Case Report

Major haemorrhage following vascular injury during exchange of cardiac pacemaker leads

A. Elrefaey¹ and A. Pai²

1 Locum Consultant Anaesthetist, Addenbrooke's Hospital Cambridge University Hospitals NHS Foundation Trust, Cambridge, UK

2 Consultant Anaesthetist, The Essex Cardiothoracic Centre, Basildon, UK

Summary

An 80-year-old lady suffered loss of cardiac output during an elective pacemaker lead exchange. Right ventricular perforation, cardiac tamponade, vascular lacerations and circulatory shock are known major complications of pacemaker lead exchange and may necessitate aggressive resuscitation. An emergency sternotomy revealed the administered fluid, blood products and resuscitative drugs, which were administered through an upper limb cannula, had likely extravasated at the site of an iatrogenic injury to the superior vena cava. Unfortunately, further resuscitation attempts were unsuccessful. There are no recommendations regarding sites for intravascular access during pacemaker lead exchange and we argue that lower limb veins should be considered for venous access, as the superior vena cava and innominate veins are possible sites of unintentional vascular injury.

Correspondence to: A. Elrefaey

Email: dr.a.elrefaey@gmail.com

Accepted: 26 May 2019

Keywords: cardiac pacemaker; intravascular access; major haemorrhage; vascular injury

Twitter: @AhmedEl14305911

Introduction

Cardiac pacemakers are increasingly used for the management of symptomatic bradycardia, other arrhythmias and heart failure [1]. The increased incidence of device implantation is also associated with an increased frequency of system extraction and pacemaker lead exchange [2]. Indications for lead extraction include infection, such as infected, systems or leads, lead vegetations, valvular endocarditis, even if the leads are not proven to be involved, and persistent or recurrent bacteraemia or fungaemia despite appropriate antibiotic therapy with no other identifiable source. Non-infectious indications for extraction include: chronic pain; thromboembolic events from lead or lead fragments; superior vena cava stenosis or occlusion; arrhythmia secondary to retained leads; implanted devices that interfere with cancer treatment; magnetic resonance imaging (MRI) access facilitation; abandoned leads and malfunctioning or fractured leads [3]. This case describes a devastating complication in a patient undergoing elective pacemaker lead exchange due to malfunctioning leads.

Report

An 80-year-old lady with type-2 diabetes mellitus, chronic kidney disease, rheumatoid arthritis and polymyalgia rheumatica was scheduled for elective cardiac pacemaker lead exchange. She had paroxysmal atrial fibrillation with pharmacological rate control but without anticoagulation, and dilated cardiomyopathy with an ejection fraction of 30%, for which a biventricular permanent pacemaker was implanted 15 years prior. The pacemaker, which also included a tachyarrhythmia control function, was implanted for cardiac resynchronisation therapy and was programmed as DDDR. The device had been functioning well,

however, there had been two previous lead exchanges in the past and the device had recently delivered several inappropriate shocks. A device check revealed the sensing functions of the leads were malfunctioning. The implantable cardioverter defibrillator function was deactivated and she was listed for an elective pacemaker lead exchange.

The procedure was performed in a hybrid theatre by the cardiology team under general anaesthesia provided by a consultant cardiac anaesthetist. As per local protocols, the cardiothoracic surgical and perfusion team were immediately available. Standard monitoring was connected and an 18-gauge venous cannula (dorsum of the right hand) together with a 20-gauge arterial cannula (right radial artery) were inserted. Induction of anaesthesia and tracheal intubation proceeded uneventfully. An additional 18-gauge cannula was inserted in the right forearm. The cardiology team inserted an 8-French vascular sheath in the right femoral vein. This was used to place two pacing leads that paced the heart during the exchange procedure. As the patient had five leads in place, three were left in situ and two were removed, with replacements sited via the left subclavian vein and connected to the pulse generator.

After 160 min, the blood pressure suddenly dropped and there was no immediate improvement with intravenous (i.v.) boluses of a total of 10 mg metaraminol, 1 mg adrenaline, 1 l balanced crystalloid solution and 500 ml colloid. Within 4 min, the cardiac output was lost and a pulseless electrical activity (PEA) cardiac arrest was declared together with activation of the institutional massive haemorrhage protocol. Mechanical chest compressions were commenced immediately using a LUCAS® device. A rapid infusion of a total of seven units of packed red cells, three units of fresh frozen plasma and two units of cryoprecipitate were administered via the two peripheral cannulae. During the first cycle of chest compressions, a cardiac output was transiently observed on the arterial line trace with a systolic blood pressure of ~50 mmHg. The rhythm was PEA for two cycles followed by asystole for the rest of the resuscitation. Adrenaline 1 mg i.v. was administered every 3 min as per advanced life support guidelines.

An emergency sternotomy was performed after seven cycles of cardiopulmonary resuscitation (CPR) and administration of a total of adrenaline 5 mg i.v. A large volume of blood was observed in the superior mediastinum and in the right pleural space. There was minimal blood in the pericardial space and the heart appeared empty. A central venous catheter guidewire was passed via the right internal jugular vein and the tip of the wire was seen emerging through a large tear in the superior vena cava. The surgeons declared that the left innominate vein and the superior vena cava were completely bisected longitudinally. At this point, the decision was made to discontinue resuscitation due to futility following over 30 min of no cardiac output and the discovery of a vascular injury, which was deemed unreparable in this context.

Discussion

Extraction of pacemaker leads greater than 12 months old carries several potential major and minor procedure-related complications. For this reason, cardiologists often prefer to abandon malfunctioning leads and insert new ones beside them, rather than risk the complications of extraction. That said, certain circumstances, such as an infection involving the leads, may indicate the need for removal. Major complications of pacemaker lead extraction include: death; cardiac avulsion; vascular and ventricular wall lacerations; stroke; haemopericardium or haemothorax requiring intervention; flail tricuspid valve and massive pulmonary embolism. Minor complications include: pericardial effusion; pulmonary embolism; moderate bleeding requiring blood transfusion; vascular puncture site injury and a migrated lead fragment without sequelae. Most potential major complications present with on-table cardiac arrest requiring resuscitation, hence the requirement for a hybrid theatre or catheter laboratory with cross-matched blood ready and a backup surgical and perfusion teams available to enable cardiac bypass [3, 4].

In this case, the major complication encountered was vascular laceration in the form of superior vena cava and innominate vein injuries. There was no response to vasopressors, inotropes or volume replacement with crystalloids, colloids and blood products. Following the sternotomy, it was apparent that the administered fluid and drugs had extravasated at the site of injury, as all transfusions and drugs given through cannulae in the right upper limb veins would have drained into the injured superior vena cava. It was, therefore, impossible by this method to ensure sufficient cardiac filling to create an adequate cardiac output during cardiopulmonary resuscitation. Conversely, administering fluid through this route may have caused more damage, as a massive transfusion into the thoracic cavity could have put external pressure on the heart and lungs which would further hinder venous return, cardiac output and lung expansion.

We were unable to find any recommendations in the literature regarding vascular access for removal of cardiac pacing leads, and this case report provides a timely opportunity to share our learning with the wider peri-operative community. For patients undergoing cardiac pacemaker lead removal or exchange, a large-bore cannula in one lower limb should be inserted following induction of anaesthesia and before starting the procedure. This should be used as the main i.v. access point during

the procedure. If this is not possible, for example, due to oedema, femoral venous access should be considered to exclude the superior vena cava and innominate vein involvement in drug and fluid delivery to the heart, as these are possible injury sites. We would also consider requesting an extra guidewire in the femoral vein beside the sheath to be used in an emergency to railroad a 5–10 French catheter, which would be useful when transfusing large volumes quickly into the inferior vena cava. Finally, in an emergency, we suggest avoiding upper limb, subclavian or internal jugular i.v. access and use only veins that drain into the inferior vena cava for administering fluids and drugs in the context of suspected major haemorrhage during this procedure.

The next logical step in management would be cardiopulmonary bypass. We decided against this as there had been a significant period without adequate cardiac output due to hypovolaemia. A recent observational study suggests that an extracorporeal cardiopulmonary resuscitation is feasible, and may even be indicated for peri-operative major haemorrhage [5]. Again, in this case, this would likely have failed, given the prolonged low-flow time and depleted intravascular volume [6]. In summary, major haemorrhage during pacemaker lead exchange or extraction must be managed promptly [7]. We suggest that, as the superior vena cava and innominate veins may be injured during this procedure, lower limb vascular access may better allow the delivery of resuscitative fluids and drugs to the heart and allow for adequate CPR before cardiopulmonary bypass.

Acknowledgement

Published with written assent from the patient's next of kin. No external funding or competing interests declared.

References

1. Cunningham D, Cunningham M, Donkor A, Linker N, Murgatroyd F and the CRM Steering Group. National audit of cardiac rhythm management devices April 2015 – March 2016, 2016. <http://www.bhrs.com/files/files/Audit%20Reports/CRM%20Devices%20National%20Audit%20Report%202015-16.pdf> (Accessed 20/05/2019).
2. Farooqi FM, Talsania S, Hamid S. Extraction of cardiac rhythm devices: indications, techniques and outcomes for the removal of pacemaker and defibrillator leads. *International Journal of Clinical Practice* 2010; **64**: 1140–7.
3. Kusumoto FM, Schoenfeld MH, Wilkof BL. 2017 HRS expert consensus statement on cardiovascular implantable electronic device lead management and extraction. *Heart Rhythm* 2017; **14**: e503–48.
4. Hauser RG, Katsiyannis WT, Gornick CC, Almquist AK, Kallinen LM. Deaths and cardiovascular injuries due to device-assisted implantable cardioverter-defibrillator and pacemaker lead extraction. *Europace* 2010; **12**: 395–401.
5. Min JJ, Tay CK, Ryu DK. Extracorporeal cardiopulmonary resuscitation in refractory intra-operative cardiac arrest: an observational study of 12-year outcomes in a single tertiary hospital. *Anaesthesia* 2018; **73**: 1515–23.
6. Charlesworth M, Ashworth A. Peri-operative extracorporeal cardiopulmonary resuscitation. *Anaesthesia* 2019; **74**: 262.
7. Caniglia-Miller JM, Bussey WD, Kamtz NM, et al. Surgical management of major intrathoracic hemorrhage resulting from high-risk transvenous pacemaker/defibrillator lead extraction. *Journal of Cardiac Surgery* 2015; **30**: 149–53.