A 77-year-old female underwent implantation of a left-sided dual chamber permanent pacemaker for symptomatic bradycardia with active fixation leads. Eight hours after the procedure, the patient complained of shortness of breath and was found to have a 30% right pneumothorax on chest X-ray. Immediately, a chest tube was inserted, promptly relieving the symptoms. A CT scan of the chest revealed extrusion of the helix of the screw-in atrial lead, through the wall of the right atrial appendage. The helix was abutting a bulla in the right lung, the likely cause for pneumothorax and pneumopericardium. The atrial lead was explanted without incident.

Case report

A 77-year-old female with chronic obstructive lung disease and long-standing right bundle branch block was hospitalized for chest pain. A cardiac catheterization was performed and showed no haemodynamically significant epicardial coronary artery disease. During the hospitalization while on telemetry, the patient experienced an episode of loss of consciousness associated with 4.5-s sinus pause. At that time, she was not on negative chronotropic drugs, and no other precipitating factors were identified. A permanent pacemaker implantation was recommended.

The patient underwent a dual chamber permanent pacemaker (Medtronic Kappa, KDR 901-Medtronic, MN, U.S.A.) implantation using left subclavian venous access. Active fixation leads (Medtronic active fixation, Model 5076, Medtronic, MN, U.S.A.) were used for both atrial and ventricular pacing. Atrial lead pacing threshold was 1 V at 0.5 ms and pacing impedance 544 Ω. Sensed P wave was 2 mV. Ventricular lead pacing threshold was 0.5 V at 0.5 ms, and pacing impedance 1030 Ω. Sensed R wave was 5 mV. The initial chest X-ray after implantation showed adequate lead position and no evidence of pneumothorax.

Eight hours later, the patient complained of sudden onset of shortness of breath. A chest X-ray revealed a right-sided (contralateral) pneumothorax (Fig. 1). A chest tube was inserted, promptly relieving the symptoms. Pacemaker interrogation revealed no change in lead data and a CT scan of the chest (Fig. 2) was done to investigate the aetiology of the contralateral pneumothorax. This revealed extrusion of the helix of the screw-in atrial lead, through the wall of the right atrial appendage, causing a 30% pneumothorax. The helix of the atrial lead was adjacent to an intact bulla of the right lung. Pneumopericardium was also seen. The patient was taken to the electrophysiology laboratory for atrial lead extraction. The atrial lead was uneventfully
explanted under continuous intracardiac echocardiography and haemodynamic monitoring with a pulmonary artery catheter. The pneumopericardium resolved within a few days and the right pneumothorax also sealed without complication.

**Discussion**

Pneumothorax is usually a complication of subclavian venous access\(^1\). Perforation of the right ventricle with or without pericardial effusion is also well recognized\(^2\).

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**Figure 1** Chest X-ray showing right pneumothorax (arrow) 8 h after placement of a left-sided permanent dual chamber pacemaker for symptomatic bradycardia.

**Figure 2** CT scan of the chest showing extrusion of the helix of the atrial lead through the right atrial appendage (arrowhead) causing pneumopericardium (arrow). Right pleural effusion (chevron) is also seen.
Pneumopericardium has been reported from temporary ventricular endocardial lead perforation[3]. Pneumothorax, contralateral to venous access site, due to atrial lead perforation is a rare complication[4]. Concomitant pneumothorax (contralateral to venous access site) and pneumopericardium secondary to perforation through the wall of the right atrial appendage has to our knowledge not been previously reported.

The benefit on quality of life associated with dual chamber pacing as compared with ventricular pacing for sinus node dysfunction is well documented[5]. Physiological pacing may not offer benefit over ventricular pacing for the prevention of stroke or death due to cardiovascular causes[6]. Dual chamber systems are widely used in the United States in patients with sinus node disease. The rate of implant related complications between dual and single chamber pacemaker implantation has been reported as either equivalent[7] or higher[8] for dual chamber pacing[8].

An atrial lead is essential for dual chamber pacing but dislodgment of this lead is not infrequent[9]. In order to reduce the dislodgment rate, active fixation (screw-in) leads have been developed. However, the screw-in atrial leads increase the chance of perforating the thin-walled atrial appendage. Active fixation, polyurethane insulated atrial leads (Accufix) are associated with 2.4% acute lead related complications, (i.e. perforation, micro-dislodgment and pericarditis)[10]. Independent cases of atrial perforation by an atrial screw-in electrode have also been reported[11].

Several risk factors may be responsible for the increased complication rate of screw-in atrial leads. Variation in patient anatomy such as an extremely thin-walled or multilobed atrial appendage may play a role. Lead factors such as design and stiffness of the helix may differ between manufacturers and could be important. The experience of the operator is equally important to avoid over-screwing during atrial lead fixation.

Usually the lead parameters, in particular the pacing threshold, will show a significant change on lead perforation[12]. The helix may offer mechanical support by anchoring the lead but may not be part of the electrode. Thus the lead parameters may not change in some cases after perforation[4]. In this case, the helix was part of the electrode (active helix), but the lead parameters did not change. The reason for the lack of change in lead parameters is unclear. However, a large part of the electrode may have been in contact with the atrial myocardium resulting in lack of change in the lead parameters.

Pneumothorax secondary to subclavian venous access is uncommon and occurs between 1 and 2% with experienced operators[13]. Pneumothorax may be detected during the procedure or delayed until 48 h after implantation. Pneumothorax secondary to perforation of the atrial lead through the wall of the atrial appendage has been reported once previously[9]. Concomitant pneumothorax and pneumopericardium as happened in this case has not been previously reported. This patient developed pneumopericardium, pleural effusion but no discernible pericardial effusion. The lead may have plugged the small defect, although no pericardial effusion developed on explantation of the lead. The presence of a bulla abutting the lead helix as seen on the CT scan suggests that bullous lung disease likely played a role in the development of this complication.

After lead extraction, implantation of a new atrial lead was deferred to allow time for the atrial appendage to heal.

This case illustrates that if a right pneumothorax develops in a patient where the pacemaker was placed from a left subclavian approach, perforation of the atrial appendage should be considered and immediately investigated. In haemodynamically stable patients, CT scan of the chest is the investigation of choice. In unstable patients emergency echocardiography may be useful to identify pericardial effusion. Extra post-procedural vigilance should be considered when implanting atrial leads in patients with bullous emphysema.

References