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Multiple pacemaker lead breakages due to clavicle dislocation following clavicle fracture

Hideyuki Hasebe

Division of Arrhythmology, Shizuoka Saiseikai General Hospital, 1-1-1 Oshika, Suruga-ku, Shizuoka 422-8527, Japan

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ABSTRACT

A 58-year-old man undergoing cardiac resynchronization therapy with a defibrillator in his right subcostal area fell from his bed, leading to fracture of the right clavicle. Serial radiographs showed dislocation of the distal clavicle 2 months after the initial fracture. Lead parameters dramatically changed after dislocation of the distal clavicle. Radiography indicated that the device leads seemed to be compressed by the distal clavicle in certain positions of the right upper limb. It was likely that various movements of the right upper limb during his daily life insidiously damaged the device leads, leading to the lead breakages.

1. Introduction

Subclavian vein puncture is usually used for implantation of pacemaker leads. However, mechanical stress around the costoclavicular region is a well-known cause of lead breakage after implantation by this approach [1].

Herein, we report a rare case of lead breakage associated with fracture of the clavicle. The distal clavicle was dislocated a few months after the fracture, resulting in a dramatic change in lead parameters. It is likely that the clavicular displacement, rather than the initial fracture itself, resulted in serious damage to the leads.

1.1. Case report

A 58-year-old man was being treated with cardiac resynchronization therapy with a defibrillator (CRTD) after being diagnosed with New York Heart Association (NYHA) class IV heart failure associated with complete left bundle branch block. He had a hemodialysis access site in his left arm. Therefore, the CRTD generator (COGNIS 100D, Boston Scientific, Marlborough, MA) was implanted beneath the right pectoral muscle taking account of unfavorable effect for blood access in his left arm, and pacing leads (atrial lead: Tendril model 2088TC, St. Jude Medical, St. Paul, MN, dual-coil right ventricular [RV] defibrillator lead: Durata model 7120, St. Jude Medical, and left ventricular [LV] lead: COGNIS 100D, Boston Scientific) were implanted by extrathoracic subclavian venipuncture. The CRTD device implantation shortened his QRS duration from 196 to 148 ms, leading to improvement in his left ventricular ejection fraction (LVEF) from 20% to 35%, and NYHA class from IV to II 6 months after the implantation. One year after the implantation, he fell from his bed to the floor while asleep, resulting in fracture of the right clavicle. The following day, he was referred to the department of orthopedics at our institute. At that time, no dislocation of the right clavicle was observed, and there were no signs of vessel or nerve damage. Therefore, he was followed up without any specific treatment. Subsequently, serial radiographs taken at monthly intervals showed dislocation of the distal clavicle up to the medial side 2 months after the clavicle fracture, and a further dislocation of the distal clavicle accompanied by flexion of the RV lead 3 months after the clavicle fracture (Fig. 1). The first scheduled in-person device clinic was performed 4 months after the clavicle fracture. This revealed that the pacing thresholds of the RV and LV leads were elevated (RV lead: from 0.3 [6 months earlier] to 1.9 V at 0.4 ms, LV lead: from 0.3 V [6 months earlier] to 2.9 V at 0.4 ms). Dramatic changes in bipolar pacing impedance were also observed (RV lead: from 630 [6 months earlier] to 235 Ω, LV lead: 872 [6 months earlier] to 1521 Ω). A unipolar pacing impedance of LV lead was 612 Ω, and high voltage impedance was 48 Ω. A study of the data trend showed that the changes in lead parameters had started 2 months after the clavicle fracture (Fig. 1). Radiographs were taken of the area around the right clavicle in various positions of the right upper limb, which revealed that the distal part of the clavicle

E-mail address: h153478@siz.saiseikai.or.jp.
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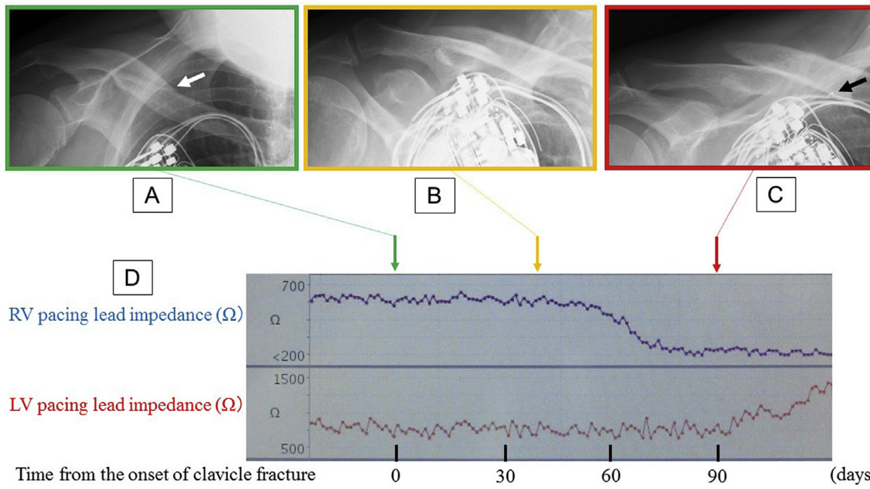

Fig. 1. Panel A: An X-ray taken at the time of the clavicle fracture shows a fracture line (indicated by the white arrow), but no displacement of the clavicle. Panel B: An X-ray taken 40 days after the clavicle fracture shows apparent dislocation of the distal clavicle. Panel C: An X-ray taken 90 days after the clavicle fracture shows further displacement of the distal clavicle and flexion of the right ventricular (RV) lead (indicated by the black arrow). Panel D: Time course of RV and left ventricular (LV) lead impedance. Changes in the RV lead and LV lead impedance started after the distal clavicle had been dislocated.

seemed to compress the device leads in certain positions of the right upper limb (Fig. 2A).

The LV lead pacing threshold decreased to 0.5 V at 0.40 ms by changing the pacing mode from bipolar to unipolar. Since the damage to the RV lead seemed serious based on radiographic images, replacement of the lead was considered necessary to maintain function of the CRTD system. An operation to implant a new RV defibrillator lead was performed. During the surgery, the inner wires of the RV lead were found to be protruding from the outer insulation material (Fig. 2B). It was impossible to pass a new RV defibrillator lead through the subclavian vein due to venous stenosis. A trial of RV lead extraction was also unsuccessful because a lead stylet could not be passed due to flexion of the lead. Instead of a defibrillator lead, a 5 Fr pacing lead (Tendril model 2088TC, St. Jude Medical) was somehow passed through the subclavian vein using 7Fr sheath and was successfully implanted at the RV apex. After the procedure, continuous biventricular pacing was maintained by utilizing the LV lead in a unipolar fashion and the newly implanted RV lead. Surgical treatment of the clavicular fracture with plate fixation was also simultaneously performed to prevent further damage to the device leads. However, the LV unipolar lead pacing impedance was found to be elevated to 2500 Ω and higher 9 months after the clavicle fracture, and LV lead pacing in a unipolar fashion could not capture the myocardium even with maximum output, suggesting that the LV lead was damaged further more. This LV lead pacing failure resulted in deterioration of the patient's heart failure. Unfortunately, while we were discussing how to deal with the problematic LV lead, he died due to severe congestive heart failure secondary to a sepsis caused by bacterial infection in oral cavity 10 months after the clavicle fracture.

2. Discussion

Lead fracture following subclavian puncture is usually caused by mechanical stress around the costoclavicular region, and its occurrence in association with subclavian fracture is very rare [1].

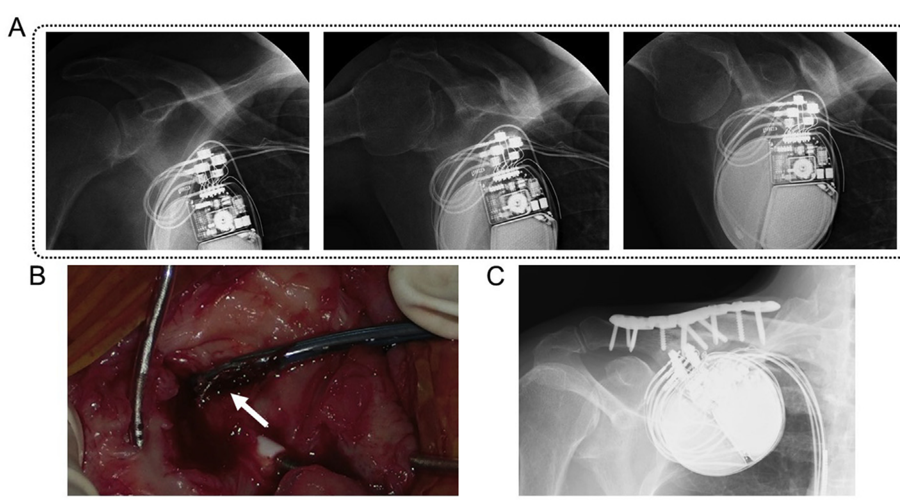

Fig. 2. Panel A: Three representative radiographs in various right upper limb positions. The device leads seemed to be compressed by the distal right clavicle and adjacent soft tissue when the right upper limb was in the neutral position. In contrast, the device leads seemed to be less affected by the distal right clavicle when the right upper limb was elevated. Panel B: Intraoperative photograph of the inside of the device pocket. The inner wires of the right ventricular (RV) lead can be seen protruding from the outer insulation material (indicated by the white arrow). Panel C: Radiographs after surgical fixation of the right clavicle using a fixation plate.

The drastic change in lead parameters in this case started 2 months after the subclavian fracture, when apparent displacement of the distal clavicle was observed. A subcutaneous defibrillator implantation could be one of useful options to deal with lead troubles now, but it was not available at that time of lead troubles in this case.

Radiographs suggested that the distal clavicle and the peripheral soft tissue compressed the device leads in certain particular positions of the right upper arm. It is likely that various movements of the right upper limb in daily life insidiously damaged the device leads, leading to lead fractures. While an extrathoracic axillary puncture was applied in our case, cephalic vein cutdown was one of options to insert lead. In general, an insertion site of cephalic vein cutdown tends to be further from the clavicle than that of extrathoracic axillary puncture. Therefore, if a cephalic vein cutdown had been applied in our case, it might have prevented or reduced lead damages. Closed clavicle fractures with mild clavicular displacement, as in our case, are generally treated without open surgical treatment if they are not complicated by vessel or nerve damage [2,3]. In our case, if surgical fixation had been performed before the distal clavicle had been significantly displaced, it would have avoided damage to the leads due to compression by the distal clavicle. However, it was difficult for the orthopedist to predict that the clavicle fracture would cause the lead to fracture. Surgical fixation of the clavicle using plates requires careful attention because the plate screws may potentially damage the device lead [4]. Fixation with tension bands is another option for clavicle fractures, which could have prevented damage to the leads in our patient by minimizing clavicle dislocation [3]. This method is noninvasive and would have been safe in the present case. However, the orthopedist did not apply a tension band for fear that the band itself would damage the CRTD generator or device leads. Hence, in the case of clavicle fractures on the same side as the pacing device, it is essential that the orthopedists and cardiologists who are managing the pacing device discuss all options and cooperate with each other to ensure that the patient receives the best possible care.

Disclosures

None.

Conflict of interest

The author declares no conflict of interest.

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