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Shift From Left to a Right Bundle Block on ECG Leading to the Diagnosis of a Malpositioned Lead in the Coronary Sinus: A Case Report

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Abstract

On electrocardiography (ECG), ventricular pacing appears as a spikes that precede induced QRS complexes. The induced complexes with a right ventricular lead have the morphology of a left bundle branch block (LBBB). We describe a case of malposition right ventricular (RV) lead in the coronary sinus diagnosed based on the changes noted in the ECG tracing. An 80-year-old man with a pacemaker implanted for high-grade AV block was found unresponsive. Six minutes of cardiopulmonary resuscitation resulted in return of spontaneous circulation. The ECG demonstrated a new paced right bundle branch block (RBBB) pattern. Chest radiography revealed a misplaced right ventricular (RV) lead in the coronary sinus which was confirmed by 2D-echocardiography. The patient's healthcare proxy (HCP) declined invasive interventions. The patient expired due multiorgan failure secondary to ventilator associated pneumonia. When an RBBB pattern is seen with RV pacing, patients must be evaluated for mispositioning of the RV lead navigation through an atrial septal defect (ASD) or perforation of the ventricular septum, aberrant retrograde conduction, pre-existing right bundle disease and the "pseudo-RBBB" pattern (seen with the ventricular lead placed in the RV apex/distal septum). A frontal axis of 0° to 90° and precordial transition by lead V3 differentiates RV septal pacing from all fonns of LV pacing, including lead placement in the coronary sinus. Our patient had precordial transition at V3.

Keywords

dual-chamber pacemaker; bradyarrhythmia; right lead perforation; right bundle branch pattern; pseudo-RBBB

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1. Introduction

A cardiac pacemaker is a device that generates artificial electrical impulses to restore and/or maintain a normal heart rate and rhythm, ft also enables the operator to interrogate and control the pacing rate, the pulse width, and the voltage of the impulses delivered [1]. A dual-chamber pacemaker consists of two parts: a power source or generator that generates electrical impulses and transvenous pacing leads placed in the right atrial appendage (RA) and the right ventricle (RV) [2]. The atrial lead is placed in the right atrial appendage and the ventricular lead at the apex of the right ventricle [2,3]. The most common indication for pacemaker implantation is symptomatic bradyarrhythmias. These arrhythmias may be secondary to sinus node dysfunction, high-grade atrioventricular block, bifascicular block, or sick sinus syndrome [4]. Dual-chamber pacemakers can sense the underlying cardiac rhythm and pace the RA, RV or both the chambers with the goal of maintaining the heart rate above a prograimned threshold while preserving atrioventricular synchrony [2,3,4]. On an electrocardiogram (ECG), atrial pacing appears as spikes that precede the induced P waves, while ventricular pacing appears as a spike that precede the induced QRS complexes. The induced ventricular complexes have the morphology of a left bundle branch block (LBBB) [5]. Though rare, complications related to cardiac pacemaker implantation include lead misplacement, infection, pneumothorax, myocardial perforation, venous thrombosis, and erosion [6]. We describe a case of a malpositioned ventricular lead in the coronary sinus after cardiopulmonary resuscitation (CPR) in an 80-year-old man with a dual chamber pacemaker. The QRS complexes had a Right Bundle Branch (RBBB) morphology on ECG.

2. Case Report

An 80-year-old man with a history of diabetes, hypertension, hyperlipidemia, coronary artery bypass graft, Alzheimer’s disease, and permanent pacemaker implantation for a high-grade AV block was found unresponsive at home. Emergency medical services initiated CPR for pulseless electrical activity and ROSC was achieved six minutes into resuscitation. The patient was also intubated on the field for airway and was started on vasopressors for hypotension. On arrival to the emergency room, the patient was afebrile, had a heart rate of 60 beats per minute and a blood pressure of 143/58 mm of Hg. No gross abnormality was noted on physical examination. A diagnosis of a non-ST segment myocardial infarction (NSTEMI) was established after ST-segment depressions were noted in leads V2 to V5 on ECG (Figure 1) and serum troponin level was found elevated at 15.8 ng/mL. The patient underwent a computed tomography scan of the head, which ruled out an acute intracranial hemorrhage, and subsequently was started on dual antiplatelet therapy, high intensity statins and full-dose anticoagulation. Patient was also placed on hypothermia protocol. The patient’s pacemaker was interrogated, and revealed a normal working pacemaker with acceptable impedance, sensitivity, and thresholds of the RA and RV leads. On day three of his hospitalization, the ECG revealed a paced rhythm but now with a RBBB QRS morphology, with extreme (northwest) axis deviation and a QS pattern in lead I (Figure 2). The RBBB pattern was also detected upon asynchronous pacing when a magnet was placed over the can of the permanent pacemaker (Figure 3). This was concerning for possible RV lead perforation into the left ventricle. A Chest X-ray revealed a misplaced RV lead in the coronary sinus (Figure 4). A transthoracic echocardiogram confirmed the presence of the

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RA lead in the right atrial appendage and the misplacement RV lead in the coronary sinus. No intervention to correct the displaced RV lead was performed as the HCP opted to defer any surgical intervention for the patient.

On day four of hospitalization the patient developed a fever of 102.8^0 F. Chest radiograph demonstrated a new opacity in the right lower lobe. Treatment with piperacillin-tazobactam, levofloxacin and vancomycin for a suspected ventilator associated pneumonia was initiated. Despite the antibiotic regimen, his oxygen and vasopressor requirements continued to escalate. Chest imaging evolved to bilateral pulmonary opacities compatible with acute respiratory distress syndrome (ARDS). Over the next two days, he progressed to severe ARDS and developed acute renal failure. While discussing the possibility of continuous renal replacement therapy and his overall prognosis with HCP, a decision was made to terminate all resuscitative efforts and the patient was terminally extubated on day nine of the hospitalization.

3. Discussion

On ECG, RV pacing normally results in a QRS morphology similar to that of a LBBB, whereas left ventricular pacing result in a QRS morphology similar to that of a RBBB [7,8]. When an ECG reveals a RBBB pattern when RV pacing is intended patients must be evaluated for malpositioning of the RV lead with a chest X-ray and an echocardiogram. The right ventricular lead can potentially navigate through an atrial septal defect and the left atrium and be positioned in the left ventricle, resulting in inadvertent pacing of the left ventricle and consequently a RBBB pattern on ECG. [9]. A RBBB pattern can also be seen if the ventricular lead is erroneously placed in the arterial system instead of the venous system, resulting in trans-arterial pacing of the left ventricle [10–14]. Unintended trans-arterial LV pacing can sometimes have deleterious consequences, such as acute myocardial infarction due to lead placement in a coronary artery [13] or stroke secondary to an arterial thromboembolism [14]. Also, an RBBB pattern on ECG can result when the ventricular lead perforates the interventricular septum and enters the left ventricle [7].

A RBBB QRS morphology may also appear in a normally placed RV lead. Klein et al. described the “pseudo-RBBB” pattern seen with an RV lead as an RBBB pattern in leads V1 and V2 but a LBBB pattern in lead I [15]. This unique pattern is not due to a mispositioning of the RV lead but appears when the ventricular lead is placed either in the RV apex or distal septum and is explained by the marked superior and slight anterior orientation of the main QRS complex in right ventricular pacing. The pseudo-RBBB pattern resolves when the V1 and V2 leads are placed one costal space lower than the standard placement [16]. This pseudo-RBBB pattern is not position-dependent and did not disappear on ECG when the ventricular lead was repositioned to the mid-interventricular septum. This pseudo-RBBB pattern was the result of RV depolarization preceding LV depolarization [15,17]. If a pseudo-RBBB pattern is seen on EKG and a proximal or mid-interventricular septal lead placement has been ruled out, one can differentiate between RV and LV pacing using an algorithm developed by Coman et al [17]. Their analysis demonstrated that a frontal axis of °0to 90° and precordial transition by V3 differentiates RV septal pacing from all forms of

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LV pacing, including lead placement in the coronary sinus. They describe their algorithm to yield an 86% sensitivity, 99% specificity, and 95% positive predictive value [17].

Pseudo-RBBB and RBBB morphologies of QRS complexes may appear in correctly placed ventricular leads due to pre-existing conduction abnormalities in the heart. Specifically, abnormal circuitry in the interventricular septum may result in LV depolarization followed by RV depolarization [18]. RBBB patterns in RV pacing may appear secondary to an aberrant retrograde impulse conduction that circles through right branch, the atrioventricular node and finally through the left bundle, resulting in a relatively earlier LV depolarization [18]. RBBB morphology of the QRS complex may also appear due to portions of right-sided interventricular septum mimicking the left ventricle mechanically and electrically [19]. Finally, pre-existing RBBB and severe right bundle disease are other conditions that result in RBBB of the QRS complex despite appropriate position of the right ventricular lead. In our case, the patient had an RBBB pattern and precordial transition at V3. The position of the lead in the coronary sinus was confirmed by echocardiography.

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References

[1]. Puette JA, Ellison MB. Pacemaker. [Updated 2019 Mar 3]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2019 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK526001.

[2]. Castelnuovo E, Stein K, Pitt M, Garside R, Payne E. The effectiveness and cost-effectiveness of dual-chamber pacemakers compared with single-chamber pacemakers for bradycardia due to atrioventricular block or sick sinus syndrome: systematic review and economic evaluation. In NIHR Health Technology Assessment programme: Executive Summaries 2005. NIHR Journals Library.

[3]. Singh N, Madan H, Arora YK, Dutta R, Sofat S, Bhardwaj P, Sharma R, Chadha DS, Ghosh AK, Sengupta S. Malplacement of endocardial pacemaker lead in the left ventricle. Medical Journal, Armed Forces India. 2014 Jan;70(1):76. [PubMed: 24669072]

[4]. Nishimura RA, Symanski JD, Hurrell DG, Trusty JM, Hayes DL, Tajik AJ. Dual-chamber pacing for cardiomyopathies: a 1996 clinical perspective. In Mayo Clinic Proceedings 1996 Nov 1 (Vol. 71, No. 11, pp. 1077–1087). Elsevier. [PubMed: 8917293]

[5]. Coman JA, Trohman RG. Incidence and electrocardiographic localization of safe right bundle branch block configurations during permanent ventricular pacing. The American journal of cardiology. 1995 Oct 15;76(11):781–4. [PubMed: 7572654]

[6]. Link MS, Estes NM, Griffin JJ, Wang PJ, Maloney JD, Kirchhoffer JB, Mitchell GF, Orav J, Goldman L, Lamas GA. Complications of dual chamber pacemaker implantation in the elderly. Journal of Interventional Cardiac Electrophysiology. 1998 Jun 1;2(2):175–9. [PubMed: 9870010]

[7]. Stillman MT, Richards AM. Perforation of the interventricular septum by transvenous pacemaker catheter: Diagnosis by change in pattern of depolarization on the electrocardiogram*. American Journal of Cardiology. 1969 Aug 1; 24(2): 269–73. [PubMed: 5799087]

[8]. Ormond RS, Rubenfire M, Anbe DT, Drake EH. Radiographic demonstration of myocardial penetration by permanent endocardial pacemakers. Radiology. 1971 Jan; 98(1): 35–7. [PubMed: 5541430]

[9]. Winner SJ, Boon NA. Transvenous pacemaker electrodes placed unintentionally in the left ventricle: three cases. Postgraduate medical journal. 1989 Feb 1; 65(760): 98–102. [PubMed: 2780472]

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[10]. Malick Bodian FA, Bamba MN, Kane A, Jobe M, Tabane A, Mbaye A, Sarr SA, Diao M, Sarr M, Bâ SA. Sinus venosus atrial septal defect: a rare cause of misplacement of pacemaker leads. International medical case reports journal. 2013;6:29. [PubMed: 23847433]

[11]. MAZZETTI H, DUSSAUT A, TENTORI C, DUSSAUT E, LAZZARI JO. Transarterial permanent pacing of the left ventricle. Pacing and Clinical Electrophysiology. 1990 May 1;13(5):588–92. [PubMed: 1693195]

[12]. Bajaj RR, Fam N, Singh SM. Inadvertent transarterial pacemaker lead placement. indian heart journal. 2015 Sep 1; 67(5): 452–4. [PubMed: 26432733]

[13]. Issa ZF, Gill JB. Transarterial pacemaker lead implantation results in acute myocardial infarction. Europace. 2010 Jul 1; 12(11): 1654–5. [PubMed: 20601362]

[14]. ASLAM AA, McILWAIN EF, TALANO JV, FERGUSON TB, McKINNIE JA, KERUT EK. An unusual case of embolic stroke: a permanent ventricular pacemaker lead entirely within the arterial system documented by transthoracic and transesophageal echocardiography. Echocardiography. 1999 May 1; 16(4): 373–8. [PubMed: 11175163]

[15]. Klein HO, Beker B, Sareli P, DiSegni E, Dean H, Kaplinsky E. Unusual QRS morphology associated with transvenous pacemakers: the pseudo RBBB pattern. Chest. 1985 Apr 1; 87(4): 517–21. [PubMed: 3979141]

[16]. Erdogan O, Aksu F. Right bundle branch block pattern during right ventricular permanent pacing: Is it safe or not?. Indian pacing and electrophysiology journal. 2007 Jul; 7(3): 187. [PubMed: 17684578]

[17]. Coman JA, Trohman RG. Incidence and electrocardiographic localization of safe right bundle branch block configurations during permanent ventricular pacing. American Journal of Cardiology. 1995 Oct 15; 76(11): 781–4. [PubMed: 7572654]

[18]. Lister JW, Klotz DH, Jomain SL, Stuckey JH, Hoffman BF. Effect of pacemaker site on cardiac output and ventricular activation in dogs with complete heart block. The American journal of cardiology. 1964 Oct 1; 14(4): 494–503. [PubMed: 14215060]

[19]. Mower MM, Aranaga CE, Tabatznik B. Unusual patterns of conduction produced by pacemaker stimuli. American heart journal. 1967 Jul 1; 74(1): 24–8. [PubMed: 6027566]

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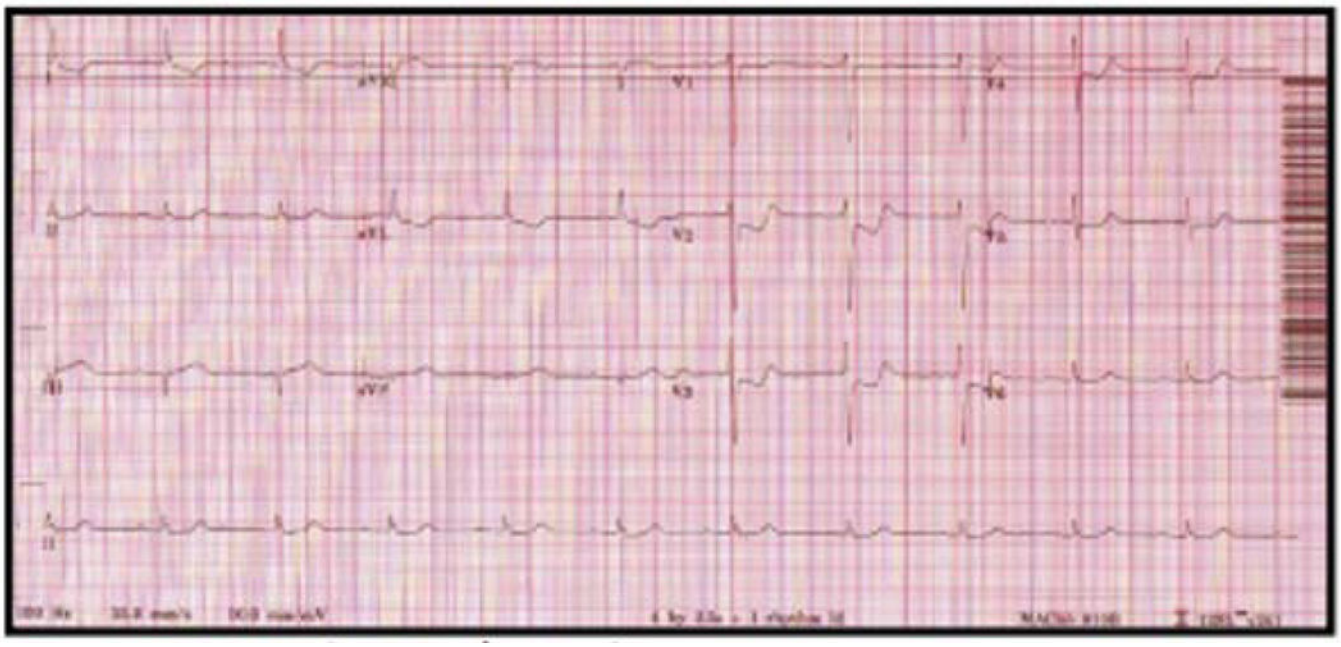

Figure 1.
Initial EKG showing normal sinus rhythm, note ST-Segment depression in lead V2- V3

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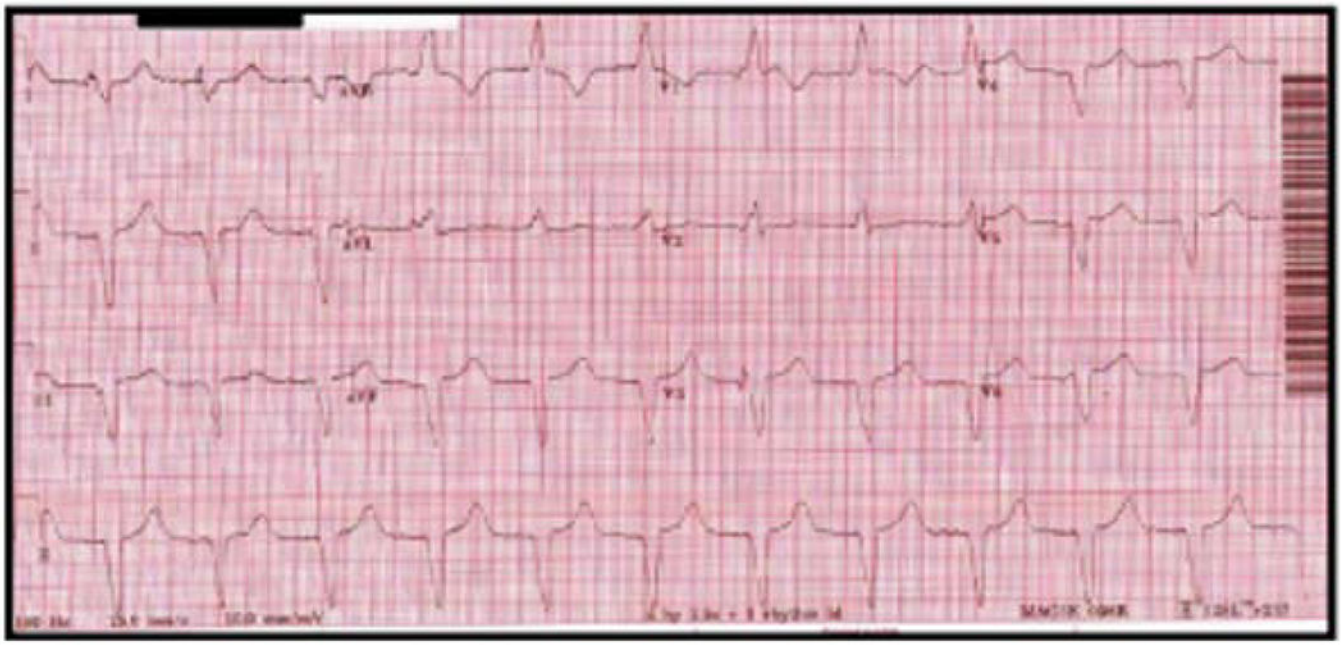

Figure 2.
EKG showing RBBB pattern with RV pacing

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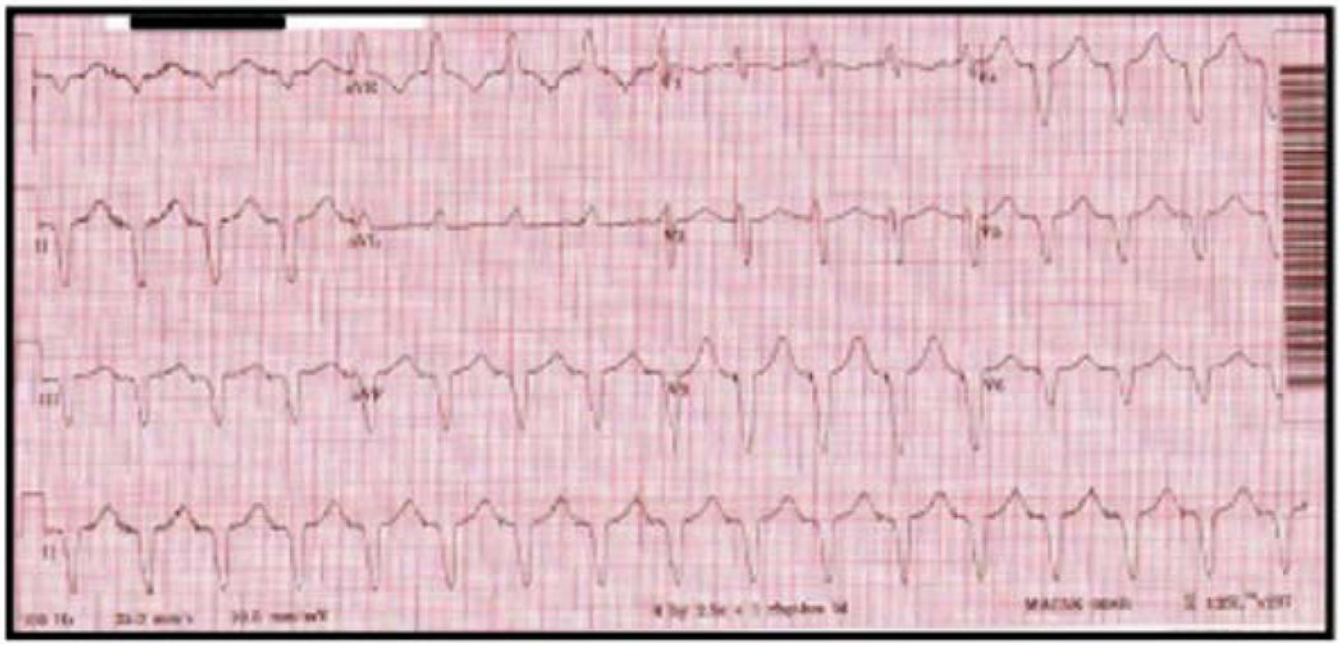

Figure 3.
EKG with asynchronous pacing (with magnet on the pacemaker) showing RBBB

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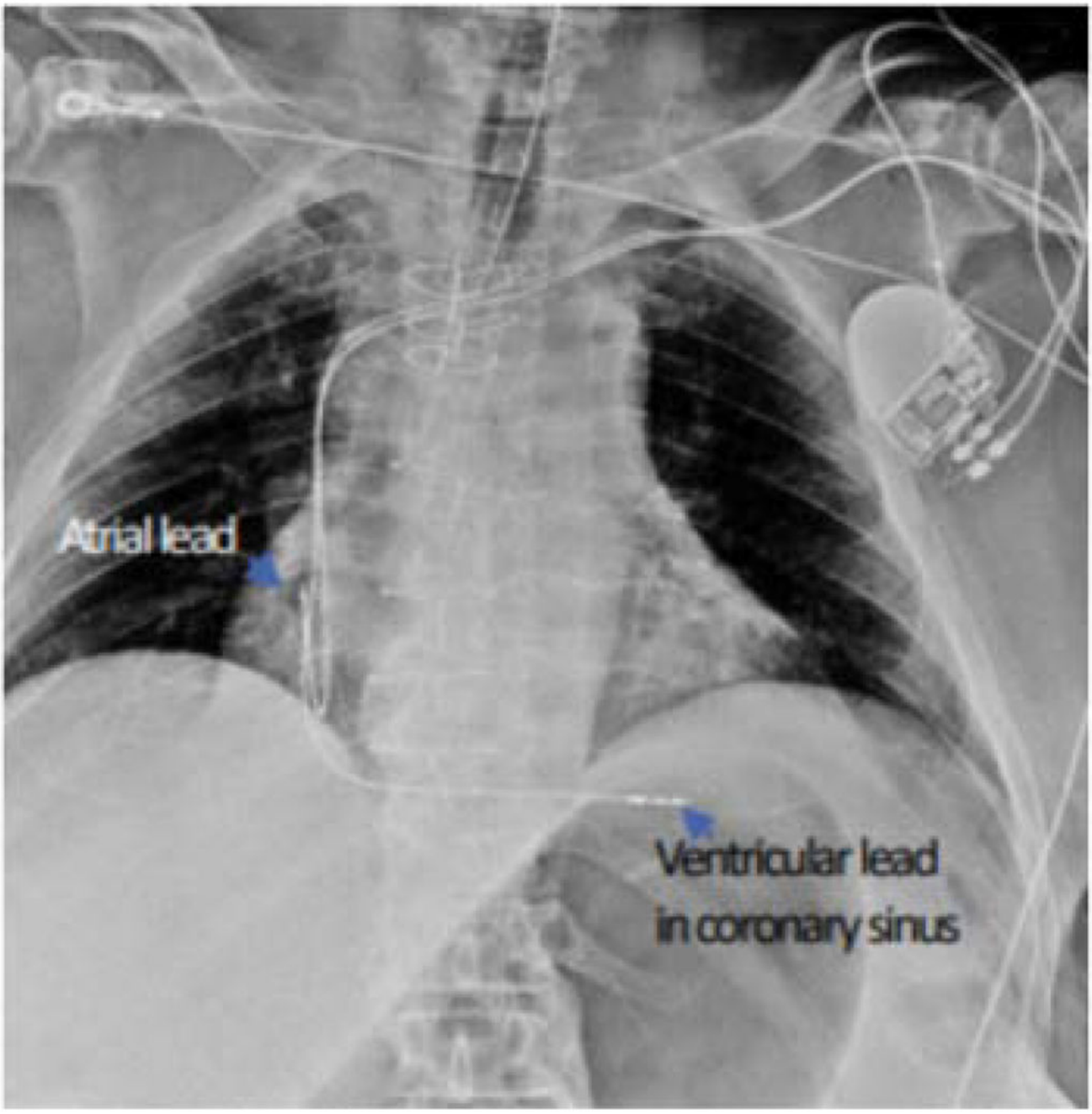

Figure 4.
Chest X ray showing mispositioned right ventricular lead in the coronary sinus