

A Guideline Protocol for the Echocardiographic assessment of Diastolic Dysfunction

Echocardiography plays a central role in the non-invasive evaluation of diastole and should be interpreted in the clinical context. Multiple echocardiographic measurements have been proposed to assess diastolic function but no single parameter should be used in isolation. This document gives recommendations for the image and analysis dataset required for the assessment of diastolic dysfunction (DD) using established indices acquired as part of the minimum dataset. Due to the variable sensitivity and specificity of the available parameters in different clinical settings, contradictory data can occur and in a proportion of patients a final diagnosis may not be achieved. In these situations the conventional echo data should be supplemented with information from other forms of assessment including haemodynamic measurement.

In this document, the parameters assessed are first set out systematically, with the key measurements highlighted in bold. For ease of reference they are also listed below. A simplified flow chart follows to assist in diastolic dysfunction grading. Appendix 1 summarises normal values. Appendix 2 provides recommendations on assessing diastolic function in specific clinical situations.

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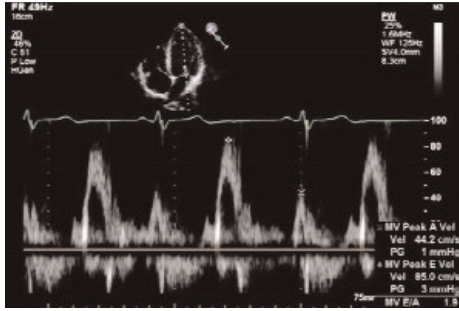
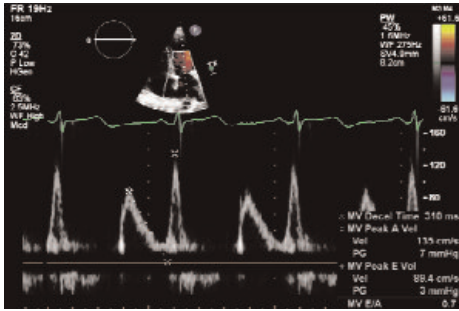
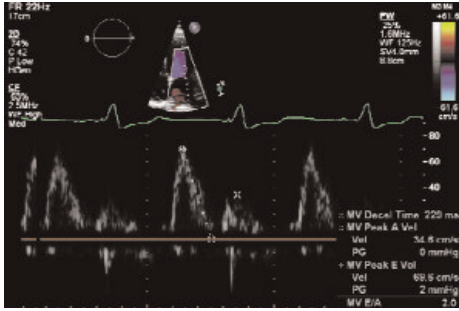
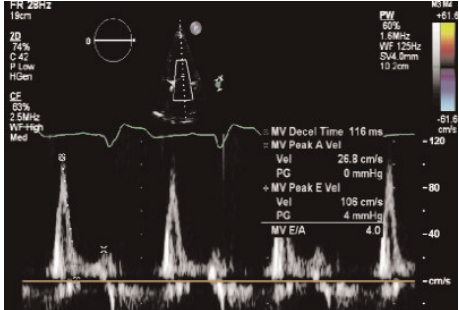
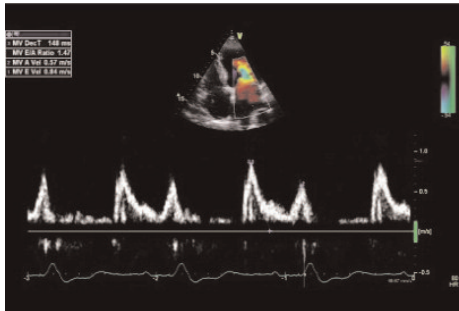
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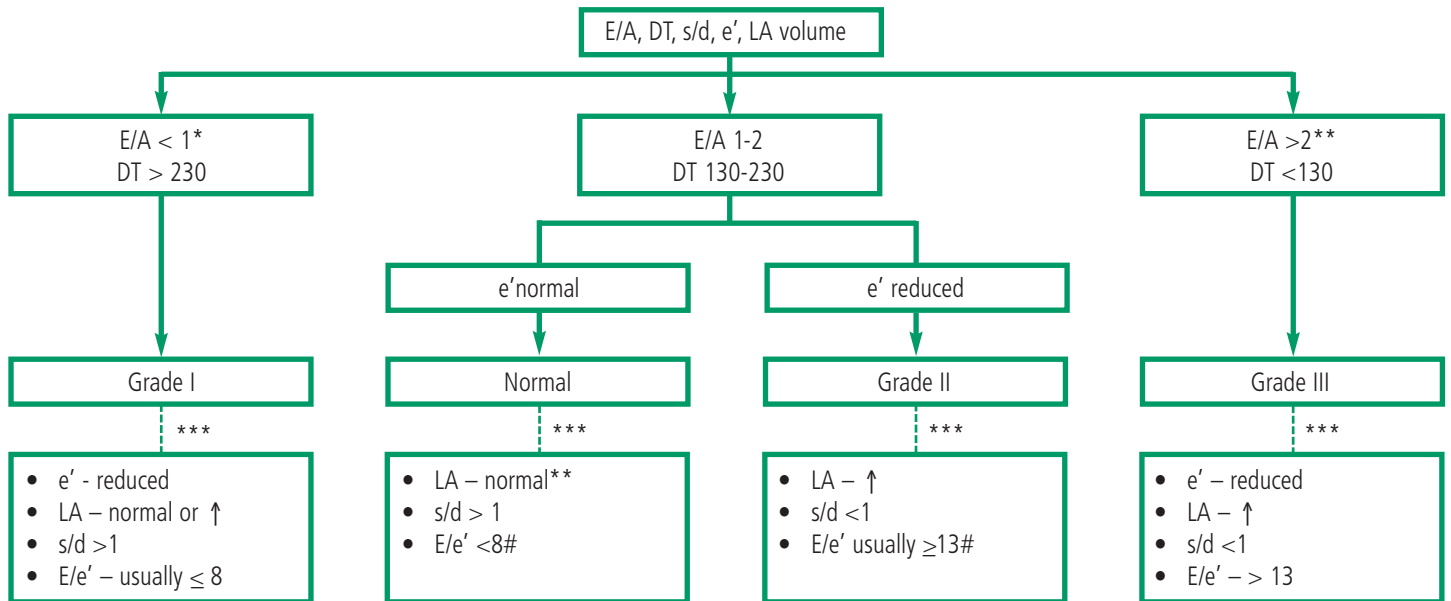
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Abbreviations:

E Vmax	Mitral valve early filling on PW Doppler (m/s)
A Vmax	Mitral valve atrial filling (m/s)
A dur	Duration of atrial filling wave on PW Doppler (ms)
E/A ratio	Ratio of E Vmax/A Vmax
DT	Deceleration time (ms)
PV s	Pulmonary vein systolic wave peak velocity (m/s)
PV d	Pulmonary vein diastolic wave peak velocity (m/s)
PV s/d	Ratio of pulmonary vein peak systolic velocity/peak diastolic velocity
PV a dur	Duration of atrial reversal from PW Doppler of pulmonary vein flow (ms)
LAi	Left atrial volume indexed to body surface area (mls/m ²)
e'	Velocity of early myocardial relaxation measured on tissue Doppler imaging (cm/s)
E/e'	Ratio of MV E Vmax/ tissue Doppler early myocardial relaxation velocity
Mitral Vp:	Propagation velocity of early filling wave into the LV (cm/s)

NOTE: key parameters are highlighted in bold. The remaining parameters are useful adjuncts when the diagnosis of diastolic dysfunction severity remains unclear

VIEW	Modality	Measurements	Explanatory note for ARVC	Image
A 4C	PW Doppler	E Vmax, A Vmax, E/A ratio DT A dur	<p>Sample volume is placed at the level of mitral leaflets tips (colour flow can be helpful for optimal alignment, particularly when LV is dilated)</p> <p>Optimise spectral gain/wall filters to ensure clear crisp signal of onset and cessation of LV inflow</p> <p>Measurements are obtained over 3 cardiac cycles at end expiration</p> <p><i>See appendix 1 for normal values</i></p>	 <p>Normal</p>  <p>Grade 1</p>  <p>Grade 2</p>  <p>Grade 3</p>  <p>Grade 2 before valsalva</p>
	PW Doppler with Valsalva	Change in Mitral E/A ratio from baseline	<p>Decrease in 20cm/s in E wave velocity generally indicates a good Valsalva technique</p> <p>Decrease in mitral E/A ratio of $\geq 50\%$ is highly specific of raised LV filling pressure.</p> <p><i>Useful when differentiating grade 2 from normal.</i></p>	



Flow chart

*E/A < 1 without any additional evidence of diastolic dysfunction can be normal above 60 years of age.
 **E/A >2 and/or increased LA size without structural heart disease can be seen in young subjects and athletes.
 ***Combined with one or more parameters from below. Confidence of categorisation increases with increasing number of corroborative parameters.
 # If E/e' is between 9 and 12, additional measurements should be used (see text).

Figure 1: Practical approach to assessment and grading of Diastolic Dysfunction

Appendix 1

Measurement	16-20 years	21-40 years	41-60 years	>60
Mitral E/A ratio	1.88 ± 0.45 (0.98-2.78)	1.53 ± 0.40 (0.73-2.33)	1.28 ± 0.25 (0.78-1.78)	0.96 ± 0.18 (0.6-1.32)
Mitral DT (ms)	142 ± 19 (104-180)	166 ± 14 (138-194)	181 ± 19 (143-219)	200 ± 29 (142-258)
PV S/D ratio	0.82 ± 0.18 (0.46-1.18)	0.98 ± 0.32 (0.34-1.62)	1.21 ± 0.2 (0.81-1.61)	1.39 ± 0.47 (0.45-2.33)
Septal e' (cm/s)	14.9 ± 2.4 (10.1-19.7)	15.5 ± 2.7 (10.1-20.9)	12.2 ± 2.3 (7.6-16.8)	10.4 ± 2.1 (6.2-14.6)
Lateral e'(cm/s)	20.6 ± 3.8 (13-28.2)	19.8 ± 2.9 (14-25.6)	16.1 ± 2.3 (11.5-20.7)	12.9 ± 3.5 (5.9-19.9)

Table 1. Normal values for age related Doppler derived diastolic measurements. Data are expressed as Mean ± SD (95% confidence interval) except those marked with asterisk. Adapted from reference 1.

Appendix 2

In certain clinical situations, conventional echo indices cannot be readily applied to assess diastolic dysfunction. The following section provides recommendations on assessing diastolic function in this group of patients. In these patients, grading of DD is not always possible and the aim is to estimate the filling pressures as a marker of diastolic dysfunction.

- Left ventricular hypertrophy: In patients with heart failure symptoms and normal EF, evidence of concentric remodelling or raised LV mass index is itself indicative of diastolic dysfunction. In this group of patients, assessment of other markers of diastolic dysfunction does not provide additional diagnostic information
- Sinus tachycardia: E A fusion occurs rendering E/A ratio and deceleration time unreliable in assessing DD. E/e' ratio using fused peak mitral inflow velocity and peak fused mitral annular velocity can still be used to predict LV filling pressures in this situation.

- c. Atrial Fibrillation: Loss of atrial contraction, variable cycle length and the frequent occurrence of atrial dilatation limit the usefulness of conventional indices in the assessment of DD. DT and E/e' ratio averaged over 5-10 cardiac cycles (recorded from cycle lengths equivalent to a heart rate between 60-80 beats/minute) can be used to assess LV filling pressures in this group.
- d. Constrictive pericarditis: Constrictive pericarditis can present with heart failure symptoms and restrictive filling pattern (Grade III) in the absence of diastolic dysfunction. Normal or increased e' velocity can differentiate this condition from DD.
- e. Mitral valve disease: Mitral E Vmax and PVs are affected by significant primary MR. a dur- A dur is the strongest predictor of LV filling pressure in this situation.
- f. Systolic dysfunction: Grading of DD and estimation of filling pressures provide additional prognostic information in patients with established systolic dysfunction. Mitral inflow pattern (E/A ratio and DT) alone can be used to estimate filling pressure in this population and no further evaluation is necessary except in borderline cases. Accordingly E/A ratio < 1 in this population often indicates normal filling pressures and E/A ratio of 1-2 or > 2 strongly suggest raised pressures.

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