Fracture of an S-ICD lead after two prior transvenous lead-related complications with conventional defibrillators

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Abstract
Six months after subcutaneous implantable cardioverter defibrillator (S-ICD) implantation a 26-year-old Brugada patient presented because of a beeping tone emitted by his device. Chest X-ray displayed two functionless transvenous shock leads and the S-ICD system with a lead fracture. During lead revision procedure, extensive preparation of the lead from unexpectedly firm surrounding fibrous tissue encapsulating the lead was necessary before it could be removed, and a new shock lead could be implanted. This is the first report of an S-ICD lead exchange due to very early lead fracture and unexpectedly severe fibrous tissue hampering surgical lead extraction.

KEYWORDS
implantable defibrillator, lead failure, subcutaneous defibrillator

1 | INTRODUCTION

Implantable cardioverter defibrillator (ICD) therapy is an established technique to prevent sudden cardiac death (SCD), and its use is based on clear indications and guideline-based recommendations. However, transvenously implanted leads seem to be the achilles-heel of these systems as lead-related complications like lead dislodgment, perforation, infection/endocarditis, damage to the tricuspid valve, vascular obstruction, pneumothorax, and lead malfunction during long-term follow-up are frequent and associated with a relevant increase in morbidity and mortality. Entirely subcutaneous ICDs (S-ICDs) without the need for transvenous leads have been developed to reduce these complications. Indications are similar as for transvenous ICD, unless there is need for anti-tachycardia pacing, anti-bradycardia pacing, or cardiac resynchronization therapy. Data from observational studies and data from the randomized PRAETORIAN trial, most recently presented at the 2020 Heart Rhythm Society scientific sessions suggest that the S-ICD is associated with reduced lead-related complications. However, little is known about specific lead failures, lead fractures, lead explantation, and reimplantation procedures. We report on a rare case of an S-ICD lead explantation and reimplantation of a new lead due to complete lead fracture at an unusual location.

2 | CASE REPORT

A 26-year-old asthenic male patient (height: 184 cm, body weight: 72 kg) presented to our emergency department for the first time in April 2019 because of a beeping tone of his S-ICD. Since then he experienced adequate ICD therapy in May 2015, and he...
required additional surgical revision procedures due to unacceptably low right ventricular sensed electrograms in October 2015 and due to an impedance drop with the second transvenously implanted shock lead in October 2018. Moreover, limited venous access necessitated a contralateral right pectoral approach at the time of first revision procedure with the result of two functionless single coil ICD shock leads. In view of the above, in October 2018 the decision was made to also explant the second conventional ICD pulse generator and to implant the patient with an S-ICD. At admission to our hospital, chest X-ray displayed both functionless single coil shock leads from prior transvenous ICD systems and the S-ICD including its fractured lead. The defect was visible between the shock coil and the proximal sensing electrode (Figure 1). Device interrogation revealed high impedance; thus, the device was deactivated, and lead revision procedure was scheduled.

2.1 | S-ICD lead revision procedure

After application of general anesthesia, the device pocket was reopened, and the device was removed. Additional incisions were made parasternally at the level of the lead tip and close to the xiphoid. Subcutaneous and fibrous tissue around the lead and the suture sleeve was dissected, and a complete lead fracture became visible 1.5 cm distal to the suture sleeve and 2 mm distal of the proximal sensing electrode (Figure 2A). The proximal fragment of the lead was easily retractable through the S-ICD pocket whereas the distal part, including the shock coil, was severely stuck to firm surrounding fibrous tissue encapsulating the shock coil. An attempt to grab and extract the lead from the cranial incision after dissection as far as possible was unsuccessful. With the application of gentle traction, the helically wound shock coil spread and tended to tear off (Figure 2B, C). Since this lumenless lead type does not allow to insert a lead locking stylet, an additional vertical midsternal incision parallel to the shock coil was made and the fibrous tissue was dissected conventionally off the lead before it could be removed completely (Figure 2D). A new shock lead was implanted through the old lead channel in the same position and fixated with non-absorbable sutures at the lead tip and at the xiphoidal incision using the suture sleeve provided by the manufacturer. After wound closure the S-ICD-system was interrogated and tested with satisfying results.

3 | DISCUSSION

Transvenous leads have been described as the weak point of conventional ICD systems since they are associated with a variety of complications over time. Thus, the S-ICD has been developed, and several studies have shown lower lead-related complication rates compared to transvenous ICD leads. Most recently, Knops et al presented the results from a prospective randomized comparison of subcutaneous and transvenous ICD therapy (PRAETORIAN) trial.
FIGURE 2  S-ICD lead (A-D), fractured distal of the proximal sensing electrode further away from the fixation sleeve, known as predetermined breaking point of leads (A). Grabbing the lead from the cranial incision (B). With the application of gentle traction, the helically wound shock coil spreads and tends to tear off (C).

...at the 2020 Heart Rhythm Society congress. They found a highly significant reduction in lead-related complications with S-ICDs compared to transvenous ICDs (1.4% vs 6.6%, hazard ratio 0.24, 95% Confidence Interval [CI] 0.10-0.54, \(P = .001\)) in a cohort of 849 patients during a follow-up of 48 months. Some early lead dislodgments have been attributed to inadequate lead fixation, and lead dislodgments during mid-term follow-up were partly seen in context of vigorous physical activity. Additionally, two cases of lead dislodgments due to twiddler syndrome were reported. Both were treated with uncomplicated lead revisions without any procedural difficulties regarding lead ingrowth with fibrous tissue.

To the best of our knowledge we are the first to report on a complete lead fracture, located atypically between shock coil and distal sensing electrode approximately 1.5 cm distal of the fixation sleeve, which is known to be a predetermined breaking-point of leads. Moreover, this complication occurred only 6 months after lead implantation. Although the patient claimed that he did not perform vigorous physical activities as in a case reported by Cappato et al., this nevertheless could also have been a factor in our case, possibly in connection with the patient’s asthenic constitution. Young patients are known to be at higher risk of lead fractures, and many of these are associated with sporting activities like basketball, weight lifting, or martial arts, which could also increase mechanical stress to S-ICD leads. Striation patterns at the fracture site of the lead indicate that mechanical stress applied to the lead during implantation could have been another possible cause for this complication. Although relatively early after implantation, lead explantation was unexpectedly difficult and hampered by severe lead ingrowth with fibrous tissue. Lead extraction needed extensive dissection of the lead from firm surrounding tissue. Recently Li et al also reported two cases with fibrous encapsulations of S-ICD leads associated with high-voltage impedance and defibrillation failure after ventricular fibrillation induction 2 years after implantation. However, in contrast to our case lead extraction was easily achieved by simple traction, and reimplantation of the same lead in another position was performed.

Another important point is the fact that our patient experienced multiple and severe lead-related complications with two previously implanted transvenous leads and with an S-ICD lead. Some, if not all of these complications: (a) drop of the sensing signal with the first transvenous lead, (b) limited venous access at first revision procedure, and (c) severe ingrowth of the S-ICD lead could have been attributable to the general tendency of fibrous adhesions developing around implanted material. Thus, it seems that transvenous ICD leads and subcutaneous leads used with S-ICDs share some risks leading to complications. Despite that, in the case of lead extraction, S-ICD leads do not bear the same risks as transvenous leads.

4 | CONCLUSION

Our case impressively demonstrates the risk of lead-related complications with transvenous as well as with subcutaneous defibrillator leads. Even S-ICD leads can suffer from lead fractures. Lead explantation and reimplantation can be hampered by severe fibrous adhesions even in S-ICD leads.

AUTHOR CONTRIBUTIONS

Study concept and design: Gutleben. Drafting of the manuscript: Gutleben. Critical revision of the manuscript for important intellectual content: Gutleben, Nelovic, Pujdak, Werner, Osmani, and Kähler. Approval of article: Kähler.
CONFLICT OF INTEREST
The authors declare that there is no conflict of interest that could be perceived as prejudicing the impartiality of the research reported.

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