Left Ventricular Mechanics in Patients with Advanced Diastolic Dysfunction and Normal LVEF

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Objective: We aimed to determine left ventricular mechanics in symptomatic patients with Doppler identified advanced diastolic dysfunction (ADD) and normal LV ejection fraction.

Methods: The study group included 33 consecutive patients admitted for dyspnea with normal LVEF and ADD. A pseudo-normal pattern (mitral E/S 0.8-1.9, E deceleration time (EDt) 140-280ms) was found in 14 patients, and 19 had a restrictive pattern (E/A>2, EDt <140ms). All patients had evidence of high atrial pressure (E/E'¡14,, or pulmonary S/D<1.0). These were compared to 16 age matched normal controls. Longitudinal and circumferential strain, strain rate (SR), rotation and twist (peak instantaneous apex to base angle difference) were measured. Systolic independent diastolic SR was assessed by dividing peak early diastolic SR (SR-E) by peak systolic strain rate (SR E/S ratio). To assess early relaxation, fractional early apical reverse rotation and untwist (FEARR, FEUT, respectively) were measured using: $$FEARR, FEUT = \frac{\theta_{peak} - \theta_{t(peak)+10\%CL}}{\theta_{peak}}$$; CL denotes cycle length

	Normals (n=16)	Pseudo Normal (n=14)	Restrictive (n=19)
Ejection Fraction (%)	70±6	67±6	66±4
LV Mass (gr)	132±22	271±93*	222±61*
LA diameter (cm)	3.7±0.4	4.5±0.3*	4.7±0.4
Mitral E/A	0.9±0.3	1.3±0.3	2.8±0.6*†
E Deceleration time (ms)	247±56	196±41	157±21*†
Mitral E/Septal E' ratio	10±2	18±5*	19±4*
Longitudinal strain (%)	-20±2	-15±3*	-16±2*
Systolic SR (%/s)	-1.0±0.1	-0.9±0.2	-0.9±0.1
Early diastolic SR (%/s)	1.0±0.1	0.6±0.1*	0.6±0.1*
Longitudinal SR E/S	1.0±0.2	0.7±0.2*	0.7±0.2*
Circumferential strain (%)	-29±4	-29±4	-29±4
Systolic SR (%/s)	-1.8±0.4	-1.5±0.3*	-1.6±0.3*
Early diastolic SR (%/s)	1.6±0.3	1.2±0.3	1.4±0.4
Circumferential SR E/S	0.9±0.3	0.7±0.3*	0.7±0.4*
Rotation – base (÷)	-2.8±2.1	-2.2±2.9	-4.4±2.7*
Rotation – apex (÷)	+7.8±4.2	+9.1±4.2	+9.9±4.6*
Twist (÷)	+9.6±4.7	+13±4*	+13±5*
FEARR	41%±10	21%±8*	20%±9*
FEUT	40±10	29±12*	24±12*

* p<0.05 compared to normal, †: P<0.05 compared to pseudonormal

Conclusions: Patients with symptomatic ADD with normal LVEF do not have normal systolic mechanics. They demonstrated low peak longitudinal strain, low peak circumferential systolic SR and increased rotation and twist. Diastolic mechanics were also abnormal showing low early diastolic SR and low SR E/S ratio. Early diastolic rotational recoil was slower with ADD manifesting low FEARR and FEUT. These results challenge the convention that ADD patients with normal LVEF have normal systolic function. Myocardial mechanics may help understand the pathophysiology of ADD, and FEARR could assist confirming the presence of ADD in challenging cases.