

Unusual cause of hypoxemia after automatic implantable cardioverter-defibrillator leads extraction

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ABSTRACT

The indication of pacemaker/AICD removal are numerous. Serious complication can occur during their removal, severe tricuspid regurgitation is one of the complication. The occurrence of PFO is not uncommon among adult population. Shunting across PFO in most circumstance is negligible, but in some necessitates closure due to hypoxemia. We report a case of 62 year old man, while undergoing AICD removal, had an emergency sternotomy for cardiac tamponade. Postoperatively, he experienced profound hypoxemia refractory to oxygen therapy. Transthoracic Echocardiogram was performed to rule out intracardiac shunts at an early stage, but it was difficult to obtain an good imaging windows poststernotomy. A small pulmonary emboli was noted on CTPA, but was not sufficient to account for the level of hypoxemia and did not resolve with anticoagulation. Transesophageal echocardiogram showed flail septal tricuspid valve with severe TR and bidirectional shunt through large PFO. Patient was posted for surgery, tricuspid valve was replaced and PFO surgically closed. Subsequently, patient recovered well and was discharged to home. Cause of hypoxemia might be due to respiratory or cardiac dysfunction. But for hypoxemia refractory to oxygen therapy, transoesophageal echocardiogram should be always considered and performed early as an diagnostic tool in post cardiac surgical patients.

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INTRODUCTION

The indications for pacemaker and automatic implantable cardioverter-defibrillator (AICD) removal are numerous, but mainly include infection or lead malfunction.^[1] The treatment of choice is the extraction of the pacemaker/AICD generator and/or the leads.^[1-3] The frequently used technique for lead extraction is a transvenous laser assisted approach.^[2] Although the risk of this approach is low, the risk of removal of AICD leads far exceeds that for pacemaker leads.^[4] Serious complications can occur, the majority of which are immediate.^[1,5,6] There are reports of severe tricuspid regurgitation (TR) after lead removal needing surgery.^[7] The occurrence of a large patent foramen ovale (PFO) with a bidirectional shunt is not uncommon in adult patients

undergoing cardiac operations^[8] and at times necessitates closure due to severe hypoxemia. Transesophageal echocardiogram is a highly sensitive investigation in diagnosing a PFO perioperatively in the Intensive Care

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Unit (ICU).^[8,9] We present a case report of severe hypoxemia after AICD lead extraction.

CASE REPORT

A 62-year-old man with a history of hypertension, smoking, and AICD implant for out of hospital ventricular fibrillation arrest 13 years earlier was scheduled for AICD generator box change under general anesthesia (GA). Anesthetic pre assessment was unremarkable with a good ventricular function on echocardiogram. During the attempted removal of the AICD generator box, the cardiologist noted a break in the insulation of the AICD lead component. Because the patient was not consented for leads removal, the generator box was removed, and leads were left *in situ* with a plan for laser extraction at a later date. Two days later, laser extraction of leads was attempted under GA. Monitoring included standard and invasive arterial pressures. The lead extraction was complicated with pericardial tamponade due to a linear tear in the free wall of the the right ventricle, which was managed successfully by emergency surgery, and the patient was extubated later that day in the ICU. Intraoperatively, central venous pressure was noted to be around 18–22 cm of water. The following day he became intermittently hypoxemic with a PaO₂ of 6.8–13.3 kPa despite being on high inspired oxygen via continuous positive airway pressure mask. Central venous pressure was around 13–15 cm of water. Clinical examination and chest X-ray which showed some left basal collapse did not correlate with his level of hypoxemia. Transthoracic echocardiogram was not conclusive because of the poor window. Although, he remained hypoxemic, his hemodynamics and metabolic parameters were normal. So, he underwent computed tomography pulmonary angiography (CTPA), which showed a small right solitary pulmonary embolism, a small left pleural effusion and atelectasis. He was then started on heparin infusion. Despite a sufficient duration of anticoagulation and 100% oxygen he remained hypoxemic. A review of his CTPA scan suggested an aneurysmal interatrial septum. Transesophageal echocardiography was performed under GA. It demonstrated a flail tricuspid valve with severe eccentric TR, an aneurysmal interatrial septum, and a large PFO with a bidirectional shunt. There was dilatation of right atrial (RA) and right ventricular (RV) with mild RV dysfunction and preserved left ventricular function. Patient was extubated, discussed with consultant cardiothoracic surgeon, and consented for surgical closure of PFO and tricuspid valve replacement [Figures 1-3]. The next day, he underwent

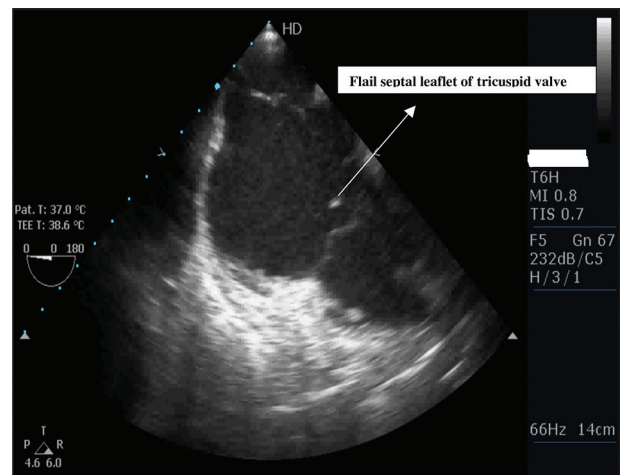


Figure 1: Mid esophageal four chamber view showing flail tricuspid valve

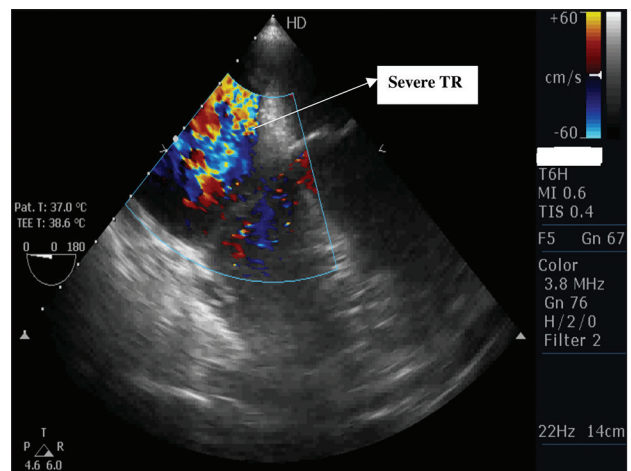


Figure 2: Mid esophageal four chamber view showing severe tricuspid regurgitation

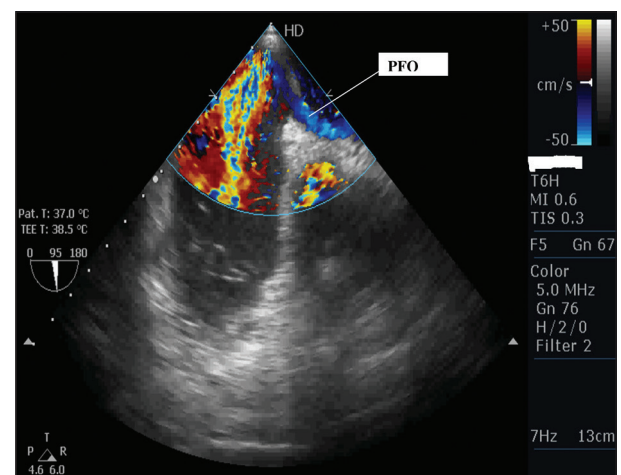


Figure 3: Mid esophageal bi-caval view showing shunt across large patent foramen ovale

tricuspid valve replacement and bovine pericardial patch closure of PFO. He made a good postoperative

recovery and was discharged home in few days' time. At follow-up, 6 weeks later, he had returned to normal activity and had an echocardiogram which showed a well seated functioning tricuspid prosthesis and no residual shunt across the interatrial septum.

DISCUSSION

Lead extraction is not without complications; though much reduced with effective current techniques.^[3] Implantable cardioverter-defibrillator (ICD) lead replacement complications were 8.1%, of which 5.8% were major complications.^[6] Many reports favor lead extraction for infective complications to reduce systemic sepsis. Risk factors for complications include younger patients,^[4,10] implantation site, female gender,^[11] physician experience, and the duration of lead implantation.^[11] Lead extraction can be difficult due to the encasement of the leads in fibrotic tissue. The process of fibrotic encapsulation is by activation of different cellular and humoral mechanisms.^[12] Because fibrous attachments to surrounding structures may involve the tricuspid valve, valvular damage may be provoked by lead removal.^[7] Methods to extract leads range from a transvenous approach to open procedures. Of the many transvenous approaches the laser assisted technique has been shown to have least complications. Laser sheaths reduce the duration and magnitude of the force applied and aids in disrupting fibrous tissues, although the possibility of serious complications still exists.^[2,13]

The incidence of PFO ranges from 14.6% to 35% in postmortem examinations.^[14-16] Morphologically findings of hypermobility of septum primum and enlargement of fossa ovalis can occur in the presence of PFO.^[17] Transient right to left shunting through a PFO causing refractory hypoxemia is less recognized and should be considered in the differential diagnosis of severe hypoxemia. This kind of shunting can also occur in pulmonary embolism, RV infarction,^[14] heart failure with left ventricular assist device,^[18] pneumonectomy,^[19] chronic obstructive pulmonary disease,^[20] and application of positive end-expired pressure during intermittent positive pressure ventilation.^[8,21] Detection of the interatrial shunt is essential for the diagnosis of PFO in the absence of atrial septal defect. Among the various modern methods of PFO detection, transesophageal echocardiogram (TOE) is generally considered to be the "gold standard."^[22] This report describes a middle aged man presenting with refractory hypoxemia after ICD leads removal. Transthoracic

echocardiogram was performed to rule out intracardiac shunts at an early stage, but it was inconclusive because of poor window poststernotomy. A small pulmonary embolism was noted on CTPA, which did not account for the level of hypoxemia and did not resolve with anticoagulation. Transesophageal echocardiogram was performed under GA and patient was woken up immediately after the procedure, primarily to obtain consent. Accentuation of the shunt across PFO results when RA pressure exceeds more than left atrial pressure or when the anatomic relationship of the interatrial septum to the inferior vena cava is altered.^[14] In this case, although the RV perforation had been dealt with immediately, the injury to the tricuspid valve and ensuing severe TR went unrecognized. In our opinion, the raised RA pressures and severe TR jet toward the septum may have opened the PFO significantly accounting for the shunt.

CONCLUSION

PFO is not uncommon in the adult population. In situations where right sided pressure exceeds the left sided pressure, the right to left intracardiac shunt may result in hypoxemia. Hypoxemia is common in post cardiac surgical/cardiology patients and is either due to respiratory dysfunction or congestive heart failure. We conclude that TOE is a vital investigating tool, which should be considered early for the diagnosis of suspected postoperative hypoxemia refractory to oxygen therapy.

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Conflicts of interest

There are no conflicts of interest.

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