Cable externalization at the proximal portion of the superior vena cava coil in Riata implantable cardioverter defibrillator leads

Case reports

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Abstract

Many Riata implantable cardioverter defibrillator (ICD) leads have reportedly developed cable externalization. The most likely cause of cable externalization is insulation abrasion, which often occurs at the can or between the right ventricular coil and superior vena cava (SVC) coil. We report a rare case of an adult male whose ICD lead cable was externalized at the proximal portion of the SVC coil. This lead became fixed to the wall at the subclavian vein and SVC and became bent between these adhesions. Furthermore, the motion of this lead was affected by pulsation of the aortic arch. The ICD lead might develop inside-out abrasion due to mechanical stress evoked by pulsation of the aortic arch at this site.

Leaning objective

Cable externalization of the ICD lead at the proximal portion of the SVC coil has rarely been reported. Externalization might be the result of deformation of the left brachiocephalic vein and the anatomical relationship with the aortic arch. The anatomical pathway of the lead should be carefully considered during the procedure, especially when a dual-coil lead is selected. Moreover, possible cable externalization at both the proximal and distal portions of the SVC coil should be kept in mind during follow-up.

Introduction

Riata implantable cardioverter defibrillator (ICD) leads were recalled in 2011, due to increased risk of insulation failure leading to cable externalization. Although the relationship between electrical abnormalities and cable externalization has not been proven, insulation defects might induce high-voltage failures.[1)] The common sites of cable externalization of Riata ICD leads are reportedly at the lead-can or between the two coils, and underneath the shocking coil.[2)3)] Here we describe a case of cable externalization in a Riata ICD lead at the proximal portion of the superior vena cava (SVC) coil.

Case report

A 70-year-old male had syncope due to ventricular tachycardia of unknown etiology in 2007. A dual-chamber ICD (Generator: Atlas TM+DR V-243, atrial lead: 1688T-52, ventricular lead: Riata 1580-65) was implanted. There was no ventricular tachycardia recurrence, but the pacing threshold of the Riata ICD lead gradually increased since early 2011. In 2014, because the battery level reached to elective replacement indicator and the pacing threshold of the Riata ICD lead was very high (2.75V at 1.5 ms width) at that time, the patient was admitted to exchange the generator and the ICD lead. On computed tomography (CT), advanced calcifications surrounding the leads were seen at the left subclavian vein and SVC portion. Furthermore, in transesophageal echocardiography (TEE), reduced mobility of the lead at the SVC portion was observed. Cable externalization at the

proximal portion of the SVC coil was confirmed by X-ray fluoroscopy (Fig.1). Because of the lead crash and increase in the pacing threshold, we decided to extract the Riata lead transvenously.

At the extraction procedure, firstly, a locking stylet was inserted into far end of Riata lead and fixed. Then, we removed tight adhesions by using a laser sheath. Riata lead was successfully extracted without affecting the atrial lead. Tightly adherent fibrous tissue at the subclavian vein and SVC coil, and also cable externalization at the proximal portion of the coil was observed on the extracted lead (Fig.2). The cable had not externalized underneath SVC coil. Though ETFE coting was damaged by extraction procedure, electrical abnormality was not observed in the entire conduction path in extracted lead analysis.

Discussion

In Riata ICD leads, an ethylene-tetrafluoroethylene (ETFE) coating is applied to the cable, which is also covered with silicone insulation. Silicone rubber is vulnerable to insulation abrasion,[4] and the rate of insulation breach in Riata ICD leads (models: 1580/1581) was reported in 2015 to be 2.09%.[5] The most common cause of insulation failure is lead-can abrasion (70%), followed by inside-out abrasion (27.9%).[6] The most frequent site of inside-out abrasion is between the SVC coil and right ventricular coil.

This was a rare case in which the ICD lead was tightly adherent to the subclavian vein and SVC, and the cable was externalized between these adhesions. In preoperative X-ray fluoroscopy, the lead

was tightly fixed to the vein wall at the subclavian vein and SVC, and became bent between these adhesions. The motion of the lead at this site was synchronized with the pulsation of the aortic arch (Fig.1). The ICD lead might develop inside-out abrasion due to mechanical stress induced by pulsation from the aortic arch.

Usually, the left brachiocephalic vein does not have direct contact with the aortic arch. However, in this case, CT before and after device implantation showed that the left brachiocephalic vein had moved downward and made contact with the aortic arch (Fig.3). The deformation of the left brachiocephalic vein might have been induced by the weight of the lead, pushing force, or extension of the SVC by lead insertion.

Extraction of Riata lead with externalized cables reported to have much difficulty sometimes. In this case, fortunately, the lead extraction succeeded relatively easily by using a locking stylet and laser sheath, and with controlling the deflection of each cable.

In this case, the pacing threshold of the ICD lead had increased with time, however, electrical abnormality was not observed in extracted lead analysis. Though the exact mechanism of the threshold elevation is unknown, focal myocardial degeneration or impaired interaction between the lead tip and the myocardium over time might affect the change.

Conclusions

In Riata ICD leads, cable externalization can occur not only between the two coils but also at the

proximal portion of the SVC coil. Deformation of the left brachiocephalic vein, firm adhesion by the SVC coil, and direct pulsation of the aortic arch may result in significant stress on the lead in this area.

Conflict of interest

The authors have no conflicts of interest to declare.

References

1) Hauser RG, et al. Deaths Caused by the Failure of Riata and Riata ST Implantable Cardioverter-Defibrillator Leads. Heart Rhythm 2012;9:1227-35.

2) Hauser RG, et al. Riata implantable cardioverter-defibrillator lead failure: analysis of explanted leads with a unique insulation defect. Heart Rhythm. 2012;9:742-9.

3) Sunthosh V, et al. High prevalence of insulation failure with externalized cables in St. Jude Medical Riata family ICD leads: Fluoroscopic grading scale and correlation to extracted leads. Heart Rhythm. 2012:9:1218-24.

4) De Lurgio D, et al. Incidence and Implications of Abrasion of Implantable Cardioverter-Defibrillator Leads. American Journal of Cardiology. 1997;79:1409-11.

5) Implantable electronic systems product performance report 2015. St. Jude Medical. https://professional.sjm.com/resources/product-performance/product-performance-reports/current

6) Ratika Parkash, et al. Insight into the mechanism of failure of the Riata lead under advisory. Heart

Rhythm. 2015;12:574-9.

Figure legends

Fig.1 Anatomical relationship between the ICD lead and aortic arch

The ICD lead received pulsation from the aortic arch [yellow arrow] between the adhesions at the subclavian vein and the superior vena cava (SVC) coil [light blue lines]. Cable externalization between the adhesions was suspected on X-ray fluoroscopy.

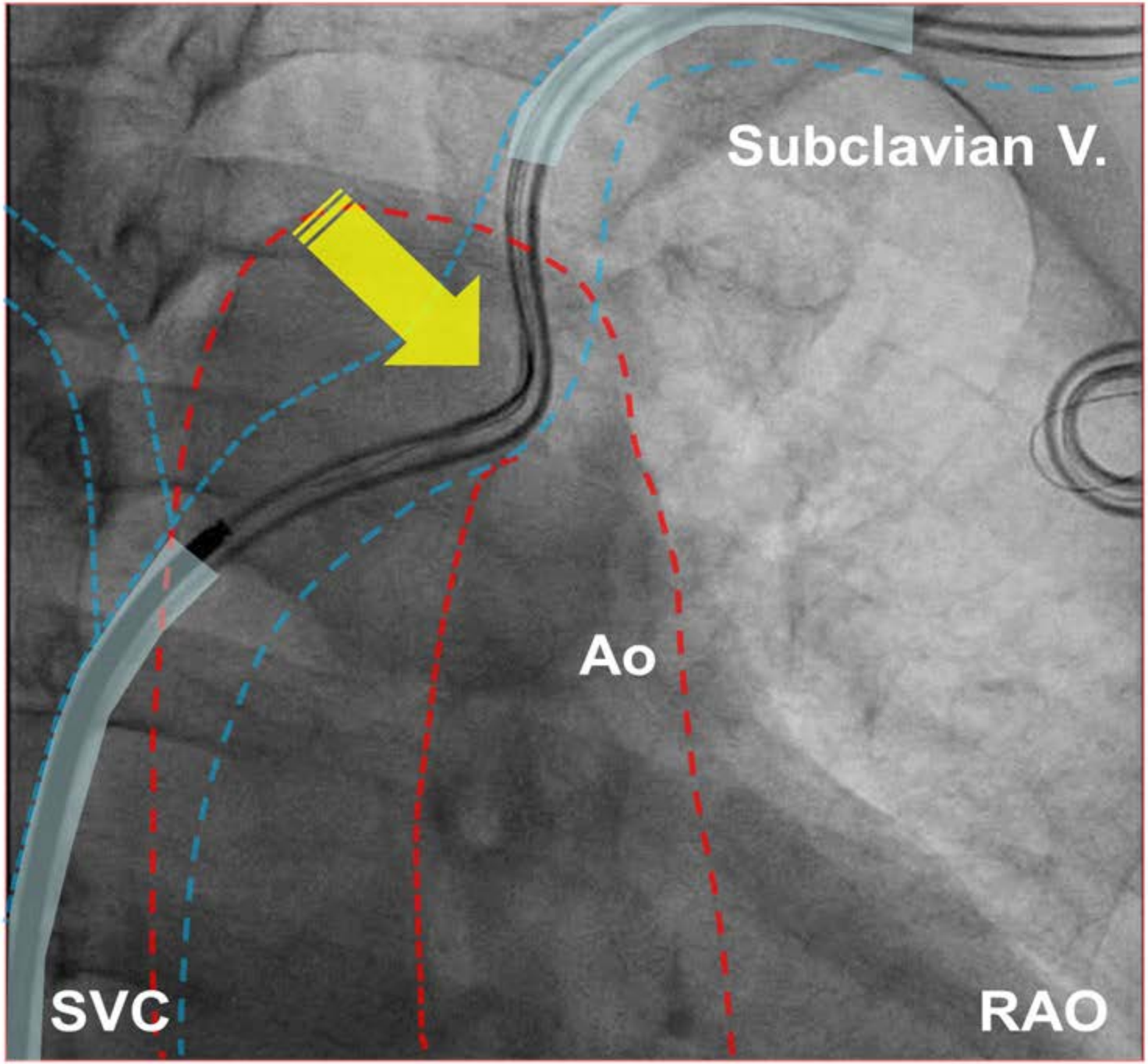
Ao, aorta; RAO, right anterior oblique view; subclavian V, subclavian vein.

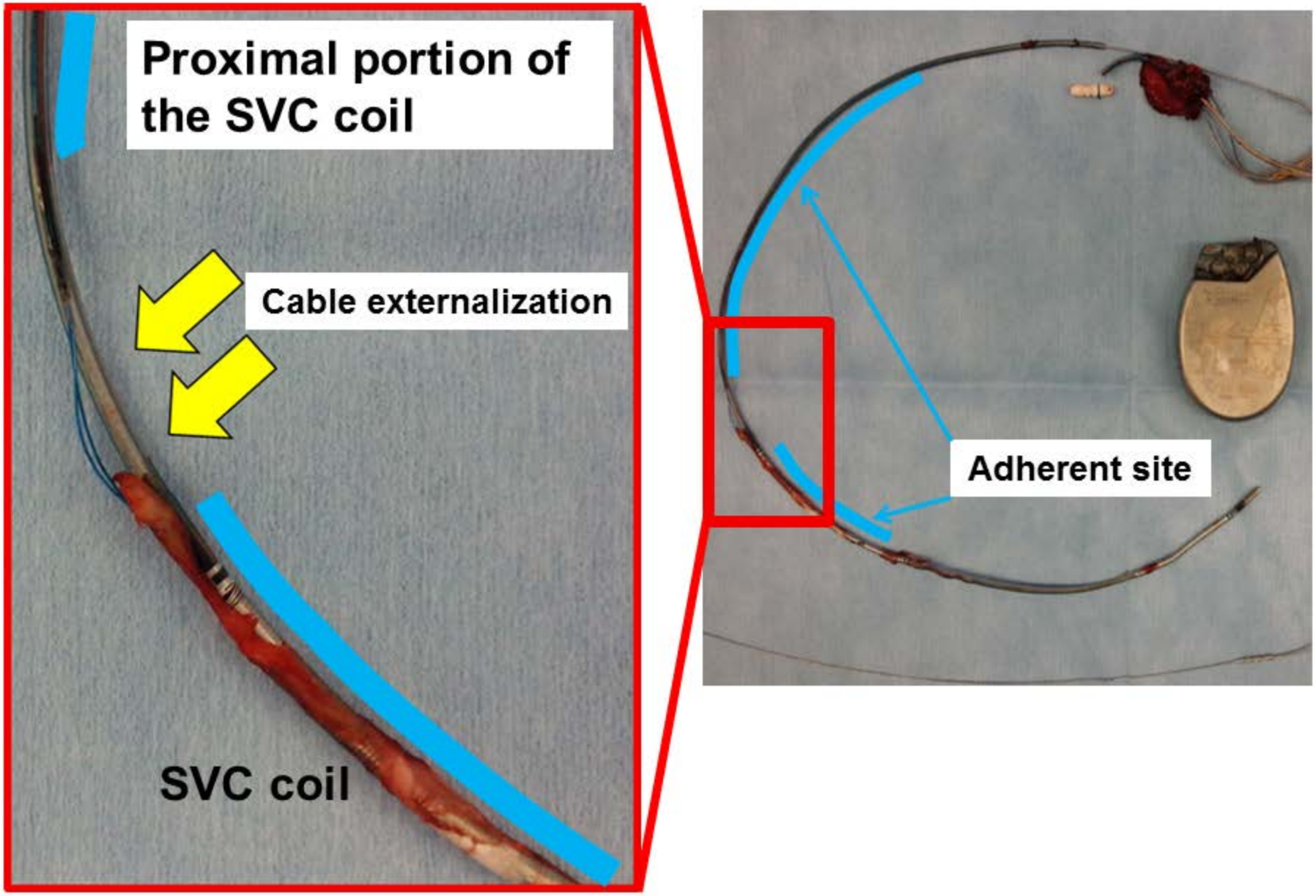
Fig.2 Extracted Riata ICD lead and generator

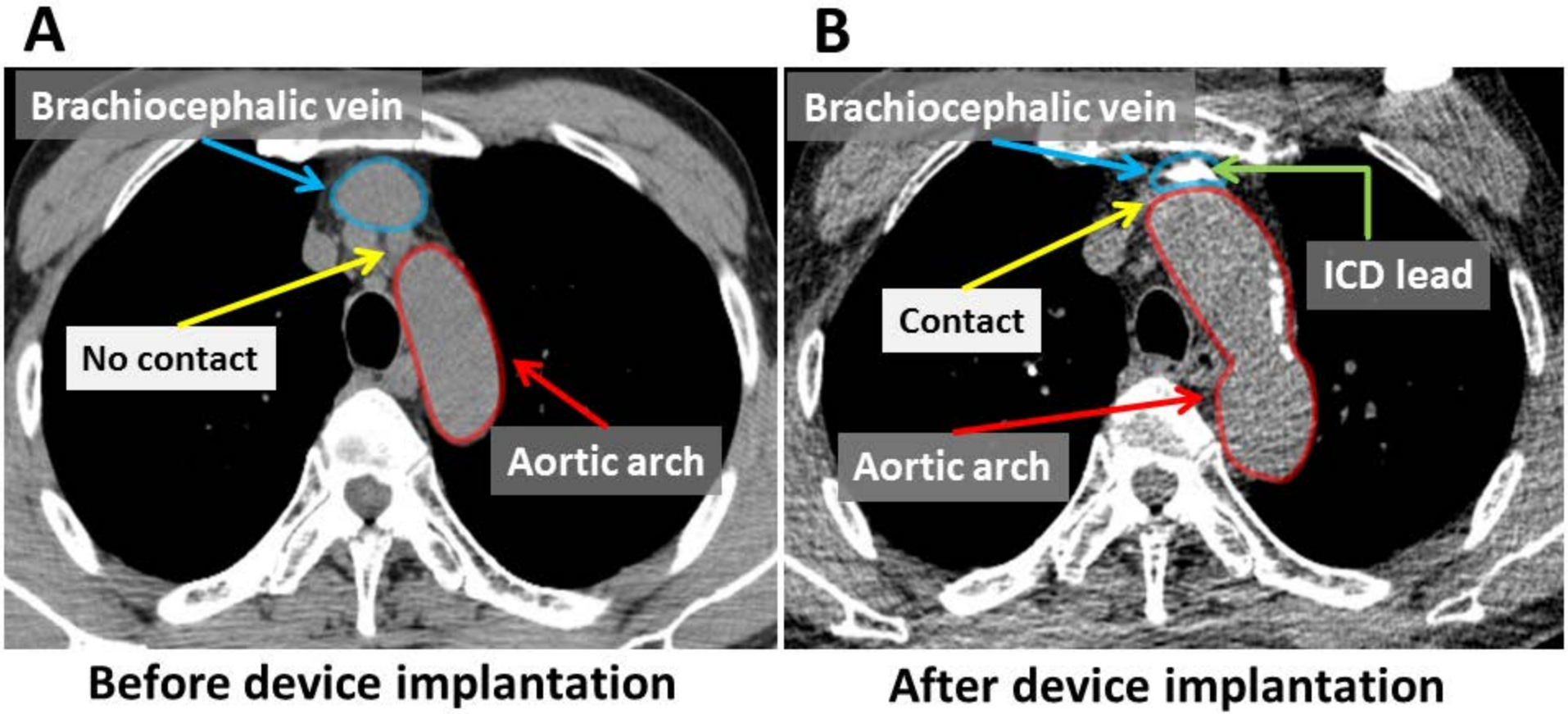
Tightly adherent tissue on the ICD lead was seen at the subclavian vein and SVC coil [blue line]. The cable was externalized between the adhesions [yellow arrow].

Fig.3 Chest CT before and after device implantation

Figure 3A showed the CT image before device implantation. The left brachiocephalic vein [blue circle] had no contact with aortic arch [red circle]. Figure 3B showed the CT image after device implantation. The left brachiocephalic vein [blue circle] moved downward and made contact with the aortic arch [red circle] after device implantation.


Subclavian V.
Ao
SVC
RAO


Proximal portion of the SVC coil
Cable externalization
SVC coil
Adherent site



Before device implantation

After device implantation