We present the case of a 68-year-old man with dilated cardiomyopathy who had an implantable cardioverter defibrillator implanted for primary prevention (Unify Assura with a Durata 7122Q ventricular lead, St. Jude Medical). The device was programmed DDDR 60–110 beats per minute and Table shows more specific programming parameters.

Discussion
In Figure 1A, we see a regular ventricular rhythm at 130 beats per minute (460 ms) on the ventricular near field channel, whereas on the atrial near field channel, we see large atrial electrograms that seem to be in phase with every second ventricular near field electrogram. These atrial events are not seen by the device because of falling in the postventricular atrial blanking period. Because no intrinsic activity is seen on the atrial channel, the device paces the atrium at 65 beats per minute (accelerometer rate), which happens to be half the ventricular rate. The differential diagnosis for this tracing then includes atrioventricular nodal re-entry tachycardia such that seen in Figure 1A, an atrial rate that is 1:1, retrograde atrioventricular conduction or atrioventricular nodal re-entry tachycardia. The onset of atrioventricular nodal re-entry tachycardia was never captured by the device because no atrial events were seen.

The morphologies on both the near field and far-field channels during sinus rhythm are shown in Figure 1B and are similar to that during tachycardia when no coincident pacing occurs; making VT less likely. Figure 1C shows an atrial tachycardia (significant variation in the VA interval and changes in the A–A interval predict changes in the V–V interval) with a similar rate to the tachycardia in Figure 1A, however, the AV interval is significantly shorter here. If the rhythm in Figure 1A were atrial tachycardia then one would expect to see a similar AV interval in Figure 1A and 1C. Finally in Figure 1D we see the same rhythm; however, consecutive intrinsic atrial events are seen on the atrial near field channel with a short VA interval that is most consistent with typical atrioventricular nodal re-entry tachycardia. The onset of atrioventricular nodal re-entry tachycardia was never captured by the device but premature atrial beats or brief runs of atrial tachycardia such that seen in Figure 1C might serve as initiators.

Subtle variations in the relative timing of ventricular and atrial events should be made if any?
time a VS event occurred. The timing of these 2 events was so similar (<10 ms difference) that it was not possible to cancel the scheduled AP and initiate a new VA interval. The next VS event is marked by an F (arrow 7), as it falls within the ventricular fibrillation zone (it is coupling interval with the preceding ventricular pace is <280 ms [ventricular fibrillation zone]). This shows how St. Jude defibrillators include ventricular pace events when calculating intervals for tachycardia zones and lead alerts. If ventricular pace events that fuse with intrinsic events are ignored or if pacing occurs during lead noise from a fracture then blanking these events could lead to delayed tachycardia or lead noise detection.

At this point, the device declares the rhythm to be NSLN. Two of 3 fast ventricular intervals (within a VT zone) on the near field channel (boxed intervals) without any fast ventricular intervals on the far-field channel initiate the SecureSense algorithm (shown by VS2). When the counter for fast intervals on the near field channel reaches 5 (now 10 in the current version) without being reset by 2 fast intervals on the far-field channel then an episode of NSLN is declared (or right ventricular oversensing as it in now referred to). Ventricular intervals on the discrimination (far-field) channel are not displayed by the device, however, potentially making clarification of SecureSense algorithm

<table>
<thead>
<tr>
<th>MODE/LOWER RATE LIMIT</th>
<th>DDDR 60</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAX TRACK/MAX SENSOR RATE</td>
<td>110/110</td>
</tr>
<tr>
<td>PACED/SENSORED ATRIOVENTRICULAR DELAY</td>
<td>160 ms/150 ms</td>
</tr>
<tr>
<td>PVARP RATE RESPONSIVE</td>
<td>275–225 ms</td>
</tr>
<tr>
<td>PVAB</td>
<td>70 ms</td>
</tr>
<tr>
<td>VENTRICULAR BLANKING</td>
<td>52 ms</td>
</tr>
<tr>
<td>MODE SWITCH</td>
<td>DDIR at 180 beats per minute (initially)</td>
</tr>
<tr>
<td>VT ZONE</td>
<td>171 beats per minute (350 ms), 24 intervals</td>
</tr>
<tr>
<td>VF ZONE</td>
<td>214 beats per minute (280 ms), 12 intervals</td>
</tr>
</tbody>
</table>

PVAB indicates postventricular atrial blanking period; PVARP, postventricular atrial refractory period; VF, ventricular fibrillation; and VT, ventricular tachycardia.

Table. Programming Parameters for Bradycardia and Tachycardia Therapies From the Patient’s Defibrillator

Figure 1. A, A stored electrogram from the patients implantable cardioverter-defibrillator that was classified as nonsustained right ventricular lead noise. Respective electrograms and marker channels are labeled and are consistent for each panel. Numbered arrows indicate key points in the tracing for discussion. Intervals annotated with a (−) on the ventricular marker channel indicate that the current interval is within the tachycardia zone, however, the interval average (average of the current interval and the previous 3 intervals) is not. These beats do not count toward tachycardia detection. B, Electrograms in sinus rhythm for comparison. C and D, Tachycardias recorded on different occasions. AP indicates atrial pace; F, beat in the ventricular fibrillation zone; NSLN, nonsustained lead noise; SIR, sensor-indicated rate; VP, ventricular pace; VS, ventricular sense; and VSP, ventricular safety pace.
behavior difficult. Fortuitously, this algorithm brought our attention to a sustained tachycardia that was occurring below the VT zone in this patient, however, this also demonstrates how dual chamber timing windows and coincidental ventricular and atrial events can confuse the SecureSense algorithm.

What is the best strategy to correct device function? Stopping the device from pacing the atrium during tachycardia would seem to prevent AP events leading to safety pacing or absolute blanking of some ventricular events. One way to do this would be to turn off the accelerometer so that atrial pacing rates would not be driven up to approximate a multiple of the ventricular rate, however, this may lead to chronotropic incompetence. In this instance, we introduced a mode switch to VVIR at a rate of ≥125 beats per minute to prevent the device from pacing the atrium or tracking atrial events during tachycardia. Had the arrhythmia shown in Figure 1A been VT then lowering the VT monitor zone to ≥125 beats per minute would also cause the device to switch to VVI pacing mode and similarly ignore any atrial events until return to sinus rhythm occurred. We also increased the patients’ β-blockade and no further tachycardia episodes have been logged as NSLN during 8 months of follow-up. Should further events occur then an electrophysiology study±catheter ablation of the slow pathway may be indicated.

Disclosures
None.

References

Key Words: implantable defibrillators • primary prevention • tachycardia
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