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CASE REPORT

Refractory ventricular fibrillation with prolonged resuscitation in dialysis-sensitive dysrhythmic patient

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ABSTRACT

Sudden cardiac death is a leading cause of death in chronic renal failure patients. We present a case of refractory ventricular fibrillation with successful prolonged resuscitation (> 1 hour) without neurological sequel in an outpatient dialysis centre. Implantation of a cardioverter-defibrillator is able to identify patients as dialysis-sensitive. Smoother potassium removal during hemodialysis could eliminate dysrhythmias. Prehospital (point-of-care) blood gas analysis can be helpful especially in prolonged resuscitation.

Keywords: successful resuscitation, ventricular fibrillation, point-of-care, blood gas analysis, potassium, hemodialysis, ICD

Introduction

Though sudden cardiac death is one of the leading causes of death in chronic renal failure patients, cardiac arrest during hemodialysis (HD) is an infrequent complication. (1)

Patients most commonly present with ventricular tachycardia or fibrillation. (2) We report a case of successful prolonged resuscitation of a HD patient in an outpatient dialysis centre who survived without any neurological deficit. The presence of an implantable cardioverter-defibrillator (ICD) and smoother potassium removal during HD seems to reduce the incidence of complex ventricular dysrhythmias.

Case report

A 51-year old female suffered a cardiac arrest in an outpatient dialysis centre shortly after hemodialysis. Fortunately, the delay between the emergency call and the arrival of the emergency physician was only 3 minutes. On arrival of the emergency response team, the patient was being resuscitated in the dialysis chair by a physician performing chest compressions and bag-valve mask ventilation. After moving the unconscious patient from the soft chair to the ground, the defibrillator was prepared and attached while the trachea was intubated. ECG showed ventricular fibrillation (VF).

A biphasic shock at 150J was applied, but the ECG still showed VF after two minutes – VF also persisted after the second biphasic shock. Following the ALS-algorithm for refractory VF, 1mg epinephrine and 300 mg amiodarone were given intravenously accompanied by two further shocks. After 20 minutes of continuous resuscitation and several shocks, VF still persisted. End-tidal CO_2 and SO_2 by pulse oximetry were in a tolerable range, indicating effective cardiopulmonary resuscitation (CPR).

The first blood gas check showed slight acidosis with a pH of 7.33 and a potassium level of 3.9mmol/L. Potassium (44mmol/250ml) and sodium bicarbonate were given, but there was no change in cardiac rhythm. Further shocks remained ineffective. A second blood gas check after 10 minutes showed an increased potassium level of 4.7 mmol/L. Additionally, 500ml of isotonic fluid were administered.

There was no evidence of other reversible causes of VF. Using a portable ultrasonic device, a subcostal four-chamber view showed ventricular fibrillation, no significant enlargement of the right atrium and no pericardial fluid.

Failing successful conversion of refractory VF, a second dose of amiodarone 300mg was given after 40 minutes of CPR. After approximately 1 hour of CPR, sinus rhythm was detected for the

first time. The CPR was interrupted for an ECG and pulse check, and peripheral pulses were easily palpable. The patient's level of consciousness improved rapidly, and she tried to remove the tube. Heart rate was 110 and blood pressure 190/110.

Fentanyl, propofol and cis-atracurium were administered and approximately 70 minutes after arrest the patient was uneventfully transferred to a cardiac intensive care unit (CICU). On admission, pH was 7.29, potassium 5.0mmol/L, calcium 2.26mmol/L, lactate 2.9mmol/L, TnT 0.244ng/mL, CK 311 U/L, CK-MB 179 U/L.

Echocardiographic assessment showed a hypertrophic left ventricle with a left ventricular enddiastolic diameter (LVEDD) of 38mm, an EF of 60-65%, and no hypokinesia.

The patient was extubated the next day without neurological deficit. The patient's medical records revealed mitral valve annuloplasty and closure of a patent foramen ovale 4 months earlier. The cause of end-stage renal disease in our patient was cystic kidney disease.

On day 4, the patient was discharged from the CICU. Less than one month later, ICD was uneventfully implanted.

The ICD check-up one month after implantation showed, that 11 episodes of VF with efficient shock termination had been recorded. The fact that all VF-episodes occurred during or after hemodialysis led to the initiation of smoother potassium removal during HD. No further dysrhythmias were recorded.

Discussion

Cardiovascular diseases represent the main causes of death in patients affected by renal failure. Dysrhythmias are frequently observed in patients undergoing hemodialysis. The etiology of dysrhythmias during hemodialysis is likely multifactorial. Dialytic treatment itself can be considered a dysrhythmic stimulus, as it induces alterations in electrolyte concentration, particularly calcium and potassium. Moreover, uremic patients represent a "pro-dysrhythmic substrate" because of the high prevalence of ischemic heart disease, left ventricular hypertrophy and autonomic neuropathy.

However, cardiac arrest before, during and after HD is rather infrequent. Lafrance et al. reported an incidence of 0.012% of cardiac arrest during HD. (1)

In our case, the cardiac arrest occurred in a female on Monday, which corresponds to the fact that several studies report a higher incidence of cardiac arrests on the days after the weekend interval and for women. (1,2)

Ventricular tachycardia or fibrillation is the initial arrest rhythm in most of the cases. Davis et al. found a 5-fold greater probability of VF in HD patients and a 14-fold greater probability of VF in HD patients after cardiac arrest. (3)

Bozbas et al. suspected hypertension, QT dispersion and coronary artery disease as independent predictors for complex ventricular dysrhythmias, while Voicelescu et al. found no significant correlation between QT dispersion and the incidence of ventricular dysrhythmias. (4,5) There was no evidence of QT dispersion in our case.

HD patients who survived cardiac arrest seem to benefit from early ICD Implantation. (6) However, the survival benefit of ICDs is significantly better in patients without end-stage renal disease. (7)

In a meta-analysis of 2516 patients including 89 HD patients who received an ICD, Sakhuja et al. found a 2.7-fold increased mortality in HD patients compared to non-HD patients. (8)

In our case, the presence of an ICD probably prevented another cardiac arrest (11 successful shock terminations of VF episodes recorded) and was helpful in diagnosing a dialysis-sensitive dysrhythmic patient. Smoother potassium removal during HD seems to be protective in such patients. (9)

There are several possible causes for the refractory VF in this case: potassium and/or acid base state, fluid shift during/after HD and previous cardiac surgery.

The fact that not a single episode of VF was recorded after changing to smoother potassium removal during HD shows the importance of a potassium disorder as a dysrhythmic stimulus in this case.

Conclusion

Better strategies to detect HD-sensitive dysrhythmic patients are warranted.

There is still need for further studies to assess if early ICD implantation and smoother potassium removal could decrease cardiac arrest in HD patients.

A prehospital blood gas analysis could be helpful, especially in renal patients, to optimize management of potassium and acidosis during CPR.

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