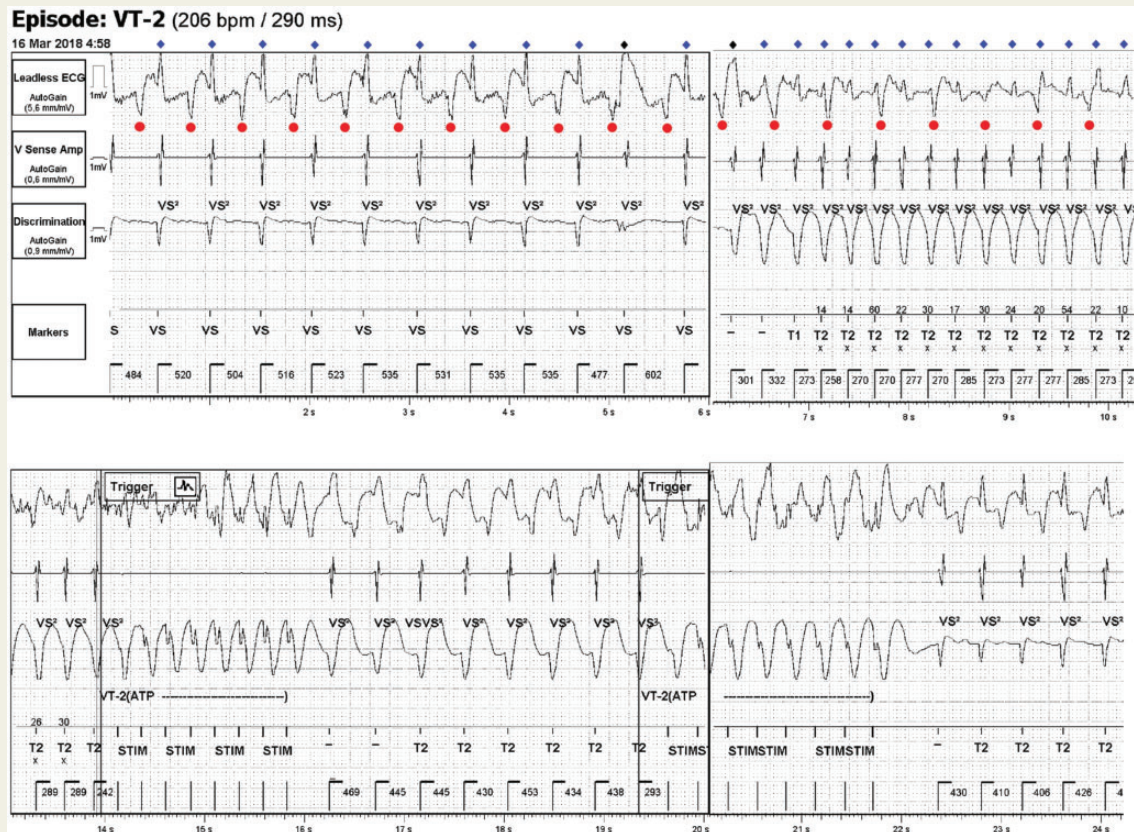# EP CASE REPORT

Inappropriate shock caused by programming of a slow ventricular tachycardia-zone with anti-tachycardia pacing only: a case report

Pernille Steen Bække and Michael Vinther*

Department of Cardiology B, Rigshospitalet, Blegdamsvej 9, DK-2100 Copenhagen OE, Denmark

* Corresponding author. Tel: +45 35 45 69 94. *E-mail address*: michael.vinther@regionh.dk

Figure 1 Sinus tachycardia converts in the first panel to VT in the VT2-zone due to ventricular extrasystoles. The device correctly classifies this as VT. In the second panel, ATP converts the VT into sinus tachycardia that falls in the VT1-zone and is continually treated. ◆, ventricular deflection; ●, atrial deflection; ATP, anti-tachycardia pacing; STIM, stimulation (=pacing); VS, ventricular sensing; VT, ventricular tachycardia.

Patients with haemodynamically tolerable slow ventricular tachycardia (VT) can often benefit from anti-tachycardia pacing (ATP) delivered by an implantable cardioverter-defibrillator (ICD). It can, however, be undesirable to program shocks in a slow VT-zone since the shocks will be delivered to a fully awake patient which in turn can lead to psychological stress, proarrhythmias, and increased mortality.[1]

Nonetheless, programming of a slow VT-zone without shocks does not always protect against unnecessary or, as seen in the following case, inappropriate shocks in the slow VT-zone.

Case presentation

A 28-year-old male patient was implanted with an ICD in 2005 due to VT and structural heart disease. In 2017, he had a pocket infection leading to complete removal of the system and right-sided implantation of a dual-coil ICD-lead and a single-chamber ICD from St Jude Medical.

Throughout the years, the patient has had many appropriate ATP's mainly for slow VT's and several ICD shocks. After the last VT-ablation in 2017 and up to the present episode, the patient was free of VT on a combination of metoprolol and amiodarone. The ICD was configured with three therapy zones:

- VT1-zone (131–193 b.p.m.): ATP×16
- VT2-zone (193–250 b.p.m.): ATP×12, shock×3
- Ventricular fibrillation-zone (>250 b.p.m.): ATP×1, shocks×6

In March 2018, the patient developed VT in the VT2-zone while being physically active (*Figure 1*). The episode was correctly detected and treated with ATP, converting the rhythm back to sinus tachycardia that unfortunately now had accelerated into the VT1-zone leading to continued VT-2 treatment. The 11th ATP induced VT again, which was converted back to sinus tachycardia by the last ATP. During the episode, it appears from the 'leadless electrogram (EGM)' channel when there is atrioventricular (AV)-dyssynchrony indicative of VT or a 1:1 AV-relation indicative of sinus tachycardia. The ICD delivered in the end of the episode three inappropriate shocks before the heart rate fell below the VT1-zone and the episode ended.

Discussion

Redetection after the initial treatment only relies on heart rate, which in this case lead to continued treatment. There is an option in St Jude devices to make redetection 'same as VT2', which could have prevented the inappropriate shocks. The risk is, however, that a f-VT converting to a slower VT in the VT1-zone will be designated as 'return to sinus'. In this case, it would have been preferable to use supraventricular tachycardia (SVT) discriminators when the tachycardia converted to a rhythm that fell in the lowest treatment zone. Whether it could be a good idea in general needs further exploration.

Prior studies have suggested using the information in the far-field EGM from the superior vena cava-coil to can in single-chamber devices both for the differentiation between SVT and VT and for AV-synchronous pacing,[2,3] but so far it has not been implemented in the ICD software.

Conclusion

Programming of a slow VT-zone with ATP only does not protect against inappropriate shocks due to sinus tachycardia. With three-zone programming, it could be desirable to be able to program SVT discriminators 'on' when redetecting in the lowest zone to help prevent inappropriate shocks.

Conflict of interest: none declared.

References

1. Poole JE, Johnson GW, Hellkamp AS, Anderson J, Callans DJ, Raitt MH *et al*. Prognostic importance of defibrillator shocks in patients with heart failure. *N Engl J Med* 2008;**359**:1009–17.
2. Xiong WW, Karam PY, Marsh JD, Varma N, Verdino RJ, Paydak H. Innovative P-wave detection for discrimination between ventricular and supraventricular tachycardia in single-chamber ICDs: is the P-wave invisible during tachycardia? *Europace* 2013;**15**:827–34.
3. Grom A, Baron TW, Brunner M, Giesler U, Faber TS, Bode C *et al*. A technical approach to optimized atrial recognition in the ICD: the intrathoracic six-channel farfield ECG. *Pacing Clin Electrophysiol* 2003;**26**:1472–8.