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MINI-FOCUS ISSUE: EP AND DEVICES

INTERMEDIATE

CASE REPORT: CLINICAL CASE

Pneumopericardium and Pneumomediastinum After Implantation of a Cardiac Resynchronization Pacemaker

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ABSTRACT

A patient with previous coronary artery bypass grafting developed an iatrogenic pneumothorax, along with pneumopericardium and pneumomediastinum, after elective implantation of a cardiac resynchronization therapy pacemaker. There was no evidence of lead perforation, and the patient remained well and was successfully managed conservatively. We hypothesize that air tracked from the pneumothorax via microscopic pleuropericardial fistulae. (**Level of Difficulty: Intermediate.**) (J Am Coll Cardiol Case Rep 2019;1:381–4) © 2019 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

HISTORY OF PRESENTATION

An 84-year-old man was admitted electively to the department for implantation of a permanent pacemaker.

MEDICAL HISTORY

The patient's medical history included coronary artery bypass grafting in 1995 and paroxysmal atrial fibrillation with symptomatic tachy-brady syndrome. He was in New York Heart Association functional class III and referred for a pacemaker to allow pharmacological rate control of his paroxysmal atrial fibrillation. Given that he had severely impaired left ventricular systolic function (ejection fraction <35%), a decision was made to implant a cardiac resynchronization therapy (CRT) device. A CRT pacemaker (CRT-P) was implanted per patient preference, after discussion regarding the advantages and risks of a CRT defibrillator.

LEARNING OBJECTIVES

- To be able to make a differential diagnosis of causes of pneumomediastinum after pacemaker implantation.
- To understand the investigation and management of pneumomediastinum after pacemaker implantation.

PROCEDURE

Due to the patient having chronic kidney disease stage 4 (creatinine 2.4 mg/dl; estimated glomerular filtration rate 28 ml/min/1.73 m^2), a pre-procedural contrast venogram was not performed. Left-sided venous access proved challenging; a cephalic cut-down was attempted, but a suitable cephalic vein could not be located. Venous access was therefore gained via the extrathoracic subclavian approach above the first rib under fluoroscopic

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ABBREVIATIONS AND ACRONYMS

CRT = cardiac resynchronization therapy

CRT-P = cardiac resynchronization therapy pacemaker

CT = computed tomography

CXR = chest radiograph

guidance (1), which required multiple attempts with a standard introducer needle. Subsequently, the procedure was uncomplicated, with placement of active fixation right ventricular and atrial leads, and a left ventricular Attain Stability quadripolar lead (Medtronic, Minneapolis, Minnesota) in a low posterolateral branch of the coronary sinus.

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INVESTIGATIONS

On the patient's routine post-procedural chest radiograph (CXR), he was noted to have a small left-sided, predominantly basal pneumothorax (3.3 cm at the base, 1.2 cm at the level of the hilum, and a 3 mm rim at the apex). The patient's condition was discussed with the respiratory team, and because he was clinically stable with oxygen saturations of 95% on room air, he was admitted to the cardiology ward and managed conservatively with high-flow oxygen. A repeat CXR the following day revealed an unchanged pneumothorax, with an additional pneumopericardium and pneumomediastinum (**Figure 1**), which were confirmed on a computed tomography (CT) scan of his chest.

DIFFERENTIAL DIAGNOSIS

The initial differential diagnosis for the pneumopericardium and pneumomediastinum included a medial puncture at the time of obtaining central venous access, pacing lead perforation, or occurrence secondary to the pneumothorax.

MANAGEMENT

An echocardiogram excluded any pericardial effusion, and no hemothorax was present on the CT chest scan. Interrogation of the patient's CRT-P device confirmed that all lead parameters were satisfactory and pacing thresholds were unchanged from implantation. As the patient remained clinically stable, he continued to be managed conservatively and was discharged on the third day after the procedure. Because there was no evidence of lead perforation, it was believed that the pneumothorax resulted from accidental pleural puncture at the time of obtaining venous access, with the pneumomediastinum and pneumopericardium resulting from the tracking of air from the pneumothorax via pleuropericardial fistulae created by his previous cardiac surgery.

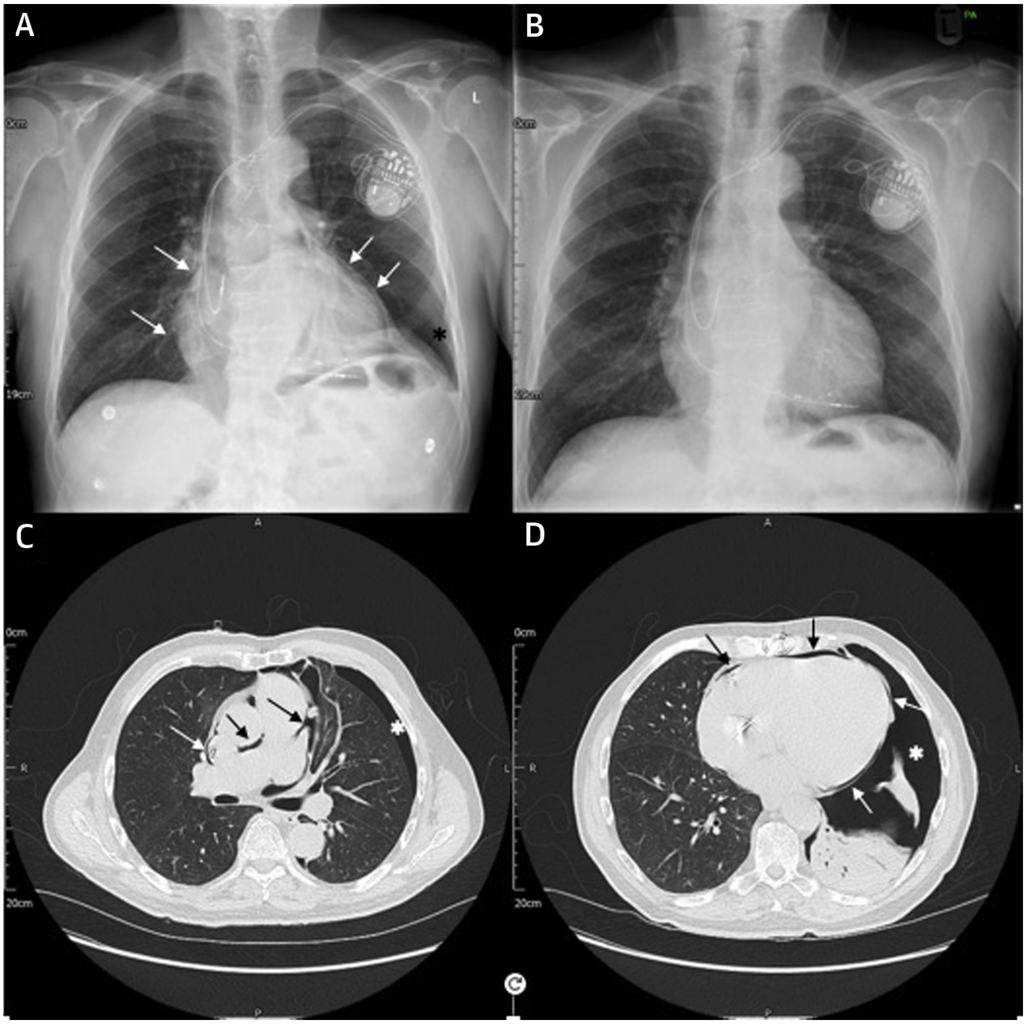
DISCUSSION

Pneumothorax as a complication of pacemaker insertion was found to be associated with increasing age (>80 years), multiple lead implantation, and lower body mass index in a large retrospective analysis (2). Our patient had a body mass index of 22.3 kg/m^2. These factors may therefore have contributed to a pneumothorax as a complication of obtaining central vascular access. In addition to venous access via direct venotomy of the cephalic vein, or fluoroscopically guided extrathoracic subclavian vein puncture, ultrasound-guided axillary vein access can also be used (3); this method was not attempted in this case.

Pneumopericardium and pneumomediastinum have been reported as complications of pacing lead insertion, via perforation of the atrial lead (4). This can be checked by assessing if the sensing of the P-wave has decreased or if the pacing threshold or impedance has increased, and by comparing the unipolar tip electrogram with the ring electrogram, with a difference seen if the tip has perforated. In addition, placement of the atrial lead can be assessed on the CXR, to determine if it was deployed on the lateral atrial wall and protruded beyond the cardiac silhouette. There was no evidence of lead perforation in this case either radiologically or through changes in any of the leads' electrical parameters. Pneumopericardium and pneumomediastinum have also been reported as complications of conventional subclavian vein access due to puncture of the mediastinal aspect of the lung (5). This was believed to be extremely unlikely in this case given the lateral puncture sites used. Furthermore, the previously reported case resulted in significant surgical emphysema, which was not present here.

Apart from resulting from penetrating trauma or iatrogenic causes, pneumomediastinum can result from air escaping from ruptured alveoli and then tracking along perivascular sheaths and into the mediastinum (6). Indeed, histological preparations have shown a potential site of weakness at the ostia of the pulmonary veins (especially in infants), where the visceral pericardium reflects onto the parietal pericardium (7). This can result in pneumomediastinum or pneumopericardium following barotrauma (e.g., after a Valsalva maneuver) (8). However, it should be noted that this complication predominantly occurs in younger patients (hypothesized to be due to tissues being more flaccid in this population) (9), which makes this mechanism less likely in the presented case given the patient's age. In addition, pneumopericardium can result from the

FIGURE 1 **Radiological Demonstration of Pneumothorax, Pneuomomediastinum, and Pneumopericardium**



(A) Posterior-anterior (PA) chest radiograph demonstrating pneumothorax **(asterisk)** and pneumopericardium/pneumomediastinum **(arrows)**. **(B)** Resolution on follow-up radiograph. **(C and D)** Axial computed tomography chest slices demonstrating pneumothorax and pneumopericardium/pneumomediastinum.

creation of fistulae to the pericardial space from surrounding air-containing organs. For example, fistulae from the lung secondary to malignancy (10) have been described.

Given the history of previous cardiac surgery in this patient, we hypothesized that air from the pneumothorax tracked into the pericardium and mediastinum through microscopic pleuropericardial fistulae, resulting from the previous surgery. To the authors' knowledge, this complication has been reported only once before but as a late rather than as an early complication of device implantation (11). Importantly, spontaneous pneumomediastinum can normally be managed conservatively, with good prognosis (9). Although this case could not be classified as spontaneous, the successful conservative management of the patient highlights the importance of the recognition of this as a potential cause of pneumopericardium/pneumomediastinum, which may not require intervention. A summary of the potential mechanisms of pneumomediastinum formation is given in Figure 2.

FOLLOW-UP

A follow-up CXR 1 week after discharge confirmed resolution of the pneumothorax, pneumomediastinum, and pneumopericardium (Figure 1). The patient has remained well at subsequent clinic follow-up.

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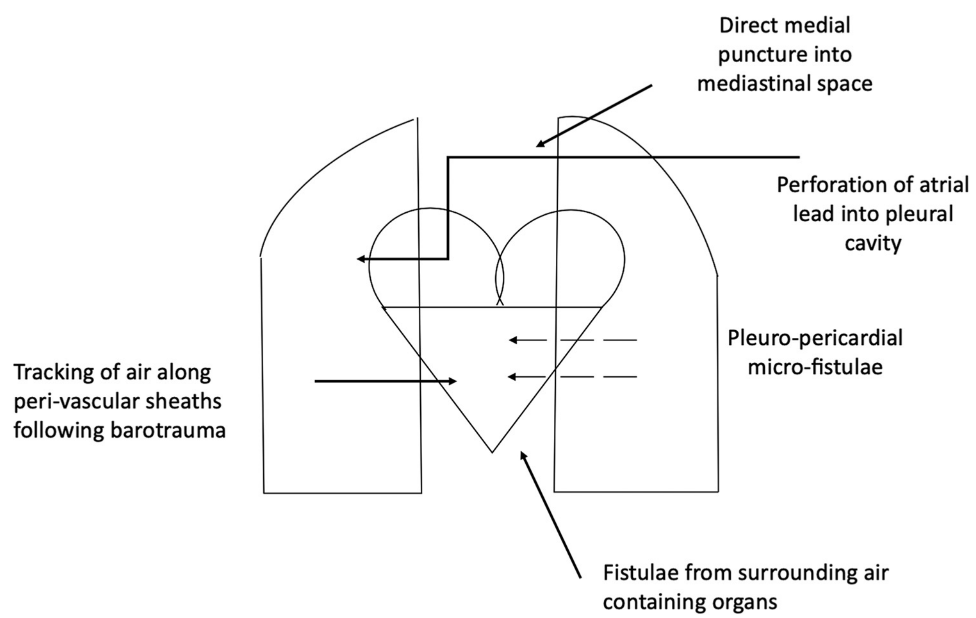
FIGURE 2 Diagrammatic Representation of the Mechanisms of Pneumomediastinum Formation



CONCLUSIONS

The authors report a case of pneumomediastinum and pneumopericardium after pacemaker implantation and hypothesize that this complication was a result of air tracking from a small iatrogenic pneumothorax, through pleuropericardial fistulae. To the authors' knowledge, this is the first time this situation has been reported as an acute pacing complication, and importantly it was successfully managed conservatively.

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KEY WORDS complication, fistula, pacemaker, pneumomediastinum, pneumopericardium