Influence of anodal stimulation on effectiveness of programming an interventricular delay during biventricular pacing

Berry M. van Gelder, Frank A. Bracke, Albert Meijer. Catharina Hospital, Eindhoven, The Netherlands.

Aim: Unipolar coronary sinus leads can be programmed in a “common ring” configuration in which the anodal electrode of the right ventricular lead is used as anodal electrode for the coronary sinus lead. In this configuration, a left ventricular (LV) stimulus can give rise to anodal stimulation at the right ventricular (RV) lead, causing simultaneous biventricular activation. This may interfere with programming of an interventricular (VV) pacing delay.

Methods: Twelve lead ECGs were compared in 5 pts during biventricular pacing in common ring modes with progressive advancing LV stimulation. Anodal capture was present in all patients. Interelectrode distance of the RV lead was 16 mm.

Results: For a VV interval between 80 and 24 ms, all patients showed simultaneous RV and LV pacing with unchanging morphology. Shortening the VV interval below 24 ms gave a sudden change in the morphology of the QRS complex. This was characterized by an increased contribution of right ventricular activation and most clearly elucidated in the precordial leads. This is explained as follows: at long VV intervals the cathodal RV stimulus is delivered into refractory myocardium already pre-excited by anodal stimulation. At short VV intervals (<24 ms) the anodal activation has not yet reached the tip electrode of the RV lead and the RV stimulus will be effective resulting in sudden fusion with anodal RV stimulation.

Conclusion: Anodal RV stimulation can render timing of a VV interval ineffective when the LV is stimulated before the RV, resulting in unaltered simultaneous biventricular stimulation over a wide range of VV intervals. At shorter V-V intervals a change in morphology is observed which is due to anodal as well as cathodal RV stimulation.

Echocardiographic optimization of the AV- and VV-delay in patients treated with cardiac resynchronization therapy

Stähler Marcus, Gadler Fredrik, Karlsson Helena, Oblack Pia, Ersgard David, Linde Cecilia, Braunschweig Frieder.
Dept of Cardiology, Karolinska University Hospital, Stockholm, Sweden

In patients treated with cardiac resynchronization therapy (CRT) for chronic heart failure (CHF), the atrio-ventricular (AV) and interventricular (VV) intervals can be individually optimized by means of echocardiography. We assessed the outcome of 55 consecutive optimization procedures.

Methods: Fifty-five patients (age 67±12, range 29-87 y) with CHF (LVEDD 66±10 mm, EF 22±7) received a biventricular pacemaker. Forty-three patients were in stable sinus rhythm (SR) and 12 had chronic atrial fibrillation (AF). The etiology of CHF was ischemic cardiomyopathy in 33 and dilated cardiomyopathy in 22 cases. Within 3 months after implantation, the AV-delay was optimized according to the mitral inflow pattern as described by Ritter. If the pacemaker permitted a differential programming of the interventricular delay (n=44), the VV-delay associated with the highest aortic time velocity integral (TVI, mean of 3 cardiac cycles) was considered optimal.

Results: In patients with SR the average optimal sensed AV-delay was 116±19 ms (range 80-150). In 18 of 43 cases, the optimal sensed AV-delay differed at least 20 ms from the nominal programming suggested by the pacemaker manufacturer (120 ms). The optimal VV interval was 23±18 ms (left ventricular lead paced first). Patients with ICM and DCM yielded an optimal AV-delay of 120±17 and 108±16 ms, respectively (p<0.05). There was no difference between ICM and DCM patients with respect to the VV-delay. Patients with SR had a shorter optimal VV-delay (21±18 ms) compared with AF patients (32±13 ms).

Conclusion: In CRT patients the average optimal AV-delay and VV-delay were close to the nominal programmed values. However, according to echocardiographic evaluation, AV- and VV-delays were changed in a substantial number of patients, suggesting that individual optimization is useful. Furthermore, our findings indicate, that the etiology of CHF might play a role in AV-delay optimization.

There is a relation between the hemodynamic effects of right and left ventricular pacing and the optimal V-V interval in biventricular pacing


Aim: To investigate the relationship of right and left ventricular pacing and the optimal interventricular pacing interval (VV-interval) in biventricular (BiV) pacing in patients with chronic atrial fibrillation (AF).

Methods: 31 patients (21 male, age 67±18.3 years) with heart failure class III - IV, left ventricular (LV) asynchrony and right ventricular (RV) pacing as baseline rhythm had BiV systems implanted. All patients were in chronic AF. Ventricular leads were positioned in the apex or mid septum of the RV, and in one of the posterolateral branches of the coronary venous system for LV pacing. The hemodynamic effect of pacing was evaluated by invasive measurement of left ventricular (LV) dp/dtmax, performed by a pressure sensor tipped 0.014” guide wire positioned in the LV cavity. LV dp/dtmax was measured during RV, LV and BiV pacing and BiV pacing with optimization of the V-V interval (BiVopt). Correlation between the logarithm of the ratio between RV and LV pacing and the optimal V-V interval was evaluated by Pearson correlation and Kendall’s tau correlation statistics.

Results: The Pearson correlation between the logarithmic LV versus RV maximum dp/dt ratio and the optimal V-V interval is 0.55 (p=0.0013). There is also a strong relationship between the superiority of LV pacing over RV pacing and the optimal V-V interval being positive (Kendall’s tau = 0.68, p=0.0002).

Conclusion: In patients with chronic AF there is a clinical significant correlation between the ratio of LV dp/dtmax during LV and RV pacing and the optimal V-V interval. Further study is necessary to determine whether this relationship can be used for optimizing the V-V interval in BiV pacing by measuring the effect of RV and LV pacing separately.