speckle tracking echocardiography (STE) in various cardiac diseases including reduced LV ejection fraction (EF) and validate eTau by invasive Tau measured by catheterization.
Methods: Isovolumic relaxation time (IVRT) was reported to be measured by Doppler echo. Pulmonary capillary wedge pressure (PCWP) was reported to be accurately estimated by STE as 10.8 - 12.4 x Log (left atrial active emptying function / minimum left atrial volume index). Tau was reported to be calculated as IVRT / (ln LV end-systolic pressure – ln LA pressure or PCWP). Thus, eTau by echo is noninvasively obtained using the formula: eTau = IVRT / (ln 0.9 x systolic blood pressure – ln ePCWP). Echo parameters including eTau, e', E/e' and LV strain were measured just before catheterization in 115 patients (age 72±8) with various cardiac diseases including coronary artery disease, hypertensive heart disease, congestive heart disease, valvular heart disease and atrial fibrillation. Moreover, the accuracy of this eTau was examined in patients with reduced EF <50% versus those with preserved EF.
Results: The ePCWP had a good correlation with LV end diastolic pressure (r=0.66, p<0.001). There was a good correlation between eTau estimated by STE and Tau obtained by cardiac catheterization (r=0.75, n=115, p<0.001) and good correlations were noted in both subgroups (reduced EF, n=15, r=0.77 and preserved EF, n=100, r=0.75, both P<0.001), whereas IVRT, e', E/e' and LV peak longitudinal strain had a poor correlation with Tau (r=0.44, -0.40, 0.37 and 0.47, respectively, all p<0.01). Using eTau cutoff of 45ms, the sensitivity and specificity to predict prolonged Tau (>47ms) was 76 and 83%, respectively and positive and negative predictive value was 71 and 87% with AUC of 0.86. Multiple regression analysis revealed that eTau was the best independent predictor of Tau measured by catheterization among echo parameters. Bland-Altman analysis revealed a good agreement between eTau and Tau without fixed and proportional bias.
Conclusions: This study demonstrated that eTau estimated by our noninvasive method using STE has a good correlation with Tau obtained by cardiac catheterization in various cardiac diseases in both patients with preserved and reduced EF. The eTau as an index of LV relaxation can be noninvasively assessed by echocardiography and may have utility and value in routine clinical practice for diagnosis and treatment in diastolic dysfunction.

P4334 | BENCH
Characterization of relative pressure profiles in the inflow tract of the normal and ischemic left ventricle. a study by new ultrasonic relative pressure imaging

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Background: The existence of diastolic intraventricular pressure gradients was first described by high fidelity catheters. Later, also systolic gradients have been shown invasively.
We have developed a new method, Ultrasonic Relative Pressure Imaging (RPI), based on the Navier-Stokes equation applied to velocity fields. RPI visualizes and calculates pressure difference (PD) noninvasively.
Purpose: Our purpose was to noninvasively characterize normal and ischemic PD waveforms in the left ventricular (LV) inflow tract by RPI.
Methods: In an open-chest dog model (n=7), a Millar catheter was introduced into the LV. Color Doppler images were recorded from apical long axis views. RPI was created offline. PD was automatically computed between LV apex and left atrium (LA). LAD occlusion was applied for 15 minutes (min).
Results: Figure shows PD waveforms in one representative dog throughout one cardiac cycle from R to R of ECG.
At baseline, during isovolumic contraction, there is a short biphasic wave. During early systole, there is lower positive pressure at LA than LV apex, generating positive PD, of magnitude 1.5±0.6 mmHg, with peak at aortic valve opening (AVO). During late systole, there is a small negative PD wave, corresponding to aortic valve closure (AVC). During isovolumic relaxation time (IVRT), there is no prominent wave in either direction, PD is close to zero, 0.0±0.3 mmHg.
Furthermore, during early diastolic filling, there is higher positive pressure at LA than LV apex, generating a negative PD of 1.3±0.7 mmHg, with peak at mitral valve opening (MVO).
During mid diastolic filling, there is a positive PD wave, 0.9±0.7 mmHg. During atrial contraction, there is again a negative PD, typically smaller than E wave. Finally, at mitral valve closure (MVC), there is a positive PD wave.
At ischemia, the most apparent finding in systole is a reduction of peak systolic

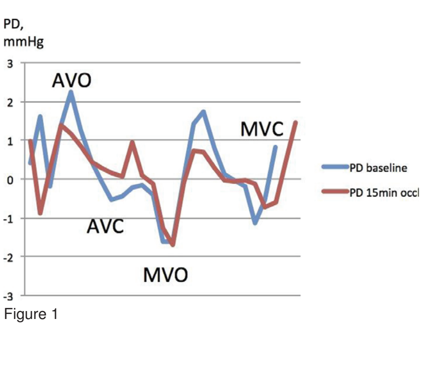

Figure 1

PD to 1.3±0.3 mmHg (p=0.179). During IVRT, there is a consistent increase of PD in all dogs to 0.4±0.3 mmHg (p=0.140). During early diastole, there is slight reduction of peak negative PD to 1.2±0.5 mmHg (p=0.5), and also a reduction of the positive PD during mid diastole to 0.6±0.3 mmHg (p=0.272).
HR is slightly reduced during ischemia, from123±21 to 116±15 bpm (p=0.114). LVEDP is unchanged during ischemia (5±3 mmHg), while Tau increases slightly (from 43±12 to 47±19 ms (p=0.247). +dP/dt decreases from 2029±634 to 1548±406 mmHg/s (p=0.019).
Conclusions: We could determine PD waveforms by RPI throughout the cardiac cycle noninvasively; these closely resemble the previously demonstrated pattern invasively.
Both systolic PD and diastolic PD decrease during ischemia.
Systolic dysfunction causes smaller PD in systole, which may explain reduced stroke volume, and diastolic dysfunction causes smaller PD in diastole compatible with impaired diastolic suction.

P4335 | BEDSIDE
Elastic properties of pulmonary artery and right ventricular-arterial coupling in patients with IPAH and CTEPH

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Background: Recent studies have shown that right ventricular adaptation to chronic pressure overload depends not only on pulmonary vascular resistance, but also on elastic properties of pulmonary artery (PA) and right ventricular-arterial coupling (RVAC). However PA elastic properties and RVAC were assessed only in a few studies and need further investigation.
Purpose: To assess PA elastic properties and RVAC in patients with IPAH and CTEPH using 2D and 3D echocardiography.
Methods: The study included 40 patients with IPAH (WHO FC I-II – 50%, III-IV – 50%), 40 patients with inoperable CTEPH (WHO FC I-II – 37.5%, III-IV – 62.5%), and 20 healthy volunteers. For the first time we assessed all PA elastic properties (strain, distensibility coefficient, global capacitance, beta stiffness index, Peterson's elastic modulus, and global stiffness) and RVAC in patients with different functional status using 2D and 3D echocardiography. RVAC was calculated as the ratio of PA effective elastance (Ea) and right ventricular end-systolic elastance (Es).
Results: In patients with IPAH and CTEPH PA distensibility was significantly decreased and PA stiffness was significantly increased compared to healthy volunteers (p<0.05). The most pronounced changes were observed in subgroups with WHO functional class III-IV. Patients with IPAH and CTEPH had significantly decreased PA strain (6.1 [3.3; 7.4] and 6.5 [3.3; 8.0] %, respectively) compared to healthy volunteers (22.0 [21.0; 25.0] %) (p<0.05). PA strain closely correlated with right atrium area, TAPSE, FAC, right ventricular ejection fraction, RVAC, and other parameters of PA elastic properties. Patients with IPAH and CTEPH had significantly increased RVAC (1.62 [1.13; 2.75] and 1.69 [1.19; 2.00], respectively) compared to healthy volunteers (0.33 [0.28; 0.40]) (p<0.05). The highest RVAC values were observed in subgroups with WHO functional class III-IV.
Conclusions: Patients with IPAH and CTEPH had impaired PA elastic properties, increased PA Ea and RVAC with the most pronounced changes in subgroups with WHO functional class III-IV. We did not observe significant differences in PA elastic properties and RVAC between patients with IPAH and CTEPH.

P4336 | BEDSIDE
Assessment of regional mitral leaflet thickness using novel semi-automated three-dimensional echocardiography software in normal, fibro-elastic deficiency and in barlow disease valves

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Introduction: Degenerative mitral valve disease is mainly classified into Barlow disease (BD) and fibro-elastic deficiency (FED). Published anatomo-pathological studies reported macroscopic differences between BD and FED mitral valves, including different patterns of leaflet thickening. Yet a robust and comprehensive in vivo quantification of leaflet thickness in BD and FED is currently lacking.
Purpose: To identify potential differences in leaflet thickness among BD, FED and normal valves using 3D trans-esophageal echocardiography (3DTEE).
Methods: 3DTEE was performed on 30 subjects (10 normal, 10 FED and 10 BD). Datasets were semi-automatically processed through a novel and dedicated custom software. At mid-systole, the commissure-commissure axis was set and 10 cross-sections equally spaced over this axis were automatically defined. On each section, based on the manual tracing of annulus and free margin, the leaflets' mid-section (excluding the commissural areas), atrial surface and ventricular surface were identified automatically and in real time; tissue thickness was automatically measured as the local distance between the ventricular and the atrial surfaces at the annular, mid and free margin regions. Thickness distributions in the three groups of subjects were characterized through 25th and 75th percentiles, and compared through Kruskal-Wallis test.