Late Hemopneumothorax Resulting from Subclavian Venipuncture for Transvenous Permanent Pacemaker Implantation
— Report of Two Cases

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This is a report of two cases of late hemopneumothorax resulting from subclavian venipuncture for permanent pacemaker implantation. In both cases the hemopneumothorax, which was not demonstrated on post-procedural chest radiography, became clinically apparent more than 36 hours after the procedures. After prompt chest tube drainage, both patients recovered uneventfully. We recommend that late hemopneumothorax should be considered in a patient who develops respiratory difficulty or hemodynamic instability after pacemaker implantation.

Key Words: Hemopneumothorax • Pacemaker implantation • Subclavian arterial puncture

INTRODUCTION

Pneumothorax has been reported in 1% to 2.6% of endocardial pacemaker lead implantations.1-4 However, hemopneumothorax or hemorhorax secondary to subclavian artery puncture and dissection are extremely rare.4 Chest radiography is advised soon after this procedure, implying that when hemopneumothorax occurs, it occurs shortly after subclavian venipuncture. In the literature, only rare cases of late pneumothorax after subclavian catheterization have been reported.5,6 The presumed mechanism for the late appearance of pneumothorax is a slow air leak from a pleural tear that went undetected. To the best of our knowledge, late hemopneumothorax after transvenous permanent pacemaker implantation has never been reported. We report two cases of late hemopneumothorax resulting from subclavian venipuncture for permanent pacemaker implantation.

CASE REPORTS

Case 1
A 58-year-old woman underwent single chamber pacemaker implantation for symptomatic sick sinus syndrome on June 1, 1999. A VVIR pacemaker (Medtronic Prodigy SR 8162, Medtronic Inc., Minneapolis, MN, USA) was implanted via the left subclavian vein approach. The attempt at insertion of the ventricular pacing lead (Medtronic Capsure SP 4024) into the left subclavian vein was successful, and the whole implantation procedure was performed smoothly. The ventricular pacing threshold was 0.5 V, pacing impedance was 960 ohms, and R-wave amplitude was 5.4 mV. Post-procedural radiography performed 1 hour thereafter showed the lead and the pulse generator to be properly placed, with no abnormalities were noted in the pleural space (Fig. 1A).

The period immediately following the procedure was uneventful until about 36 hours after implantation, when the patient started to complain of difficulty in breathing. Physical examination demonstrated rapidly increasing dullness, with absent breath sounds in the left hemithorax. Her condition deteriorated rapidly, with the development of cyanosis, dizziness, increasing confusion and hypotension. Her blood pressure was 88/50 mmHg, heart rate was 76 beats/minute, and respiratory rate was 28 breaths/minute. A chest X-ray film showed a large pneumothorax on the left and the presence of a large
amount of pleural fluid. The ventricular lead was displaced, with the tip of the lead having migrated upward and away from the right ventricular apex (Fig 1B). Electrocardiography demonstrated loss of ventricular pacing and sensing. Tube thoracostomy and underwater drainage were required to remove about 1,000 mL of bloody pleural fluid and to relieve the pneumothorax. Transvenous repositioning of the dislodged ventricular lead was performed thereafter via the initial left subclavian approach under fluoroscopy. The ventricular pacing threshold was 0.4 V, pacing impedance was 572 ohms, and R-wave amplitude was 8.4 mV after revision. The patient’s condition promptly stabilized after the procedures and she was discharged on the tenth day of hospitalization.

Case 2
A 74-year-old woman underwent dual chamber pacemaker implantation for sick-sinus syndrome on November 18, 1999. A DDDR pacemaker (Medtronic Prodigy DR 7862) was implanted via the left subclavian vein approach. The ventricular lead (Medtronic Capsure SP 4024) was introduced first, followed by insertion of a passive fixation atrial lead (Medtronic Capsure SP 4524). The two venipuncture attempts to insert the pacing leads into the left subclavian vein were both successful, and the whole procedure went smoothly and without difficulty. Pacing thresholds were 0.4 V and 0.5 V, and impedances were 402 ohms and 590 ohms for the atrial and ventricular leads, respectively. The P-wave and R-wave amplitudes were 1.0 mV and 1.8 mV, respectively. The results of chest radiography performed about 40 minutes after the procedure were normal (Fig 2A).

On the third postoperative day, the patient became increasingly tachypneic and dyspneic. Auscultation revealed coarse crackles in the right chest with diminished breath sounds on the left. Blood pressure was 100/70 mmHg, heart rate was 94 beats/minute, and respiratory rate was 25 breaths/minute. Thoracostomy tube drainage was instituted immediately after confirmation of left hemopneumothorax by chest radiography (Fig 2B) and about 550 mL of bloody pleural effusion was drained, symptoms improved after this procedure. The chest tube was removed 4 days later, and the patient was discharged on the 24th day of hospitalization, with electrocardiography showing normal dual-chamber pacing, there was no significant change of the pacemaker parameters.

DISCUSSION

The subclavian vein is generally the intended venous structure used for percutaneous venous access in cardiac pacing. Because both subclavian veins rest upon the pleura, any blind approach with a sharp instrument will

Figure 1. (A) The chest X-ray film of patient 1 on the second postoperative day showed a large pneumothorax and collapsed lung (large white arrow) on the left and the presence of a large amount of pleural fluid (small white arrows), which was not demonstrated on post-procedure chest radiography. (B) Ventricular lead migration was also observed (dotted lines are the lead paths shown on the chest radiographs). After tube thoracostomy with underwater drainage and surgical repositioning of the dislodged ventricular lead, the patient’s chest X-ray normalized.
result in punctures of the pleura, lung and blood vessels. In clinical practice, many methods have been used to access the subclavian approach for pacemaker lead implantation, including the subclavian window, the safety zone, axillary vein puncture, fluoroscopic guidance or contrast venographic guidance, and others. The pros and cons of the various approaches and techniques have been well reviewed and discussed by Belott et al; they also emphasize several important procedural points for avoiding hemo- and/or pneumothorax.  

It is recommended that if air is withdrawn through the needle during attempted venipuncture, the operator should withdraw the needle, wait a moment or two to make certain that a rapid-onset, large, markedly symptomatic pneumothorax is not occurring, and then proceed to reattempt venipuncture. Most lung punctures due to forward instead of lateral needle motion do not immediately result in clinically apparent pneumothorax, but instead may develop over a period of hours and should not even be apparent radiographically at the end of the procedure. The presence of pneumothorax may also be suspected if the patient complains of pleuritic pain, dyspnea, and coughing. Once lung puncture is suggested and the possibility of pneumothorax is raised, Belott et al recommend another postoperative upright chest X-ray 6 hours after completion of the procedure because most hemopneumothoraces occur in the first few hours postoperatively. The cases in the literature reported that the symptoms of pneumothorax appeared at 48 hours and 4 days after the procedures, respectively. Similarly, if an artery is punctured resulting in hemothorax, follow-up chest X-ray 6 to 18 hours after the procedure is advisable, and postoperative hemoglobin-hematocrit measurements are suggested. Currently there is no strict definition of lateness for the appearance of hemo- and/or pneumothorax. We, therefore, arbitrarily defined hemo- and/or pneumothorax as late if the event occurred more than 24 hours after the procedure.

Although the overall complication rate is no different for the implantation of dual compared to single chamber pacing systems, patients with pacemakers placed by inexperienced operators are significantly more likely to sustain complications associated with venous access than those placed by experienced operators. Therefore, it is recommended that subclavian venipuncture be performed only by skilled personnel, under constant supervision by a cardiologist experienced in pacemaker implantation. Furthermore, routine, post-operative chest radiography should not be done immediately; it should, instead, be deferred to 6 or more hours after the operation. If it is done too early, the presence of slowly developing hemo- and/or pneumothorax might not be detected.

Even though the incidence of serious hemo- and/or pneumothorax with subclavian venipuncture appears to be low, it may be devastating. For this reason, some authors advocate the cephalic vein cut-down method for pacemaker implantation. We suggest that if a permanent pacemaker lead is to be placed, the blind

Figure 2. (A) The posteroanterior view of the chest radiograph of patient 2 clearly shows left pneumothorax (A large white arrow) and pleural effusion (small white arrows), (B) which could not be demonstrated on post-procedure chest radiography.
subclavian vein approach should be avoided. Instead, the cephalic vein cut-down method should be the method of choice. In our hospital, we successfully inserted pacing leads via the cephalic vein in about 60% of cases.

In the two cases we report, two different experienced cardiologists performed the venipunctures; the cardiologists implant more than 40 pacemakers per year. In both cases, the procedures were performed via the subclavian vein approach without any difficulty, so the exact reasons for inadvertent injury to the lung and blood vessel are unknown. Routine chest radiography 6 hours after pacemaker implantation can detect hemopneumothorax that occurs shortly after pacemaker implantation, but does not detect late hemopneumothorax occurring 24 hours or more after implantation. Nevertheless, recommendation of a routine second follow-up chest X-ray 6 to 18 hours after the procedure is not advisable, because the incidence of such an unexpected complication is extremely low. We recommend, therefore, that even when there is no air or arterial blood withdrawn through the needle during venipunctures, and postoperative chest radiography does not identify the appearance of hemopneumothorax, the operator should keep alert to its possibility and examine the patient postoperatively. If the patient develops respiratory difficulty or hemodynamic instability after pacemaker implantation, prompt physical examination and repeated chest radiography should be done to investigate the possibility of hemopneumothorax.

The management of pneumothorax depends on the severity and symptoms. In the case of tension pneumothorax, emergency chest tube insertion, and drainage may be necessary, although frequently, a small-to-moderate pneumothorax that is not expanding can be managed conservatively without evacuation. Nonetheless, most hemopneumothoraces and hemothoraces require drainage. In our patients, blood transfusion was not given because the patients' symptoms and hemodynamic conditions promptly stabilized after chest tube drainage.

In conclusion, late hemopneumothorax should be considered as one of the possible causes of cardiopulmonary embarrassment and deterioration of hemodynamics after transvenous permanent pacemaker implantation via the subclavian vein approach. Immediate chest tube drainage is the mainstay for successful treatment when serious hemothorax or pneumothorax, or both, are present.

REFERENCES