Management of Pace-Terminated Ventricular Arrhythmias

Sean D. Pokorney, MD, MBA, Sana M. Al-Khatib, MD, MHS*

KEYWORDS

• Antitachycardia pacing • Implantable cardioverter-defibrillator • Ventricular tachycardia
• Sudden cardiac death • Ventricular fibrillation

KEY POINTS

- Antitachycardia pacing (ATP) can prevent implantable cardioverter-defibrillator (ICD) shocks by capturing the excitable gap and terminating ventricular tachycardia.
- ICD shocks are associated with higher mortality; however, the data on the association between ATP and higher mortality are conflicting.
- Antiarrhythmic medications can reduce the need for ICD therapies, although their use can be limited by the medication side-effect profiles.
- Ventricular tachycardia ablation may be an effective treatment for patients who receive appropriate ICD therapies.
- More evidence is needed to evaluate early ablation in patients with pace-terminated ventricular arrhythmias.

INTRODUCTION

Sudden cardiac death (SCD) is an important public health issue with more than 350,000 cases of SCD annually in the United States.[1] Randomized controlled trials have established that implantable cardioverter-defibrillators (ICDs) improve survival in patients who have experienced prior cardiac arrest or sustained ventricular tachycardia (VT).[2–4] Primary prevention ICDs have also demonstrated improved survival in patients with significant left ventricular dysfunction in clinical trials.[5,6] The use of ICDs has increased by 12% in the United States between 2005 and 2009.[7]

Despite the fact that ICDs can prolong life by treating life-threatening ventricular arrhythmias, patients who received appropriate ICD shocks had a 3.5 fold higher risk of death relative to patients who did not receive appropriate therapy in the Multicenter Automatic Defibrillator Implantation Trial II (MADIT-II) and 5.7 times the risk of death relative to patients who did not receive shocks in the Sudden Cardiac Death in Heart Failure Trial (SCD-HeFT).[8,9] Beyond the association with higher mortality, ICD shocks are associated with lower functional status and quality of life.[10] Programming that delays ICD therapy in primary prevention patients with therapy of more than 200 beats per minute or more than 170 beats per minute after a prolonged detection has been shown to decrease inappropriate shocks and may even be associated with improved mortality.[11] There is growing evidence that antitachycardia pacing (ATP) is effective for treating fast VT.[12–17] All of these findings have resulted in the goal of reducing inappropriate and appropriate ICD shocks with optimal device programming, such as with turning on ATP for fast VT.

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Electrophysiology Section, Duke University Medical Center, Durham, NC, USA
* Corresponding author. Duke Clinical Research Institute, PO Box 17969, Durham, NC 27715.
E-mail address: alkha001@mc.duke.edu

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ATP is a series of paced stimuli that are delivered by the ICD. The number of stimuli in the series and the interval between those stimuli are programmable. A burst sequence has a consistent R-R interval between the stimuli that is programmed as a percentage of the cycle length of the VT, whereas a ramp sequence has a decremental R-R interval between stimuli. By capturing the excitable gap, the ATP can terminate the VT (Fig. 1). If the ATP is not able to capture the excitable gap, then ATP will not terminate the VT, and the device would deliver a shock to terminate the persistent VT (Fig. 2).

MECHANICS OF ANTITACHYCARDIA PACING

As mentioned previously, ATP is one option to painlessly treat re-entrant VT, while avoiding ICD shocks. Myocardial scar is the typical substrate for re-entry circuit ventricular arrhythmias.[18] Scar consists of a mixture of fibrosis and functional myocytes, and the fibrosis results in areas of slow conduction between the functional myocytes and other areas of electrical block that can create re-entrant arrhythmias.[19] The functional myocytes create exit sites, where there is a connection at the border zone of the scar with surrounding normal

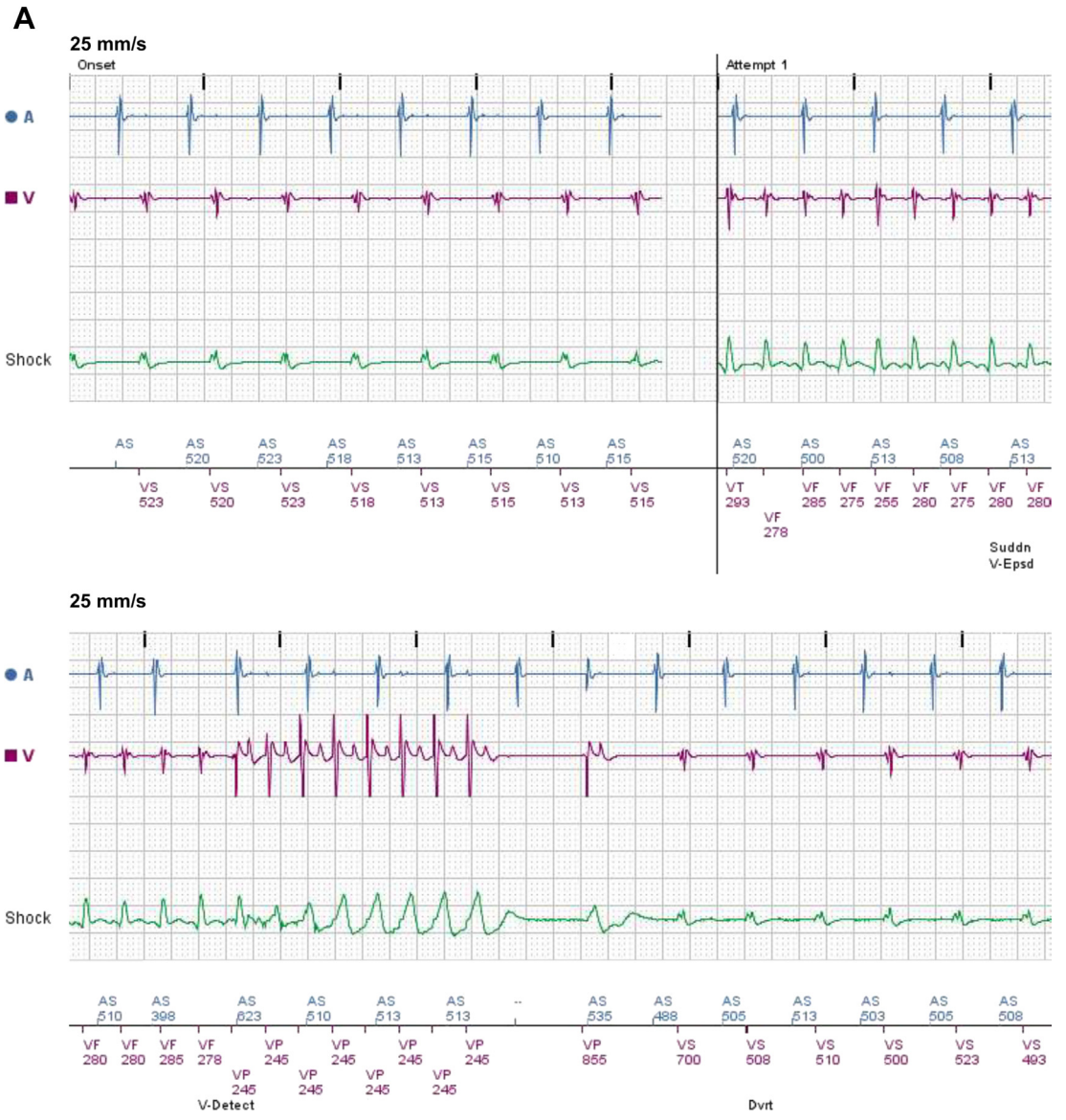

Fig. 1. Example of VT appropriately and successfully treated with ATP with electrocardiogram (*A*) and interval plot (*B*).