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Case Report

Crossed my heart, into the gut? A case of cardiac perforation with accompanying diaphragmatic perforation during temporary transvenous pacemaker placement[☆]

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ABSTRACT

Temporary transvenous pacing is generally considered a safe procedure and is commonly performed for various emergent indications. However, complications are quite common with minor complications being more frequent than major life-threatening events. Cardiac perforation is a serious complication associated with the procedure with possible life-threatening consequences. Our report describes the imaging findings in a rare case of cardiac perforation with accompanying diaphragmatic perforation during temporary transvenous pacemaker placement.

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Introduction

Temporary cardiac rhythm pacing is used as a supporting cardiac pacing system both in emergent life-threatening arrhythmias and as a bridge to permanent pacemakers. Transvenous route, usually via the femoral vein, to the atria or ventricles or both, under fluoroscopic imaging guidance is the most common method of lead placement. Common indications include symptomatic brady-arrhythmias (AV-blocks), wide-complex

tachycardias (bundle-branch blocks), narrow complex tachycardias (atrial flutter, PSVTs), which may be primary arrhythmias or complicating acute myocardial infarction (AMI), cardiac surgery, among other conditions [1]. Complications are common, usually minor and not life-threatening, including pacemaker malfunction, femoral hematoma, arrhythmias, fever, transient hoarseness, and inadvertent right ventricular pacing. However, major complications causing imminent danger of death are possible and include, but are not limited to, right ventricular perforation with or without cardiac

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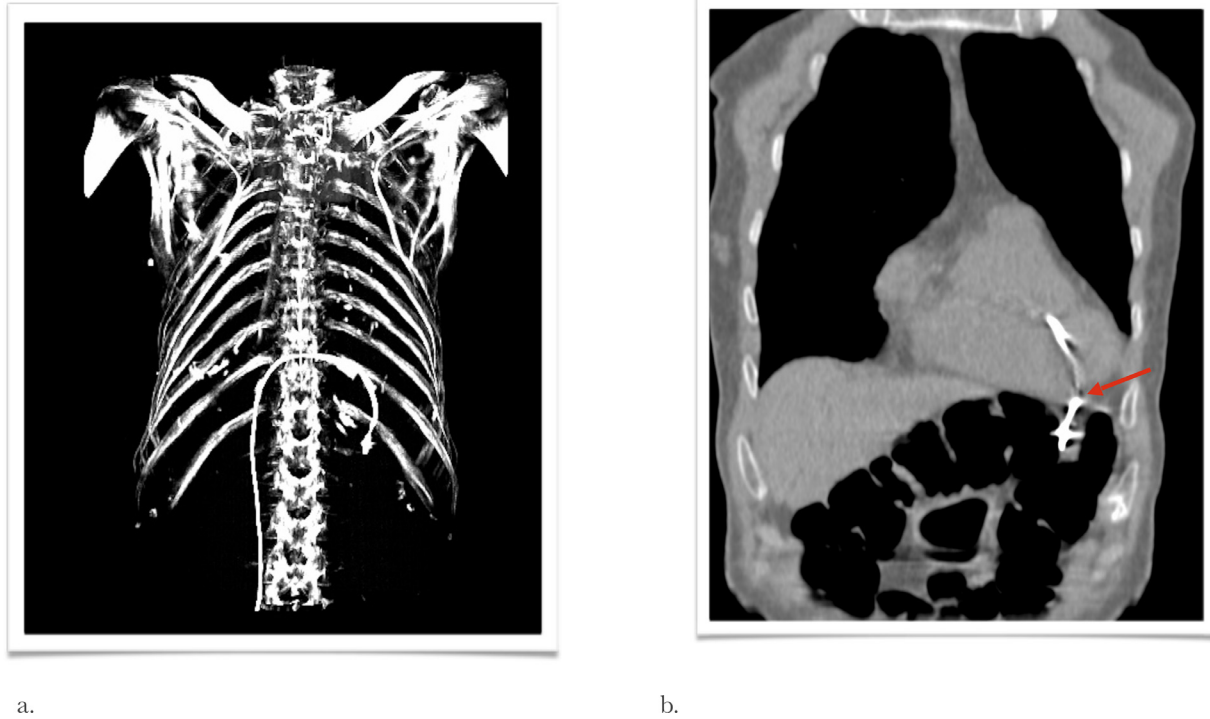


Fig. 1 – (A) Coronal Maximal Intensity Projection (MIP) CT image of chest and abdomen showing a pacing lead below the level of the twelfth rib, at the level of L1 vertebra. (B) Coronal nonenhanced CT image showing the pacing lead (arrow) going through the apical region of right ventricular myocardial wall and diaphragm and into the peritoneal cavity.

tamponade, asystole, ventricular fibrillation, ventricular tachycardia, pneumothorax, thromboembolism, septicemia, which in very rare cases culminate in death.

Temporary transvenous pacemakers (TTP) are used in advanced AV blocks, AV blocks complicating acute MI, prophylaxis during generator replacement of permanent pacemakers, drug intoxication, and sinus nodal disease, to prevent severe ventricular arrhythmia secondary to long-QT interval [1].

Complications are frequently related to these devices and not the procedure, and are on a decreasing trend [4].

We report cross-sectional imaging of a rare complication of right ventricular perforation with associated diaphragmatic perforation and resultant intra-abdominal, intraperitoneal positioning of the pacing leads during TTP placement.

Case presentation

A 70-year-old male with prior hypertension, diabetes, and dyslipidemia was brought to the emergency department of an urban tertiary health care institute 4 hours after an episode of loss of consciousness, which resolved spontaneously, and complaints of dizziness after the episode. The patient also reported feeling dizzy and experiencing palpitations just before the episode. There was no history of chest pain, sweating preceding or following the episode, any kind of trauma, an emotional stressor preceding the episode, headache, or

abnormal body/eye movements. Vitals were significant for a slowed pulse rate of 45 bpm, and blood pressure of 95/65 mm Hg. The O₂-saturation was 95% on room air. There were no associated neurological deficits on neurological examination. A 12-lead EKG was recorded along with a complete blood count, serum electrolytes, serum urea/creatinine, and a qualitative high-sensitivity troponin test. The results for the blood analyses were within normal limits except for mild hyponatremia of 128 mEq/L. The troponin test was negative. The serum lactate was 1.2 mmol/L. The 12-lead EKG revealed a wide-QRS brady-arrhythmia with a tri-fascicular block at a heart rate of 47 bpm. Initial management included aspirin, clopidogrel, and intravenous fluid bolus followed by a maintenance infusion. After initial management, the patient was shifted for temporary transvenous pacing to the cath-lab where fluoroscopy-guided venous access to the right ventricle was attempted using 6F curved, balloon-guided bipolar temporary pacing leads (Pacel, Abbott Inc., MN) as per the protocol by the cardiologist on call. Preprocedure point-of-care echo revealed an ejection fraction (EF) of 50% with no regional wall motion abnormalities. A preprocedure IV bolus of 2 mg/kg lignocaine was used. With a fluoroscopy-guided approach using the balloon-guided catheter, leads were navigated via a trans-femoral route into the right atrium and then the right ventricle, with a sudden giveaway in resistance during final ventricular positioning. Pacing rhythm was not achieved and pacing failure was recorded, with the leads in place, suspecting a myocardial perforation. Immediate point-of-care echo revealed no myocardial wall motion abnormality, no change in the EF, or any

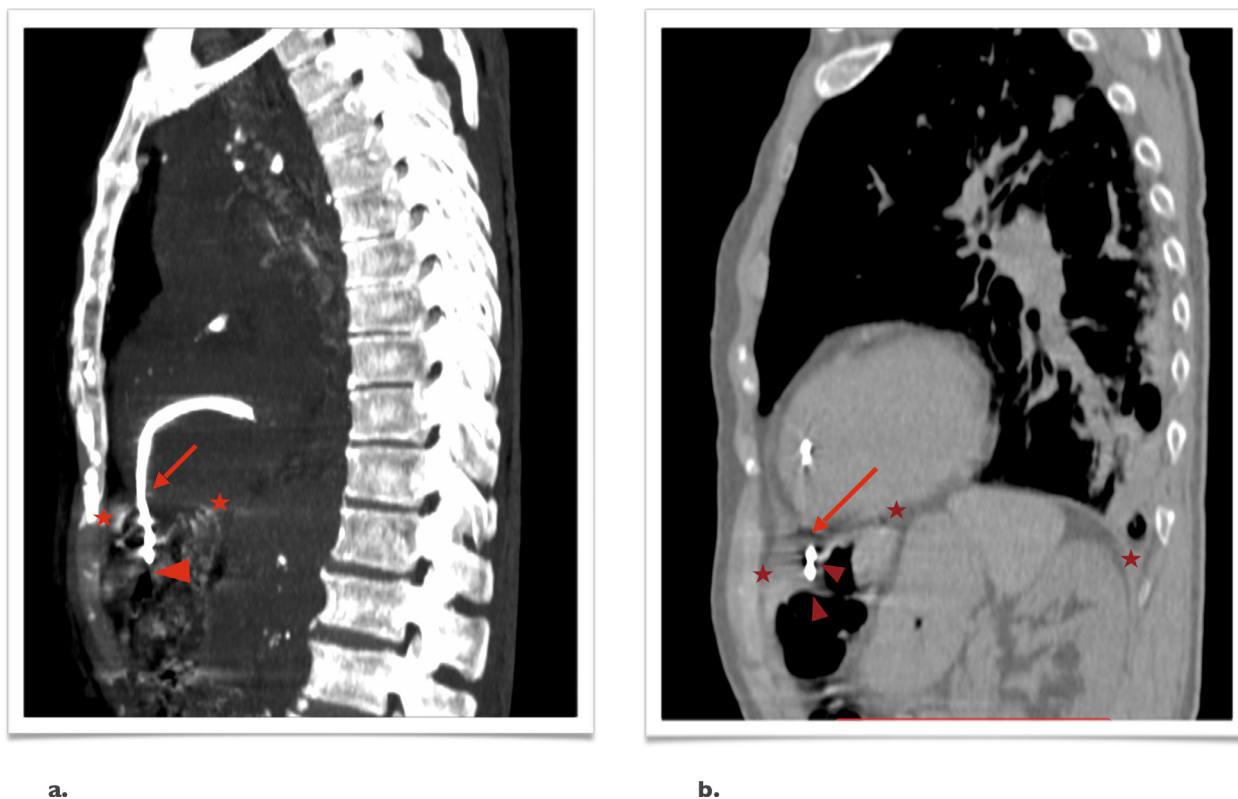


Fig. 2 – (A) Sagittal Maximal Intensity Projection (MIP) CT image showing the pacing lead going through the right ventricle (arrow) and the diaphragm (stars) with tip in the peritoneal cavity (arrowhead). (B) Sagittal non-enhanced CT image showing the pacing lead going through the right ventricle (arrow) and the diaphragm (stars), in close relation to distal transverse colon wall (arrowheads).

pericardial effusion, with one of the pacing leads seen going through the right ventricle. The patient remained stable in the immediate postprocedure period, and was taken for an emergent CT (computed tomography) to locate the position of the pacing leads for any appropriate surgical management, if necessary.

Imaging

CT imaging of the chest and abdominal regions was done using a 16-slice CT-scanner (Somatom Emotion, Siemens Healthcare GmbH, Germany) using the standard non-contrast protocol. Imaging revealed a linear hyper-dense structure (pacing lead) traveling via the inferior vena cava into the right ventricle and seen coursing along the inferior wall of right ventricle of the heart, crossing through it at the apex and crossing the underlying diaphragmatic outline, into the peritoneal cavity. The tip of the pacing lead was seen lying in close proximity to the distal one-third of the transverse colon in the surrounding fat, with no evidence of bowel perforation. The pleural, pericardial, and peritoneal cavities showed no significant dependent hypo-attenuating areas suggestive of a hemorrhagic fluid collection. The diaphragm was symmetrical in position with no areas of focal thickening, and the mediastinal region did not show any signs of hemorrhage. Lung parenchyma, abdominal solid organs including liver, spleen, and pancreas showed

no signs of a laceration or hematoma. A study impression of a right ventricular perforation secondary to transvenous pacing lead insertion via the right femoral vein, with associated diaphragmatic perforation, with an intraperitoneal position of the pacing lead, was made. [Figs. 1–4.](#)

Postimaging patient course

Cardio-thoracic and Vascular Surgery (CTVS) consult was sought and recommended percutaneous manipulation and transvenous removal of the perforating leads in the operating room under general anesthesia and fluoroscopic guidance in the early post-procedure period [9,10]. The procedure was carried out synergistically by cardiology, critical care, and CTVS services, with no complications, with the patient remaining hemodynamically stable throughout the procedure. Immediate and interval postprocedure point-of-care ultrasound revealed no pericardial effusion, no decrease in ejection fraction, and no abdominal or pleural free fluid in the dependent regions. The POCUS scans were repeated initially at 15-minute timed intervals for 1 hour, followed by hourly scans for 4 hours, with subsequent scans showing a nonprogressing mild pericardial effusion with an unchanged ejection fraction of 50%. The patient was then shifted to the general wards for observation and further conservative medical management by the cardiology services. The patient

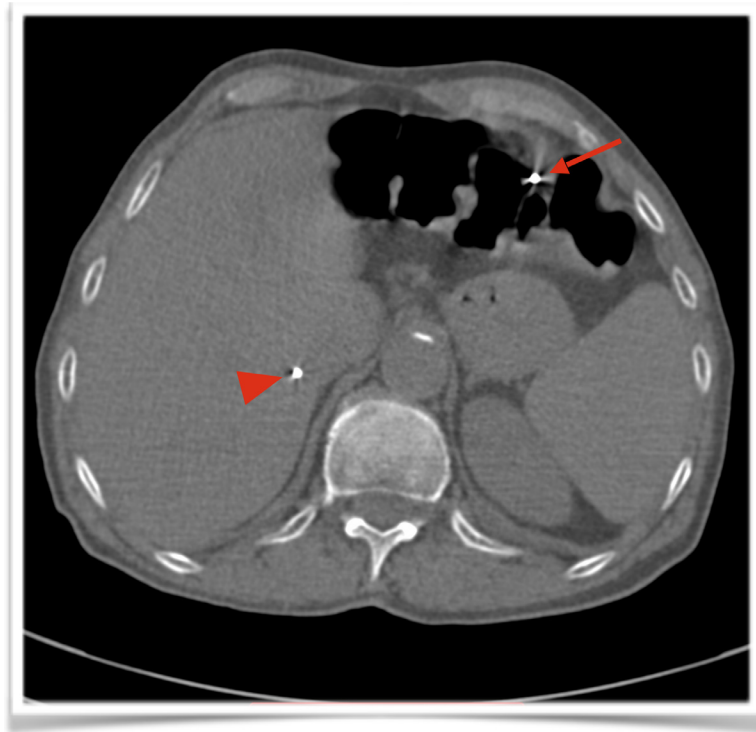


Fig. 3 – Axial nonenhanced CT image at the level of L1 vertebra showing the pacing the lead in the inferior vena cava (arrowhead) and the distal end (arrow) of the pacing lead in the peritoneal cavity.

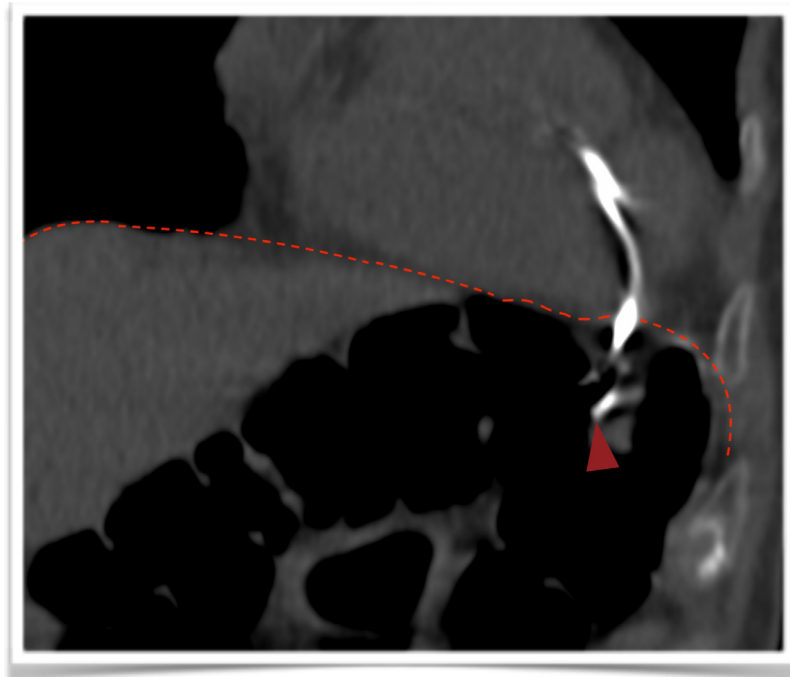


Fig. 4 – Image showing diaphragmatic line (dotted red line) and the pacing lead coursing through. The tip is seen in pericolic fat (arrowhead). No typical signs of diaphragmatic rupture are seen [7].

remained stable during conservative management for a period of 15 days and was on continuous cardiac monitoring accompanied by regular point-of-care echo examinations throughout this period. After that a permanent pacemaker placement was achieved on the 16th day and the patient was discharged for out-patient follow-up. The patient remains on cardiology follow-up at the time of publication.

Discussion

Temporary transvenous pacing is generally considered a safe procedure with a very small major complication rate [4,5]. Life-threatening complications, including ventricular arrhythmias, septicemia, and cardiac perforation, which is presented here, are relatively rare [2–4]. Imaging outline of a normal diaphragmatic dome is usually difficult to delineate unless a pathology, especially a space-occupying lesion, or thickening is associated with the diaphragm [7]. Diaphragmatic perforation during temporary transvenous pacing is very rare, with a PubMed search using “diaphragmatic perforation and temporary transvenous pacing” returning no citable reports. In the presented case, we have demonstrated the diaphragmatic dome by delineation of the diaphragmatic and bowel outlines using sequential images. Blunt and penetrating traumatic diaphragmatic injury is associated with a number of demonstrable CT signs with a focal discontinuity being the most common finding [7,8]. In the presented images, a focal discontinuity in the left diaphragmatic dome is depicted with no associated thickening and minimal stranding in the pericolic fat. The pacing leads have a steel core with a polyurethane coating, with a balloon at the tip to facilitate flow-guided placement, explaining the hyper-dense appearance on CT. The imaging was acquired in the immediate postperforation time period which possibly explains the absence of significant focal thickening or signs of anatomical disturbance [8] in the diaphragm at the time of injury. Pericardial tamponade associated with cardiac perforation following TTP has been seen increasing in incidence over time, which has been attributed to female sex, in-hospital cardiac arrest, and teaching hospital status, whereas a history of CABG was associated with lower risk [5]. The association of teaching hospital status such as our institute, with pericardial tamponade, suggests that operator experience is important to minimize procedural complications [5,6].

Patient consent

Informed consent was acquired from the patient guardian/next of kin by relation before every procedure involved, when applicable.

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