Unusual presentation of more common disease/injury

Electrocution-induced atrial fibrillation: a novel cause of a familiar arrhythmia

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Summary

A previously fit and well 40-year-old man presented to the emergency department with palpitations after suffering an 11 000 volt electrical shock from overhead power cables through a mobile crane which he was operating. His ECG demonstrated the presence of new atrial fibrillation at a rate of 80 beats per min. He was haemodynamically stable, and had otherwise only sustained a small exit burn to his left great toe. Routine blood tests including creatine kinase and troponin T were normal. A bolus of intravenous flecainide failed to restore sinus rhythm, but an amiodarone infusion was successful. An electrical shock is a rare cause of atrial fibrillation. There is no consensus over optimal medical management. Numerous treatment plans have been previously employed with varying degrees of success.

BACKGROUND

This case presents a novel aetiology of a common arrhythmia. Although rare, there is no current consensus on the optimal management of electrical shock-induced atrial fibrillation.

CASE PRESENTATION

A previously well 40-year-old man presented to the emergency department after suffering an 11 000 volt DC electrical shock from overhead power lines through a portable crane which he was manipulating from the ground. He had initially been unable to remove his right hand, the entry point, from the controller as it had experienced tetanic contraction. After approximately 5 s he was thrown backwards onto turf. He denied loss of consciousness, head injury, shortness of breath or chest pain, but admitted to lethargy, a dull generalised headache and occasional palpitations. Paramedics had initially noted an irregular tachycardia.

On examination, he was of athletic build and comfortable at rest. His right hand was generally mildly tender but was normal to inspection. His left great toe, the exit point, had a small blister on the lateral aspect which was painful to touch. There was no evidence of internal burns or compartment syndrome in the limbs or thorax. There were no signs of haemodynamic compromise. His pulse was irregularly irregular at a rate of 80 beats per min. His blood pressure was stable at 120/80 mm Hg.

INVESTIGATIONS

Full blood count, urea and electrolytes, prothrombin time and activated partial thromboplastin time, creatine kinase, troponin T and thyroid function tests were all within normal ranges. Chest radiography was normal. A targeted echocardiographic study demonstrated normal left ventricular systolic function. Electrocardiography undertaken before a routine minor surgical procedure 3 years previously had demonstrated sinus rhythm (figure 1). His ECG on this occasion showed atrial fibrillation with a controlled ventricular rate (figure 2).

TREATMENT

The patient was transferred to the coronary care unit for cardiac monitoring. He was given a therapeutic dose of enoxaparin and simple analgesia. A 150 mg bolus of flecainide over 10 min, given 4 h after the initial injury, failed to restore sinus rhythm. An amiodarone infusion (300 mg over 1 h followed by a further 900 mg over 23 h), started 11 h after the initial injury, restored sinus rhythm 24 h after the initial injury. DC cardioversion had been intended had the amiodarone infusion failed to work.

OUTCOME AND FOLLOW-UP

The patient's palpitations ceased on restoration of sinus rhythm. He was discharged home the same day. Follow-up in 1 month with a transthoracic echocardiograph was arranged.

DISCUSSION

Atrial fibrillation is by far the most common persistent cardiac arrhythmia, with approximately 1–2 per cent of adults being affected at any one time. Incidence increases with age, with 9 per cent of those aged 80 or over being affected.¹ Other main risk factors for the development of atrial fibrillation include hypertension and valve disease; less common causes include thyroid dysfunction, alcohol abuse and malignancy.²

Electrocution as a precipitating factor, however, has been reported only sporadically throughout medical literature. This can be mainly attributed to the very low risk that an electrical shock, once sustained, will actually result in atrial fibrillation. One study reporting the complications of 182 separate cases of electrocution over 20 years found only two patients to be in new onset atrial fibrillation as a result of their shock.³ Another study reported cardiac complications of any type in only four from 145 cases of electrocution, just one of which was atrial fibrillation.⁴ Defibrillation performed in a clinical setting for ventricular arrhythmias is also known to infrequently result in atrial fibrillation.⁵

Figure 1 ECG taken previous to admission.

Figure 2 ECG taken following electrical shock.

A shock of higher voltage is generally regarded as more likely to precipitate atrial fibrillation, and one case report even describes it as the result of a lightning strike.⁶ However, low voltage household-type shocks are also capable of doing so.⁷ Of interest, even a shock from a

torpedo ray fish has also been observed to precipitate atrial fibrillation.⁸

There is no clear guideline or consensus on the management of electrocution-induced atrial fibrillation, quite possibly due to the scarcity of occurrences. Multiple

management strategies have been used with varying degrees of success. DC cardioversion has been undertaken successfully on at least one patient,⁹ but has also been observed to fail.¹⁰ Oral quinidine has been seen to be successful,¹¹ as has intravenous digoxin.^{9 12} Amiodarone has been previously seen to restore sinus rhythm on a reliable basis,^{8 10} and is suggested by both National Institute for Health and Clinical Excellence¹³ and the American College of Chest Physicians¹⁴ as the secondary choice (after β blockade) for the chemical cardioversion of atrial fibrillation of acute onset in a haemodynamically stable patient.

Timely self-reversion to sinus rhythm has also been documented,^{6 9 15} but conversely in two cases the arrhythmia proved refractory to all forms of cardioversion for decades.^{16 17}

With these facts in mind it seems prudent to suggest that DC cardioversion be employed for electrocution-induced atrial fibrillation only in the event of haemodynamic compromise, and that chemical cardioversion be attempted in all other circumstances. Amiodarone appears to be a sensible first choice in such situations but due to the scarcity of evidence the most efficacious agent remains to be determined.

Learning points

- ▶ Electrocution is a rare cause of a common arrhythmia in atrial fibrillation.
- ▶ No consensus exists towards treatment.
- ▶ Amiodarone infusion appears to work at least as well as any other method, though evidence is scarce.
- ▶ DC cardioversion, as for all other aetiologies of atrial fibrillation, should be used in the presence of haemodynamic compromise.

Competing interests None.

Patient consent Obtained.

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