The Kappa test was used for assessing the between-method agreement.

Background and Purpose: Cardiac resynchronization therapy (CRT) is an adjuvant treatment for patients with refractory heart failure. Electrophysiographic techniques, especially tissue Doppler imaging (TDI), has an expanding role for selection and optimization of biventricular pacing. Electromechanical delay using TDI, measuring Q to peak systolic shortening (S-wave) is currently used for defining inter- and intraventricular dyssynchrony. The aim of this study was to investigate normal values for measurement currently used as TDI criteria for ventricular dyssynchrony.

Methods: We studied 100 healthy adult volunteers aged 37±9 (49M). Q to S wave time was measured by pulsed wave TDI (IE33, Philips Medical). Traces were acquired from the six segments of LV (basal lateral wall, medial septum, anterior septum, posterior wall, anterior wall and inferior wall). The same method was used for RV, sampling free wall at the level of the anterior tricuspid annulus. Pre-ejection period of RVOT and LVOT as well as LV filling time ratio to cardiac cycle and QRS width were measured in all studies.

Results: There is an average electromechanical delay between the six LV segments of 24±11ms. The basal inferior wall was the most delayed segment in 32% of the population. Six percent showed intraventricular delay more than 65ms. LV activation preceded RV activation in all cases. Seventy-one percent of subjects showed delay of RV more than 40ms and 2% more than 100ms. All of these subjects had QRS width =100ms and LV filling ratio = 39%.

Conclusion: TDI can play a major role for patient selection and optimization of CRT. Current values for defining inter- and intraventricular dyssynchrony should be studied further based on these findings.

Can the definitions of the cardiac mechanical asynchrony be compared?

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Methods: Numerous articles have been published on cardiac mechanical asynchrony, but no consensus has been reached to date on standardization of protocols. The goal of this study is to assess the coherence of the various criteria proposed to assess the presence of asynchrony.

Results: Electrophysiological study was performed on 20 patients (21 male, 5 female, with an average age of 72.5±9.3 years), an average 9.5 years after a biventricular pacing was inserted in these patients. Three definitions were compared for assessing inter-ventricular asynchrony, and six for assessing intra-ventricular asynchrony (see Table). The Kappa test was used for assessing the between-method agreement.

Results: For inter-ventricular asynchrony, the level of between-method agreement was low to very low (Kappa values ranging from −0.015 (CI 0.00%−0.434; 0.408) to 0.193 (CI 95%: −0.235; 0.619)). For left ventricular asynchrony, the level of agreement varied between total absence of to fair agreement (kappa values ranging from −0.547 (CI 95%: −0.700; 0.807) to 0.457 (CI 95%: −0.255; 1.169)). The best agreement was observed between onset of the systolic velocity in DTI pulsed-wave and the peak of this (0.457).

Conclusion: Agreement between various validated and currently used criteria for inter-ventricular asynchrony and intra-ventricular asynchrony is low. In our patients, depending on the definition used, prevalence of interventricular asynchrony ranged from 19 to 38%, and that of left intra-ventricular asynchrony from 11 to 54%. There is a need for a consensus defining both the criterion and the threshold mechanical cardiac asynchrony.

Assessment of left ventricular systolic synchrony by real-time three-dimensional echocardiography

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Objective: Cardiac resynchronization therapy (CRT) is a novel and promising therapy for patients with advanced chronic heart failure. Echocardiography has been approved to be a useful tool for selecting appropriate patients for CRT. This study was aimed to use real-time three-dimensional echocardiography to assess left ventricular systolic synchrony.

Methods: Fifteen subjects were divided into 2 groups. Group A consisted of 6 normal subjects (mean age 61.8±8.9 years, 6 male), and group B included 7 patients with abnormal wall motion (mean age 65.7±5.7 years, 5 male). Philips IE33 with X3-1 probe was used to perform full volume real-time three-dimensional echocardiography (3DE), and the global and 17-segmental volume curves were obtained by the on-line Qlab software. The end-systolic volume (ESV), end-diastolic volume (EDV), left ventricular ejection fraction (LVEF), the minimal volume of the 17 segments (Vmin) and its standard deviation (Vmin-SD), the mean maximal volume of the 17 segments (Vmax) and its standard deviation (Vmax-SD), the mean time to the point of minimal systolic volume (T) of the 17 segments and its standard deviation (T-SD), and the maximal difference of T among all 17 segments (Tmax-diff) were derived.

Results: There were no difference in age, heart rate and EDV between the two groups. The ESV of group B was larger than that of group A (p<0.05), and the LVEF of group B was lower than that of group A (p<0.05). The Vmax, Vmin and T were not significantly different between the two groups, however the Vmax-SD, Vmin-SD, T-SD and Tmax were significantly larger in group B than those in group A (all p<0.05). The T-SD and Tmax of group B were remarkably longer than those of group A (p<0.003, 0.004 respectively).

Conclusions: Real-time three-dimensional echocardiography is a useful modality to evaluate systolic asynchrony. T-SD and Tmax may be potential parameters to assessing left ventricular systolic synchrony.
1008 Optimisation of atrioventricular delay of cardiac resynchronisation therapy using aortic outflow tract velocity time integral and maximisation of continuous non-invasive blood pressure


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Atrioventricular delay can be optimised by maximising aortic outflow tract velocity time integral (VTI). We compared this method with a new non-invasive haemodynamic method which utilises continuous beat-by-beat blood pressure (BP). Methods: In 12 patients with biventricular pacemakers aortic outflow tract VTI was measured for a range of different AV delays (40, 80, 120, 140, 160, 200, 240 ms). The mean of five consecutive beats was calculated for each tested delay. The same series of AV delays were assessed using aortic non-invasive blood pressure. The relative change in systolic BP (SBPrel) was calculated compared with a reference delay of 120 ms. Reproducibility testing was performed at 3 months for both methods.

Results: The two methods selected the same optimal AV delay in 33% of patients, in a further 50% the AV delays were within 40ms of each other. The mean absolute difference between AV delays selected by the two methods was 30.7 ms. There did not appear to be a trend for either method to select longer or shorter optimal AV delays (P=0.9). The mean absolute difference of echocardiographically determined maximal AV delay measured 3 months apart was 17 ms (SD 20 ms), whereas using acute SBP it was 3 ms (SD 8 ms).

Conclusion: Selection of haemodynamically maximal AV delay using echocardiography broadly correlates with continuous non-invasive haemodynamics. It is likely that this is due to the limited reproducibility of aortic outflow tract VTI. Continuous non-invasive blood pressure appears to be a more reliable method for haemodynamically optimising AV delay.

1009 Validation of VV interval optimization in cardiac resynchronization therapy improves both left ventricular synchrony and hemodynamics


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Background: Response to cardiac resynchronization therapy (CRT) mainly depends on the degree of left ventricular (LV) dyssynchrony which appears to be best quantified by LV dispersion as determined by tissue Doppler imaging (TDI). We sought to determine whether LV interval optimization could lead to better improvement in LV synchrony and in hemodynamics.

Methods: Sixteen consecutive patients who received CRT were studied. All patients were in NYHA class III, had >35% ejection fraction and presented significant LV asynchrony (LV dispersion > 60 ms) with DTI. The dispersion was calculated as the difference, among the 4 LV walls, between the longest and the shortest times to peak myocardial sustained systolic velocity on colour TDI. Measurements were performed with (BIV) and without (OFF) active CRT before and after LV interval optimization.

Results: Mean optimized LV interval was 233±3 ms (range -100 to +20 ms). During CRT, LV dP/dt increased in all patients. Optimization leads to further increases in LV dP/dt in 14 patients (44±5±91 (OFF) vs 85±2±200 (BIV) vs 89±1±171 (Opt) mmHg/s (p<0.001). LV filling pressure, approximated by E/Ea (mean early diastolic mitral annular velocity), significantly decreased with optimal sequential CRT (39±18 vs 27±±9 vs 23±±8, p<0.05). The ratio in cardiac output to diastolic acceleration time, that increased in the clinical responders, there were no significant changes in LV diastolic function either in responders or non responders.

Conclusions: Optimization of LV filling pressure by sequential CRT improves LV systolic and diastolic synchrony. As a result, LV filling pressure decreased and cardiac pumping ability increased.

Is left ventricular remodeling related to the clinical response to cardiac resynchronization therapy? A 12 months follow-up study

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Background: Cardiac resynchronization therapy (CRT) has shown to reverse left ventricular (LV) remodeling in patients (p) with congestive heart failure (CHF). However, mechanisms leading to clinical response to CRT remain unclear.

Aim: To analyze if patients who improve clinically have greater LV reverse remodeling than those who do not respond at a follow up of 12 months.

Methods: Sixty-four p with CHF: complete left bundle branch block and LV ejection fraction (EF)<25% treated with CRT were included. Echo-Doppler scans were taken just before and immediately after the implantation of the pacemaker, and at 6 and 12-month follow-up. We compared LV diameters, volumes and EF, as well as LV diastolic function and LV filling pressure estimate. We considered responders those patients who were alive without cardiac transplantation and who improved by =>10% in the 6 minutes walking test at one year follow-up.

Results: There were no clinical differences at baseline between responders and non-responders. Seventeen out of 64 patients (26%) did not respond to CRT at 12 months follow-up. At 6 and 12-month follow-up, we compared LV diameters, volumes and EF, as well as LV diastolic function and LV filling pressure estimate. We considered responders those patients who were alive without cardiac transplantation and who improved by >10% in the 6 minutes walking test at one year follow-up.

Conclusions: There were no clinical differences at baseline between responders and non-responders. Seventeen out of 64 patients (26%) did not respond to CRT at 12 months follow-up. At 6 and 12-month follow-up, we compared LV diameters, volumes and EF, as well as LV diastolic function and LV filling pressure estimate. We considered responders those patients who were alive without cardiac transplantation and who improved by >10% in the 6 minutes walking test at one year follow-up.

Table

<table>
<thead>
<tr>
<th>Responders</th>
<th>Non-Responders</th>
</tr>
</thead>
<tbody>
<tr>
<td>LV EDV (ml)</td>
<td>207±9±0 197±7±3 272±1±00 244±±54</td>
</tr>
<tr>
<td>LV ESV (ml)</td>
<td>160±1±4 134±6±1 211±9±0 179±8±9</td>
</tr>
<tr>
<td>LV EF (%)</td>
<td>24±7 ±33±10±2 22±±6 25±6±8</td>
</tr>
<tr>
<td>Mitral DT (ms)</td>
<td>219±8±1 275±7±8 190±3±1 206±±15</td>
</tr>
</tbody>
</table>

*p<0.05 vs OFF, LV EDV: Left ventricular end-diastolic volume; LV ESV: Left ventricular end-systolic volume; LV EF: Left ventricular ejection fraction. Compared to baseline, significant

Conclusions: Patients who clinically respond to CRT have greater LV reverse remodeling than non-responders at 6 and 12 months of follow-up. The effect of CRT on LV remodeling may explain at least in part, the clinical benefit of this therapy.
Echocardiography improvement with cardiac resynchronization in patients with chronic right ventricular pacing

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Introduction: Right ventricular pacing originates an activation sequence similar to left bundle branch block. Some patients with right ventricular pacing and left ventricular dysfunction exhibit asynchrony.

Objective: To evaluate the effect of cardiac resynchronization therapy (CRT) in patients with chronic right ventricular pacing, severe left ventricular dysfunction (ejection fraction <35%) and functional class III-IV, and echocardiographic asynchrony.

Material and methods: Between June of 2004 and April of 2005, 14 out of 116 patients with permanent right ventricular pacing (mean age of 68±5 years old, 13 males, paced QRS 193±33 ms) were upgraded to biventricular pacing. The mean time before upgrade was 6 years (range 3-14). An echocardiographic study was performed, before and at midterm follow up, and parameters like left ventricular dimensions, volumes, ejection fraction, mitral regurgitation quantification, inter and intraventricular asynchrony were obtained. The mean time follow up was 286 days (range 62-452).

Results: Shown in the table.

<table>
<thead>
<tr>
<th>NYHA</th>
<th>LVEDV (mL)</th>
<th>LVESV (mL)</th>
<th>EF (%)</th>
<th>MR (cm²)</th>
<th>Inter (ms)</th>
<th>Intra (ms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basal</td>
<td>3±0.4</td>
<td>216±89</td>
<td>155±71</td>
<td>29±8</td>
<td>10±11</td>
<td>48±46</td>
</tr>
<tr>
<td>Follow up</td>
<td>1.5±0.5</td>
<td>167±62</td>
<td>113±69</td>
<td>41±10</td>
<td>14±15</td>
<td>33±32</td>
</tr>
<tr>
<td>p</td>
<td>&lt;0.001</td>
<td>0.005</td>
<td>0.009</td>
<td>0.003</td>
<td>0.054</td>
<td>ns</td>
</tr>
</tbody>
</table>

Conclusions: Patients with heart failure, severe left ventricular dysfunction and chronic right ventricular pacing with echocardiography asynchrony exhibit a marked improvement with biventricular pacing.