A cracking complication: Displacement of existing clavicle fracture complicating subcutaneous implantable cardioverter defibrillator implantation

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A B S T R A C T

An 18 year old male with an incompletely healed clavicle fracture presented with unexplained syncope. Subsequent investigations were consistent with a diagnosis of arrhythmogenic right ventricular cardiomyopathy (ARVC). A subcutaneous implantable cardioverter-defibrillator (S-ICD) was successfully implanted and defibrillation threshold (DFT) testing performed as per standard protocol. Shortly following the procedure, the patient complained of pain and swelling over the left clavicle. A radiograph revealed aggravation and displacement of the underlying clavicle fracture. Surgical reduction and internal fixation was performed one week later.

1. Introduction

Subcutaneous Implantable Cardioverter Deﬁbrillators (S-ICDs) have been approved for human use for the past 7 years. S-ICDs offer several advantages over conventional ICDs. In particular, they avoid transvenous lead(s) and the associated potential complications [1].

We present the case of an 18 year-old male whose S-ICD implantation, including DFT, was complicated by displacement of an existing clavicle fracture.

2. Case report

An 18 year old male presented with a witnessed syncopal episode while dirt-biking. After regaining consciousness, the patient described central chest pain and palpitations for 20 minutes. There was no prior history of syncope or other cardiac symptoms. The patient had history of a remote left clavicle fracture 4 years previously and a repeat fracture ten weeks prior to presentation.

There was no other medical history and no family history of premature cardiac, sudden or unexplained death.

Physical examination was unremarkable. A 12-lead EKG revealed T-wave inversion in leads V1 to V3 and an epsilon wave in V1 and V2 (Fig. 1). A chest X-ray showed a healing left clavicle fracture with callus formation (Fig. 2). A trans-thoracic echocardiogram (TTE) showed normal left ventricular systolic function with mild impairment of right ventricular (RV) systolic function. A coronary angiogram revealed no evidence of coronary artery disease, including no congenital anomaly. Cardiac MRI documented RV dilation with moderate RV systolic dysfunction (EF of 37%) and mild regional wall abnormality. A signal averaged EKG was abnormal in 3 out of 3 domains for late potentials. Telemetry showed >500 PVCs in 24 hrs. These findings fulfilled the diagnostic criteria for arrhythmogenic right ventricular cardiomyopathy (ARVC).

Given the patient’s young age and absence of a pacing indication, he was screened as per standard protocol [2] for S-ICD implantation.

Under general anesthesia, the patient was positioned supine, with the left arm abducted and externally rotated at an approximately 70° angle to the torso and placed on a standard OR arm table board. The S-ICD pulse generator and coil were implanted and ventricular fibrillation was induced using 50 Hz alternating current (AC) stimulation. Following a 20 second charge time, a 65 J shock
successfully converted the patient to sinus rhythm.

A few hours following the procedure, the patient complained of pain and swelling over the left clavicle. On examination, there was a visible deformity along the clavicle with swelling and tenderness. Neurovascular status of the left upper limb was intact. A dedicated clavicle X-ray showed aggravation of the underlying fracture with further displacement of the existing fracture midway through the clavicle and bayonetting of the fragments by approximately 1 cm (Fig. 2, Fig. 3).

3. Discussion

S-ICDs are an alternative to conventional ICDs in patients who do not have a pacing indication. Their main advantage is that venous access is not required, thereby avoiding the need for endovascular lead extraction in the future. Patients most likely to benefit include younger patients with inherited arrhythmias, congenital heart disease and other patients with limited vascular access. Limitations of the S-ICD include the inability to pace (aside from brief, post-shock pacing) or provide anti-tachycardia pacing (ATP), reduced battery life and a larger pulse generator [1].

Shoulder related problems are a well-established complication of conventional ICDs and include decreased shoulder mobility and function, pain, and insertion tendinitis. These complaints usually do not require additional intervention and usually resolve 3–12 months post procedure. The complication rate is reduced by subcutaneous generator placement as compared to subpectoral placement [3,4].

Shoulder dislocation has been described in the literature in the context of external cardioversion [5,6]. Noheria et al. described a...
case of anterior shoulder dislocation during defibrillation testing of a S-ICD in a patient with prior traumatic shoulder injury [5].

Defibrillation testing is not routinely performed following transvenous ICD insertion [7]. However, it is recommended following S-ICD implantation to ensure adequate positioning of the subcutaneous coil.

Clavicle fractures are usually the result of a fall on the shoulder, direct trauma to the clavicle or fall on an outstretched hand [8]. Our patient had previously fractured his clavicle twice with the most recent fracture 10 weeks prior not completely healed, making it more prone to further displacement. Positioning the arm during S-ICD implantation in 70-degree abduction and external rotation may destabilize the glenohumeral joint and make the shoulder more vulnerable to injury. The left arm usually remains abducted during defibrillation testing as the device site is generally not sutured closed until following testing in case repositioning of the lead or device is required.

The anatomic position of S-ICDs necessitates a higher energy shock, as the energy traverses muscle and fascia to reach the heart. This may lead to more vigorous contraction of the chest wall muscles forcing the torso, including the shoulder, to jerk anteriorly. In combination with the increased vulnerability of the shoulder due to positioning, defibrillation threshold testing during S-ICD implantation may potentially result in an increased risk of shoulder injury. In order to avoid this complication, following implantation of the S-ICD, the operator should consider adducting the arm prior to defibrillation threshold testing. Furthermore, avoiding DFT testing or delaying implantation to allow bone healing could be other considerations in this situation as well, if feasible.

In our patient, after consultation with orthopedic surgery, the patient underwent open reduction and internal fixation for clavicle stabilization. In retrospect, initial consultation with orthopedic surgery prior to the S-ICD would have been prudent.

In conclusion, we report a case of displacement of an existing clavicle fracture complicating S-ICD implantation. Measures to reduce this risk should be considered.

Declaration of competing interest
None.

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