

S-ICD: Is it time for radiological follow-ups?

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S-ICD: Is it time for radiological follow-ups?

Short title: S-ICD lead migration

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Abstract

We present the case of an asymptomatic S-ICD lead migration in a 38-years-old woman, previously implanted in 2013 (3 incision technique, subcutaneous pocket, secondary prevention) and subsequent need of MRI compatible device. During the new procedure, due to lack of the thoracic lead detection at previous scars we documented fluoroscopically its migration down and left lateral. The possibility of lead migration should be considered because an important alteration in its position position could affect defibrillation threshold. A periodic chest X-rays compared to chest X-ray that performed post implantation could be method of screening in addition to electronic follow-ups, especially before S-ICD replacement.

Introduction

The implantable cardioverter-defibrillator (ICD) is the cornerstone in sudden death prevention¹. The subcutaneous ICD (S-ICD) is an alternative to the traditional transvenous ICD (TV-ICD) without the risk of endovascular lead complications. It demonstrated no significant difference in overall and arrhythmic mortality rates but a significant reduction in device-related complications with only 2/426 lead repositionings².

Clinical case

A 38-years-old woman was admitted in 2013 because of a sustained polymorphic ventricular tachycardia, with a significant rise of troponin values and ECG signs of ischemia. The patient is also affected by gynoid obesity (body mass index 33 kg/m²). Echocardiography imaging showed a severe impairment of systolic left ventricular function (LVEF: 30%), but we found normal coronaries at coronary angiography. Cardiac magnetic resonance imaging showed late gadolinium enhancement in inferior wall, therefore a diagnosis of myocarditis was made with severe systolic left ventricular dysfunction. After a successful surface electrocardiogram (ECG) screening, the patient underwent S-ICD implantation (SQ-RX Pulse Generator Model 1010 and Q-TRAK Subcutaneous Electrode Model 3010, Cameron Health/Boston Scientific, San Clemente, CA). The generator pocket was created in the midaxillary line superficial to the latissimus dorsi between the fifth and sixth intercostal spaces and the electrode along the left parasternal border. As the technique of the time, the lead was also fixed at the level of the II intercostal space over manubrio sternal junction, (3-incision technique). All sutures were adhered to the fascia of the sternum. At implant, ventricular detection test showed appropriate sensing in primary and alternate vectors. The post implantation defibrillation test (DFT) showed a defibrillation threshold <65 Joule. Post implantation chest X-ray showed that the generator was positioned anteriorly to the midaxillary line with a correct lead positioning. Post-operative course was uneventful, and the patient was discharged from the hospital 2 days after.

At routine follow-ups good parameters were found with no need to change sensing vectors. In July 2020 the patient was scheduled for S-ICD replacement due to battery depletion (3 non treated non sustained ventricular tachycardia in event memory, 81 ohm lead impedance). Echocardiography imaging showed a partial recovery of systolic left ventricular function (LVEF: 45%). The patient was also scheduled for a brain MRI for a meningioma follow up. The lead implanted in 2013 was found not to be MRI compatible and for this reason the entire system was extracted and a fully MRI compatible device was reimplanted.

At surgical exploration the device was fixed and sitting anterior to the latissimus dorsi muscle but during the lead extraction procedure it appeared impossible to find the lead anchor points on sleeves both in the upper parasternal region (manubrio sternal junction) and in the xiphoid region. The radiological exploration allowed to highlight the displacement of the lead below the manubrio sternal junction scar about 5 cm (figure 1, klemmer forceps used as landmark of the implant scar) and the left lateral displacement of the entire coil also in the xiphoid region, so as not to completely embrace the entire cardiac shadow (figure 2). The ICD lead was extracted and the 1-0 silk retention appeared to be frayed and broken, as a result of a traction or sliding of the entire lead which tore down both the manubrio sternal junction retention and that in the xiphoid region.

The new fully MRI compatible device was implanted (EMBLEM MRI S-ICD Pulse Generator A219 Boston Scientific and SQ1 Emblem S-ICD 3501-45 cm) with a 3-incision technique (in order to ensure a solid fixation of the distal lead tip). It was positioned in a new intermuscular pocket position by blunt dissection between the posterior surface of the latissimus dorsi muscle and the anterior surface of the serratus anterior muscle to have the pocket in the virtual anatomical space between the two muscles. The post implantation ventricular detection test showed appropriate sensing in primary and alternate vectors and the defibrillation test showed a defibrillation threshold <65 Joule. Post-operative course was uneventful, and the patient was discharged from the hospital after 2 days. X-ray examination showed a correct lead positioning at discharge (figure 3).

Question: Would the old device deliver effective therapy for malignant ventricular arrhythmia?

Discussion

Totally subcutaneous ICD (S-ICD) is designed to afford the same life-saving benefit of the conventional transvenous (TV) ICDs while avoiding the shortcomings of the TV-leads and to simplifying the implant techniques and hence expanding the use of ICDs in clinical practice. Both the EFFORTLESS REGISTRY³ at first and the PRAETORIAN trial² demonstrated appropriate system performance with clinical event rates and inappropriate shock rates comparable with those reported for conventional ICDs. S-ICD lead dislodgment rates are very low and clinically relevant as associated with inappropriate shocks due to sensing alterations⁴.

Answer: Our case is the first that describes a partial lead migration without altering the sensing parameters. To date, few cases of displacement have been recorded to clearly define in literature its risk factors. Probably the patient's obesity and her young age (as well as in sports athletes) represented breeding grounds for the subcutaneous lead migration. The routine follow-ups done over the years have never detected the dislocation, but we cannot know if the lead was in a suitable position to guarantee an effective shock in case of ventricular fibrillation. In fact it is shown by post S-ICD implant defibrillation threshold tests that a slightly more lateral or more immersed in fat position can significantly affect this threshold, with the need to immediately reposition the lead⁵⁻⁷. Also, the need to extract the lead to perform the brain MRI allowed to clearly reveal the displacement. The limit in our case report is represented by the non-induction of VF before the replacement of the entire S-ICD system to verify the effectiveness or otherwise of the shock and it is justified by the unethicity of this approach, as a new induction was carried out for the evaluation of the final defibrillation thresholds. The absence of inappropriate shocks during the follow-up can be explained by preserved sensing and the absence of appropriate shocks by the absence of ventricular tachyarrhythmias. In fact, after the first implant only 3 non sustained ventricular tachycardia were detected (there was also a partial recovery in ejection fraction).

Teaching points and proposed solution

The S-ICD represents a cornerstone in the sudden death prevention in young subjects. However, due to the characteristics of these patients, the possibility of lead migration (often asymptomatic and not diagnosable with the device electronic check) must be considered in the S-ICD follow up program, especially in obese patients or sports athletes. Indeed, an important alteration in lead position could affect the defibrillation threshold. At this point we may need to answer a question: Is it possible to demonstrate only with electronic control in the follow up that S-ICDs are sufficiently effective? In fact, it is very difficult to appreciate changes in the EGMs amplitude at an ordinary follow-up. Probably, in subjects at higher risk of dislocation a periodic (or at least one in the first months after implantation) chest x-ray to be compared to the one performed post implantation could represent a means of screening to be added to the electronic follow-ups. Data regarding DFT testing in S-ICD patients undergoing its replacement is scarce and it is unknown how many physicians perform DFT testing after its replacement⁸. Current guidelines recommend DFT testing in patients undergoing S-ICD implantation but do not indicate DFT after replacement. Surely this indication could be mandatory at the time of S-ICD replacement, in case of suspected partial dislocation diagnosed by chest x-ray.

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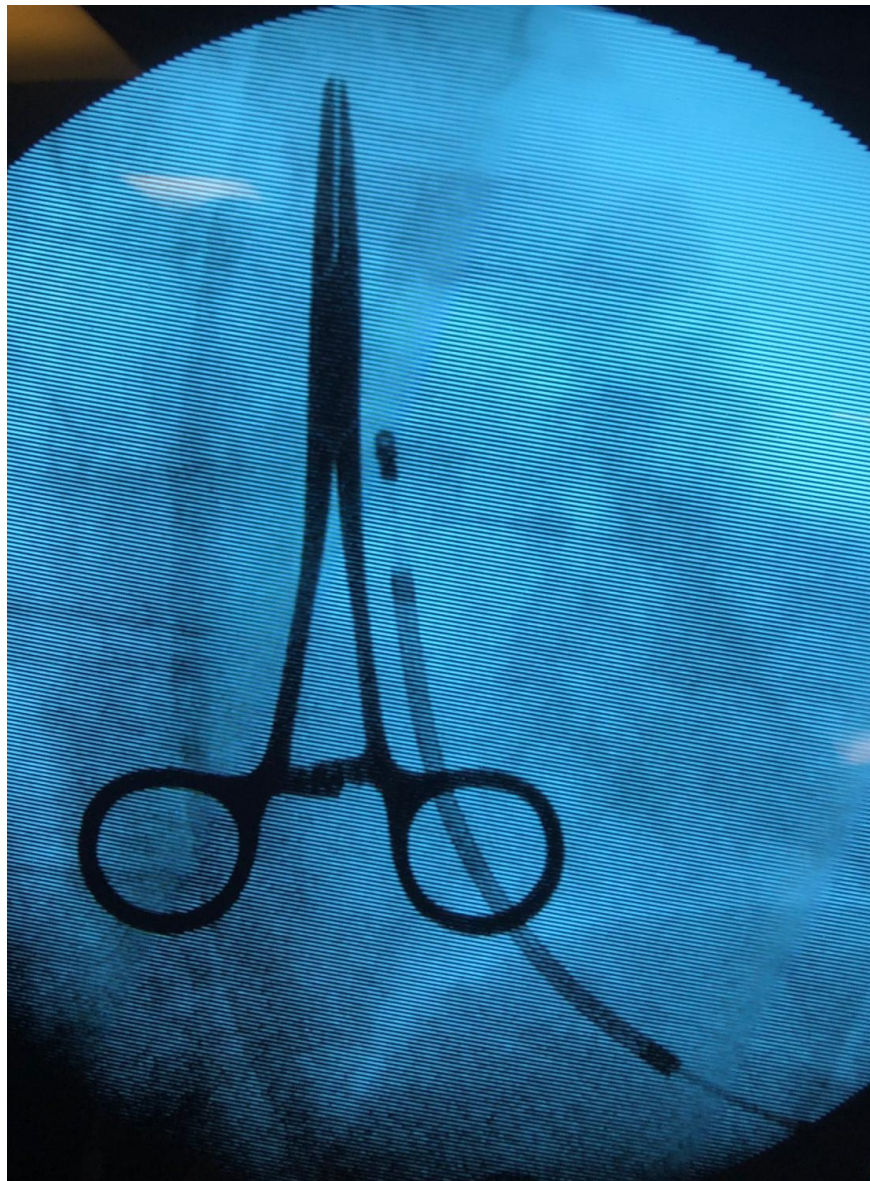


Figure 1: X-ray showing lead tip migration below the manubrio sternal junction scar about 5 cm, klemmer forceps used as landmark of the implant scar.

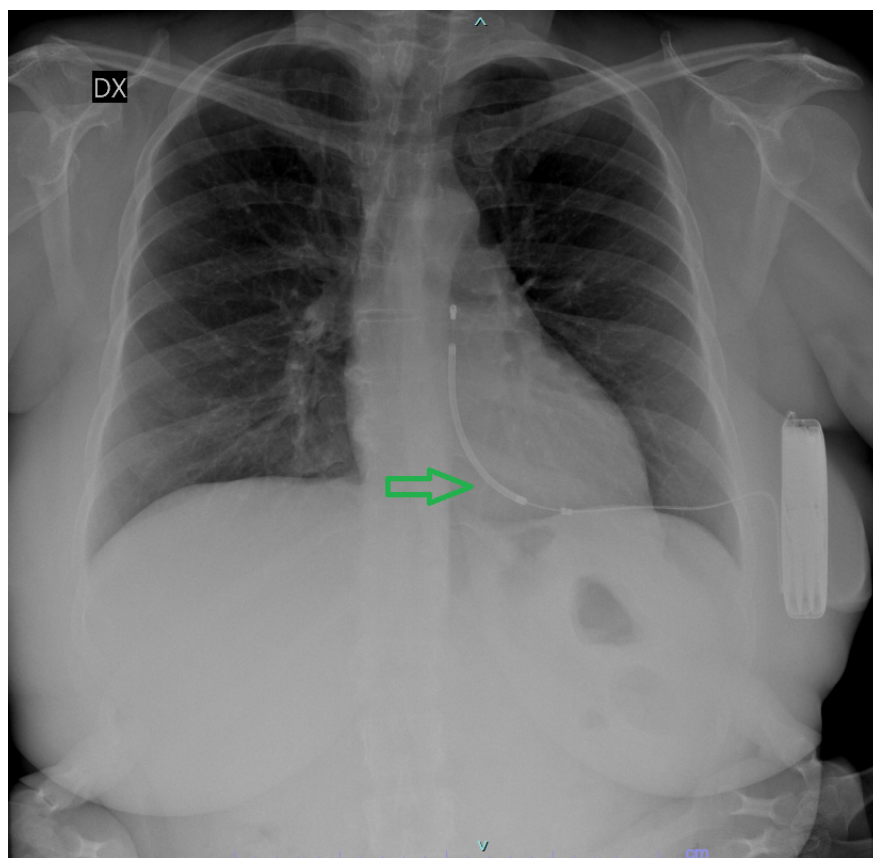


Figure 2: X-ray showing left lateral displacement of the entire coil so as not to completely embrace the entire cardiac shadow (arrows shows lead migration).

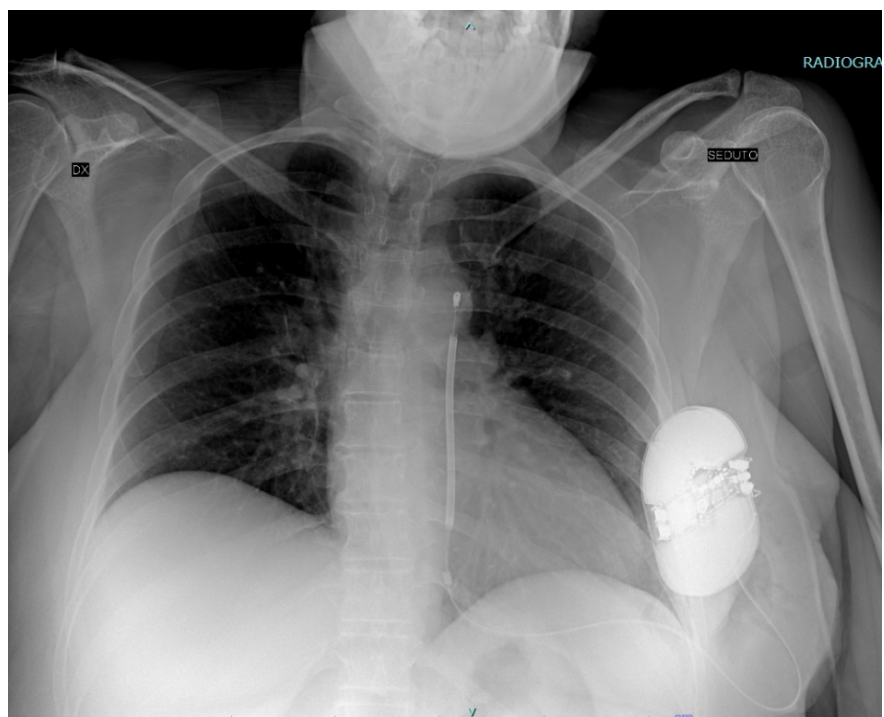


Figure 3: Post implant X-ray showing correct lead positioning.