Case Report

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Brachial Plexus Injury Caused by Indwelling Axillary Venous Pacing Leads

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A 64-year-old male patient underwent cardiac resynchronization therapy (CRT) device implantation via the axillary venous approach. Two weeks later, the patient started complaining of "electric shock-like" pain in the left axillary area. During physical examination, typical pain in the left axillary area was reproduced whenever his left shoulder was passively abducted more than 60 degrees. Fluoroscopic examination showed that the left ventricle (LV) and right atrium (RA) leads were positioned at an acute angle directing towards the left brachial plexus whenever the patient's shoulder was passively abducted. Brachial plexus irritation by the angulated CRT leads was strongly suspected. To relieve the acute angulation, we had to adjust the entry site of the LV and RA leads from the distal to the proximal axillary vein using the cut-down method. After successful lead repositioning, the neuropathic pain improved rapidly. Although transvenous pacing lead-induced nerve injury is not a frequent complication, this possibility should be kept in mind by the operators. **(Korean Circ J 2015;45(5):428-431)**

KEY WORDS: Cardiac resynchronization therapy; Complications; Peripheral nerve injuries; Brachial plexus.

Introduction

During the cardiac device implantation procedure, selection of the appropriate vein puncture site is important to reduce the risk of vascular and lead-related complications.[1)] Nerve injuries that arise during device implantation procedures are sparsely reported in the literature.[2)3)] Here, we report a case of brachial plexus injury caused by indwelling transvenous pacing leads.

Case

A 64-year-old male patient underwent cardiac resynchronization therapy (CRT) device with defibrillator implantation for dilated cardiomyopathy and recurrent ventricular tachycardia. During the implantation procedure, it was difficult to determine the location of the left axillary vein as although the left subclavian vein was punctured and a guide wire could be inserted, we could not insert a peel-away introducer across the costoclavicular junction and handle the inserted right ventricular lead due to mechanical resistance at the costoclavicular junction. To avoid the risk of difficult lead handling and future subclavian crush syndrome, a second puncture was performed at a more lateral site approximately two fingers away from the initial puncture point. Although a puncture needle should be inserted almost vertically in order to reach the lateral axillary vein near the junction of the cephalic and brachial veins, we were able to insert peel-away introducers and the left ventricle (LV) and right atrium (RA) leads without any difficulty. The LV and RA leads were positioned where the optimal values of sensing and pacing parameters were obtained. After starting biventricular pacing, the episodes of ventricular tachycardia decreased remarkably, suggesting successful electrical remodeling. The patient was discharged without overt complications.

However, two weeks after the implantation of the CRT device, the patient started complaining of "electric shock-like" pain in the left axillary area radiating to the medial border of the left arm. The patient described the pain as being usually triggered by active shoulder movements, especially when pulling up his pants. During physical examination, typical pain in the left axillary area was

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• The authors have no financial conflicts of interest.

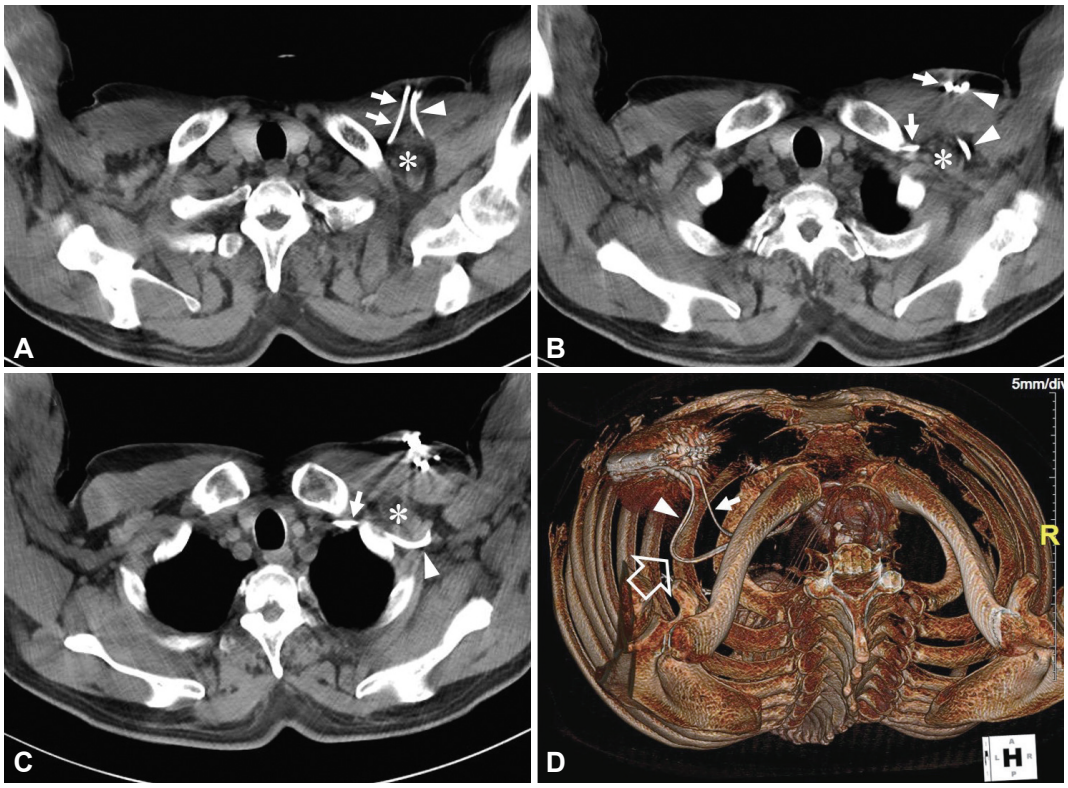

Fig. 1. Chest computed tomography images. A, B, and C: axial images showing an RV lead (arrows) running into the left subclavian vein at the medial side of the pectoralis minor muscle (asterisks). The LV and RA leads (arrowheads) were running together along the lateral side of the pectoralis minor muscle into the left axillary vein at the outer border of the first rib (D). A three-dimensional volume-rendered image showing overall directions of each lead. The LV and RA leads were forming a curvature with an acute angle (empty arrow) before insertion into the left axillary vein. There were no specific findings of vascular complication or local infection. RV: right ventricle, LV: left ventricle, RA: right atrium.

reproduced whenever his left shoulder was passively abducted more than 60 degrees. However, there were no objective sensory changes or motor weakness. The patient's symptoms and signs suggested irritation of the left brachial plexus. Chest computed tomography scans showed the LV and RA leads running together into the lateral axillary vein along the lateral side of the pectoralis minor muscle causing a curvature with an acute angle (Fig. 1). Fluoroscopic examination in the supine position showed that the LV and RA leads were positioned at an acute angle directing towards the left brachial plexus whenever the patient's shoulder was passively abducted more than 60 degrees (Fig. 2; Video in the online-only Data Supplement). Severe left axillary and radiating arm pain recurred whenever the LV and RA leads formed such an acute angulation on fluoroscopic examination. Brachial plexus irritation by the angulated CRT device leads was strongly suspected. Analgesics and antibiotics were prescribed to control the pain and to treat the possible subclinical device-related infection. However, the patient complained of gradual worsening of the pain despite continued administration of high-dose pain killers. Six months after implantation of the CRT device, the patient was readmitted for adjustment of lead angulation due to worsening of the left axillary and radiating arm pain which impeded the patient's daily physical activities.

Due to the fact that the LV and RA leads were inserted across the pectoralis major and minor muscles into the lateral axillary vein, which was located deep in the patient's chest, correction of the lead angulation by generator repositioning was technically impossible. Operators had to move the entry site of the LV and RA leads from the distal to the proximal axillary vein using the cut-down me-thod. Under general anesthesia, the pectoralis minor muscle was cut and the axillary vein was exposed. The vein was clipped and incised transversely at a proximal site (Fig. 3A). After disconnection of the LV and RA leads from the generator, we attempted to manually extract the disconnected leads through the transverse incision line. However, the leads were tightly adhered to the axillary venous wall, and the possibility of vascular injury and LV lead mal-positioning due to extraction force was considered. Finally, we had to open the left axillary vein to separate the leads safely. The left axillary vein was incised longitudinally from the initial insertion site of the LV and RA leads to the more proximal site which was 3 cm away (Figs. 2D and 3B). The adhesions between the leads and

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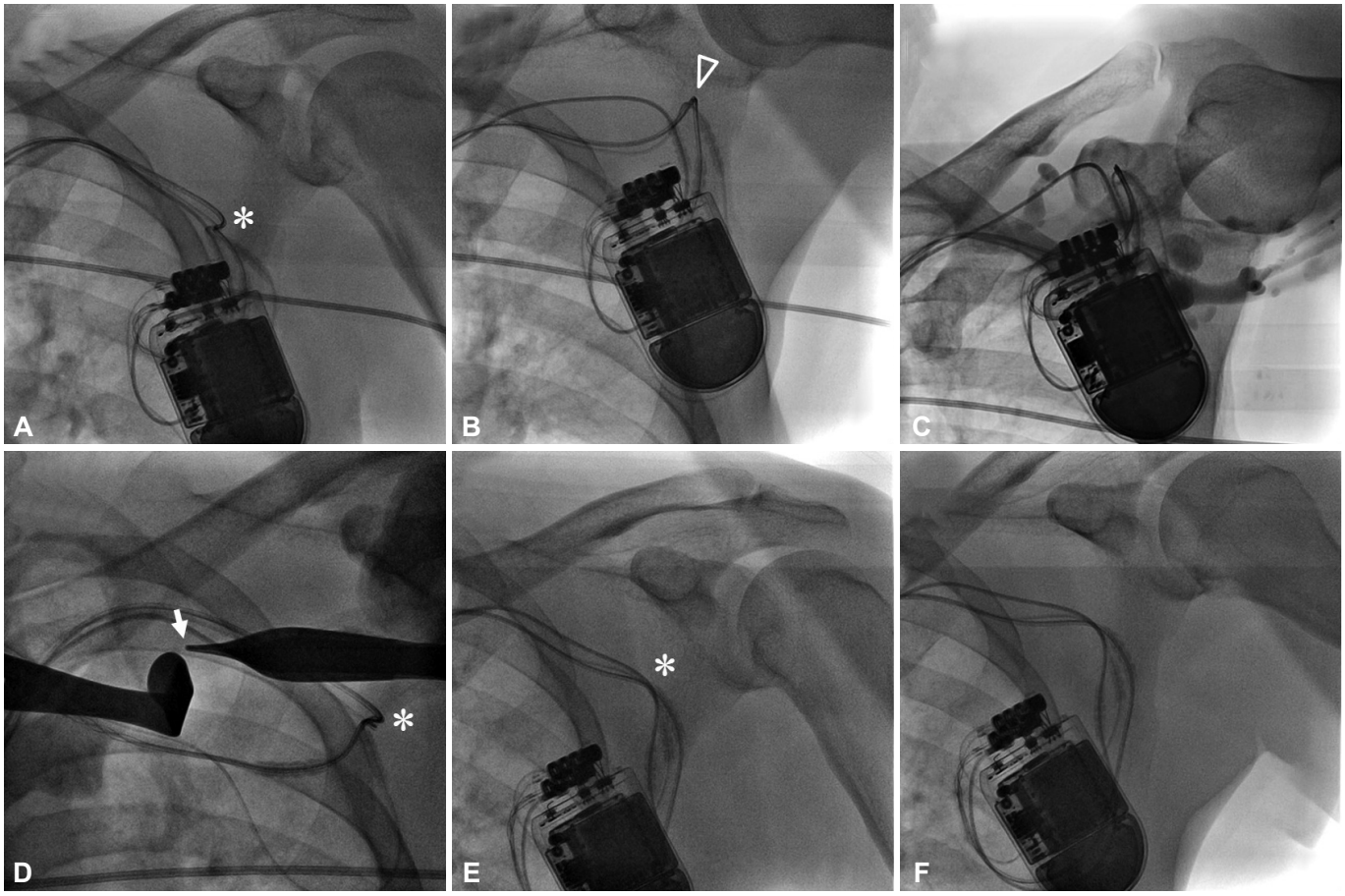

Fig. 2. Fluoroscopic examination images. A: fluoroscopic examination in the supine position showed the LV and RA leads inserted nearly vertically (asterisk) into the lateral axillary vein. B: active or passive shoulder abduction more than 60 degrees induced an acute angulation (empty arrowhead) of the LV and RA leads directing towards the left brachial plexus (Video in the online-only Data Supplement). Severe axillary and radiating upper extremity pain recurred whenever the LV and RA leads formed an acute angulation. C: left arm venography demonstrated that the extravascular portion of the LV and RA leads formed an acute angulation. D: the operators decided to move the initial insertion site (asterisk) of the LV and RA leads to a more proximal site at a 3 cm distance (arrow). E: after adjusting the insertion site of the LV and RA leads, the initially noted vertical insertion of the leads was not observed (F) and acute angulation of the LV and RA leads did not occur during passive shoulder abduction more than 60 degrees. LV: left ventricle, RA: right atrium.

vessel wall were then dissected carefully. Separated leads were moved to the proximal site through the longitudinal incision line and the remaining incision lines were closed. After adjusting the LV and RA lead insertion site, acute angulation was not observed during passive shoulder abduction more than 60 degrees on fluoroscopic examination (Fig. 2). After confirming successful lead repositioning, all of the procedures were completed without complications. Although curvatures of the LV and RA leads were slightly modified after the correction surgery, there was no significant change in the LV lead tip location and LV capture threshold. Neuropathic pain decreased remarkably two weeks later and analgesic agents could be withheld two months later. There were no symptoms and signs of left subclavian vein obstruction. The ranges of passive and active shoulder movements increased gradually but were nearly completely normalized at six months after the surgery.

Discussion

During the cardiac device implantation procedure, selection of the appropriate vein puncture site is important to avoid the risk of vascular or pacing lead-related complications.[1] In the present case, to avoid the risk of subclavian crush syndrome, the LV and RA leads were inserted into the lateral axillary vein which is close to the brachial plexus, under the guidance of contrast venography.[4] Unfortunately, the inappropriately inserted CRT device leads caused brachial plexus injury. Although transvenous pacing lead-induced nerve injury is not a frequent complication seen in clinical practice, this possibility should be kept in mind by the operators. If this type of complication occurs, correction surgery for the lead insertion site using the cut-down method can be considered as a therapeutic option. Understanding the vascular anatomy with adjacent nerve structures and carefully selecting the vein puncture site are necessary

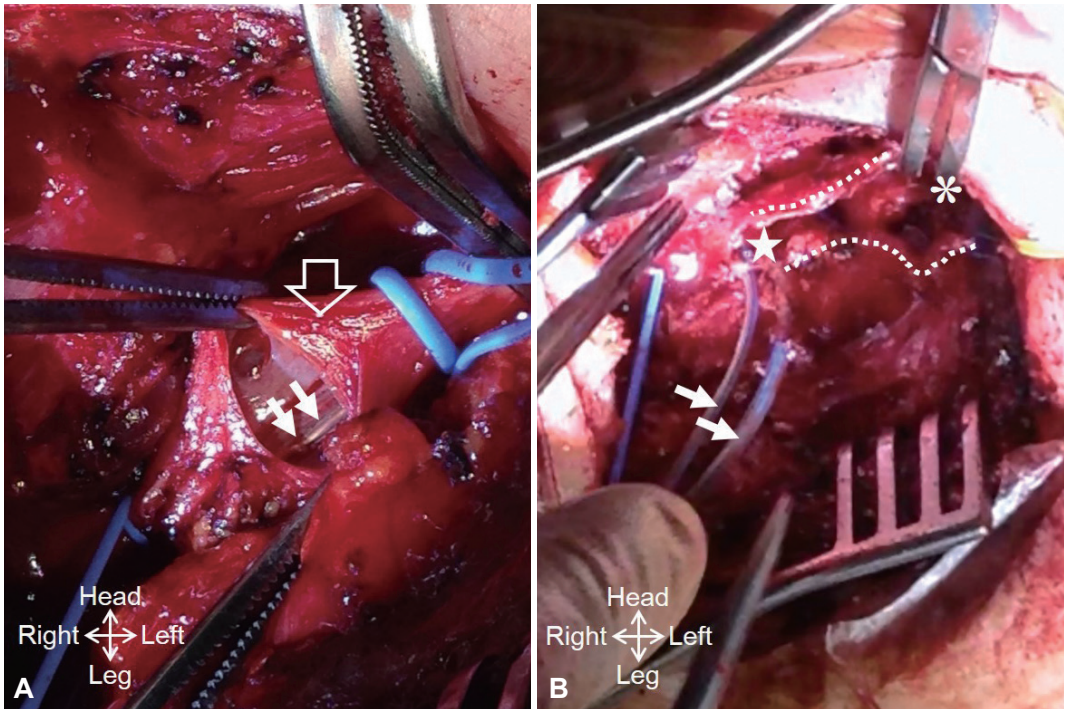

Fig. 3. Operation field findings. A: the left axillary vein (empty arrow) was exposed and incised transversely at the medial site. However, the LV and RA leads (arrows) were tightly adhered to the posterior wall of the vein, and it was impossible to manually extract them through the transverse incision line. B: the left axillary vein was incised longitudinally (dotted lines show the cutting edges) from the initial insertion site (asterisk) of the LV and RA leads to the more proximal site (star) at a 3 cm distance. After separation from the axillary venous wall, the LV and RA leads (arrows) were moved proximally and the remaining incision lines were closed. LV: left ventricle, RA: right atrium.

for minimizing the risk of pacing lead-induced nerve injury.

Supplementary Materials

The online-only Data Supplement is available with this article at http://dx.doi.org/10.4070/kcj.2015.45.5.428.

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