

LV diastolic dysfunction: Echo findings

Definition: Heart failure with preserved ejection fraction (HFpEF) is a clinical syndrome in which patients have symptoms and signs of HF with normal or near normal left ventricular EF (LVEF >50 percent). Most patients also display evidence of diastolic dysfunction (eg, abnormal pattern of LV filling and elevated filling pressures)

Doppler echocardiographic criteria for classification of diastolic function

	Normal diastolic function	Mild diastolic dysfunction	Moderate diastolic dysfunction*	Severe diastolic dysfunction	
		Impaired relaxation	Pseudonormal	Reversible restrictive	Fixed restrictive
Mitral inflow	$0.75 < E/A < 1.5$ DT > 140 ms	$E/A \leq 0.75$	$0.75 < E/A < 1.5$ DT > 140 ms	$E/A > 1.5$ DT < 140 ms	$E/A > 1.5$ DT < 140 ms
Mitral inflow at peak Valsalva Maneuver	$\Delta E/A < 0.5$	$\Delta E/A < 0.5$	$\Delta E/A \geq 0.5$	$\Delta E/A \geq 0.5$	$\Delta E/A < 0.5$
Doppler tissue imaging of mitral annular motion	$E/e' < 10$	$E/e' < 10$	$E/e' \geq 10$	$E/e' \geq 10$	$E/e' \geq 10$
Pulmonary venous flow	$S \geq D$ ARdur < Adur	$S > D$ ARdur < Adur	$S < D$ or ARdur > Adur + 30 ms	$S < D$ or ARdur > Adur + 30 ms	$S < D$ or ARdur > Adur + 30 ms
Left ventricular relaxation	Normal	Impaired	Impaired	Impaired	Impaired
Left ventricular compliance	Normal	Normal to ↓	↓↓	↓↓↓	↓↓↓↓
Atrial pressure	Normal	Normal	↑↑	↑↑↑	↑↑↑↑

Participants with atrial fibrillation with DT > 140 ms, other arrhythmia, fusion of E and A, or in whom diastolic parameters were not obtained, who had only one criterion suggesting moderate or severe diastolic dysfunction, or in whom diastolic parameters were borderline and suggestive of but not diagnostic of abnormality were classified as having indeterminate diastolic function.

Grade I (mild) diastolic dysfunction is characterized by the impaired relaxation pattern.

Grade II (moderate) diastolic dysfunction is characterized by a pseudonormal pattern.

Grades III and IV (severe) diastolic dysfunction is characterized by a (irreversible and fixed) restrictive pattern.

E: peak early filling velocity; A: velocity at atrial contraction; DT: deceleration time; Adur: A duration; ARdur: AR duration; S: systolic forward flow; D: diastolic forward flow; AR: pulmonary venous atrial reversal flow; e': velocity of mitral annulus early diastolic motion; a': velocity of mitral annulus motion with atrial systole; DT: mitral E velocity deceleration time.

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Differential diagnosis of heart failure with preserved ejection fraction

Heart failure with preserved ejection fraction (HFpEF)
HFpEF (contributing factors include hypertension, aging, coronary heart disease, diabetes mellitus, sleep-disordered breathing, chronic kidney disease, and obesity)
Cardiomyopathies with preserved ejection fraction
Restrictive cardiomyopathy
<ul style="list-style-type: none"> ▪ Familial causes include sarcomeric gene mutations, familial amyloidosis (TTR or apolipoprotein mutation), unknown gene mutation, familial causes of iron overload (hereditary hemochromatosis, hereditary anemias), Fabry disease, glycogen storage disease, desminopathy, and pseudoxanthoma elasticum ▪ Non-familial causes include amyloid (AL or wild-type TTR), systemic sclerosis, endomyocardial fibrosis (idiopathic, caused by hypereosinophilic syndrome, or drugs), carcinoid heart disease, metastatic cancer, radiation, non-familial iron overload (eg, acquired iron-loading anemia, high-dietary intake) and drug toxicity (anthracycline)
Hypertrophic cardiomyopathy
<ul style="list-style-type: none"> ▪ Familial causes in addition to sarcomere gene mutations include unknown mutations, glycogen storage disease, lysosomal storage disease (including Fabry disease), syndromic hypertrophic cardiomyopathy (eg, Noonan's syndrome, LEOPARD syndrome, Friedrich's ataxia), and familial amyloidosis (TTR or apolipoprotein mutation) ▪ Non-familial causes include non-familial amyloidosis (AL or wild-type TTR)
Noncompaction cardiomyopathy
Valvular heart disease
Valvular stenosis
Valvular regurgitation
Right heart failure
Pulmonary hypertension
Right ventricular infarction
Arrhythmogenic right ventricular cardiomyopathy
Pericardial disease
Cardiac tamponade
Constrictive pericarditis
Effusive-constrictive pericardial disease
Obstructive lesion in heart or great vessel
Atrial myxoma
Pulmonary vein stenosis
High-output heart failure
Transient left ventricular systolic dysfunction

Adapted from: Oh JK, Hatle L, Tajik AJ, Little WC. Diastolic heart failure can be diagnosed by comprehensive two-dimensional and Doppler echocardiography. *J Am Coll Cardiol* 2006; 47:500.