

CASE REPORT

T wave oversensing in subcutaneous implantable cardioverter defibrillator secondary to hematoma formation: A potential cause of early postimplantation inappropriate shocks

Ahmad Halawa MD  | Sandeep Gautam MD, FHRSDivision of Cardiovascular Medicine,
University of Missouri-Columbia, Columbia,
Missouri**Correspondence**Ahmad Halawa, Division of Cardiovascular
Medicine, University of Missouri-Columbia,
Columbia, MO.

Email: halawaa@health.missouri.edu

Abstract

T wave oversensing (TWOS) is the most common cause of inappropriate shocks in subcutaneous cardioverter-defibrillators (S-ICD). We are presenting a patient with severe ischemic cardiomyopathy who received a S-ICD while on antiplatelets therapy. Pressure dressing was applied due to significant bleeding. On the first postoperative day, the device delivered 26 inappropriate shocks after removal of the pressure dressing. Interrogation revealed new TWOS, likely related to changes in the sensing vectors after hematoma formation.

KEYWORDS

inappropriate shocks, pocket hematoma, subcutaneous implantable cardioverter defibrillator

1 | INTRODUCTION

Subcutaneous cardioverter-defibrillators (S-ICD) have a growing role in primary and secondary prevention of sudden cardiac death.¹ S-ICD have many advantages over transvenous ICD (TV-ICD) especially in young patients who do not require pacing, patients with difficult venous access or at high-risk of systemic infection.¹ However, S-ICD and TV-ICD share a major issue of inappropriate shocks (IAS). The rates of IAS in S-ICD vary between 5% and 25%.² In a recent study, the incidence of IAS with S-ICD was approximately 8.1% at 1 year and 11.7% at 3 years follow-up.³ We are reporting a unique case of S-ICD inappropriate shock triggered by pocket hematoma in a patient on dual antiplatelets therapy (DAPT).

2 | CASE REPORT

A 51-year-old female with severe ischemic cardiomyopathy, persistently depressed left ventricular ejection fraction (EF) of 30% following drug eluting stent (Promus Premier) placement in the right

coronary artery and ramus intermedius, and end-stage renal disease (ESRD) on maintenance hemodialysis, underwent S-ICD placement for primary prevention of sudden cardiac death.

Patient also had multiple comorbidities including chronic obstructive pulmonary disease, chronic anemia, depression, hyperlipidemia, hypertension, diabetes mellitus, and below the knee amputation. Her medication list included dual antiplatelets therapy with Aspirin and Clopidogrel, in addition to optimal medical therapy for heart failure. Electrocardiogram showed nonspecific intraventricular conduction delay (QRS duration of 109 milliseconds).

Stents were placed about 3 months before the planned S-ICD placement. Patient was considered as high-risk for stent thrombosis so DAPT was not discontinued.

Preoperative manual screening showed adequate sensing in all three S-ICD sensing vectors in supine and upright positions. Standard S-ICD placement was performed using a dual incision technique, with appropriate sensing function and defibrillation threshold testing (Figure 1A). The primary sensing vector (distal electrode ring to can) was selected by the device for QRS sensing.

Patient had significant pocket bleeding during the procedure due to combination of dual antiplatelet therapy and renal failure, so we

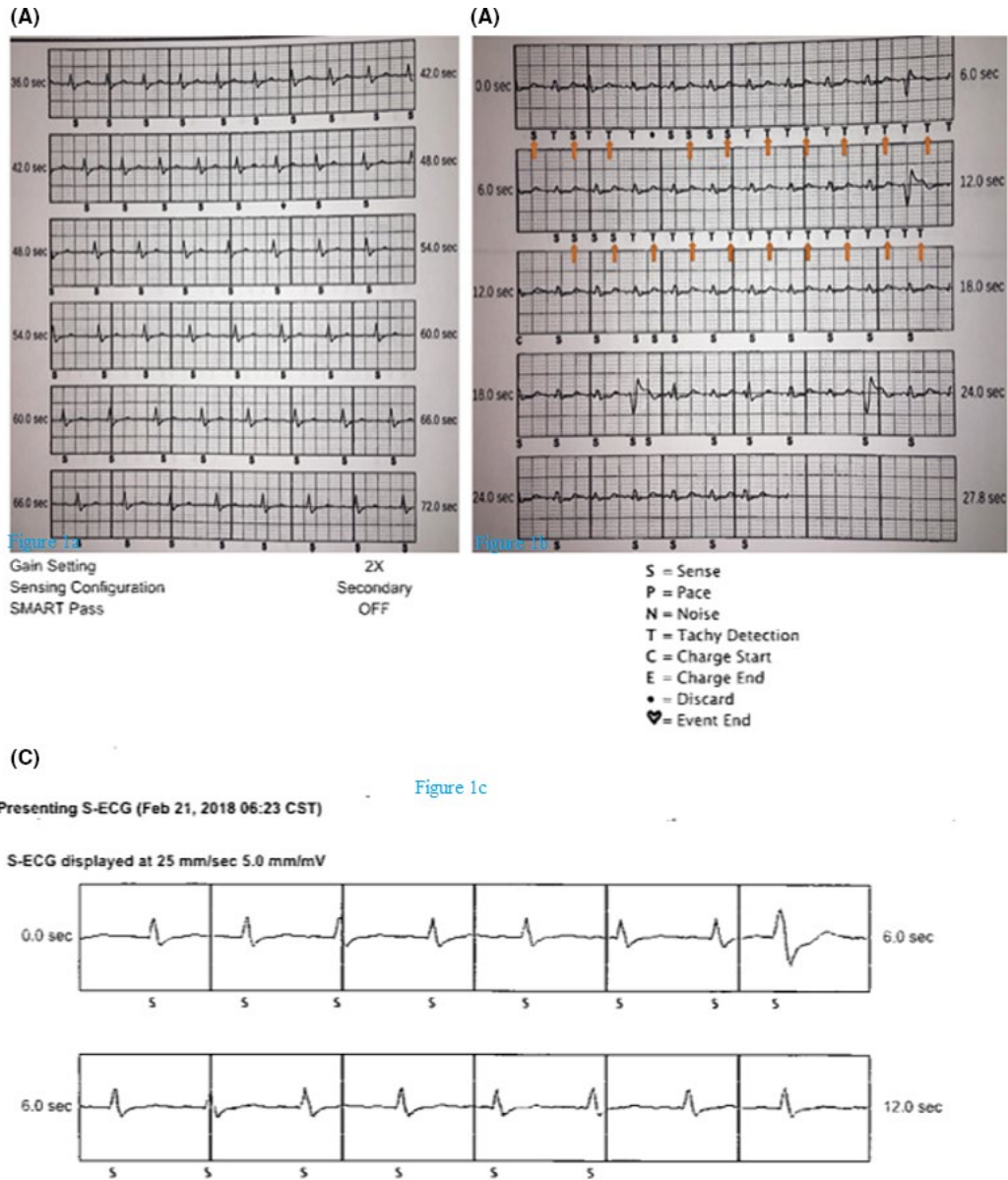


FIGURE 1 A, Proper R-wave sensing at the day of S-ICD implant. Sensing configuration is primary. B, TWOS on POD#1. Arrows indicate the over-sensed T waves. Sensing configuration is primary. S-ICD, subcutaneous implantable cardioverter defibrillator; TWOS, T wave over sensing; POD, postoperative day. C, Proper R wave sensing after changing the sensing configuration to secondary and applying SMART Pass

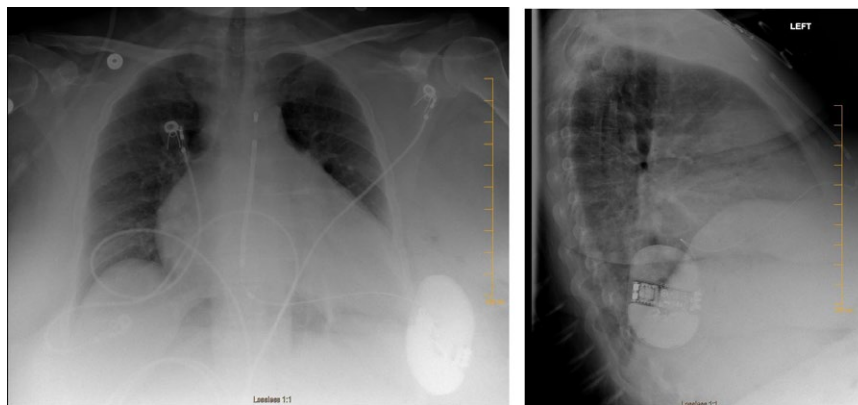


FIGURE 2 Chest-X Ray showing generator and both electrodes in position after implantation

elected to apply a tight pressure dressing to prevent postoperative hematoma. She underwent hemodialysis the day of the procedure.

On the first postoperative day, the device delivered 26 inappropriate shocks right after removal of the pressure dressing. Device interrogation revealed smaller R wave amplitude compared to R wave after procedure, with new TWOS (T wave oversensing) leading to IAS, most likely related to a slight shift in the generator position (Figure 1B).

Follow-up Chest-X Ray showed proper position of the generator and both electrodes. (Figure 2).

TWOS resolved after switching the sensing vector to secondary and activating the SMART Pass filter (Figure 1C).

Patient was observed in the hospital for 1 day without any further sensing issues. She was discharged home in a stable condition without any IAS on outpatient follow up.

3 | DISCUSSION

IAS is still a challenging problem in S-ICD patients. T wave oversensing (TWOS) is the most common reason for inappropriate shocks suffered by S-ICD patients.¹ IAS can also result from supra-ventricular tachycardia, atrial fibrillation or flutter.³

Soft tissue bleeding can happen during and after S-ICD implantation and occasionally requires a pressure dressing, with unknown effect on the sensing vectors. Our patient suffered multiple IAS right after removal of the pressure dressing. We believe that release of the pressure dressing resulted in slight displacement of the generator, by the effect of small hematoma or soft tissue swelling under/above the device, which led to a significant change in the primary sensing vector and IAS. That will explain the small R waves on device interrogation after multiple IAS.

Hematoma after S-ICD placement is a rare complication and it was reported in 0.9%-5% of patients.^{3,4} In a new study, out of 200 patients with S-ICD, only 10 had hematoma that required surgical intervention. Three of these hematoma patients suffered IAS/TWOS.⁴

In our patient, DAPT and platelets dysfunction due to end-stage renal disease both contributed to difficulty in achieving hemostasis. Applying pressure dressing to control hematoma formation is a known technique in TV-ICD placement, but is unusual in S-ICD.

We believe that our report is a unique presentation and pocket hematoma has never been reported as the cause of multiple IAS in S-ICD patients.

To resolve this problem, we changed the sensing vector and applied SMART Pass filter. SMART Pass is an additional high pass filter that reduces the amplitude of lower frequency signals such as T

waves, without altering higher frequency signals like R-waves and ventricular arrhythmias. It is an additional safety mechanism in S-ICDs to avoid TWOS, by activating a 9-Hz high-pass filter designed to prevent oversensing of relatively high-amplitude T or P waves.⁵

Conclusion: To the best of our knowledge, this is the first case report of multiple inappropriate S-ICD shocks due to delayed TWOS related to postoperative hematoma. To avoid this complication, we recommend programming the SMART pass filter on initial device programming, and to obtain device interrogation after removal of pressure dressing to reveal any changes in the sensing vectors.

CONFLICT OF INTEREST

Authors declare no conflict of interests for this article.

ORCID

Ahmad Halawa  <http://orcid.org/0000-0001-5455-2378>

REFERENCES

1. Priori SG, Blomström-Lundqvist C, Mazzanti A, et al. 2015 ESC Guidelines for the management of patients with ventricular arrhythmias and the prevention of sudden cardiac death. *Eur Heart J* [Internet]. 2015;36:2793–867.
2. Aziz S, Leon AR, El-Chami MF. The subcutaneous defibrillator: a review of the literature. *J Am Coll Cardiol* [Internet] Elsevier. 2014;63:1473–9.
3. Boersma L, Barr C, Knops R, et al. Implant and midterm outcomes of the subcutaneous implantable cardioverter-defibrillator registry: the EFFORTLESS study. *J Am Coll Cardiol*. 2017;70:830–41.
4. Sheldon SH, Cunnane R, Lavu M, et al. Perioperative hematoma with subcutaneous ICD implantation: impact of anticoagulation and antiplatelet therapies. *Pacing Clin Electrophysiol*. 2018;41:799–806. <https://doi.org/10.1111/pace.13349>
5. Theuns DAMJ, Brouwer TF, Jones PW, et al. A prospective, blinded evaluation of a novel sensing methodology designed to reduce inappropriate shocks by the subcutaneous implantable defibrillator. *Heart Rhythm*. 2018;15:1515–22.

How to cite this article: Halawa A, Gautam S. T wave oversensing in subcutaneous implantable cardioverter defibrillator secondary to hematoma formation: A potential cause of early postimplantation inappropriate shocks. *J Arrhythmia*. 2019;35:130–132. <https://doi.org/10.1002/joa3.12132>