Autonomic Nervous System optimized fixed delay left-ventricular cardiac resynchronization

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Introduction: Cardiac Resynchronization Therapy (CRT) is used to treat heart failure patients with left bundle branch block (LBBB). With good right ventricular (RV) conduction (RVc), adaptive atrioventricular delay (AVD) using left-ventricular (LV) pacing, no RV pacing, is used to extend device longevity. Simpler fixed AVD LV-only is discussed here.

Methods: Three LBBB CRT pacemaker (CRT-P) patients with good RVc were reprogrammed to fixed AVD LV-only to extend device longevity utilizing intrinsic RVc. With the RVs triggering feature when an early RVs is detected (before LVp) an LVp is immediately triggered, forcing resynchronization. An RVs arriving after the LVp is not detected. The patients were implanted with 3 different CRT-P models from a manufacturer. Follow-up (FU) durations: 4 years, 8 & 8 months. FUs are performed every 2-12 months. To increase data collection, we initiated home remote monitoring (RM) for nightly statistics.

Result: Extending daily the LV AVD to 300 ms, the CRT-Ps measure the intrinsic atrial sense/pace to ventricular sense (Ax-Vs) intervals. At the start of LV-only, from prior biventricular pacing, the intervals were found to be spread over the 0-300 ms range. With fixed AVD LV-only, autonomic nervous system, ANS, optimization is recognized when the intervals coalesce into ≤2 adjacent 10 bpm bins from then on. In the late model CRT-P, we were able to aggressively remote schedule the full FUs with electrogram (EGM). Each full FU includes 10 s each for normal rhythm, enhanced sensing with LV AVD to 300 ms, fast atrial pacing. EGMs were also received for atrial fibrillation (AF) episodes. Over 4 months of RM, 18 reports with 3 channel EGMs were received: 11 periodic FUs, 7 short 12 s AF records. In this abstract we focus on this patient. The paper will discuss the other 2 patients from whom we received 5+19 and 3+0 EGM records. The daily RM data include %As-Vs, and atrial rate. The Vs are actually RVs. With LV AVD of 125 ms, the histogram of the daily %As-Vs (Ap = 0%) with early RVs and triggered LVp is shown in Fig. 1. The median daily %As-Vs is 11%. The 13 times the daily %As-Vs are > 30% cannot be random, since each corresponds to > 7 hours. The associated atrial rates are also high. This shows active dromotropic RVc modulation. Fig. 2 shows the distribution of the %As-Vs versus the daily atrial rate. Dromotropic RVc shortening allows more early RVs at high atrial rates, increasing %As-RVs. From the 18 EGM records, As-RVs intervals are measured. Fig. 3 summarizes the results. All 3 regression curves exhibit dromotropic shortening at increased atrial rates.

Conclusion: In fixed AVD LV-only CRT, dromotropy is shown to modulate the RVc to optimize hemodynamics. The other ANS functions will similarly be recruited to optimize hemodynamics using the RV timing with a fixed LVp reference time. Thus this is ANS optimized LV-only CRT, superior to device driven adaptation.