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BEGINNER

CASE REPORT: CLINICAL CASE

Lead Macrodislodgement of a Subcutaneous Implantable Cardioverter-Defibrillator Results in a Reel Problem

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ABSTRACT

Lead macrodislodgement is a rare complication of cardiac implantable electronic devices associated with patient-related risk factors. This paper outlines a case of reel syndrome secondary to device manipulation 3 months after subcutaneous implantable cardioverter-defibrillator implantation and describes the challenges with lead macrodislodgement diagnosis, mechanisms, and management. (**Level of Difficulty: Beginner.**) (J Am Coll Cardiol Case Rep 2021;3:523–7) © 2021 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

HISTORY OF PRESENTATION

A 63-year-old woman underwent implantation of a subcutaneous implantable cardioverter-defibrillator (S-ICD) (EMBLEM, Boston Scientific, Marlborough, Massachusetts) for primary prevention on November 5, 2019. During implantation, a 2-incision technique was utilized with the use of a 3501 S-ICD lead. Defibrillation testing was performed with 50-Hz induction; a 65-J shock was successful in terminating ventricular arrhythmias with appropriate shock impedance (70 Ω). The subcutaneous electrocardiogram (S-ECG) showed strong amplitude and sensing (Figure 1A). On February 3, 2020, 3 months after S-ICD implantation, the patient submitted a remote latitude transmission that revealed an untreated episode consistent with noise and oversensing; the patient denied any associated symptoms. An in-office device interrogation showed no detectable QRS complexes in all tested vectors. The amplitude had precipitously decreased on the S-ECG (Figure 1B).

LEARNING OBJECTIVES

- To recognize lead macrodislodgement in subcutaneous implantable cardioverter-defibrillators.
- To highlight the importance of device interrogation and shock impedance in investigating lead macrodislodgement.

MEDICAL HISTORY

The medical history included hypertrophic cardiomyopathy (septal dimension: 3.56 cm), coronary artery disease, hypertension, hyperlipidemia, and severe obesity (body mass index: 37.7 kg/m^2).

DIFFERENTIAL DIAGNOSIS

The decreased S-ECG QRS amplitude was concerning for poor R-wave sensing and/or potential T-wave oversensing. In addition, our differential diagnosis

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ABBREVIATIONS AND ACRONYMS

LMD = lead macrodislodgement

PG = pulse generator

S-ECG = subcutaneous electrocardiogram

S-ICD = subcutaneous implantable cardioverter defibrillator

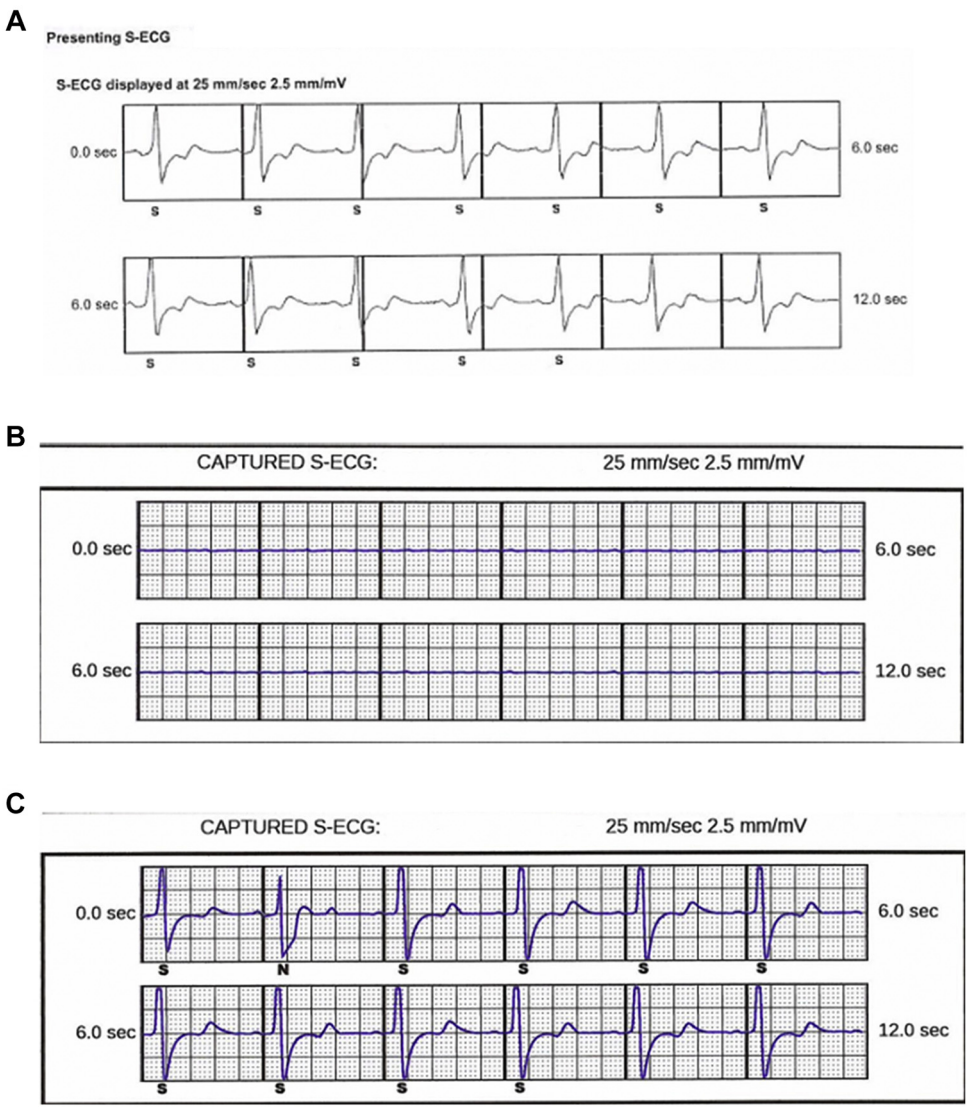
TV-ICD = transvenous implantable cardioverter defibrillator

for decreased shock impedance included lead macrodislodgement and lead insulation breach.

INVESTIGATIONS

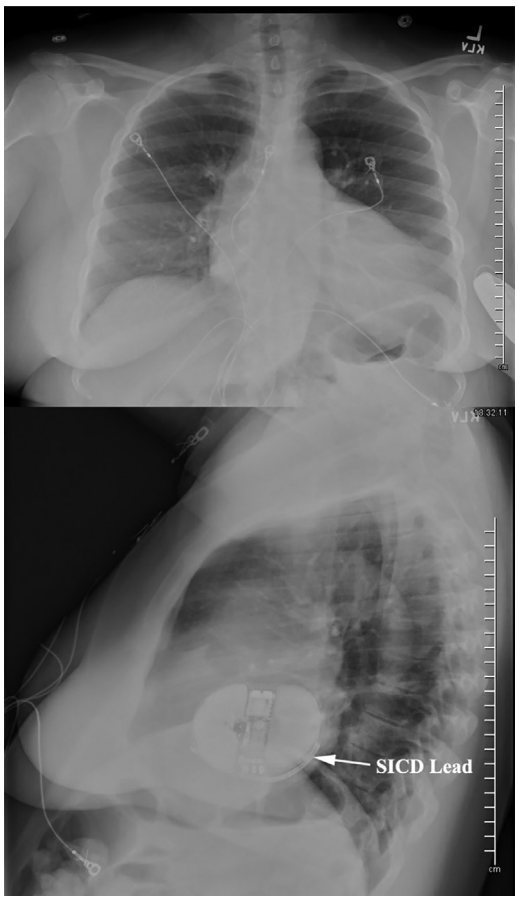
On detailed discussion, the patient did admit to repositioning on her side multiple times per day and moving the pulse generator (PG) by hand. She denied any chest pain, syncope, delivered shocks, or extracardiac stimulation. A chest radiograph revealed lead dislodgement and retraction of the electrode back into the pocket next to the PG. The coil was wrapped around the PG along its sagittal axis (Figure 2). Shock impedance (low-voltage impedance) that was obtained from the manufacturer retrospectively showed significant reduction (from 51 Ω to 16 Ω), concerning for potential lead dislodgement (Figure 3).

FIGURE 1 Subcutaneous Electrocardiogram of S-ICD



(A) S-ECG shows primary vector post-initial implantation of the S-ICD with adequate amplitudes indicating appropriate R-wave sensing. **(B)** S-ECG shows the primary vector with significantly reduced amplitude, concerning for lead dislodgement. **(C)** S-ECG shows appropriate R-wave sensing on the primary vector post-device revision. S-ECG = subcutaneous electrocardiogram; S-ICD = subcutaneous implantable cardioverter-defibrillator; sec = seconds.

FIGURE 2 Chest Radiograph of Reel Syndrome



Chest radiograph image 3 months after implantation of S-ICD shows complete retraction and reeling of the lead around the pulse generator. SICD = subcutaneous implantable cardioverter-defibrillator.

MANAGEMENT

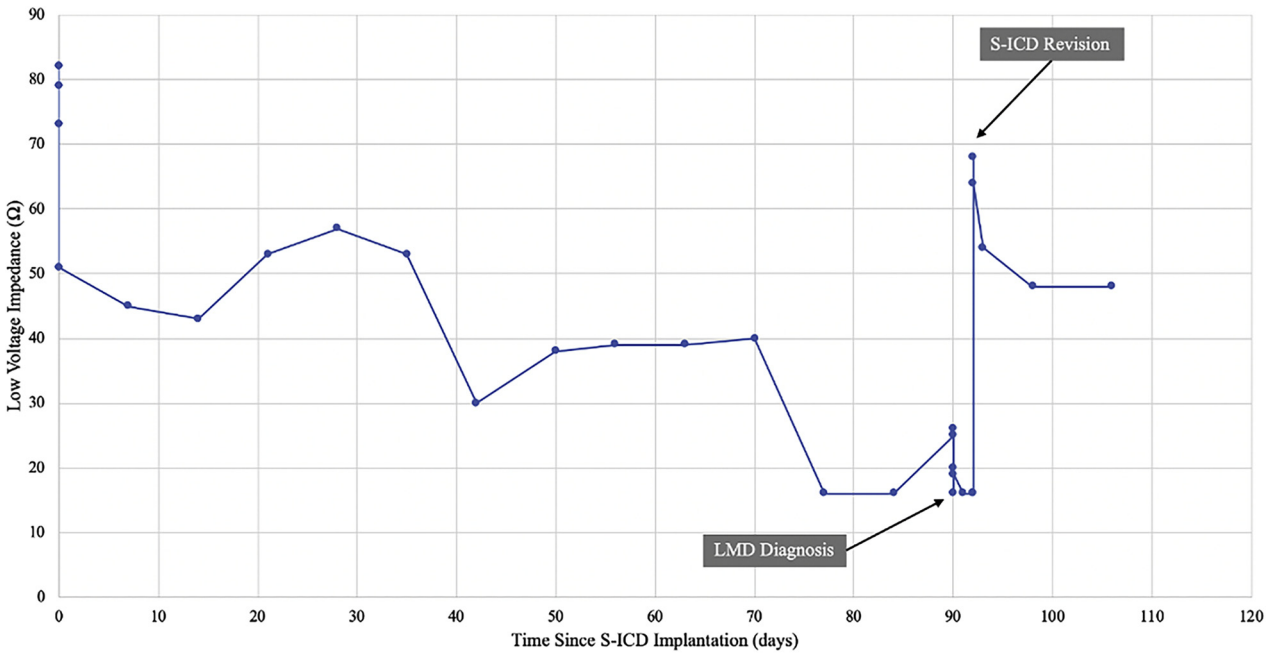
Subsequently, the patient was admitted to the hospital for device extraction, and device therapies were turned off to prevent inappropriate shock. During extraction of the S-ICD, the entire electrode was found to be retracted and reeled around the PG. The PG was freely moveable despite being fixed with 2 sutures to the serratus anterior muscle during the first implantation. The subxiphoid site revealed 2 intact loosened silk sutures on dissection. On reimplantation, the pocket was kept the same size. A new but similar EMBLEM 3501 subcutaneous lead was placed in a similar parasternal position. The suture sleeve, however, was fixated to the muscle with 2 2-0 Ethibond (Ethicon, Somerville, New Jersey) sutures in comparison to the silk sutures from the first implant. The PG was positioned in between the latissimus dorsi and serratus anterior and fixated once again with Ethibond sutures. Repeat defibrillation testing was successful, with shock impedance of 61 Ω. The S-ECG also showed normal sensing of the QRS complex (**Figure 1C**).

DISCUSSION

Lead macrodislodgement (LMD) refers to the gross dislodgement of leads after implantation. It is an uncommon condition, with an incidence of 0.61% to 1.8%, that is reported with transvenous devices (1,2). The 2 postulated mechanisms for dislodgement are device manipulation and mechanical forces (procedure related and non-procedure related). Twiddler, reel, ratchet, fixation release, and flip are the main forms of LMD, differentiated by their mechanisms (2). LMD has been demonstrated predominately in transvenous ICDs (TV-ICDs). S-ICDs are also susceptible to lead macrodislodgment. We report a case of reel syndrome occurring in a patient with a S-ICD, after remote monitoring revealed untreated episodes of noise.

First described by Carnero-Varo et al. (3) in 1999 with TV-ICDs, reel syndrome is a form of LMD that results in coiling of the lead around the PG, like line in a fishing reel. It can cause device failure or inappropriate shock in pacemakers and ICDs, respectively. Symptoms associated with reel syndrome and other forms of LMD can include extracardiac stimulation, syncope, worsening of heart failure, inappropriate shocks, and undetected ventricular fibrillation. Although our patient was fortunately asymptomatic, most patients are symptomatic at the time of diagnosis in 52% to 73.6% of TV-ICD cases (1,2). In a review of published reports, only 1 other case of reel syndrome in association with an S-ICD has been reported (4). Unlike the case described, that patient was diagnosed 9 months post-implant, denied any device manipulation, and was suspected to have had an inappropriate shock causing secondary damage to the device (4). In addition, we recognized that LMD had occurred because of significant reduction in S-ECG amplitude and impedance. Consistent with our case, reel syndrome has been shown to present earlier post-implantation than other forms of LMD, such as twiddler (1). Although they remain undefined, the most commonly reported risk factors of LMD in transvenous patients include device manipulation, female sex, obesity, history of mental health disorders, and increased age. Although the aforementioned LMD involved an S-ICD, our patient had several risk factors, namely, female sex, device manipulation, and severe obesity (body mass index: 37.7 kg/m^2).

FIGURE 3 Low-Voltage Impedance Post-S-ICD Implantation



LMD = lead macrodislodgement; S-ICD = subcutaneous implantable cardioverter-defibrillator.

Conceptually, reel syndrome requires loose sutures to permit lead retraction and excess PG movement in an oversized pocket (2). During our device extraction, the PG was noted to be freely moveable in its pocket, and the lead/suture sleeves were displaced from the 2 subxiphoid silk sutures, which remained intact but loosened. On the initial S-ICD implantation, silk sutures were used, whereas Ethibond was utilized on post-LMD revision. Given the reduction in tensile strength of silk sutures over time, Ethibond has been reported to have increased durability and strength in comparison (5,6).

S-ICDs are an alternative to TV-ICDs to avoid complications related to venous access, intracardiac leads, and infection. Pertaining to LMD, in a recent meta-analysis, S-ICDs had significantly less risk of lead-related complications and lead-related movement compared to TV-ICDs (7). Although its risk is lower, reel syndrome can alter the sensed vectors and result in inappropriate device shocks in S-ICD patients. This is why remote monitoring remains critical in the diagnosis of LMD, even before symptom onset. The vast majority of LMD events (89.5%) are detected by a change in lead parameters on remote monitoring (2). In our case, the dramatic alteration in sensing and impedance prompted radiographic re-evaluation of lead positioning and established the diagnosis. Further studies are needed to address the gap in knowledge regarding phenotypic characterization, diagnosis, and management of LMD in S-ICDs.

FOLLOW-UP

At the 2-month follow-up, the patient remains asymptomatic without any new complications. Device checks have been unremarkable, without any evidence of dislodgement or untreated episodes.

CONCLUSIONS

We highlight that reel syndrome can occur in those with an S-ICD and the importance of its consideration in those with device parameter changes.

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The authors have reported that they have no relationships relevant to the contents of this paper to disclose.

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REFERENCES

1. Morales JL, Nava S, Márquez MF, et al. Idiopathic lead migration: concept and variants of an uncommon cause of cardiac implantable electronic device dysfunction. J Am Coll Cardiol EP 2017;3:1321–9.

2. Tseng AS, Shipman JN, Lee JZ, et al. Incidence, patterns, and outcomes after transvenous cardiac device lead macrodislodgment: insights from a population-based study. Heart Rhythm 2019;16:140–7.

3. Carnero-Varo A, Pérez-Paredes M, Ruiz-Ros JA, et al. "Reel syndrome": a new form of twiddler's syndrome? Circulation 1999;100:e45–6.

4. Calcaianu M, Bresson D, Lévy J. A potentially lethal dysfunction of a subcutaneous implantable cardiac defibrillator: "the phantom menace"? Can J Cardiol 2017;33:1066.e9–11.

5. Greenwald D, Shumway S, Albear P, Gottlieb L. Mechanical comparison of 10 suture materials before and after in vivo incubation. J Surg Res 1994;56:372–7.

6. Dunn DL, editor. Wound Closure Manual. Somerville, NJ: Ethicon Inc., 2005.

7. León Salas B, Trujillo-Martín MM, García J, et al. Subcutaneous implantable cardioverter-defibrillator in primary and secondary prevention of sudden cardiac death: a meta-analysis. Pacing Clin Electrophysiol 2019;42:1253–68.

KEY WORDS **cardiac implantable electronic devices, lead failure, lead macrodislogement, reel syndrome, subcutaneous implantable cardioverter-defibrillator, twiddler syndrome**