Topic 03 – Echocardiography / Cardiac imaging

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Left atrium enlargement is an independent predictor of overall mortality in patients with systemic amyloidosis

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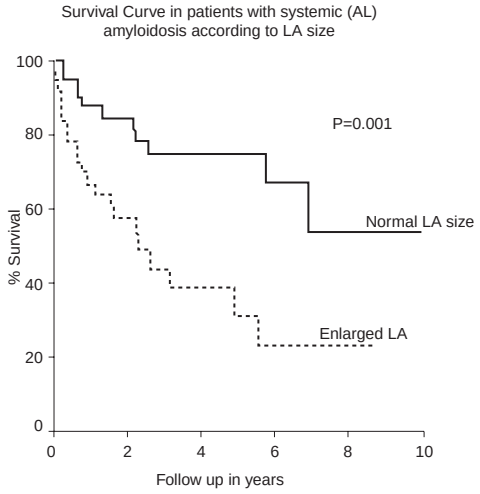
Background: Primary systemic amyloidosis (AL) is a severe plasma cell disorder characterized by amyloid fibrils extracellular deposition in different organs. Myocardial involvement is frequent and has major impact on prognosis. Echocardiography (TTE) is the most common test performed when cardiac involvement is suspected. We hypothesized that a simple measurement of left atrium enlargement (LA) by TTE may provide an important risk marker for this disease.

Methods and results: Between 1997 and 2010, 109 patients were diagnosed with systemic AL and had first TTE within 21 days. Patients were mainly treated with conventional chemotherapy (M-Dex) with new agents for refractory or relapsing patients We retrospectively collected demographic baseline characteristics along with biological and echo data of these patients. Mean age was 63±11 years; 58% were male; 24% had hypertension. Mean left ventricular ejection fraction and mean LV wall thickness were respectively 62±13% and 13±3 mm. Mean follow up time was 2.42±2 years. None had significant valvular heart disease. LA enlargement was defined by M mode as > 40 mm in male and > 36 mm in female. Patients with enlarged LA were more often male, slightly older (p=0.05) and with slightly more hypertension (p=0.07) but had significantly lower ejection fraction and more hypertrophied LV walls (All P< 0.05). At 5 years, survival rate was markedly reduced in patients with enlarged LA vs. those with normal LA: 31±10% vs.75±7% (P=0.001). By multivariate analysis, after adjusting for age, gender, LVEF, LV wall thickness and presence of hypertension, LA enlargement remained an independent predictor of overall mortality at five years (P=0.03).

Conclusion: In patients with systemic AL amyloidosis, LA enlargement, a surrogate marker of diastolic dysfunction and elevated LV filling pressure, is a powerful independent predictor of long-term mortality. Therefore LA enlargement may help to enhance risk stratification in patients presenting with this disease.



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2D and 3D diastolic strain rate by speckle tracking for assessing left ventricular end diastolic pressure

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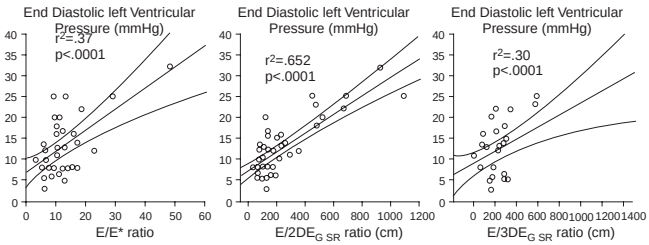
Purpose: The aim of the study was to compare the accuracy of longitudinal diastolic velocity and strain rate (SR) obtained by tissue Doppler imaging (TDI), 2D and 3D speckle tracking in assessing left ventricular end diastolic pressure (LVEDP)

Methods: LVEDP measurements were performed in 40 consecutive patients referred for coronary angiogram (mean age= 60 ± 15 years, mean EF= 41 ± 14%). A comprehensive transthoracic echocardiography (Artida, Toshiba) study was performed immediately after LVEDP measurement. Echocardiography data acquired included mitral early diastolic velocity (E) by conventional pulsed Doppler, early diastolic mitral annulus velocity by TDI (E'), and high frame rate 2 and 3D apical views. Global longitudinal SR by 2D ($2DE_{GSR}$) and 3D ($3DE_{GSR}$) were assessed using longitudinal strain curves from speckle tracking analysis. LV filling pressure estimated using echocardiography data (E/E', E/$2DE_{GSR}$, E/$3DE_{GSR}$) were correlated to invasive LVEDP measurements.

Result: On the whole, LVEDP averaged 13mmHg (5 to 32,) and best correlated with LV filling pressure assessed by 2D speckle tracking (r^2=0.65, p<0.0001). In contrast, conventional E/E' by TDI and E/$3DE_{GSR}$ poorly correlated with LVEDP (see Figure).

Conclusions: Longitudinal diastolic strain rate by 2D and not 3D speckle tracking appears superior to conventional E/E' by TDI for assessing LV filling pressure.



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"New" echocardiographic isovolumetric parameters combined with standard parameters for the assessment of left ventricular filling pressures

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Left ventricular filling pressures' evaluation is still challenging. The ratio of the transmitral and myocardial early diastolic velocities (E/E') can be used to estimate LV filling pressures (LVFP), but between 8 and 15 it remains unclear. Additionally, the time difference between the onset of E and E' (Δ (RE-E')), the time difference between onset of mitral inflow and onset of early diastolic mitral annulus velocity (Δ (IVRT-IVRT')) and the mitral early diastolic velocity (E)/Strain rate ratio during the isovolumetric relaxation period also correlate to LVFP. The aim of this study was to evaluate the incremental value of those indices to evaluate LVFP (as measured by left ventricular end diastolic pressure (LVEDP)) in a heterogeneous group of patients during a simultaneous invasive procedure.

Simultaneous cardiac catheterization, BNP dosage and doppler echocardiography were performed in 30 patients. LVEDP was elevated (>16 mm Hg) in 14 patients (46,7%). The 3 previously described "new" parameters are significantly correlated to LVEDP, but particularly highly significant correlation was found between Δ(IVRT-IVRT') and LVEDP (r = -0,74, p < 0,005). ROC

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curves predict a 80% sensibility and specificity of Δ(IVRT-IVRT'). Δ (RE-E') sensibility and specificity at lateral site are 87% and 93% respectively. E/SRivr has a 71% sensibility and a specificity. The incremental diagnostic value of each parameter and BNP in combination with "classic" parameters (E/A, E/E') was evaluated by kappa coefficient. Δ (IVRT-IVRT') at septal site (k=0,777) and Δ(RE-E') (k=0,73) are the most accurate parameters, whereas additional use of E /SRivr (k=0,41) isn't more useful than "classic" echocardiographic strategy (k=0,478) such as BNP (k=0,533).

Δ (IVRT-IVRT') and Δ(RE-E') can predict LV filling pressures with reasonable accuracy.

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Importance of ventricular longitudinal function in chronic heart failure

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Aims: Despite its immediate relevance, cardio-pulmonary exercise testing (CPET) is infrequently performed in presence of chronic heart failure (CHF). Previous studies of patients suffering from CHF have found a closer correlation between exercise capacity and measurements of diastolic than systolic ventricular function. We examined the correlation between echocardiographic measurements and a) results of CPET and b) cardiovascular prognosis.

Methods and results: We performed resting two-dimensional echocardiograms and CPET in 140 patients with CHF (mean age = 61±13 years, 111 men). The underlying heart disease was ischemic in 48 patients. They were followed for a mean of 38 months (range 28-52). The mean left ventricular (LV) ejection fraction (EF) was 30±9%, and peak VO_2 17.2±6.5 ml/kg/min. LVEF correlated weakly with peak VO_2 (r=0.21), while systolic and early diastolic LV longitudinal function correlated best [early diastolic peak velocity at the mitral annulus (e'): r=0.38; global longitudinal strain (GLS): r=-0.4; p<0.001 for both]. By multiple variable regression analysis, the best prediction of peak VO_2 was derived from a model based on age, mitral annulus end-diastolic peak velocity (a'), GLS, right ventricular (RV) systolic strain and left atrial systolic strain (r^2=0.57; p<0.0001). The 2 best independent predictors of adverse cardiovascular events at 28 months were GLS (odds ratio 1.31, p<0.001; prognostic cut-off =-8%) and RV systolic strain (odds ratio 1.05, p=0.01; prognostic cut-off -22%).

Conclusion: Resting RV and LV longitudinal functions explained the presence of exercise intolerance and were more reliable predictors of adverse cardiovascular events than CPET measurements.

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Risk of ventricular arrhythmia and death in heart failure population using global longitudinal strain by speckle tracking.

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Background: Left Ventricular Ejection Fraction (LVEF) is commonly used to identify patients at high risk of sudden cardiac death and ventricular arrhythmia. However LVEF by Simpson biplane method may be challenging in heart failure patients with severe LV deformation and abnormal wall motion. The aim of the study was to assess the additional value of global longitudinal strain by 2D speckle tracking in predicting the occurrence of ventricular arrhythmia.

Methods: The study included 45 heart failure patients (86% men, 64±22 years, 60 % ischemic) with left ventricular dysfunction (median=28%, range 13 to 47%) referred for Implantable Cardiac Defibrillator (ICD). LVEF and longitudinal global strain by speckle tracking before ICD implantation was compared to major cardiac outcome (MACE defined by cardiovascular death and ventricular arrhythmia).

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Results: Global strain averaged -7±3% (median=7%, range -3 to -13%) and correlated with LVEF (r=-0.71, p < 0.0001). During the follow-up (380± 272days), ventricular arrhythmia (n=17) and death (n=2) occurred in 42% patients. MACE did not differ according to LVEF (52% vs. 36%, p=0.3), and global strain median value (42% vs. 42%, p=0.9). However, in patients with LVEF<28%, MACE tended to be greater when global strain was > – 7% (100% vs. 41%, p=0.06).

Conclusion: Global longitudinal strain by 2D speckle tracking may improve the identification of patients at risk of ventricular arrhythmia and death in heart failure population with severe left ventricular dysfunction.

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Speckle tracking imaging assessment of left ventricular twist in heart transplant patients

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Denervation, pericardiotomy and immunosuppressant drugs may affect mechanical properties of the left ventricle (LV). We aimed to assess LV twist in heart transplant patients with normal LV ejection fraction (LVEF), and without or with mild acute rejection on cardiac biopsy.

Methods: Twenty biopsies and echocardiographic studies were performed in 10 heart transplant patients (mean age: 40±17 years) a median of 6 months after transplantation (range: 1 to 120 months). No patients had evidence of cardiac allograft vasculopathy. The mean age of the donor heart at the time of echocardiography was 37±14 years. Routine endomyocardial biopsy was performed 24 hours after echocardiography. Ten age-matched controls (43±15 years) were also studied. Short axis views were analyzed using speckle tracking software. LV twist was defined as the difference between the apical and basal rotation.

Results: Eight biopsies were on grade 0 (no rejection) and 12 on grade 1^R (mild rejection). The transplant groups and the control group did not differ in terms of LVEF (Grade 0: 66±7%, grade 1R: 67±11% and controls: 66±6 %) and in systolic mitral annular velocities (8.5±1.6 cm/s, 7.7±2.1 cm/s and 8.4±1.4 cm/s, respectively, p=NS). Peak LV twist was reduced in patients with grade 0 and grade 1^R (6.0±3.3° and 7.1±3.6°, respectively) as compared to controls (12.1±2.9°, p<0.005 for both comparison). A reduction in apical rotation accounted for most of this alteration (4.5±2.7° for grade 0, 4.7±3.3° for grade 1^R and 8.9±3.1° for controls, p<0.017). There was no difference in peak LV twist among the transplant groups. Early diastolic LV untwisting (at 5%, 10% and 15% of diastole) did not significantly differ between the three groups.

Conclusions: Speckle tracking imaging allows to detect a reduced LV twist in the transplanted heart. A reduced apical rotation accounts for most this alteration. However, our data suggests that the assessment of LV twist does not allow to detect the early stage of rejection.

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Relation between global longitudinal strain in patients with aortic stenosis: relation with severity and symptoms

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Background: Patient with aortic stenosis (AS) and reduced ejection fraction (EF) should be promptly operated on. Global longitudinal strain (GLS) has been proposed as a subtle subclinical marker of left ventricular (LV) systolic

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