

# World Journal of *Clinical Cases*

*World J Clin Cases* 2019 December 26; 7(24): 4172-4425



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**RESPONSIBLE EDITORS FOR THIS ISSUE**

Responsible Electronic Editor: Ji-Hong Liu

Proofing Production Department Director: Yun-Xiaojuan Wu

**NAME OF JOURNAL**

*World Journal of Clinical Cases*

**ISSN**

ISSN 2307-8960 (online)

**LAUNCH DATE**

April 16, 2013

**FREQUENCY**

Semimonthly

**EDITORS-IN-CHIEF**

Dennis A Bloomfield, Bao-Gan Peng, Sandro Vento

**EDITORIAL BOARD MEMBERS**

<https://www.wjnet.com/2307-8960/editorialboard.htm>

**EDITORIAL OFFICE**

Jin-Lei Wang, Director

**PUBLICATION DATE**

December 26, 2019

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<https://www.wjnet.com/bpg/gerinfo/208>

**ARTICLE PROCESSING CHARGE**

<https://www.wjnet.com/bpg/gerinfo/242>

**STEPS FOR SUBMITTING MANUSCRIPTS**

<https://www.wjnet.com/bpg/GerInfo/239>

**ONLINE SUBMISSION**

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## Percutaneous management of atrium and lung perforation: A case report

Xu Zhou, Feng Ze, Ding Li, Xue-Bin Li

**ORCID number:** Xu Zhou (0000-0001-8417-2368); Feng Ze (0000-0001-9561-2402); Ding Li (0000-0001-5496-5092); Xue-Bin Li (0000-0002-8253-8490).

**Author contributions:** Li XB contributed to the conception and design of the work; Ze F and Li D collected the patient's clinical data; Zhou X analyzed the data and wrote the paper.

**Informed consent statement:** Consent was obtained from the patient for publication of this report and any accompanying images.

**Conflict-of-interest statement:** The authors declare that they have no conflicts of interest.

**CARE Checklist (2016) statement:** The manuscript was prepared and revised according to the CARE Checklist (2016).

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**Manuscript source:** Unsolicited manuscript

**Xu Zhou, Feng Ze, Ding Li, Xue-Bin Li,** Department of Cardiac Electrophysiology, Peking University People's Hospital, Beijing 100044, China

**Corresponding author:** Xue-Bin Li, PhD, Academic Fellow, Chief Doctor, Department of Cardiac Electrophysiology, Peking University People's Hospital, 11 Xizhimen South Street, Xicheng District, Beijing 100044, China. [lxbpku@163.com](mailto:lxbpku@163.com)

**Telephone:** +86-13701107107

**Fax:** +86-10-88325353

### Abstract

#### BACKGROUND

Cardiac perforation by a transvenous lead is an uncommon but serious complication. Delayed perforation, defined as migration and perforation of an implanted lead at least 1 mo after implantation, is exceedingly rare and prone to underdiagnosis, and its optimal management is currently unclear. We report an uneventful transvenous extraction of an active fixation lead that led to delayed perforation of the right atrium, pericardium, and lung, disclosed 2 mo after implantation.

#### CASE SUMMARY

A 61-year-old woman with atrial lead perforation was transferred to our center. She had a dual-chamber pacemaker with active fixation leads implanted 8 mo previously. At 2 mo after implantation, she complained of chest pain and hemoptysis. Chest computed tomography revealed atrial lead migration into the lung. No pericardial or pleural effusion was detected. She underwent transvenous lead extraction in the electrophysiology room with surgical backup. The percutaneous subxiphoid pericardial puncture was performed first, and a pigtail catheter was left in the pericardial sac throughout the procedure. Then, a new active fixation lead was implanted at a different site with less tension. After the active screw was retracted, the culprit atrial lead was explanted successfully with simple traction. There were no complications during or after the procedure. The patient recovered well and follow-up was uneventful.

#### CONCLUSION

Percutaneous management of perforated active fixation lead outside the pericardial sac under surgical backup is safe and effective.

**Key words:** Lead perforation; Transvenous lead extraction; Percutaneous subxiphoid pericardial puncture; Pacemaker lead; Active fixation; Case report

**Received:** September 16, 2019  
**Peer-review started:** September 16, 2019  
**First decision:** October 24, 2019  
**Revised:** October 30, 2019  
**Accepted:** November 15, 2019  
**Article in press:** November 15, 2019  
**Published online:** December 26, 2019

**P-Reviewer:** Choe YH, Jha NK  
**S-Editor:** Zhang L  
**L-Editor:** Filipodia  
**E-Editor:** Liu MY



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**Core tip:** Delayed lead perforation is a rare complication but can be life-threatening. Surgical management is recommended by expert consensus. We describe a delayed lead perforation of the right atrium, pericardium, and lung, which was successfully managed by transvenous lead extraction followed by preoperative pericardial drainage.

**Citation:** Zhou X, Ze F, Li D, Li XB. Percutaneous management of atrium and lung perforation: A case report. *World J Clin Cases* 2019; 7(24): 4327-4333  
**URL:** <https://www.wjgnet.com/2307-8960/full/v7/i24/4327.htm>  
**DOI:** <https://dx.doi.org/10.12998/wjcc.v7.i24.4327>

## INTRODUCTION

Delayed complications of pacemaker implantation that are well recognized include infection, lead malfunction, and subclavian vein thrombosis. Less well recognized as a late complication of device implantation is lead perforation. Delayed cardiac perforation (diagnosed 1 mo or later after implantation) by a pacemaker lead is a rare complication but can be life-threatening if misdiagnosed. The optimal management of this complication remains unclear. The traditional approach to correcting this problem has been an open surgical procedure, especially when the lead has migrated beyond the pericardial space or into other organs<sup>[1]</sup>.

Here, we propose a percutaneous procedure as alternative management of delayed lead perforation that is less invasive. Our report describes a delayed perforation of the right atrium, pericardium, and lung tissue by an active fixation atrial lead, which was uneventfully managed by transvenous lead extraction with preoperative pericardial drainage.

## CASE PRESENTATION

### Chief complaints

A 61-year-old woman with a dual-chamber pacemaker implanted 8 mo previously was admitted to our hospital because of pleuritic right-sided chest pain and hemoptysis of 6 mo in duration.

### History of present illness

The patient presented with repeated syncopal episodes and was diagnosed with intermittent complete heart block 8 mo prior, when a dual-chamber pacemaker with active fixation leads (atrial: St. Jude Medical, model no. 2088T; ventricular: St. Jude Medical, model no. 2088T) (St. Jude Medical, St. Paul, MN, United States) was implanted. At 6 mo prior to admission, the patient suffered pleuritic right-sided chest pain followed by hemoptysis. She was admitted to a local hospital where anti-infection treatment was administered, which was unsuccessful in relieving symptoms. Therefore, she was transferred to our department for further management.

### History of past illness

The patient had no history of bronchiectasis, tuberculosis, or lung cancer.

### Personal and family history

The patient had no history of smoking or alcohol consumption, no additional family history, and no history of hereditary diseases.

### Physical examination on admission

The patient's blood pressure was 135/80 mmHg, heart rate was 75 beats/min, temperature was 36.5°C, and breathing rate was 18/min. Further physical examination revealed no remarkable abnormality.

### Laboratory examinations

Laboratory examinations revealed elevated serum bilirubin (2.2 mg/dL). There were no other abnormal findings including routine blood tests, routine urine tests, routine fecal tests, occult blood tests, and blood biochemistry and infection indexes.

### Imaging examinations

The chest X-ray showed the tip of the atrial lead appearing outside the cardiac silhouette (Figure 1). Chest computed tomography (CT) revealed the tip of the atrial lead migrating into the lung tissue with signs of local inflammation (Figure 2). No pericardial effusion was detected. Interrogation of the pacemaker revealed the failure of atrial pacing and sensing. Echocardiography indicated normal structure and function of the heart, and no signs of pericardial effusion were observed.

## FINAL DIAGNOSIS

Delayed atrial lead perforation of the right atrium, pericardium, and lung tissue caused the symptoms.

## TREATMENT

The patient underwent transvenous lead extraction performed in the electrophysiology room with surgical backup, under general anesthesia and transesophageal echocardiology (TEE) monitoring. First, a percutaneous subxiphoid pericardial puncture was carried out using the technique previously described (Figure 3)<sup>[2]</sup>. Subsequently, a pigtail catheter was inserted. The pocket was surgically explored and the atrial lead was freed from its extravascular adhesions. The terminal pin was then cut, and a standard stylet was inserted into the lead body. Before the extraction of the targeted atrial lead, a new atrial lead was implanted at the right atrial appendage (Figure 4) with less tension. The screw of the target atrial lead was then retracted, and simple traction was applied carefully under fluoroscopy (Figure 5). The culprit atrial lead was easily explanted.

## OUTCOME AND FOLLOW-UP

The patient was hemodynamically stable and the TEE showed no pericardial effusion. Less than 10 mL of serosanguineous fluid was drained from the pigtail catheter. There were no complications, and she was admitted to the cardiac intensive care unit for close monitoring. Serial echocardiology showed no pericardial effusion, and the pigtail catheter was removed 1 d later. The patient was discharged 5 d after the procedure, and a repeat echocardiogram prior to discharge demonstrated no pericardial effusion. She had no chest pain or hemoptysis during 6 mo of follow-up. The chest X-ray was normal and the pacemaker functioned well.

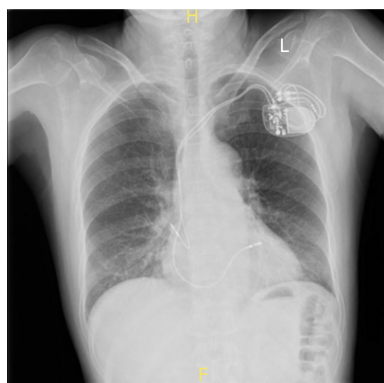
## DISCUSSION

Myocardial perforation is a serious but uncommon complication associated with the placement of a cardiac implantable electronic device. The reported incidence ranges from 0.1% to 0.8% for pacemaker leads and 0.6% to 5.2% for implantable cardioverter defibrillator leads<sup>[3]</sup>. Lead perforations are defined as acute, subacute, or delayed when they occur within 24 h, 1 mo, or more than 1 mo after implantation, respectively. Subacute or delayed lead perforations are fewer in number than acute lead perforations<sup>[4]</sup>.

The most frequently reported risk factors of lead perforation are advanced age, low body mass index (BMI), female sex, active fixation lead, temporary pacing wires, and concomitant anticoagulation or steroid use<sup>[5]</sup>. Our patient was a 61-year-old woman with a BMI of 18.5 kg/m<sup>2</sup>. With regard to the mechanism, we speculated that a combination of exaggerated torsion of the atrial lead helix screw and placement of the active fixation lead on the lateral free wall allowed the perforation to occur. Therefore, in high-risk patients, preference should be given to placing the atrial lead on the septal wall of the right atrium, inside or at the base of the right atrial appendage, as we did in the present case.

Symptoms such as chest pain, dyspnea, syncope, and inappropriate shocks are important clues for reaching an accurate diagnosis. However, symptoms may vary widely, and asymptomatic cardiac perforations are not uncommon<sup>[6]</sup>. For equivocal cases, abnormal electrical parameters and abnormal signs on chest radiography or echocardiography may be helpful. Because visualization of the lead tip is the key component of the diagnosis of cardiac perforation, normal parameters do not exclude





**Figure 1** Posteroanterior chest X-ray shows the tip of the atrial lead located outside the cardiac shadow.

a perforation. Among the imaging tests, chest CT is currently considered the optimal imaging modality<sup>[7]</sup>.

The optimal treatment of lead perforation remains unclear, and various strategies can be found in the literature. According to the 2017 Heart Rhythm Society expert consensus statement, lead extraction should be considered if a lead perforation causes pain, pericardial bleeding, or other complications<sup>[8]</sup>. Malfunction of the perforating lead is also an indication for extraction. However, in asymptomatic lead perforations with normal lead function, whether or not to extract remains controversial. Most authors agree that extraction is not mandatory, while some recommend the removal of the leads. Recently, a multicenter study with a 48-patient cohort concluded that, compared with early lead revision, conservative management of lead perforation is associated with more complications<sup>[9]</sup>.

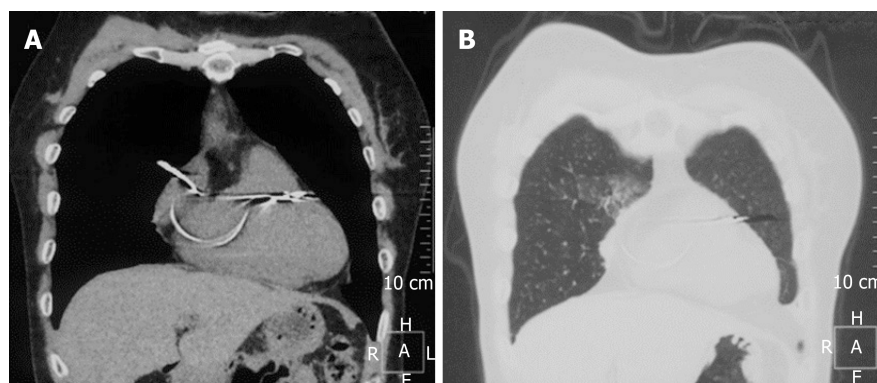
According to a consensus endorsed by the American Heart Association, surgical removal of the perforating leads should be the preferred strategy<sup>[1]</sup>. Alternatively, many authors have agreed that the transvenous extraction of a perforating lead with surgical backup is a safe and effective approach, especially for recent implantations. Using a stepwise lead extraction approach, a complete procedural success rate of 92%–96% has been reported<sup>[7,10,11]</sup>. Most of the perforating leads were removed by simple extraction because the dwelling time was usually not overlong. In the case of long implant time, advanced extraction tools may be employed.

In cases of lead perforation that has migrated beyond the pericardial space or into another cavity, surgical extraction seems to be the optimal option to repair the site of perforation and injury of the adjacent structures at the same time; the open surgery approach is more invasive and tends to have potential complications of sternotomy as well as long-term hospital stay. Our patient had a right atrium and lung perforation, while the culprit lead had an active fixation tip and the dwell time was not overly long (< 1 year), so less tissue was damaged during withdrawal. Moreover, there was no evidence of pericardial effusion or pneumothorax. Therefore, we proposed that the lead may be safely removed percutaneously, with transesophageal echocardiographic monitoring and cardiac surgical backup.

One potentially fatal complication during transvenous extraction of the perforated lead is pericardial tamponade. Huang *et al*<sup>[11]</sup> reported three cardiac tamponades that developed 1–4 d after percutaneous lead removal in a cohort of 31 patients. Laborderie *et al*<sup>[12]</sup> reported one case of cardiac tamponade among 10 patients with late right ventricle perforation (longest dwell time, 105 d) treated with percutaneous lead extraction by simple traction. However, the complication rate of pericardial bleeding was not high. Myocardial “self-sealing” properties, low pressure in the right heart chamber, and fibrous tissue formed at the perforating site may be beneficial to hemostasis of the perforated myocardium.

However, as is well known, the atrial myocardium is thinner and consists of fewer myocytes, and therefore has limited ability for spontaneous closure, especially when the pericardial sac is ruptured as in the present case. For this reason, we accessed the pericardial sac prior to the extraction procedure. In cases of pericardial bleeding or cardiac tamponade, aspiration through the pigtail catheter could relieve symptoms quickly and maintain hemodynamic stability.

Access to the pericardial space without pericardial effusion by the subxiphoid percutaneous approach has been widely used in pericardial ventricular tachycardia ablation procedures. Complication rates at experienced centers are acceptably low<sup>[13]</sup>. To the best of our knowledge, the use of this technique in transvenous lead extraction has not yet been reported.



**Figure 2** The chest computed tomography shows the atrial lead tip migrating into the lung tissue with signs of local inflammation.

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## CONCLUSION

Percutaneous management of active fixation lead perforation outside the pericardial sac under surgical backup is a safe and effective option, with preoperative pericardial puncture worthy of consideration in some high-risk cases.

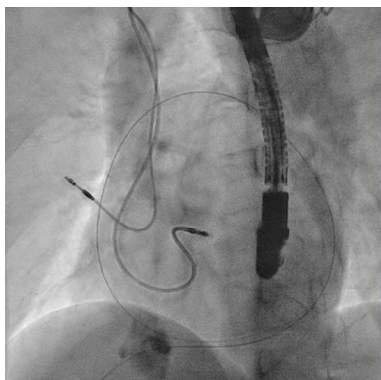


Figure 3 After percutaneous subxiphoid pericardial puncture, a soft floppy-tipped guidewire was advanced along the lateral heart border in the left anterior oblique projection.

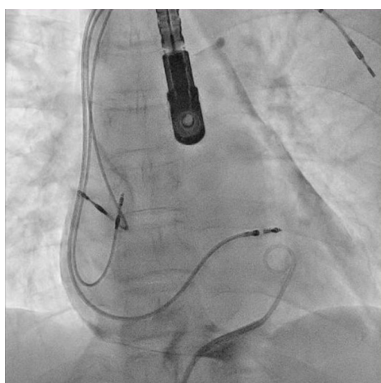


Figure 4 A new active fixation atrial lead was implanted at a different site with less tension, prior to removal of the culprit lead.

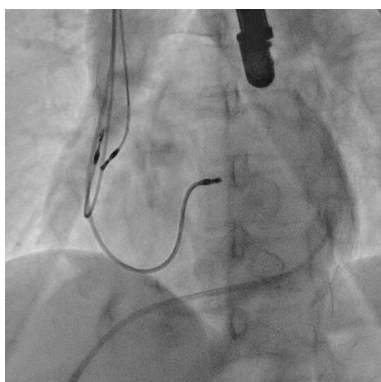


Figure 5 The culprit atrial lead was removed with simple traction after the active screw was retracted.

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## ACKNOWLEDGEMENTS

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Feng Ze performed the operation and edited the manuscript.

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