Rhabdomyolysis complicating percutaneous radiofrequency ablation of persistent atrial fibrillation

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Introduction

Atrial fibrillation (AF) is the most common sustained arrhythmia in the adult population. Invasive treatment of paroxysmal and persistent AF with radiofrequency ablation is a well-recognized and effective treatment in appropriately selected patients.1 Higher numbers of patients are being treated with radiofrequency ablation for symptomatic paroxysmal and persistent AF. AF is associated with obesity, and therefore it is likely that higher numbers of obese patients will undergo such procedures. We report an unusual complication associated with a prolonged procedure carried out under general anesthesia that is likely to have contributed to our patient’s body habitus. An awareness of such complications is critical for both cardiologists and anesthetists treating patients with these commonly coexisting medical conditions.

Case report

A 43-year-old man with a history of obstructive sleep apnea treated with continuous positive airway pressure support at home, elevated body mass index (BMI), hypercholesterolemia, and asthma attended our institution for elective radiofrequency ablation for symptomatic paroxysmal persistent AF. The patient had undergone left atrial ablation under general anesthesia for persistent AF. The patient had undergone left atrial ablation for symptomatic persistent AF 5 months earlier (pulmonary vein isolation and linear ablation to create roof block). On this occasion, sinus rhythm had resulted in a positive symptomatic response but had been maintained for only 3 days. On echocardiography, his left ventricular function and valvular function were normal. The left atrium was mildly dilated at 27 cm.2 He had no significant alcohol history. Medications at admission were digoxin 250 µg daily, nebivolol 7.5 µg daily, omeprazole 40 mg twice daily, diltiazem 70 µg twice daily, and warfarin at therapeutic dose. He was intolerant of statins, which had previously caused “muscle spasms,” but there was no history of rhabdomyolysis with statins. He had no history of renal disease, and his baseline creatinine level was 90 µmol/L, giving an estimated glomerular filtration rate of 80 mL/min.

On the day of the procedure, the patient weighed 125 kg and was 1.72 m tall, and thus his BMI was 42.3 kg/m². Anesthesia was induced with 180 mg of propofol and 100 µg of fentanyl. Neuromuscular blockade was achieved with rocuronium. Remifentanil infusion was initiated 20 minutes after induction at 3 ng/mL, which was increased to 4 ng/mL 1 hour 10 minutes later for the remainder of the procedure. Anesthesia was maintained with end-tidal anesthetic levels and control ventilation, and oxygen saturations were maintained above 94% throughout the procedure with the exception of desflurane. Intubation was relatively easy—Lehane and Cormack Grade 2 view—however, manual ventilation of the lungs using a face mask was relatively difficult requiring 2 people to achieve adequate tidal volumes. This was due to the increased BMI.

The procedure was performed with uninterrupted warfarin with an international normalized ratio of 2.0. Transesophageal echocardiography at the time of the procedure excluded left atrial appendage thrombus. He was in AF at the start of the procedure. Two transesophageal echocardiography-guided transeptal punctures were made. Three of the 4 pulmonary veins had reconnected and were reisolated. He remained in AF after pulmonary vein isolation and underwent external direct current cardioversion to restore sinus rhythm. In sinus rhythm there was recovery of roof conduction and a further roof line was made with confirmed conduction block. A mitral isthmus line was created and block was achieved with ablation required within the coronary sinus. In addition, right-sided ablation was performed to achieve cavotricuspid isthmus block (Figure 1).

The patient was ventilated uneventfully using volume-control ventilation, and oxygen saturations were maintained above 94% throughout the procedure with the exception of decreasing twice to 91%, requiring recruitment maneuvers.

KEYWORDS Radiofrequency ablation; Obesity; Rhabdomyolysis

ABBREVIATIONS AF = atrial fibrillation; BMI = body mass index; CK = creatine kinase (Heart Rhythm Case Reports 2015;1:169–171)

This study was funded/support by the National Institute for Health Research (NIHR) Clinical Research Facility at Guy’s & St Thomas’ National Health Service (NHS) Foundation Trust and NIHR Biomedical Research Centre at Guy’s and St Thomas’ NHS Foundation Trust and King’s College London. The views expressed are those of the author(s) and not necessarily those of the NHS, the NIHR, or the Department of Health.

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The patient remained hemodynamically stable throughout; however, urine output was 50 mL for the entire procedure despite 2.8 L of the total fluid input. Positioning during surgery was supine with arms by the side, which were padded using standard gel arm pads. The total procedure time from the induction of anesthesia to extubation was 4 hours 45 minutes. The patient was transferred intubated and ventilated (sedated on a propofol target controlled infusion) to a preplanned critical care bed with a standard mattress. This was later changed to a pressure-relieving mattress.

The patient was extubated onto a standard face mask, as he was oxygenating well but was agitated immediately after extubation, complaining of severe pain behind his shoulders. All arm compartments were soft, and there was no distal neurovascular compromise. His pain was initially managed with opiate bolus analgesia. He went on to receive paracetamol, nonsteroidal anti-inflammatory drugs, ketamine, infusion, and clonidine but had severe ongoing pain despite these. Six hours postprocedure, his urine turned dark. No red cells were identified on cytometry. His serum creatine kinase

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**KEY TEACHING POINTS**

- Obesity is associated with atrial fibrillation, and it is likely that the number of invasive electrophysiological procedures carried out in this population will increase.
- Obese patients are at higher risk of rhabdomyolysis, complicating prolonged procedures.
- An awareness of and vigilance for rhabdomyolysis is crucial to allow prompt recognition and treatment of this potentially serious complication.

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Figure 1  A: Left anterior oblique view of electroanatomic mapping system–generated shell of anatomy of the left atrium (Carto 3, Biosense Webster, Inc, Diamond Bar, CA) through mitral valve. Radiofrequency energy delivered on epi- and endocardial surface of the mitral isthmus (arrow 1), the left atrial roof, and cavotricuspid isthmus (arrow 2). B: Electrocardiogram (ECG) recorded before the ablation procedure, showing atrial fibrillation (AF). C: ECG recorded after the procedure, showing sinus rhythm. D: Temporal changes in serum creatinine kinase and serum creatine with respect to procedure at hour 0. E: Temporal progress of serum creatinine (in μmol/L) with reference to procedure at hour 0. F: Temporal progress of serum calcium (in mmol/L) with reference to procedure at hour 0. G: Temporal progress of serum alanine aminotransferase (in U/L) with reference to procedure at hour 0.
(CK) level postprocedure was elevated at 18,426 U/L, and a diagnosis of rhabdomyolysis was made. We considered other diagnostic possibilities carefully. After review of the procedure, we were satisfied that there were no unusual or excessive catheter movements or positions that would have predisposed him to an excessive risk of arterial thromboembolism. Periprocedural anticoagulation was satisfactory, with the activated clotting time maintained above 300 seconds throughout the procedure.

The patient was treated with aggressive intravenous fluid therapy and intravenous furosemide boluses. He required intravenous nitrate infusion for a short period on the first postoperative day for pulmonary edema. His CK level peaked at 20,033 U/L on the first postoperative day (Figure 1). His serum creatinine level peaked at 146 μmol/L, and he did not require renal replacement therapy (Figure 1). The lowest serum-corrected calcium level was 2.07 mmol/L (normal range 2.15–2.55 mmol/L), and he did not require calcium replacement (Figure 1). His temperature remained in the normal range throughout the postoperative period. The serum lactate dehydrogenase level was elevated to 1300 U/L. The serum alanine aminotransferase level was elevated to 110 U/L and peaked at 186 U/L (Figure 1).

He had ongoing pain in his shoulders up until the eighth postoperative day, although it did gradually improve. On direct questioning, he reported experiencing similar pain after his previous procedure, for which he had required 20 mg of morphine and 100 mg of clonidine in recovery. The anesthetic in this previous admission had lasted 185 minutes, which was significantly shorter than that in the current procedure. However, the induction of anesthesia was very similar on both occasions, with a similar mean arterial pressure recorded. On review of his notes, it was found that he had reported pain intermittently until 72 hours postprocedure. The CK level was not measured during this period in the previous admission, but his creatinine level had remained in the normal range.

The patient reverted to AF on the first postoperative day, and he was loaded with amiodarone with a view to direct current cardioversion once he had recovered from this episode. His CK level on discharge was 272 U/L, and his creatinine level was 100 μmol/L.

Discussion
Rhabdomyolysis is characterized by the leakage of muscle cell contents into the circulation, caused by an increased level of intracellular calcium secondary to adenosine triphosphate depletion within the myocyte. Muscle hypoxia in cases of limb compression by head or in cases of prolonged immobilization by torso is a well-recognized cause.

Early fluid resuscitation is the mainstay of treatment of rhabdomyolysis, aiming to prevent rhabdomyolysis-induced renal failure. The current recommendation is that 1000 mL of 0.9% NaCl be given in the first hour, and 400 mL/h thereafter, with a urine output target of 3 mL/kg. Diuresis may be encouraged with diuretic agents. It is important to check serum calcium, but caution is advised in calcium replacement, because refractory hypercalcemia may occur with resolution of rhabdomyolysis. Therefore, replacement is advised only in symptomatic hypocalcemia. Alkalization of urine with bicarbonate may be considered if the pH is less than 6.5. Mannitol may be tried if it helps diuresis. In cases of oliguria and hyperkalemia, early renal replacement therapy should be considered.

Most of the literature related to postoperative rhabdomyolysis comes from experience with bariatric surgery. A recognized risk factor for the development of rhabdomyolysis relevant to our patient was the long duration of surgery. Other risk factors include “superobesity” (BMI > 50 kg/m²), diabetes, peripheral vascular disease, and hypertension. It is recommended that additional operative padding be used in patients at risk of rhabdomyolysis. Of note is the patient’s intolerance to statins, previously described as causing “muscle spasms.” On direct questioning, this was found to be a sensation of muscle aches while taking statins. He had never sought medical advice for this, so there is no contemporary medical record or investigation at the time of this symptom. It may be, however, that this previous symptom was indicative of a predisposition to developing rhabdomyolysis, in particular in the context of our patient’s additional risk factors.

There are several reports of post–bariatric surgery rhabdomyolysis in adult patients in the literature, and a smaller but significant selection of reports of obese patients undergoing nonbariatric procedures involving this complication. However, this is the first description that we are aware of involving a cardiac procedure and the first description in a patient undergoing percutaneous AF ablation.

Conclusion
Obesity is associated with AF, and it is likely that the number of invasive electrophysiological procedures carried out in this population will increase. An awareness of and vigilance for rhabdomyolysis is crucial to allow prompt recognition and treatment of this potentially serious complication.

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