Pseudo Inappropriate Shock: A Technical Dilemma

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Abstract

With liberal availability of high end cardiac implantable devices in recent era, we frequently encounter patients who are recipients of implantable cardioverter defibrillators (ICDs) in our routine clinical practice. Despite improvements in shock detecting algorithms by various manufacturers, incidence of inappropriate shock therapy remains high, it is cause of distress to physicians and patients. Here we present an interesting case of inappropriate shock in one of patient.

Keywords: *Implantable cardioverter defibrillator, inappropriate shock, long QT syndrome*

Introduction

Despite proven survival benefits, implantable cardioverter defibrillators' (ICDs) are often associated with inappropriate shocks delivered for causes other than potentially life-threatening ventricular arrhythmias. The reported incidence of inappropriate shocks in patients with ICDs is 4%–25%.[1,2] Such shocks are not only psychologically disturbing and painful to the patients but also reduce battery longevity and are often proarrhythmogenic.[3,4] Increased shock delivery and high shock burden associated with recurrent inappropriate shocks is associated with increased mortality.[5]

Automatic QRS morphology template update is an algorithm to help prevent inappropriate therapies in patients with single chamber automatic ICDs in place.[6] We present an interesting case in which an automatic QRS morphology template detection which was inadvertently switched on to auto update" lead to inappropriate ICD therapy and resultant shocks.

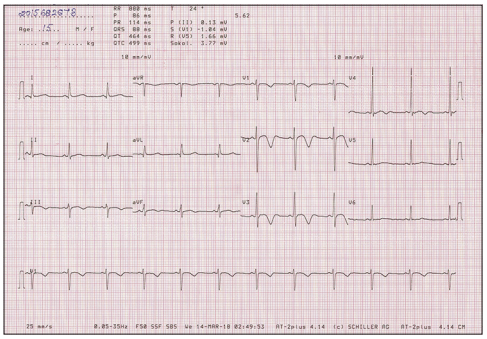


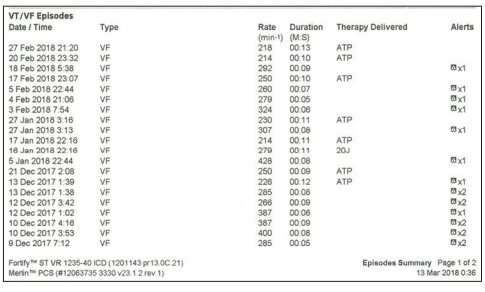
Figure 1: Electrocardiography of the patient showing T-wave inversions and long QT interval (calculated QTc of 499 ms)

Case Report

A 15-year-old boy, with long QT syndrome [Figure 1] and an episode of resuscitated cardiac arrest was implanted with a single chamber ICD (St. Jude, model FORTIFY™ ST VR 1235-40 ICD) in March 2016.

He did well for 2 years until he presented with a device shock in February 2018. The device interrogation data revealed multiple episodes of anti-tachycardia pacing and 1 shock therapy of 20 J [Figure 2], all of which were inappropriately delivered in response to high background noise [Figures 3 and 4].

It was found that the automatic QRS morphology template auto-update was turned on. Background noise at the time of recording of reference electrogram for automatic QRS morphology template algorithm detection can lead to



VT/VF Episodes

Date / Time	Type	Rate (min-1)	Duration (M:S)	Therapy Delivered	Alerts
27 Feb 2018 21:20	VF	218	00:13	ATP	
20 Feb 2018 23:32	VF	214	00:10	ATP	
18 Feb 2018 5:38	VF	292	00:09		x1
17 Feb 2018 23:07	VF	250	00:10	ATP	
5 Feb 2018 22:44	VF	260	00:07		x1
4 Feb 2018 21:06	VF	279	00:05		x1
3 Feb 2018 7:54	VF	324	00:06		x1
27 Jan 2018 3:16	VF	230	00:11	ATP	
27 Jan 2018 3:13	VF	307	00:08		x1
17 Jan 2018 22:16	VF	214	00:11	ATP	
16 Jan 2018 22:16	VF	279	00:11	20J	
5 Jan 2018 22:44	VF	428	00:08		x1
21 Dec 2017 2:08	VF	250	00:09	ATP	
13 Dec 2017 1:39	VF	226	00:12	ATP	
13 Dec 2017 1:38	VF	285	00:08		x1
12 Dec 2017 3:42	VF	266	00:09		x2
12 Dec 2017 1:02	VF	387	00:08		x1
10 Dec 2017 4:16	VF	387	00:09		x2
10 Dec 2017 3:53	VF	400	00:08		x2
9 Dec 2017 7:12	VF	285	00:05		x2

Fortify™ ST VR 1235-40 ICD (1201143 pr13.0C.21) Merlin™ PCS (#12063735 3330 v23.1.2 rev 1) — Episodes Summary Page 1 of 2 — 13 Mar 2018 0:36

Figure 2: Interrogation data show multiple episodes of ventricular tachycardia/ventricular fibrillation detected by the device with antitachycardia pacing and a single shock of 20 J

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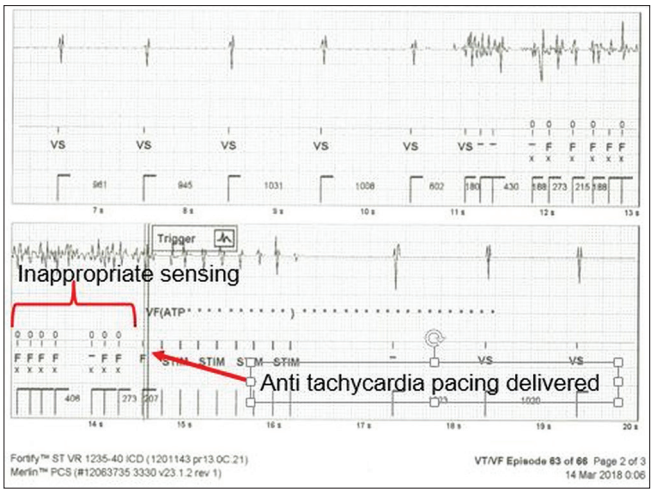

Figure 3: One event of antitachycardia pacing in response to inappropriately sensed background noise

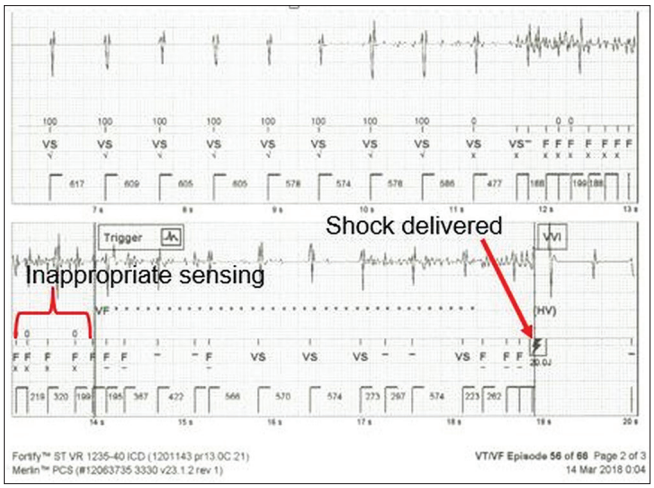

Figure 4: Event of inappropriate shock in response to high background noise inappropriately sensed as ventricular fibrillation

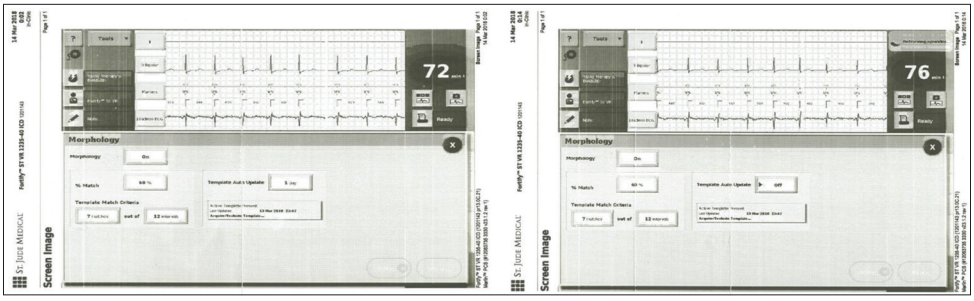

Figure 5: QRS morphology template auto-update algorithm switched on (left) and off (right)

inappropriate sensing of background noise as ventricular tachycardia (VT)/ventricular fibrillation resulting in inappropriate therapy. After turning this off, no further inappropriate therapies were delivered [Figure 5].

Discussion

Inappropriate shocks in patients with ICDs can cause anxiety, depression, impaired quality of life, and increased risk of adverse events including higher morbidity and mortality.[7] Important causes of noise/artifact and oversensing causing inappropriate shocks are include external noise interference and lead/connector and muscle noise. Improved discrimination between true and pseudo-arrhythmias is important to reduce the incidence of inappropriate shocks. The QRS morphology template creates an algorithm and stores it for future referencing and matching with tachycardia morphology. Turning on the auto-update can lead to background noise or interference being sensed when the reference electrogram for automatic QRS morphology template algorithm is being recorded periodically by the device. This noise can then be detected by the device as VT or fibrillation leading to inappropriate shocks. In this patients as well, it was noted that the feature was inadvertently programmed on. After turning it off, no further shocks were delivered, and the patient remains asymptomatic on follow-up.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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