92 g/L (NR 11.1–14.6) and a haematocrit 30.3% (NR 33.2–43.4).

Initial ECG revealed a sine-wave pattern (figure 1). The patient was treated with 2 g of intravenous calcium gluconate, nebulised albuterol treatments, 10 units of regular insulin intravenous combined with intravenous dextrose 50%, intravenous sodium bicarbonate 50 mEq and 10 g of oral sodium zirconium cyclosilicate. Emergent haemodialysis was initiated. ECG post-treatment showed a return to baseline sinus rhythm, improved QRS complexes and normalised T waves (figure 2). The patient received haemodialysis for three consecutive days and was discharged home.

ECG changes have poor sensitivity for detecting hyperkalaemia.[1] Initial characteristics observed in the ECG of patients with hyperkalemia include tall and peaked T waves, elevation of the ST segment, followed by flattened and broadened P waves, PR prolongation and atrioventricular block of first or higher degrees and widening of the QRS complex.[2 3] These changes can be explained by other medical conditions, and even in patients with severe hyperkalaemia the ECG may be normal or have minor changes. Progression of hyperkalaemia causes a merger of the widened QRS complex with the elevated ST segment and T wave, and loss of the P wave that will lead to the appearance of the sine-wave pattern. ECG with a sine-wave pattern has high specificity for detecting hyperkalaemia. If there is a high clinical suspicion for hyperkalaemia (as in our patient who missed two dialysis sessions), if the patient is clinically unstable or unconscious, and if a point-of-care potassium result is not available in the emergency department, initiation of treatment might be considered prior to laboratory confirmation.[1] Ventricular fibrillation or asystole, associated with flaccid motor weakness or quadriplegia, are further complications of unrecognised hyperkalaemia. The rapid recognition of the ECG abnormalities associated with weakness in our patient guided us to an early diagnosis and emergent treatment.

In cases of severe hyperkalaemia emergent treatment with rapid acting therapies and haemodialysis

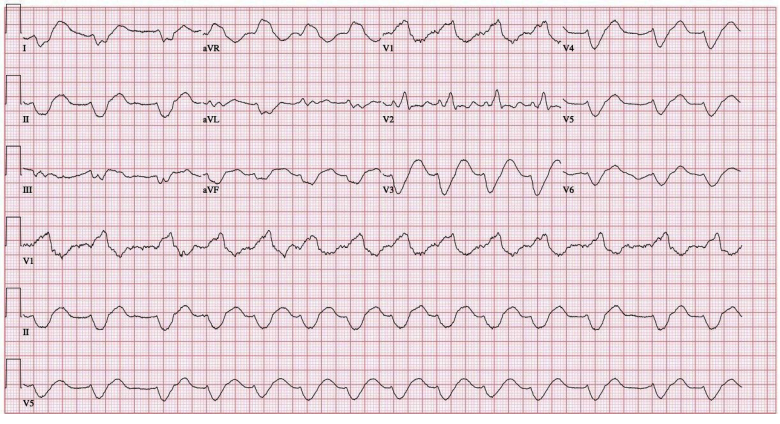

Figure 1 ECG at admission with sine-wave rhythm. Augmented Vector Right; aVR, augmented Vector Left; aVL, augmented Vector Foot; aVF.

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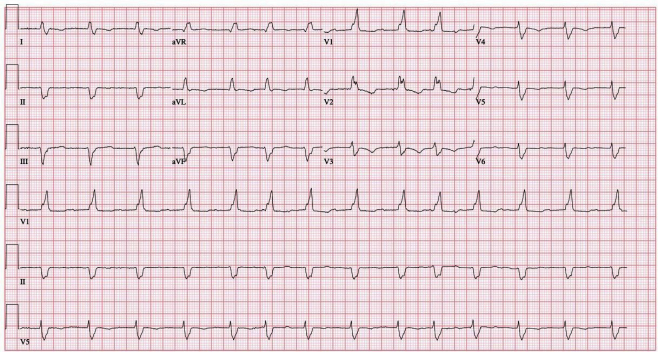

Figure 2 ECG after first haemodialysis treatment completed. Augmented Vector Right; aVR, augmented Vector Left; aVL, augmented Vector Foot; aVF.

should be initiated promptly. The first-line treatment includes calcium gluconate to antagonise cardiac toxicity, insulin with dextrose and nebulised albuterol to shift potassium intracellularly, but the treatment should not delay the transfer for or the initiation of haemodialysis.[4] The role of some treatments in the emergency setting such as sodium zirconium cyclosilicate and intravenous bicarbonate are poorly established and further research is needed.[4 5] Glycaemia should be monitored before and after the administration of intravenous insulin to prevent and manage iatrogenic hypoglycaemia.[6 7]

Severe hyperkalaemia is a life-threatening condition with an increased incidence in patients with chronic renal failure. Rapid initiation of treatment is very important to decrease further complications.[8]

Contributors JL, LPB, IF and DC participated in the clinical management of the patient. IF and DC obtained and edited the picture. JL, LPB, IF and DC have been involved in the drafting and discussion of the manuscript. JL, LPB, IF and DC reviewed and approved the final version.

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Learning points

- Sine-wave pattern is a manifestation of severe hyperkalaemia that depicts worsening cardiac conduction and needs emergent medical treatment.
- In cases of severe hyperkalaemia emergent treatment with rapid acting pharmacological measures and haemodialysis should be initiated promptly.
- Glycaemia should be monitored before and after treatment with intravenous insulin to prevent iatrogenic hypoglycaemia.

Competing interests None declared.

Patient consent for publication Consent obtained directly from patient(s).

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Case reports provide a valuable learning resource for the scientific community and can indicate areas of interest for future research. They should not be used in isolation to guide treatment choices or public health policy.

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