Minimizing Right Ventricular Pacing in Patients With Implantable Cardioverter-Defibrillators

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Received 2016 March 16; Accepted 2016 May 14.

Keywords: Pacemaker Algorithms, Right Ventricular Pacing, Implantable Cardioverter-Defibrillators

Frequent right ventricular (RV) pacing is associated with heart failure, atrial fibrillation and increased morbidity and mortality in patients with implantable cardioverter defibrillators (ICD) (1, 2). Dysynchronous electrical activation of the heart from RV pacing may result in alteration in mechanical activation, deleterious myocardial fiber strain and mitral regurgitation. It may also cause chronic changes in cellular structure and ventricular geometry that result in impaired ventricular performance (1).

Therefore, in modern pacemakers, to avoid the negative effect of RV pacing and prolong generator longevity, some pacing algorithms are designed (managed ventricular pacing™ by medtronic; ventricular intrinsic preference™ by St Jude medical; AAISafeR2™ by Sorin group). The mechanism of these algorithms is based on the prolongation of atrioventricular (AV) interval and searching for AV conduction to minimize ventricular pacing (3).

First-degree AV block seems to be a benign condition. However, it is known that optimal AV timing to maintain AV synchrony also plays a significant role in increasing cardiac output. An extreme AV delay may also cause pacemaker mediated symptoms by loss of mechanical AV synchrony and an adverse sequence of ventricular and atrial contraction.

The community-based studies elicited from the Framingham population showed that people with first-degree AV block are associated with worse outcome compared with those with normal AV conduction. But does first-degree AV block play a role in worsening the prognosis or is it a sign of poor prognosis?

In the comparison of medical therapy, pacing and defibrillation in heart failure (COMPANION) trial, 1520 patients who fulfilled the criteria for cardiac resynchronization therapy (CRT) implantation, were enrolled in two groups of CRT implantation and medical therapy. It was shown that PR prolongation may affect mortality and heart failure hospitalizations in the medical group, but the effect of PR prolongation may decrease at least in part with correction of AV delay by CRT. Therefore, PR prolongation may worsen the prognosis that may improve with treatment partly (4).

According to the current research, there is little evidence to recommend pacemakers to improve survival in patients with isolated first-degree AV block. Maybe adverse effects of RV pacing and device related complications are greater than the benefits of correction of the PR interval (5).

But, what about patients with ICD and first degree AV block or intermittent AV block?

In DAVID’s trial, 506 ICD patients with a left ventricular ejection fraction less than 40% were randomized to dual chamber rate adaptive (DDDR)-70 versus VVI backup 40 beats/minutes (bpm) pacing. AV delay was programmed at values of 170/150 ms. A sub-analysis of this trial showed that the subgroup of dual chamber pacemaker (DDD)-paced patients with RV pacing more than 40% was associated with the highest mortality/heart failure (HF) hospitalization rate. However, in patients with DDDR pacing less than 40%, (mean RV pacing 11%) outcome was similar to that of VVI- 40 back-up pacing (mean RV pacing 0.5%), with a trend toward better outcomes (6).

INTRINSIC RV trial enrolled patients with ICD without bradycardia indication for pacing and randomized them to VVI-40 back-up versus DDDR with AV hysteresis algorithm, which could increase the AV delay to a maximum of 300 ms. The trial showed a nonsignificant trend in favor of DDDR pacing for lower the patients hospitalized for HF or...
mortality compared with the VVI arm. However, the post hoc analysis of this trial revealed that patients with a cumulative RV pacing less than 10% had a higher event rate than those with RV pacing from 10% to 19% (7).

In conclusion, in patients with DDD for sinus bradycardia, algorithms to minimize unnecessary RV pacing are useful tools. However, in patients with an ICD indication and impaired left ventricular systolic function, AV synchrony should also be noted. Hence, a very prolonged AV delay as a function of these algorithms may result in a negative hemodynamic effect. Therefore, in such patients the best pacing mode should be defined individually.

References