The parameters from our patient give the value:

\[
PVARP (\text{ms}) = \text{Escape interval (ms)} - \text{programmed AV delay (ms)} - 350 \text{ ms}
\]

The parameters from our patient give the value:

\[
PVARP (\text{ms}) = 1500 \text{ ms} - 180 \text{ ms} - 350 \text{ ms} = 970 \text{ ms}
\]

The long-derived PVARP causes the intrinsic P-wave to fall within this period and be labelled as an atrial refractory event (AR; Figure 1A, top panel). The impedance test therefore times out, and the sub-threshold stimulus is delivered asynchronously. This is sensed in both channels and labelled as a ventricular event (VS). In view of the AR–VS pattern seen during this configuration, the manufacturers do not recommend the use of Auto-PVARP in DDI mode, and PVARP should be set manually to an appropriate value.

In the DDD or AAI-DDD mode, Auto-PVARP is calculated to maintain a 2:1 block rate of 30 bpm above current atrial rate. In our patient, the atrial rate was \(~100\) bpm, therefore:

\[
PVARP (\text{ms}) = \text{atrial escape interval at 130/min} - \text{AV delay} = 461 \text{ ms} - 180 \text{ ms} = 281 \text{ ms}
\]

The P-wave is therefore sensed normally, and the sub-threshold stimulus triggered to fall within the refractory period.

Summary

DDI mode with a low base rate is commonly used to minimize RV pacing in ICDs. When used with Auto-PVARP, the algorithm may lead to an AR–VS marker pattern and asynchronous stimuli for impedance testing. It is important to be aware of the potential for this to occur, and to understand the associated algorithms, in order that device malfunction is not suspected incorrectly.

Conflict of interest: none declared.

References


CASE REPORT

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Temporary external implantable cardioverter defibrillator in the pacemaker-dependent ventricular tachycardia patient

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A patient with ischaemic cardiomyopathy underwent implantable cardioverter defibrillator (ICD) extraction for a severe pocket infection and sepsis. During 5 weeks of critical medical care after device extraction, heart block and recurrent monomorphic ventricular tachycardia (VT) were managed with an ‘externalized’ active fixation pacemaker lead and a resterilized ICD generator. This case demonstrates how a permanent pacing lead and an external ICD generator can provide reliable temporary pacing and automatic anti-tachycardia pacing for recurrent VT until a new device can be implanted and more permanent VT treatment options are feasible.

Case

When an implanted pacemaker or implantable cardioverter defibrillator (ICD) becomes infected, the entire system, including the pulse generator and all leads, must be removed for infection resolution. The timing of permanent device re-implantation is dependent upon
infection severity, the effectiveness of antimicrobial treatment, and the documentation of sterile blood cultures. In a pacemaker-dependent patient, temporary pacing is needed until the new device system can be implanted. An active fixation permanent pacemaker lead can be percutaneously implanted via the internal jugular or subclavian vein and attached to a resterilized, external permanent pacemaker for temporary right ventricular (RV) pacing. This technique is associated with fewer adverse events than other temporary pacing modalities and is cost-effective. In ICD patients with recurrent ventricular tachycardia (VT) after device extraction, tachyarrhythmias also need to be managed.

A 74-year-old man with ischaemic cardiomyopathy was transferred to our institution with a purulent pocket infection and severe sepsis with *Staphylococcus aureus*, 3 weeks after an ICD generator change. His dual-chamber ICD was implanted 9 years prior for VT, and he developed complete heart block in the interim, leaving him pacemaker-dependent. His left ventricular ejection fraction was 30%, and, since the recent ICD replacement, he had 81 episodes of asymptomatic monomorphic VT (cycle length 370–430 ms), despite chronic treatment with amiodarone. Each episode was successfully terminated with a single anti-tachycardia pacing (ATP) burst, and no shocks were delivered.

On presentation, he was ill-appearing, with persistent methicillin-sensitive *S. aureus* bacteraemia and fevers to 103°F, despite treatment with intravenous nafcillin. The patient underwent device removal, extensive debridement of the grossly purulent left pectoral device pocket, and laser extraction of his chronic atrial and ventricular leads. A femoral quadripolar catheter was used for temporary pacing during the procedure. The right internal jugular vein site was then sterniley prepared, an active fixation permanent pacemaker lead was percutaneously implanted in the RV apex, and the lead was connected to an external resterilized ICD generator (Figure 1). The ventricular pacing threshold was 0.4 V at 0.5 ms. The device was programmed for bradycardia pacing at VVI 80 p.p.m., and a VT zone of 140–250 b.p.m. was set, with six burst ATP therapies only.

The patient remained intubated after the extraction procedure because of *S. aureus* pneumonia, and a tracheostomy was necessary after 2 weeks because of ongoing dependence on mechanical ventilation. He required ongoing pressor support due to sepsis-induced hypotension in the setting of severe cardiomyopathy, and his critical clinical status precluded a VT ablation procedure. Over a 5-week period, the temporary device system provided reliable pacing and multiple successful ATP therapies for recurrent monomorphic VT, and no external shocks were needed. The patient recovered from his infection, and a new permanent right-sided biventricular ICD was implanted in the right pectoral region.
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References