Oversensing of an unexpected atrial flutter. A new tool to improve detection of supraventricular arrhythmias in subcutaneous implantable cardioverter-defibrillators

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Introduction

P-wave oversensing may be associated with inappropriate shocks in subcutaneous implantable cardioverter-defibrillators (S-ICDs). The SMART Pass algorithm was developed for Boston S-ICDs in order to reduce inappropriate shocks. We present a case of inappropriate shocks due to P-wave oversensing during atrial flutter, successfully managed with the SMART Pass algorithm.

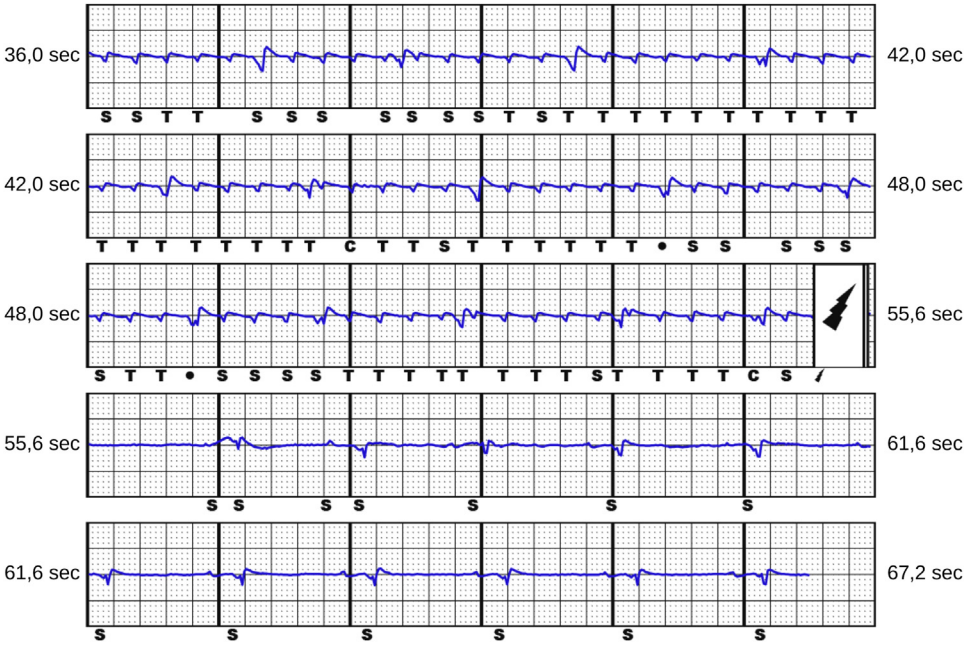

Figure 1 Atrial Flutter episode.

KEYWORDS Subcutaneous defibrillator; P-wave oversensing; Inappropriate shock; Atrial flutter (Heart Rhythm Case Reports 2017;3:286–288)

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Case report

A 32-year-old male patient with a history of dilated cardiomyopathy and endocarditis due to infection of a transvenous ICD lead was referred to our center to receive an S-ICD after successful percutaneous extraction of the transvenous system. Since 2012, the patient had had several episodes of atrial fibrillation (AF), treated with electrical cardioversion and antiarrhythmic drugs; after many recurrences of AF, a rate-control strategy was finally selected.

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KEY TEACHING POINTS

- P-wave oversensing may be associated with inappropriate shocks in subcutaneous implantable cardioverter-defibrillators.
- The recently developed SMART Pass algorithm effectively rejects oversensing caused by P waves.
- The SMART Pass algorithm can reduce the rate of inappropriate shocks in patients at risk of atrial arrhythmias.

Before implantation of the device, as suggested by the manufacturer, the patient underwent preimplantation electrocardiographic screening; a single vector (DI) was found to be acceptable in both the supine and standing positions, at rest and under exertion. In April 2016, the S-ICD (EMBLEM A209 Boston Scientific, St. Paul, MN) implantation was conventionally performed with the lead vertically positioned in the subcutaneous tissue of the chest, 2 cm to the left of the sternal midline. The alternate sensing vector was found adequate by S-ICD and was permanently programmed, with a 1× gain.

A week after being discharged, the patient arrived at the emergency room of our hospital because of ICD shock. Electrocardiography revealed sinus rhythm and the stored electrogram revealed 2 inappropriate shocks due to F-wave oversensing (Figure 1). The F waves and QRS complex had comparable amplitude and were both detected by the S-ICD as sensed complexes. This caused the calculated heart rate to fall into the shock zone. During hospitalization, we observed a new episode of AF and during this episode transitory phases of an atypical atrial flutter with giant F waves were observed. During these arrhythmias, intermittent double counting persisted as a result of atrial and R-wave detection, owing to the comparable amplitudes of the waves.

The 3 sensing vectors were tested in order to optimize S-ICD programming; the originally programmed vector was confirmed as the one associated with the highest sensed R wave and with the lowest atrial oversensing. Neither device repositioning nor replacement was considered an acceptable solution for the patient, since he was awaiting heart transplantation and was at high risk of infection. Moreover, none of the tests simulating different lead positions showed better detection of the signals.

The S-ICD software was therefore endowed with a newly available sensing algorithm: the SMART Pass, just released into the market. When programmed, the SMART Pass algorithm activates a 9-Hz high-pass filter designed to reduce the amplitude of lower-frequency signals while maintaining an appropriate sensing margin, in order to improve detection in the event of high-amplitude T or P waves. The amplitude of the F wave was immediately reduced and the wave was no longer detected by the S-ICD.

Furthermore, in order to characterize and possibly treat the atrial flutter, the patient underwent an electrophysiology study. A left atrial flutter was induced. The functioning of SMART Pass was then tested during the course of the arrhythmia, by temporarily disabling it (SMART Pass OFF: Figure 2; SMART Pass ON: Figure 3). The appropriate performance of the algorithm was confirmed, as no F waves were detected.

As the patient's condition was poor, and proper device detection during atrial flutter had been ascertained, no ablation was attempted. After hospital discharge the patient experienced further episodes of atrial flutter, but no other inappropriate therapy was delivered during 6 months of follow-up.

Discussion

The current generation of S-ICD was intentionally designed with a high degree of automaticity and limited programmability, in order to simplify device use. The device is equipped with discrimination algorithms that have been shown to markedly reduce inappropriate shocks, particularly those due to supraventricular arrhythmias.[1] In recent studies, the annual rate of inappropriate shocks delivered by S-ICDs was reported to be approximately 7%, and events were largely ascribed to T-wave oversensing.[2] Recently, a new algorithm, Alternating Morphology Double Detection Analysis, was specifically designed to reduce the oversensing of T waves.[3]

Supraventricular arrhythmias are the cause of inappropriate shocks more frequently in transvenous ICDs than in S-ICDs.[4] Nonetheless, F- or P-wave oversensing may occur, as in the present case. The results of the electrophysiologic study confirmed the improved detection with SMART Pass

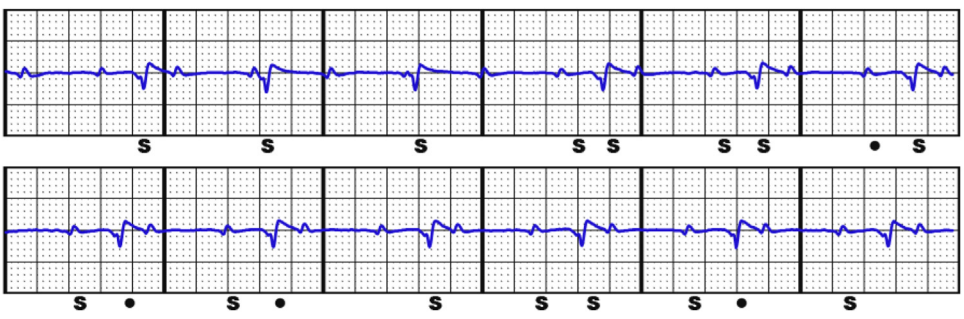

Figure 2 Atrial Flutter oversensing without SMART Pass.

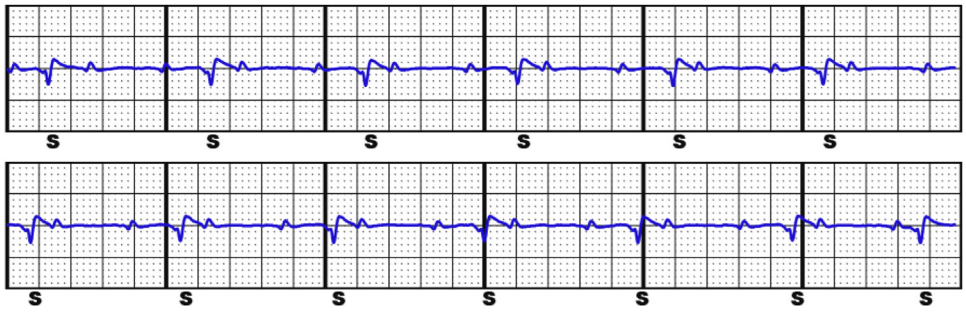

Figure 3 Correct heart rate detection with SMART Pass.

for the episode examined, and no further episodes of inappropriate shocks were observed during follow-up. This case is the first to show that the SMART Pass algorithm rejects oversensing caused by P waves and can effectively reduce the rate of inappropriate shocks in patients at risk of atrial arrhythmias.

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