Risk for contralateral pneumothorax, pneumopericardium, and pneumomediastinum in the elderly patient receiving a dual-chamber pacemaker—A case report of 2 patients with acute and chronic atrial lead perforation

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Introduction

Contralateral pneumothorax from placement of an endocardial right atrial (RA) lead is a rare complication that has been cited in select case reports where the majority of cases were successfully managed conservatively without requiring removal of the atrial lead. We present case reports of 2 elderly patients (>80 years old) who suffered contralateral pneumothorax caused by RA lead perforation that failed conservative management.

KEY TEACHING POINTS

- Contralateral pneumothorax due to micro or macro right atrial lead perforation is a rare complication of dual-chamber pacemaker insertion.
- Conservative management has been insufficient in half the reported cases.
- Clinical deterioration can occur up to 28 days postimplant, necessitating lead removal, and the risk of significant complication appears to be low.
- Chest computed tomography appears to provide the best diagnostic sensitivity for diagnosis and management.

Case report

Case 1

An 81-year-old male patient with a history of hypertension, cerebral meningioma, and Alzheimer disease presented with recurrent dizziness, a new left bundle branch block, and Mobitz type II. He underwent a dual-chamber pacemaker (Medtronic Azure XT DR MRI SureScan; Medtronic, Minneapolis, MN) insertion via left subclavian vein for symptomatic bradycardia. A right ventricular (RV) transvenous pacemaker lead (active fixation, Medtronic 3830-69 cm, MR Conditional; Medtronic) was positioned in the His bundle position. A RA transvenous pacemaker lead (active fixation, Medtronic 5076-52 cm, MRI Conditional; Medtronic) was implanted in the RA appendage position. Acceptable lead measurements were observed postimplantation (sensing 3 mV, impedance 602 Ω, and pacing threshold 2.3 V @ 0.5 ms). Postoperative fluoroscopy and chest radiography (CXR) were unremarkable. Within 24 hours postprocedure the patient developed sudden new-onset chest pain with new oxygen requirement. Minimal air movement in the right lung field was noted on physical examination without evidence of subcutaneous air. Repeat CXR was performed and demonstrated a large right-sided pneumothorax (Figure 1). The lead position was unchanged from postimplant films. RA lead impedance, sensing, and capture threshold were unchanged from postimplant values. A right-sided thoracostomy tube was placed. A computed tomographic (CT) chest examination was performed to evaluate RA lead placement and demonstrated a moderate amount of pneumopericardium from possible RA lead perforation through the anterior atrial wall into right pleural space (Figure 2). Conservative management was pursued and the thoracostomy tube was removed after resolution of the pneumothorax. Unfortunately, pneumothorax recurred, requiring tube reinsertion. A decision was made to remove the lead without replacement. Prior to removal, pacemaker interrogation was performed and demonstrated no significant difference in bipolar (tip to ring, 1.625 V at 0.4 ms threshold, 1.6 mV sensing, 361 Ω) or unipolar (tip to can, 1.25 V at 0.4 ms threshold, 1.6 mV sensing, 266 Ω) measurements for the RA lead. After RA lead removal the patient reported

KEYWORDS Pacemaker; Pneumothorax; Perforation; Pneumopericardium; Contralateral; Dual chamber; Active fixation; Passive fixation
(Heart Rhythm Case Reports 2023;9:680–684)

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https://doi.org/10.1016/j.hrcr.2023.07.004

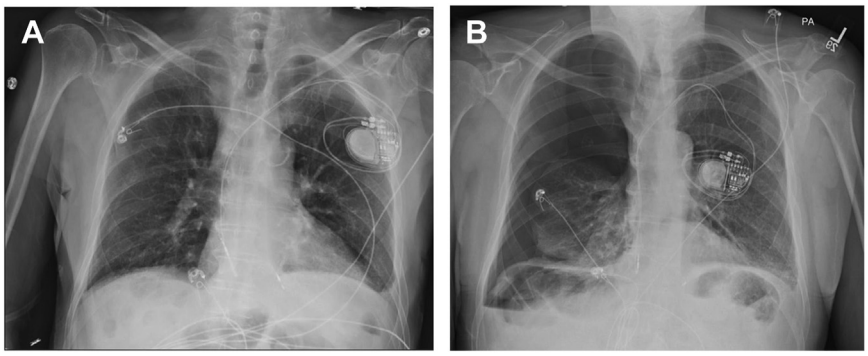

Figure 1 Chest radiography in anteroposterior (left) view. **A:** Image at device implantation conclusion, without hemopneumothorax. **B:** Image at 24 hours postprocedure, with large contralateral right-sided pneumothorax with lung collapse. Note there is no translocation observed in either right atrium or right ventricle lead position from time of implant.

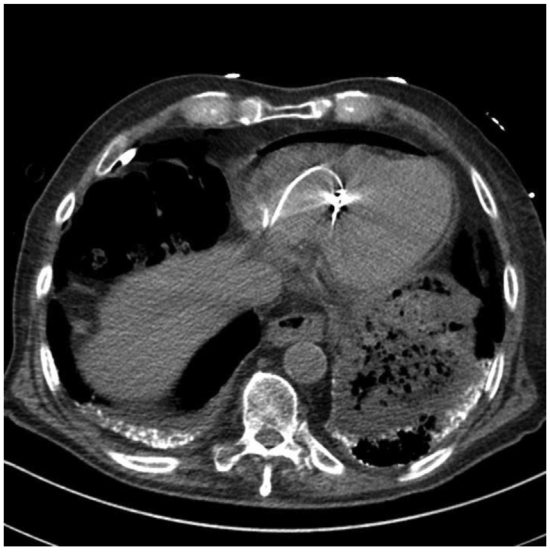

Figure 2 Computed tomography of the chest with pneumoperitoneum and atrial lead position.

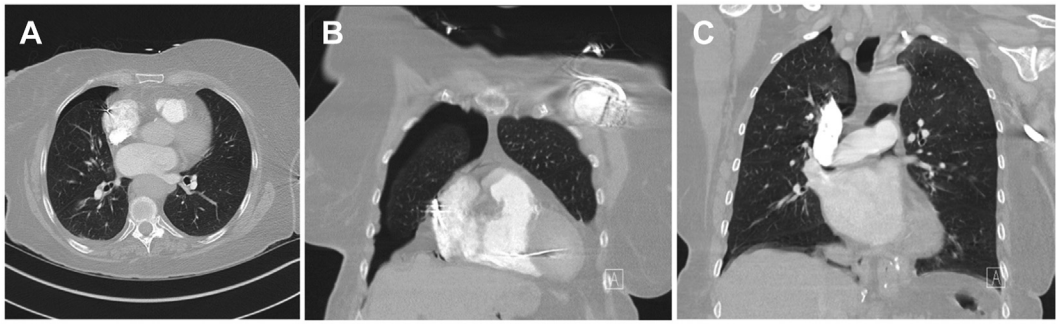

Figure 3 **A:** Axial chest computed tomography (CT) demonstrating contralateral pneumothorax. **B:** Coronal chest CT demonstrating lead tracking into contralateral pleural space **C:** Pneumomediastinum resulting from right atrial lead perforation

Table 1 Summary of case reports describing contralateral pneumothorax after right atrial lead placement

Primary author	Date	Age & sex	Lead position (RA)	Vein	Event	Useful modality contributing to diagnosis[†]				Micro- vs macro-dislodgement	Treatment	Signs/symptoms	Lead manufacturer
						CXR	CT chest	TTE	Device				
Ho[1] (Initial case report)	1999	79 F	-	Subclavian	4 hours	Y	-	N	Y	Macro	Chest tube, lead replacement	SOB	MDT
Srivathsan[2]	2003	77 F	AL	Subclavian	8 hours	Y	Y	-	-	Macro	Chest tube, lead extraction	SOB	MDT
Sebastian[3]	2005	73 M	AL	Cephalic	2 days	Y	Y	-	N	Macro	Chest tube	Pleuritic CP	MDT
Yada[4]	2008	83 M	AL	Axillary	1 day	Y	Y	N	-	Macro	Observation, oxygen	Pleuritic CP	BSX
Pettemerides[5]	2011	63 M	AL RAA	Subclavian	12 hours	Y	N	N	Y	Micro	Chest tube, oxygen	SOB	MDT
Kowara[6]	2017	86 M	AL RAA	Subclavian	5 hours	Y	-	-	N	Macro	Oxygen, chest tube	SOB CP	MDT
Ishizue[7]	2017	67 M	AL	Subclavian	4 days	Y	Y	N	N	Macro	Observation	Asymptomatic	SJM
Nantsupawat[8]	2018	83 M	AL	Axillary	1 day	N	Y	N	N	Macro	Observation, oxygen	Pleuritic neck and jaw pain	BSX
Our case	*2016*	*81 M*	*AL RAA*	*Subclavian*	*2 days*	*Y*	*Y*	*N*	*N*	*Micro*	*Oxygen chest tube, lead extraction*	*SOB CP*	*MDT*
Our case	*2021*	*83 F*	*AL RAA*	*Subclavian*	*1 day*	*Y*	*Y*	*N*	*N*	*Micro*	*Oxygen, lead extraction*	*SOB CP*	*BIO*

AL = anterolateral right atrium; BIO = Biotronik; BSX = Boston Scientific; CP = chest pain; CT = computed tomography; CXR = chest radiography; MDT = Medtronic; RA = right atrium; RAA = right atrial appendage; SJM = St Jude/Abbott; SOB = shortness of breath, TTE = transthoracic echocardiogram.

[†]Usefulness of diagnostic modalities evaluated to determine micro- vs macro dislodgment (Y = yes, N= no) included CXR, chest CT, TTE, and pacemaker device interrogation ("Device") parameters including lead sensing, impedance, and capture of the right atrial lead.

feeling well, without recurrent symptoms, and a repeat CXR demonstrated no residual pneumothorax.

Case 2

An 83-year-old female patient with a history of mild left ventricular dysfunction (ejection fraction of 45%–50%), gastrointestinal stromal tumor, gastroesophageal reflux disease, and a history of dizziness presented with new syncope in the setting of progressive conduction disease with prolonged PR interval and bifascicular block. She underwent implantation of a dual-chamber pacemaker (Biotronik 394969 Eluna 8 DR-T; Biotronik, Berlin, Germany) with insertion via left subclavian vein for symptomatic irreversible bradycardia. An RV transvenous lead (active fixation, Biotronik Setrox S 60 cm Bipolar; Biotronik) was implanted into the RV apex. Subsequently, an RA transvenous lead (active fixation, Biotronik Setrox S 53 cm bipolar; Biotronik) was positioned into the RA appendage. Acceptable lead measurements were observed postimplantation (sensing 1.1 mV, impedance 565 Ω, pacing threshold 0.8 V at 0.4 ms). Immediate postimplant CXR was unremarkable except for a questionable small left-sided pleural effusion. The next day the patient developed new chest pain with new oxygen requirement and repeat CXR demonstrated a new small right pneumothorax without change in the RA lead position. Cardiac surgery deferred thoracostomy tube and the patient was discharged home without oxygen. However, the patient developed recurrent dyspnea and increased small right pleural effusion within 1 week of discharge. Ultrasound-guided thoracentesis removed 500 cc of serosanguinous fluid. Ibuprofen and colchicine were started for presumed pleural inflammation. CT scan demonstrated no definitive extension of the RA lead through the RA wall. Approximately 25 days after implant, the patient experienced an acute onset of right-sided chest pain and dyspnea. Repeat CT performed showed an increase in the right pneumothorax with new mediastinal air tracking from the RA lead perforation (Figure 3). The RA lead was removed without replacement and the patient was discharged a few days after the procedure with an uncomplicated postoperative course.

Discussion

Including the cases in this report, the literature to date has demonstrated 10 cases of contralateral pneumothorax attributed to RA lead perforation in dual-chamber pacemaker implantation (Table 1).[1–10] The average age was 79 years (range 67–86 years) and more than 50% of the individuals were 80 years or older, suggesting that age is a risk factor.[11] One patient was on corticosteroid therapy.[7] Every patient in the literature had an active fixation lead implanted in the anterolateral right atrium or appendage and the majority presented within the first 48 hours postimplant. In most instances, it has been suggested that conservative treatment without removal of the RA lead is a viable option for treatment, especially for micro-dislodgement. The cases of micro-dislodgement presented in this report add to the literature, as they illustrate failure of such conservative management with the possibility of clinical deterioration up to 25 days postimplant. In instances of lead removal, there were no reports of cardiac tamponade or mediastinal bleeding.

Several mechanisms have been proposed to cause contralateral pneumothorax, including incidental right pleural puncture after crossing through a left vein puncture, extrusion of the atrial lead through the RA appendage causing pleural irritation, direct lung puncture via atrial wall perforation (with or without pleural effusion), and spontaneous bullae rupture (in chronic obstructive pulmonary disease on steroids).[5] Clinical lead perforation is rare, with a reported incidence of 0.1%–0.8%.[12,13] Interestingly, rates of subclinical atrial lead perforation have been reported as high as 15% based on CT scans.[14] Overturning the atrial lead can increase the risk of perforation, and care should be taken with implant. In case studies, the majority demonstrated RA lead perforation as the primary mechanism of injury and resulting sequelae. In cases where macro-dislodgement occurred, the lead could be directly visualized perforating into the lung pleura or adjacent mediastinal or venous structures.[4] In cases where micro-dislodgement occurred, associated sequelae of pneumopericardium and pneumomediastinum were seen in addition to the contralateral pneumothorax.

Though transthoracic echocardiogram, CXR, and device interrogation may be supportive in the diagnosis of sequelae, their true diagnostic yield is suboptimal at best, with device interrogation providing little to no utility in the diagnosis. With suspicion of RA lead perforation, chest CT provides what appears to be the greatest sensitivity, and in some cases specificity, of the RA lead mechanism of injury. If atrial pacing is needed, passive fixation endocardial leads may be an appropriate option to avoid further injury.[15]

Conclusion

Contralateral pneumothorax, although a rare complication, can occur in patients undergoing dual-chamber pacemaker insertion. Although conservative management with respect to removal of the existing RA lead has been successful, clinical deterioration can occur up to 28 days postimplant, requiring lead removal. In such cases, the risk of cardiac tamponade and significant mediastinal bleeding appears to be low.

Funding Sources: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-project sectors.

Disclosures: There are no conflicts of interest to disclose for any author.

References

1. Ho WJ, Kuo CT, Lin KH. Right pneumothorax resulting from an endocardial screw-in atrial lead. Chest 1999;116:1133–1134.
2. Srivathsan K, Byrne RA, Appleton CP, Scott LR. Pneumopericardium and pneumothorax contralateral to venous access site after permanent pacemaker implantation. Europace 2003;5:361–363.

3. Sebastien CC, Wu W-C, Shafer M, Choudhary G, Patel PM. Pneumopericardium and pneumothorax after permanent pacemaker implantation. Pacing Clin Electrophysiol 2005;28:466–468.
4. Yada H, Sato T, Soejima K, et al. Pseudonormal position of an atrial pacemaker lead associated with a contralateral pneumothorax: where is the atrial lead? Circulation 2008;117:2297–2298.
5. Pettemerides V, Jenkins N. Contralateral pneumothorax following repositioning of an atrial lead. Europace 2012;14:606.
6. Kowara M, Zawadzki J, Michalak M, Kołodzińska A, Opolski G, Grabowski M. Pneumothorax after pacemaker implantation localized contralaterally to the side of implantation - rare, but possible complication. Heart Beat Journal 2018;2:46–48.
7. Ishizue N, Kishihara J, Niwano S, Ako J. Subacute pneumothorax contralateral to the venous access site associated with atrial lead perforation in a patient who was receiving corticosteroid therapy. J Arrhythm 2017;33:335–337.
8. Nantsupawat T, Li JM, Benditt DG, Adabag S. Contralateral pneumothorax and pneumopericardium after dual-chamber pacemaker implantation: mechanism, diagnosis, and treatment. HeartRhythm Case Rep 2018;4:256–259.
9. Kotsakou M, Kioumis I, Lazaridis G, et al. Pacemaker insertion. Ann Transl Med 2015;3:42.
10. Greenspon AJ, Patel JD, Lau E, et al. Trends in permanent pacemaker implantation in the United States from 1993 to 2009: increasing complexity of patients and procedures. J Am Coll Cardiol 2012;60:1540–1545.
11. Armaganijan LV, Toff WD, Nielsen JC, et al. Are elderly patients at increased risk of complications following pacemaker implantation? A meta-analysis of randomized trials. Pacing Clin Electrophysiol 2012;35:131–134.
12. Fahy GJ, Kleman JM, Wilkoff BL, Morant VA, Pinski SL. Low incidence of lead related complications associated with nonthoracotomy implantable cardioverter defibrillator systems. Pacing Clin Electrophysiol 1995;18:172–178.
13. Matsuura Y, Yamashina H, Higo M, Fujii T. Analysis of complications of permanent transvenous implantable cardiac pacemaker related to operative and postoperative management in 717 consecutive patients. Hiroshima J Med Sci 1990;39:131–137.
14. Hirschl DA, Jain VR, Spindola-Franco H, Gross JN, Haramati LB. Prevalence and characterization of asymptomatic pacemaker and ICD lead perforation on CT. Pacing Clin Electrophysiol 2007;30:28–32.
15. Liu L, Tang J, Peng H, et al. A long-term, prospective, cohort study on the performance of right ventricular pacing leads: comparison of active-fixation with passive-fixation leads. Sci Rep 2015;5:7662.