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Mechanism behind pre- and postejection velocity spikes in normal left ventricular myocardium
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Background: The velocity trace of normal left ventricular (LV) wall motion has distinct waves corresponding to the different phases of the cardiac cycle. However, there are two unexplained velocity spikes in the trace - one just before and one just after the ejection wave. We hypothesize that the pre- and post-ejection velocity spikes are due to early-systolic shortening and late-systolic lengthening that is interrupted by mitral (MVC) and aortic valve closure (AVC), respectively.
Methods and results: LV long- and short-axis diameters were measured by sonomicrometry in 11 anesthetised dogs. Myocardial shortening started prior to MVC (21±10 ms). There was excellent agreement between MVC and interruption of the initial shortening during early systole (4±7 ms) where the interval was defined as peak deceleration of shortening. Onset of lengthening preceded AVC by (31±15 ms). Interruption of the late systolic lengthening, defined as peak deceleration of lengthening, corresponded to (0±3 ms) to AVC. We further investigated if abolishing aortic and mitral valve closure by stenting the valves would eliminate the pre- and post-ejection velocity spikes in separate experiments. Stenting of the mitral valve essentially abolished the pre-ejection velocity spike, and stenting the aortic valve essentially abolished the post-ejection velocity spike. In a group of 10 healthy individuals LV longitudinal and radial shortening were measured by speckle tracking echocardiography. Peak deceleration of the early systolic shortening coincided (2±14 ms) with MVC, while peak deceleration of late systolic shortening coincided (5±12 ms) with AVC.
Conclusion: This study supports the hypothesis that the normal LV pre- and post-ejection velocity spikes are attributed to mitral and aortic valve closure that temporarily interrupt early systolic shortening and late systolic lengthening, respectively.

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The effect of preload reduction by hemodialysis on conventional and novel parameters of left ventricular systolic and diastolic function
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Background: Prior studies of the effect of hemodialysis (HD) on left ventricular (LV) performance brought ambiguous results, in particular regarding the assessment of LV diastolic function.
Aim of the study: To investigate the effect of acute preload reduction induced by HD on conventional and novel parameters of LV systolic and diastolic function.
Methods: We studied 36 patients (mean age 59.5±15 years, 22 males) with chronic renal failure in sinus rhythm who underwent echocardiography 1 hour prior to and 1 hour following regular HD. The investigated parameters comprised LV ejection fraction (EF), LV fractional shortening (FS), transmitral (E) and A waves) peak flow velocities, color M-mode flow propagation velocity (FPV) and septal mitral annular tissue Doppler (TD) (systolic (Sm) and diastolic (Em, Am) velocities.
Results: The average amount of fluid removed during HD was 1.8±1.2 liters. Parameters of LV systolic function, EF (60±7% vs 62±7%) and Sm (8.5±1.4 cm/s vs 9.1±2.0 cm/s), significantly improved (both p<0.05), whereas FS did not change (0.36±0.07 vs 0.35±0.08, p=NS). As for LV diastolic function, E (81±26 cm/s vs 61±24 cm/s) and FPV (46.9±13.2 cm/s vs 40.2±13.2) significantly decreased (both p<0.05), whereas A significantly increased (77.7±5 cm/s vs 79±22 cm/s, p=0.05). However, Em (7.3±2.1 cm/s vs 6.8±1.7 cm/s) and Am (10.8±2.7 cm/s vs 11.4±2.8 cm/s) were not significantly affected (p=NS).
Conclusions: Fluid removal induced by HD increases global LV systolic function as assessed by EF. The improvement of LV longitudinal contraction documented by TD analysis seems to be responsible for this phenomenon. While standard pulsed Doppler parameters of LV diastolic function and FPV were significantly affected by preload reduction, TD indices Em and Am seem to be less load dependent. Therefore, TD analysis represents a promising method for the evaluation of LV diastolic function in this cohort of patients.

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Evaluation of global cardiac function in mouse and human with concentric left ventricular hypertrophy: the feasibility of myocardial performance index
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Background: Diastolic left ventricular (LV) function both in patients with concentric LV hypertrophy (LVH) and in aortic banded mice has been reported, but noninvasive evaluation of global cardiac function using myocardial performance index (MPI) in murine model has not been well described. The aim of this study was to assess global LV function using MPI and to determine the feasibility of MPI in both human and mice.
Methods: Forty hypertensive patients with concentric LVH on echocardiogram (Echo) and 20 healthy age- and sex-matched healthy controls were taken Echo. Fifteen ascending aortic banded male mice over 2 weeks and 10 age-matched sham-operated controls were studied using Echo with 15 MHz linear transducer including pulsed Doppler of mitral inflow and aortic outflow from the parasternal long axis view.
Results: The LV MPI both in human with concentric LVH and in aortic banded mice were significantly higher than controls. To test the diagnostic performance of MPI to detect concentric LVH, we performed ROC curve analysis. Cutoff value of LV MPI >0.44 in human had sensitivity 65% and specificity 95%, and cutoff value >0.49 in mice had sensitivity 100% and specificity 87.5%.
Conclusion: The MPI was a simple, noninvasive, and feasible Echo parameter to evaluate the global cardiac function both in patients with concentric LVH and in aortic banded mice.

Table 1. Concentric LVH and LV MPI

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Human control</th>
<th>Concentric LVH</th>
<th>Murine control mice</th>
<th>Aortic banded mice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mitral inflow E/A ratio</td>
<td>1.3±0.2</td>
<td>0.8±0.2*</td>
<td>1.3±0.3</td>
<td>0.4±0.02*</td>
</tr>
<tr>
<td>Fractional shortening (%)</td>
<td>37.7±3.8</td>
<td>40.4±4.3</td>
<td>34.2±0.9</td>
<td>36.8±6.5</td>
</tr>
<tr>
<td>LV MPI</td>
<td>0.38±0.06</td>
<td>0.47±0.09*</td>
<td>0.42±0.05</td>
<td>0.59±0.09*</td>
</tr>
</tbody>
</table>

* p<0.001 vs each control

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Non-ischemic fibrosis can be reliably detected by a typical „double peak sign” extracted from regional myocardial deformation curves
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Regional myocardial fibrosis can be non-invasively assessed by magnetic resonance imaging (MRI) using the late enhancement technique. This study investigated if regional non-ischemic fibrosis in hypertrophic myocardium is associated with a typical myocardial deformation pattern assessed by ultrasound strain rate imaging.
Methods: In 10 patients with hypertrophic cardiomyopathy, 10 patients with severe aortic stenosis and 10 patients with Fabry cardiomyopathy MRI with late enhancement imaging was done and the left ventricular segments with fibrosis were defined. In addition, strain rate imaging in all patients and also in 10 healthy controls was done and the strain rate curves were extracted for longitudinal and radial function.
Results: In all segments displaying late enhancement (LE) (n=41) a typical systolic strain rate pattern was detected: this pattern consisted of an early systolic peak followed by a rapid fall of strain rate near to the zero line and then again a second strain rate peak located during the isovolumic relaxation period (Figure). This „double peak sign” was never seen in the segments of the healthy control group. In addition, the „double peak sign” was also detected in 10 of 79 segments displaying no LE. Interestingly, all these segments belonged to Fabry patients who are known to develop further progression of fibrosis. For 6 of these 10 segments follow-up MRI data after 2.5±1 years were available. All of them displayed LE suggesting that the „double peak sign” might detect fibrosis earlier than MRI.
Conclusions: The „double peak sign” assessed by strain rate imaging seems to detect regional fibrosis.