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Conclusions: Our study has shown that global contractile function of the LV could be enhanced by means of optimal IVPD of sequential biventricular pacing as well; and offered quite simple method to determine the later.

Assessment of myocardial systolic synchronicity using 3D multi-plane myocardial velocity imaging: comparison with 2D myocardial velocity imaging

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Background: Myocardial velocity imaging (MVI) has gained its acceptance in assessing systolic synchronicity by allowing to measure regional differences in the timing of systolic myocardial wall motion. To date, such studies were performed with single-beat acquisitions, which might influence the data through changes in heart rate, loading and breathing. With the introduction of matrix array transducers, 3D multi-plane echocardiography has become feasible allowing single-beat assessment of all myocardial segments. The aim of this study was to assess the value of 3D MVI in measuring systolic synchronicity in comparison with 2D MVI.

Methods: 11 healthy normals (EF> 55%, QRS duration< 120ms), 11 patients with angiographically proven coronary artery disease (EF< 55%, QRS duration< 120ms) and 9 patients with dilated cardiomyopathy (EF<35%, QRS duration<140ms) were included. Apical 4-, 3- and 2-chamber views were acquired from all patients with 2D and 3D echo (Vivid7-Dimensions, GE, Horten, Norway). Peak systolic velocity (Vs), time to peak systolic velocity (Ts) were measured from 12 segments (6 basal, 6 mid). A tissue synchronicity index (TSI) was calculated, as the standard deviation of Ts. Vs, Ts and TSI measured with 2D and 3D MVI were compared using correlation and Bland Altman statistics.

Results: The correlation coefficient (R), bias and the limits of agreement (LOA) between two methods for Vs, Ts, and TSI were as follows: Vs: R=0.90, bias=-0.14cm/s, LOA=±2.7cm/s, Ts: R= 0.66, bias=±2.5ms, LOA=±64ms and TSI: R= 0.99, bias=±0.61ms, LOA=±2.76ms. The regression analysis for TSI is shown in the figure.

Conclusion: There were close correlations between the 3D and 2D approaches. 3D multi-plane MVI thus offers a reliable tool in assessing myocardial systolic synchronicity.

Dynamic left ventricular dyssynchrony contributes to exercise symptoms and dynamic mitral regurgitation in heart failure patients


Background: In heart failure patients, exercise-induced increases in mitral regurgitation (MR) contribute significantly to limitation of exercise capacity and convey a poor prognosis. The role of dynamic left ventricular (LV) dyssynchrony – intermittent changes in LV synchrony during exercise – as a determinant of dynamic MR has never been investigated.

Methods: Thirty-five consecutive patients with chronic ischaemic LV dysfunction underwent measurement of effective regurgitant orifice (ERO) and of LV synchrony at rest and during semi-supine exercise test.

Results: During exercise, the degree of LV dyssynchrony - the difference, among the 6 LV walls, between the longest and the shortest times to peak myocardial sustained systolic velocity - increased by at least 10 ms (range: 10 to 140 ms) in 16 patients, remained stable in 4 and decreased by at least 10 ms (range: -10 to -70 ms) in the remaining 15. With multivariate analysis, an increase in LV dysynchrony and in systolic tenting area emerged as determinants of exercise-induced changes in ERO (r²=0.67, p=0.0001). Changes in LV dysynchrony were also associated with changes in systolic tenting area (r²=0.52, p=0.0013). Changes in ERO and in LV dysynchrony at exercise correlated with changes in stroke volume (r²=0.71, p=0.0008). With multivariate regression analysis, larger increases in ERO (p<0.029) and in LV dysynchrony (p<0.045) independently predicted the occurrence of exercise-induced dyspnea.

Conclusions: In heart failure patients, dynamic LV dysynchrony contributes to exercise-induced increases in the severity of MR and hence limitation of stroke volume adaptation and exertional dyspnea.

Prognostic value of inter-ventricular electromechanical asynchrony in right-ventricular paced patients with either normal or impaired left ventricular function

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Background: Pacing from the apex of the right ventricle alters the segmental contraction-relaxation sequence of both the ventricles, producing an activation wave-front spreading asynchronously from right to left and from the apex to the base of the heart.

Aim of the study: we sought to assess the indexes of myocardial activation delay, using Doppler Myocardial Imaging (DMI), as potential predictors of cardiac events in patients with dual-chamber right-ventricular pacing (RVP) and either normal or impaired left ventricular (LV) function, followed-up for 24-46.6±6.8 months.

Methods: From an initial cohort of 210 patients with RVP in the DDD mode (HR 70 beats·min-1·AV delay 125 msec) from at least 1 year, 55 patients (62.4±6.8 years) with drug resistant dilated cardiomyopathy (group A, NYHA class II-IV; LV ejection fraction < 50%; LV end-diastolic diameter > 50mm) and 50 age- and sex-compared patients with normal LV global systolic function (group B, asymptomatic; LV ejection fraction > 60%) underwent prolonged RVP. In 5 basal myocardial segments were measured: myocardial peak velocities and systolic time-intervals; myocardial intra-ventricular (intra-V-del) and inter-ventricular (inter-V-del) systolic delays. Results: QRS width was increased in Group A (p<0.001). DMI analysis showed that the average inferior V-Del in Group A lower myocardial peak velocities of all the segments, and a significant increase of both inter- and intra-V-del (p<0.0001). Cox’s proportional-hazards regression analysis, diabetes mellitus (HR: 1.38, p<0.001), LV ejection fraction (HR: 2.78, p<0.0001) and DMI inter-V-del (HR: 2.19, p<0.0001) were the only independent predictors of the composite endpoint (cardiac death + re-hospitalization). The global chi-square of this combined model was 86.3 (p<0.00001). In particular, an Inter-V-del > 55 msec identified dilated cardiomyopathy patients at higher risk of cardiac events (sensitivity: 85.6%; specificity: 91.5%). No association was observed between QRS width and cardiac events. Conclusions: QRS width is not a reliable tool to evaluate electromechanical asynchrony in RVP patients. In patients with dilated cardiomyopathy and RVP, DMI indexes of Inter-V-del may provide additional information for selecting subgroups of patients at increased risk of cardiac events at follow-up that may benefit from more accurate risk stratification and eventually from upgrading to biventricular pacing.

Ventricular dyssynchrony as measured by total isovolumetric time may predispose to central sleep apnea in chronic heart failure

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Background: Central sleep apnea (CSA) is common in patients with chronic heart failure (CHF), and is associated with significant morbidity. The pathophysiology of CSA is not fully understood, but prolonged circulation time and enhanced chemosensitivity to CO2 are important. A recent study has suggested that cardiac resynchronization therapy (CRT) with biventricular pacing can improve CSA. Total isovolumetric time (IVT) is defined as the time, seconds/minute, when the left ventricle (LV) is neither ejecting nor filling and reflects the degree of ventricular dyssynchrony. Aim: To determine the association between ventricular dyssynchrony, as measured by the total IVT, and CSA in patients with CHF.

Method: 34 men, mean age of 60±13 years, with stable CHF due to LV systolic dysfunction (EF< 45%) and not in atrial fibrillation underwent cardiopulmonary exercise testing, trans-oesophageal echocardiography and polysomnography. All were in NYHA Class II or III and on optimal medical therapy. None had evidence of organic valve or pulmonary disease (FEV1/FVC < 0.7). The apnoea-hypopnea index >15 events/hr of sleep. Results: 17 patients (50%) had CSA. CSA patients were more symptomatic (Min-