J deflections on ECG in severe hypothermia and hypokalaemia: a case report

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Abstract The J wave, also known as Osborn wave, is a deflection that can be observed on the surface ECG as a late delta wave, seen at the end of the QRS complex. In this case, a 75-year-old woman, after 1 day of continuous haemodialysis, showed a marked hypothermia (28.5°C) and severe hypokalaemia (1.7 mEq/l). Bradycardia was seen on the monitor and J waves were recognised on the ECG recording. After appropriate replacement of potassium and treatment of hypothermia, the J waves disappeared spontaneously.

Keywords J wave · Hypothermia · Hypokalaemia

Hypothermia is generally defined as a core body temperature less than 35°C [1]. Hypothermia is classified as accidental or intentional and primary or secondary. Osborn waves are most commonly observed in hypothermia (hypothermic hump). However, some other conditions including hypercalcaemia, damage to the brain, cardiac arrest, Chagas disease, ischaemic heart disease and Brugada syndrome have been reported to cause J waves [2, 3]. Below a temperature of 30°C, the J waves are detectable in 80% of patients [4]. Sinus bradycardia, prolonged PR and QT intervals or atrial fibrillation would be found in more profound hypothermia but all of these ECG abnormalities would normalise on re-warming [5].

Case report

A 75-year-old woman was admitted to our hospital with mechanical icterus and underwent percutaneous transhepatic cholangiography. There was no history of any cardiovascular disease. Electrocardiogram (ECG) on admission revealed normal sinus rhythm and left anterior hemiblock (Fig. 1). Haemodynamics were stable with a blood pressure of 120/70 mmHg and a heart rate of 88 beats/min. Physical examination was otherwise unremarkable. Unfortunately the patient's general condition deteriorated; she became anuric and she was intubated. Soon after intubation, haemodialysis was planned for the patient and after 1 day of continuous haemodialysis, the patient's body temperature was measured at 28.5°C and bradycardia was seen on the monitor. Figure 2 shows the patient's ECG recording at that time. Soon after the first recording, large QRS complexes were seen on the monitor and repeat ECG (Fig. 3) showed characteristic hypothermic humps, J waves, the QRS complexes became larger (200 msec) and the corrected QT interval reached 680 msec. A rightward axis shift was also seen. At that point a blood sample was taken and severe hypokalaemia (1.7 mEq/l) was observed. After appropriate treatment of hypothermia and hypokalaemia, the characteristic ECG findings disappeared, the main rhythm returned to normal sinus rhythm, the QRS narrowed (80 msec), and the corrected QT interval remained the same (680 msec).

Discussion

The J wave and elevated J point were described by Dr. John J. Osborn in 1953 [6], who worked on the use of hypothermia for cardiac surgery. The proposed cellular

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Fig. 1 Patient's first ECG recorded on admission. Sinus rhythm, f:90 bpm, Left anterior hemiblock, QTc:450 msec, QRS:80 msec

basis of hypothermia-induced J waves is the accentuation of the spike-and-dome morphology of the action potential of M and epicardial cells [7]. This epicardial accentuation is mediated by a transient outward current (I_{to}) that does not occur in the endocardium, originating in a transmural voltage gradient responsible for the appearance of a camel-hump wave at the end of the QRS complex [7]. They are a characteristic finding in hypothermia but also occur in other conditions such as hypercalcaemia [8]. The presence of Osborn waves is not associated with a higher

mortality in contrast to the presence of atrial fibrillation and the absence of shivering artefacts [9].

It has previously been defined that such waves can be seen not only in hypothermia but also in electrolyte imbalance. In this case it is not clear whether these waves appeared as a result of electrolyte imbalance or hypothermia or as a result of both conditions. Other causes that are related to J waves such as Brugada syndrome, hypercalcaemia, cerebrovascular disease and ischaemic heart disease were ruled out in this case.

Fig. 2 ECG: Sinus rhythm, Osborn waves can be seen on derivations D₁, D₂, aVL, V₃₋₄₋₅₋₆

Fig. 3 ECG: Sinus rhythm, Osborn waves can easily be recognised on almost all derivations

Conclusion

This case is being reported to highlight the association of J waves with hypothermia and hypokalaemia. This wide QRS complex rhythm can be alarming for physicians and can be safely treated with the appropriate replacement of electrolytes or simply warming the patient.

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