Clinical applications

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Atrioventricular synchronous pacing in leadless ventricular pacemaker is safe and effective in patients with paroxysmal AV block and atrial arrhythmias

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Background/Introduction

Accelerometer (ACC)-based AV synchronous pacing by tracking atrial activity is feasible using a leadless ventricular pacemaker. Patients may experience variable AV conduction (AVC) and/or atrial arrhythmias during the lifetime of their device. ACC-based AV synchronous pacing should facilitate AVC and pace appropriately in those two common rhythms.

Purpose: To characterize the behavior of ACC-based AV synchronous pacing algorithms during paroxysmal AV block (AVB) and atrial arrhythmias.

Methods: The MARVEL2 (Micra Atrial tRacking using a Ventricular accELerometer) was a 5-hour acute study to assess the efficacy of atrial tracking with a temporarily downloaded algorithm into a Micra leadless pacemaker. Patients with a history of AVB were eligible for inclusion. The MARVEL2 algorithm included a mode-switching algorithm that switched between VDD and VVI-40 depending upon AVC status. The AVC algorithm requires 2 ventricular paces (VP) at 40 bpm out of 4 pacing cycles to switch to VDD.

Results: Overall, 75 patients (age 77.5 ± 11.8 years, 40% female, median time from Micra implant 9.7 months) from 12 centers worldwide were enrolled. During study procedures, 40 patients (53%) had normal sinus rhythm with complete AVB, 18 (24%) had 1:1 AVC, 5 (7%) had varying AVC status, 8 (11%) had atrial arrhythmias, and 2 other rhythms. Two patients with complete AVB had the AVC mode switch feature disabled due to an idioventricular rate >40 bpm. Among the 40 subjects with a predominant 3rd degree AVB and normal sinus function the median %VP was 99.9% compared to 0.2% among those with 1:1 AVC (Figure). In the patients with 1:1 AVC, there were 64 opportunities to AVC mode switch with 48 switching to VDI-40. In the other 16 cases (2 patients) the mode remained VDD due to sinus bradycardia varying between 40-45 bpm. High %VP was observed in 2 patients with 1:1 AVC and sinus bradycardia <40 bpm. The AVC mode switch minimized %VP (<1%) in patients with PR intervals > 300 ms (N = 2). Among patients with varying AVC, the algorithm appropriately switched to VDD when the ventricular rate was paced at 40 bpm. During infrequent AVB or AF with ventricular response >40 bpm, VVI-40 mode was maintained.

In patients with AF, the ACC signal was of low amplitude and there was infrequent sensing, resulting in VP at the lower rate (50 bpm). In the one patient with atrial flutter, the ACC was intermittently detected, resulting in VP at 67 bpm (IQR 66-67 bpm).

Conclusion(s)

The mode switching algorithm in the MARVEL2 reduced %VP in patients with 1:1 AVC and appropriately switched to VDD during complete AVB. If greater AV synchrony or rate support is required, disabling the AVC algorithm may be appropriate for low grade AVB or idioventricular rhythms. In the presence of atrial arrhythmias, the algorithm paced near the lower rate.

Abstract Figure. Distribution of VP% by heart rhythm