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Global longitudinal strain to pulse wave velocity ratio (VA coupling) is a better indicator of target organ damage than the arterial elastance to LV elastance ratio in hypertensives

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Background: Ventriculo-arterial coupling affects Left ventricular (LV) performance, structure and the resistance capacity of the microcirculation.Ventricular-arterial coupling ratio (arterial elastance (Ea) to LV elastance (Ees) is an echocardiography measurement which is widely used as a marker of ventricular arterial coupling. We hypothesised that the ratio of carotid to femoral Pulse wave velocity (PWV) -as a marker of arterial stiffness- to Global Longitudinal Strain (GLS) –as a marker of ventricular performance- ratio is a measurement of ventricular - arterial coupling and we aimed to compare it with Ea/Ees in a population of newly diagnosed untreated hypertensive patients.
Methods: In 293 hypertensive patients (age 51±11, men 56%) we assessed a) carotid to femoral PWV by Complior b) E/A ratio by Doppler echocardiography of the mitral inflow c) E' by Tissue Doppler imaging, d) GLS off the LV by speckle tracking imaging e) LV mass and Relative wall thickness (RWT) form echo derived LV diameters, f) Coronary Flow Reserve (CFR) of the left anterior descending artery by Doppler echocardiography. Additionally the ratio PWV /GLS was calculated. Ea was calculated as end-systolic pressure (systolic blood pressure * 0.9)/ stoke volume and was indexed to body surface area. Similarly, Ees was calculated as end-systolic pressure (systolic blood pressure * 0.9)/end-systolic volume index. The and Ea/Ees was then computed
Results: PWV/GLS ratio correlated with E/A (β=-2.52,p$\leq$0.001),E' (β=-0.217, p<0.001), RDTW (β=0.140, p=0.012), LV mass indexed (β=0.225, p=0.002), CFR (β=0.143, p=0.014). On the contrary, Ea/Ees did not show association with E/A (β=0.031, p=0.597),E' (β=0.021 p=0.715),RWT (β=0.034, p=0.549), LV mass indexed (β=0.119, p=0.186) or CFR β=-0.007, p=0.903). Using ROC analysis, the AUC ofPWV/GLS was 67% forthe prediction of anE/A<1,63% for E'<0.09 m/sec, 59% for RWT>0.4 and70% for CFR<2.5 (p<0.05 all cases) while it was less than 60% for Ea/Ees,or PWV and GLS alone for the prediction of the same makers of target organ damage.
Conclusion: The ratio of Pulse wave velocity to Global Longitudinal Strain shows a better association with LV diastolic dysfunction, concentric hypertrophy and impaired coronary flow reserve than the traditional arterial elastance (Ea) to LV elastance (Ees) ratio in hypertensive patients suggesting a better assessment of impaired ventricular-arterial coupling.

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Diastolic wall strain as an independent predictor of congestive heart failure events in atrial fibrillation patients with preserved ejection fraction

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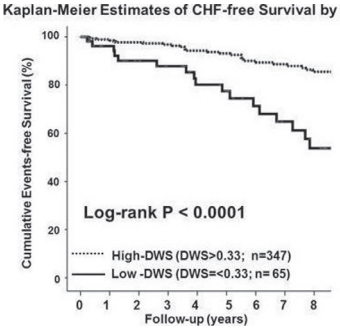
Background: Lower diastolic wall strain (DWS) has been reported as a simple and feasible echocardiographic index in assessing left ventricular (LV) stiffness and predictor of heart failure hospitalization or death in patients with heart failure and preserved ejection fraction (EF). However, the utility of this new index in patients with atrial fibrillation (AF) remains to be determined.
Purpose: We sought to evaluate whether DWS predicts congestive heart failure (CHF) development in patents with AF.
Methods: Among AF patients referred for clinically-indicated echocardiogram, those with LVEF $\geq$50% in 2007–2008 were consecutively included and followed up to 2017 or death. Patients who had a history of pacemaker/implantable cardioverter defibrillator implantation, any cardiac surgery, significant valvular heart disease, congenital heart disease, hypertrophic cardiomyopathy, pericardial disease, or LV posterior wall motion abnormalities were excluded. CHF events was ascertained using Framingham criteria. DWS was calculated with validated formula. Cox-proportional hazards modeling was used to assess risk of CHF development.



Results: Of a total number of 412 patients (70±10 year-old, 66% men, 62% hypertension, 24% diabetes), 45 (11%) developed CHF events during a mean follow-up of 58±44 months. CHF events were significantly associated with advancing age (per 10 yrs; HR -=1.8, 95% CI=1.2–2.7, P<0.01), but not with sex (P=0.89). After adjusting for comorbidities in a multivariate model, low-DWS ($\leq$0.33) was a significant predictor of CHF development (HR=3.1, 95% CI=1.7–5.9, P<0.001), independent of age (per 10 yrs; HR=1.8, 95% CI=1.2–2.6, P<0.01), indexed left atrial volume (per 10 ml/m^2; HR=1.1, 95% CI=1.0–1.2, P<0.05), and indexed LV mass (per 10 g/m^2; HR=1.2, 95% CI=1.1–1.3, P<0.01). The Kaplan-Meier estimates of CHF-free survival stratified by DWS status were shown (Figure).
Conclusion: Low-DWS provides prognostic information for future CHF development even in patients with AF.

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Validation of ASE/EACVI 2016 guidelines on diastolic function in patients with pulmonary arterial hypertension: can they help us predicting high left ventricular filling pressure?

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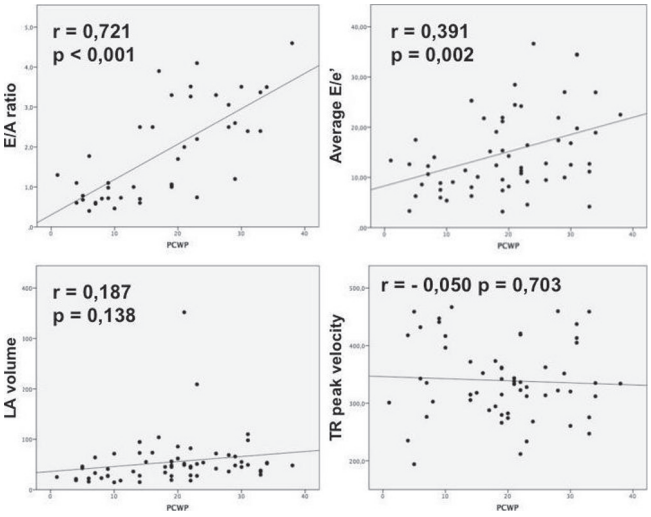
Introduction: Transthoracic echocardiography (TTE) is an invaluable tool in the diagnosis of pulmonary arterial hypertension (PAH). Determining the presence of high left ventricular (LV) filling pressure in these patients is of great importance since it may have prognostic consequences. Evidence regarding the validation of ASE/EACVI 2016 guidelines on diastolic function in this specific population is scarce.
Purpose: To evaluate the diagnostic performance of these guidelines in patients with confirmed PAH.
Methods: We prospectively enrolled patients who underwent TTE and right heart catheterization (RHC) the same day. In this analysis, we included patients with mean pulmonary artery pressure (mPAP) $\geq$25 mmHg. We measured pulmonary capillary wedge pressure (PCWP) which reflects LV filling pressure. PCWP >15 mmHg was deemed elevated (post-capillary component). Echocardiographic parameters recommended to assess diastolic function (according to ASE/EACVI 2016 guidelines) were considered.
Results: We included 64 patients with mPAP $\geq$25 mmHg. Regarding haemodynamic definitions of PAH, we found 15 patients with isolated post-capillary PAH, 23 patients with precapillary PAH and 26 patients with combined post and pre-capillary PAH. ASE/EACVI 2016 algorithm yielded indeterminate results in 11 patients, 10 of whom had normal LV filling pressure at RHC. Sensitivity (92,5%) and PPV (82,2%) of these guidelines were both high, but specificity (38,5%) and NPV (62,5%) were poor. Diagnostic effectiveness was 79,2%. Among echocardiographic parameters, EA ratio showed the best correlation with PCWP (see figure).

Comparison of the main echocardiographic parameters to assess LV filling pressure according to the type of PAH.

	Isolated postcapillary PAH (n=15)	Precapillary PAH (n=23)	Combined PAH (n=26)	p value
E/A ratio	2,9±1,2	0,9±0,5	2,4±1,0	<0,001
Average E/e'	17,3±8,7	11,1±5,9	16,7±8,4	0,029
LAVi (ml/m^2)	51,0 (46,0; 55,0)	27,7 (21,3; 55,0)	48,6 (35,5; 75,6)	0,014
TR peak velocity (m/s)	3,0±0,4	3,5±0,8	3,5±0,6	0,030
LVEF (%)	42,3±17,8	64,3±9,0	39,1±16,5	<0,001

LAVi: Left Atrial Volume index (expressed as median and IQ range); TR: Tricuspid Regurgitation; LVEF: Left Ventricular Ejection Fraction.



PCWP and TTE parameters. Correlations.

Conclusion: Echocardiographic assessment of LV filling pressure based on ASE/EACVI 2016 guidelines shows high sensitivity and PPV for the diagnosis of post-capillary component in patients with PAH. According to our analysis, indeterminate results are not unusual in this type of patients.

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Prognostic implication of relative apical sparing pattern in non-ischemic patients with diffuse left ventricular hypertrophy

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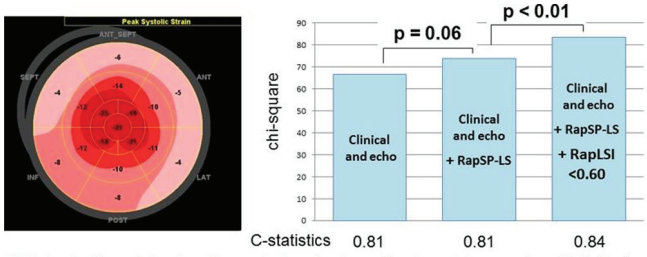
Background: Relative apical sparing pattern of left ventricular longitudinal strain [RapSP-LS; Figure (left)] is determined on the strain polar map at the time of measurement of global longitudinal strain (GLS) during speckle tracking echocardiography. This pattern is frequently observed in patients with cardiac amyloidosis. Some patients with infiltrative cardiomyopathy and severe hypertensive heart disease may also exhibit this pattern. These diseases are characterized by diffuse left ventricular hypertrophy (LVH) and are associated with poor outcomes.
Purpose: We sought to investigate the association of RapSP-LS with major adverse cardiovascular events (MACE) in patients with diffuse LVH, independent of and incremental to clinical and echocardiographic parameters.
Methods: We retrospectively studied 399 consecutive non-ischemic patients with diffuse LVH (LV mass index >115 g/m^2 for males and >95 g/m^2 for females) and preserved ejection fraction (>50%) between 2008 and 2014. Patients with asymmetric septal hypertrophy, severe valvular heart disease, or severe heart failure (NYHA 3 or 4) were excluded. RapSP-LS was visually determined by two blinded sonographers with reference to previous papers; any disagreement was resolved by a third person. Relative apical longitudinal strain index (RapLSI) [average apical LS/(average basal LS + average mid-ventricle LS)] and GLS were also measured. Patients were followed-up for MACE (cardiac death, unexpected admission due to heart failure or acute myocardial infarction) over a median duration of 4.8 years. A Cox proportional hazards model was used to assess the association of parameters with MACE.
Results: The consistency of two sonographers for RapSP-LS was good (κ=0.78). RapSP-LS was observed in 40 patients (10%). MACE (n=50, 13%) was associated with higher prevalence of RapSP-LS and higher RapLSI after adjusting for age, LV mass index, E/e', and GLS (p<0.10 for both). On receiver operating characteristic curve analysis, use of the optimal cut-off RapLSI value of 0.60 to predict the risk of MACE was associated with 50% sensitivity and 75% specificity (area under the curve, 0.62). The model based on clinical and echocardiographic parameters was improved by addition of RapSP-LS, and further significantly improved by addition of RapLSI >0.60 (Figure right).



Clinical and echo model was based on age, brain natriuretic peptide, abnormal electrocardiographic finding (low voltage or pseudo-infarct pattern), Krumholz score*, left ventricular mass index, E/e', and global longitudinal strain.
*Krumholz score consisted of hospitalization in the prior year, history of heart failure admission, diabetes, and serum creatinine level>2.5 mg/dl .
Figure 1

Conclusion: Relative apical sparing pattern provides incremental value addition to the clinical and validated echocardiographic parameters for predicting MACE in non-ischemic patients with diffuse LVH.

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Differences in right ventricular function in patients with severe aortic stenosis with normal flow/low flow undergoing TAVI

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Introduction: Right ventricular function is a well known prognosis parameter in many cardiac conditions. However, it is not usually specifically studied in patients with severe aortic stenosis, with scarce information about the prevalence and prognosis significance of different degrees of RV dysfunction. Moreover, the possible differences in RV function according to flow state (low flow/normal flow aortic stenosis) are lacking.
Purpose: The aim of the study was to identify the prevalence of RV anatomical and functional abnormalities among patients with normal flow (NF) and low flow (LF) severe aortic stenosis undergoing TAVI.
Methods: Patients with severe aortic stenosis undergoing TAVI from January 2016 to July 2017 were prospectively included. RV anatomical and functional parameters were analyzed according to ESC and ASE guidelines. RV diameters, fractional area change, TAPSE, S wave tissue Doppler of the tricuspid annulus (DTI S) and global longitudinal and free wall strain were included. LF aortic stenosis was defined when indexed stroke volume was <35 ml/m^2. Statistical analysis was performed using SSPS.
Results: 115 patients were included.37 patients were excluded due to suboptimal acoustic window for RV anatomical and functional evaluation and the final study population consisted of 78 patients, mean age 83±6 year-old, 38.5% males. 61 patients (78%) had NF aortic stenosis and 17 patients (22%) had LF aortic stenosis. Prevalence of RV dysfunction according to the different parameters in NF and LF group are shown in Figure 1.
Significant differences were noted in RV functional parameters between NF and LF aortic stenosis: TAPSE 22.2±4.3 vs 19.12±4.3 cm, p=0,01; fractional area change 45.3%±11.3 vs 38.6% ±11.4, p=0,04, DTI S 11.5±3 vs 8±2.2 cm/s p=0.03 respectively. No significant differences were noted between RV global longitudinal strain -19.7±5.1 vs -17.9±5.2, p=0.21, and RV free wall strain -20.35±5.3 vs -18.03±5.3, p=0.12.

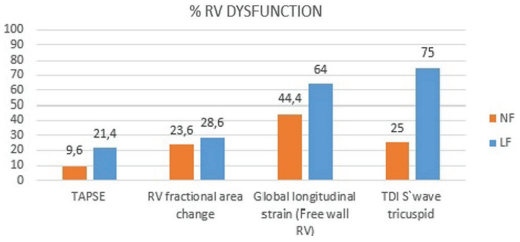

Figure 1

Conclusions: The prevalence of RV dysfunction seems to be higher in patients with LF aortic stenosis. It may reflect a more advanced disease stage. Whether these data could predict clinical outcomes in these patients, or if it can help to individualize the treatment of the aortic stenosis needs to be further explored.

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Novel non-invasive left ventricular pressure-strain loop imaging demonstrates reduced myocardial work in cardiomyopathy with significant regional variation in non-ischemic cases

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Background: Non-invasive left ventricular (LV) pressure-strain loop imaging is a novel method of calculating myocardial work (MW). The total area within the pressure-strain loop represents global MW (Figure1A). Myocardial shortening during systole and lengthening during isovolumic relaxation is classified as constructive work (CW) while myocardial lengthening during systole and shortening during isovolumic relaxation is classified as wasted work (WW).
Purpose: Non-ischemic (CMPN-ISC) and ischemic cardiomyopathy (CMPISC) heart disease etiology influences management, prognosis as well as electromechanical correlates in heart failure. Differences in global MW and regional MW in patients with CMPN-ISC and CMPISC were assessed.
Methods: Strain analysis was performed in 34 patients divided into: 1) Controls (n=10); 2) CMPN-ISC (n=10) (EF<40%; no evidence of significant coronary artery disease); 3) CMPISC (n=14) (EF<40%; coronary artery stenosis) immediately prior to coronary angiography. Dedicated MW software normalized standard

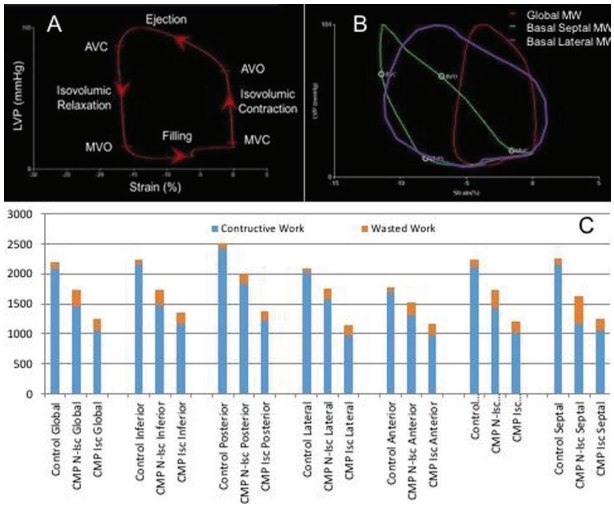

Figure 1