

### Basics of Diastolic Dysfunction

Causes		
	Aging	Dil. CMP
	Left ventricular hypertrophy	Restr. CMP
	CAD	Hypertr. CMP

**NOTE:** Every patient with systolic dysfunction also has diastolic dysfunction!

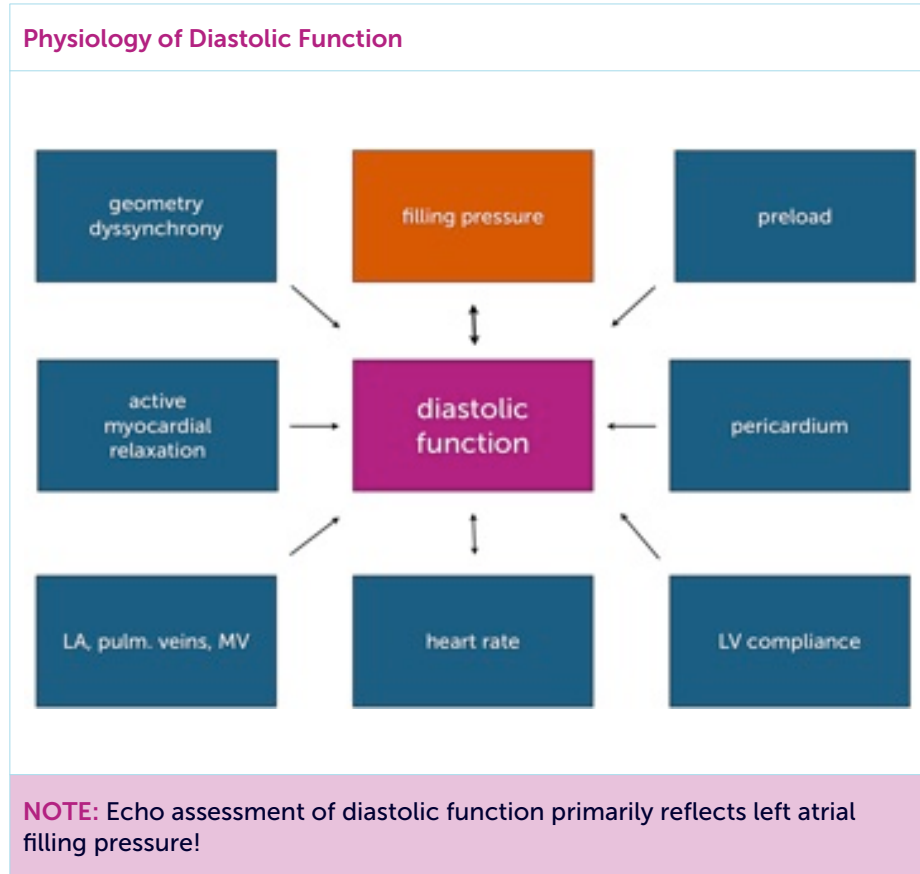
**NOTE:** Patients with diastolic dysfunction usually have a dilated left atrium

**NOTE:** Diastolic dysfunction is common and is associated with a worse prognosis

Diastole Components	
	IVRT — isovolumetric relaxation (AV closure to MV opening)
	Rapid early (passive) LV filling
	Diastasis
	Late LV filling — atrial contraction

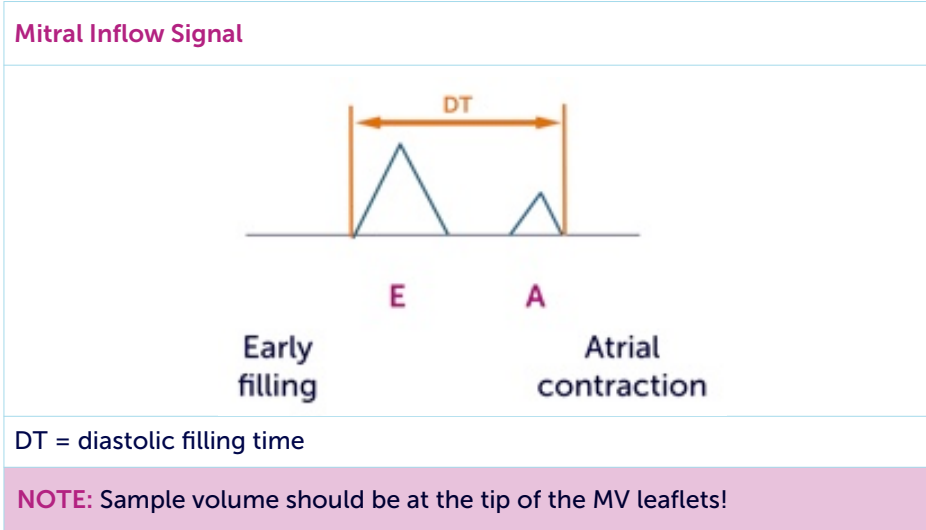
**NOTE:** Aortic valve closure can be assessed with PW Doppler in the LVOT (end of signal)!

Timing of Diastole	
	<p><b>NOTE:</b> Fusion of E and A wave can occur with tachycardia! Duration of diastasis decreases with heart rate and PQ duration!</p>



**Active Relaxation (Early Diastole)**

	Internal loading conditions	Contractility
	Wall stress	Atrial impedance



**Mitral Inflow – Reference Values**

	16- 20 years	21- 40 years	41- 60 years	> 60 years
IVRT (ms)	50 ± 9	67 ± 8	74 ± 7	87 ± 7
DT (ms)	142 ± 19	166 ± 14	181 ± 19	200 ± 29
A duration	113 ± 17	127 ± 13	133 ± 13	138 ± 19
E/A	1.88 ± 0.45	1.53 ± 0.4	1.28 ± 0.25	0.96 ± 0.18

**NOTE:** There are situations where the parameters of diastolic function are inconsistent and difficult to interpret.

**TDI Mitral Annulus – Reference Values**

	16- 20 years	21- 40 years	41- 60 years	> 60 years
Septal e' (cm/s)	14.9 ± 2.4	15.5 ± 2.7	12.2 ± 2.3	10.4 ± 2.1
Septal e'/a'	2.4	1.6 ± 0.5	1.1 ± 0.3	0.85 ± 0.2
Lateral e' (cm/s)	20.6 ± 3.8	19.8 ± 2.9	16.1 ± 2.3	12.9 ± 3.5
Lateral e'/a'	3.1	1.9 ± 0.6	1.5 ± 0.5	0.9 ± 0.4

Situations where TDI at the mitral annulus should not be used	
Annular calcification	Mitral valve prosthesis
Mitral stenosis	Moderate to severe mitral regurgitation

**Pulmonary Venous Flow**

The diagram shows a typical PV flow waveform. It starts with a negative deflection (AR), followed by a positive systolic component with two peaks (S1 and S2). The interval between the end of S2 and the start of the diastolic component (D) is labeled IVRT. The diastolic component (D) is a positive flow. Following D is a negative deflection (AR). The horizontal axis represents time.

Peak systolic PV flow vel. (S)
Peak diastolic PV flow vel. (D)
Peak reverse atrial flow vel. (AR)
AR duration

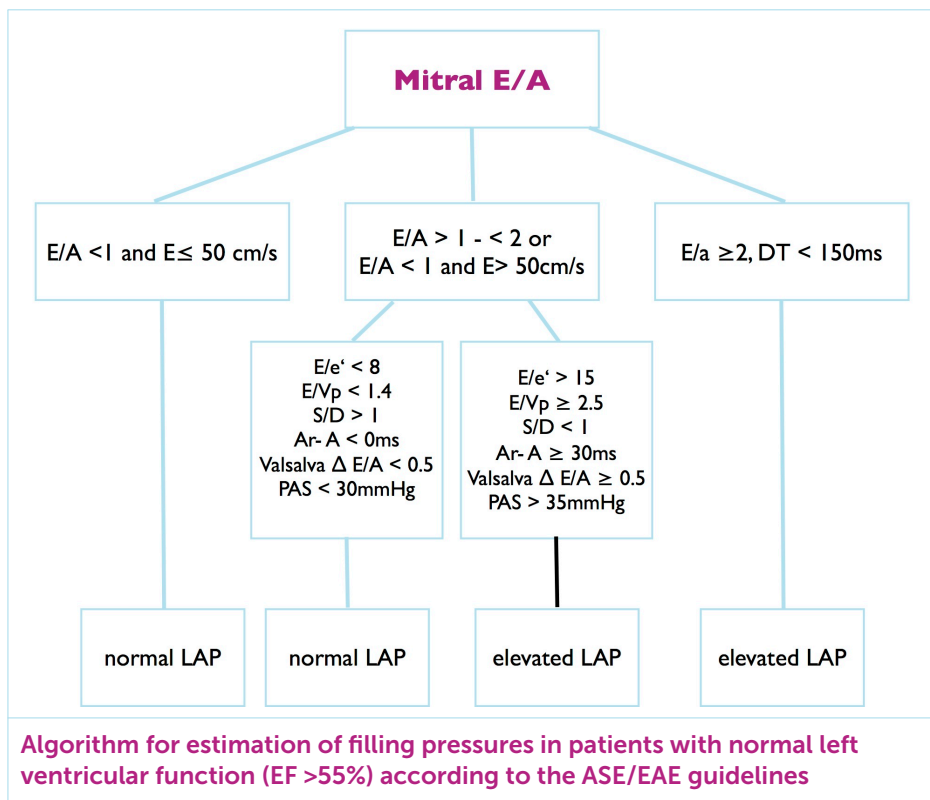
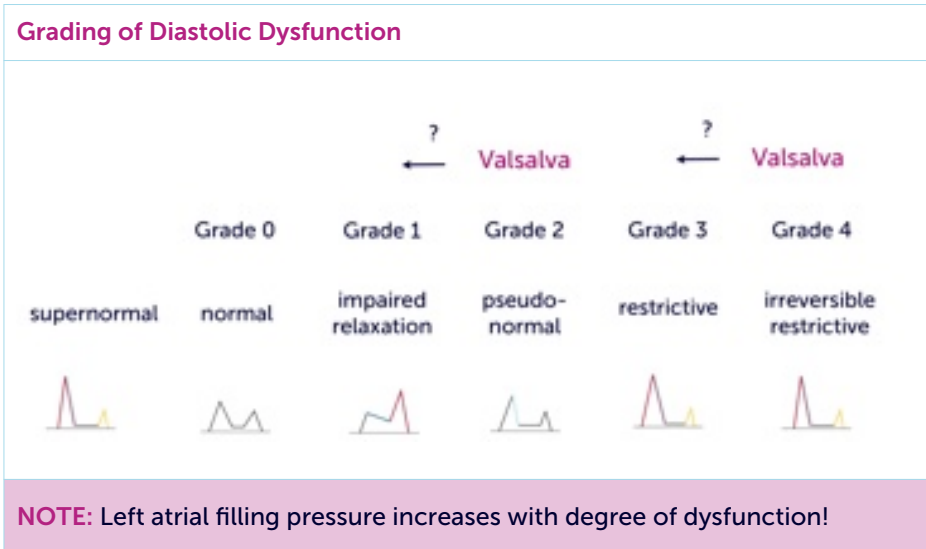
**Signs of impaired diastolic function:** decrease in systolic component, increase in peak AR, increase in AR duration

**NOTE:** Use right upper PV to record the PW signal! Remember to reduce PRF!

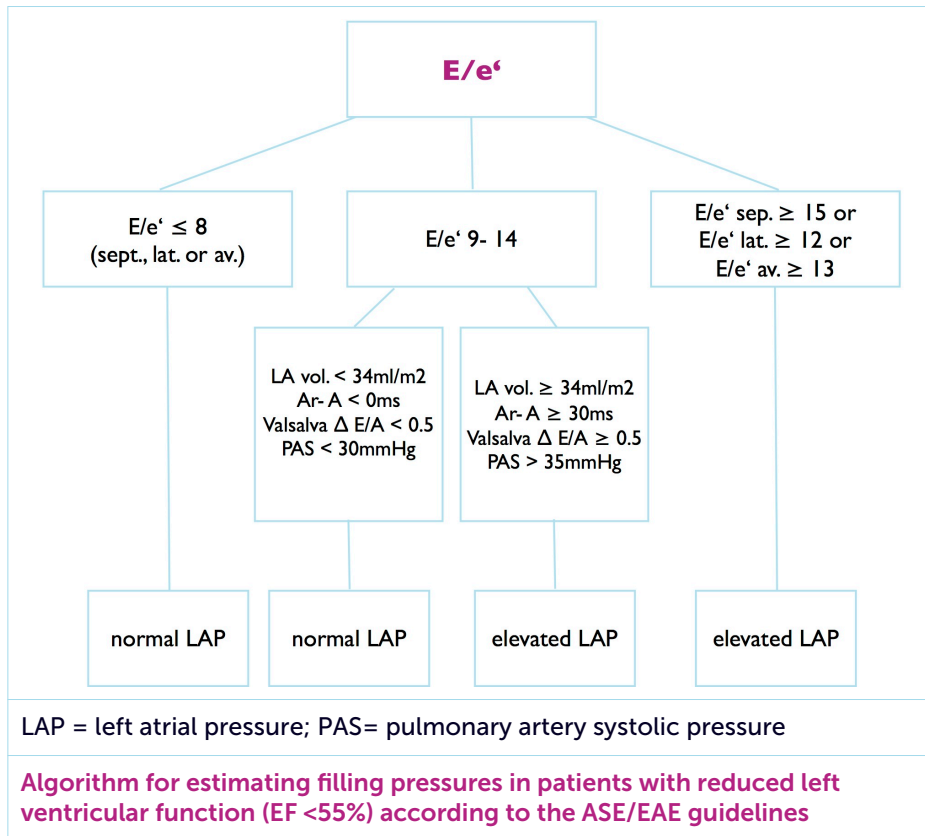
**Pulmonic Veins – Reference Values**

	16- 20 years	21- 40 years	41- 60 years	> 60 years
S/D	0.82 ± 0.18	0.98 ± 0.32	1.21 ± 0.2	1.39 ± 0.47
AR (cm/s)	16 ± 10	21 ± 8	23 ± 3	25 ± 9
AR duration (ms)	66 ± 39	96 ± 33	112 ± 15	113 ± 30

**NOTE:** Pulmonary vein flow, has many limitations and is rarely used in clinical practice



## 004 // Diastolic Function



### A Simple Approach to Diastolic Function/Rules

**Supernormal diastolic function:** If echo is normal and patient is young

**Normal diastolic function:** If echo is normal, pat < 45a and E>A

**Impaired relaxation:** If A is higher than E (E/A ratio is < 1), filling pressure is normal or mildly elevated

**Pseudonormal diastolic function:** If echo is abnormal (LVH, red LVF, etc) or pat > 65a and E is higher than A (E/A ration > 1)

**DD Normal vs Pseudonormal:** C Look at deceleration time, LA enlargement and, E/e' (≥ 8-12)


**Restrictive filling:** If E is twice A (E/A ratio is >2), filling pressure elevated


**Perform TDI:** If E/e' is > 12-15 then filling pressure is elevated (PCWP > 12mmHg)


**Perform Valsalva:** Unloading of the atrium, LA pressure (LAP) drops, unmasking of pseudonormal filling (discrimination between irreversible restrictive vs. reversible restrictive)

## 004 // Diastolic Function

### Specific Situations

Variations in E/A Ratio		
Changes of LV filling pressure with respiration?	COPD patients	
High normal filling pressures ( $E/E' = 8 - 9$ )		
E/A Fusion		
Tachycardia	Long systole (LBBB)	
Long AV delay	Carotid artery maneuver	

L- Wave		
	Mid-diastolic filling of the LV	Elevated LVFP?
	Bradycardia	Common in afib
	Common in LVH	
	<b>NOTE:</b> The presence of an L-Wave indicates elevated filling pressure!	

Atrial Fibrillation/Flutter and Heart failure		
Often associated with diastolic dysfunction	Pulm. venous flow difficult to assess	
No A wave	$E/e'$ increases with severity of HF	
$E/e'$ declines with improvement of HF		

LVFP in Mitral Valve Disease		
<b>NOTE:</b> Diastolic dysfunction/LV filling pressure should not be assessed in the setting of MR > grade II	LA size does not necessarily reflect elevated LAFP	LA size can also be enlarged due to volume overload + afib
	E wave velocity also reflects increased stroke volume	$E'$ is reduced in MS and elevated in MR (stroke volume)
<b>NOTE:</b> Estimates filling pressure to determine the severity of disease and how the LV can cope with the problem (i.e. AS,AR; CMP)		