ASE 2016 Diastolic Function Guidelines: Relax!

Gerard P. Aurigemma MD
No Relevant Disclosures
Usual reactions to discussions of diastolic dysfunction

2016 Diastology Guidelines Update

Objectives

• 2009 ASE/EACVI guidelines were too complex to grade DF and estimate LV filling pressures

• Based on too many parameters and a lot of discrepancies

• Primary goal of 2016 update is to simplify
  • increase feasibility of use of the guidelines in clinical practice

*Slide courtesy Dr. Alan Klein*
TR velocity, LA size

1. Average E/e' > 14
2. Septal e' velocity < 7 cm/s or Lateral e' velocity < 10 cm/s
3. TR velocity > 2.8 m/s
4. LA volume index > 34 ml/m²

- <50% positive
  - Normal Diastolic function
- 50% positive
  - Indeterminate
- >50% positive
  - Diastolic Dysfunction
We must have the 4 major diastole parameters!

Oh et al JASE 1997

- Mean LA pressure not elevated
- Prevalent in aging
- Relaxed abnormal
- Compliance abnormal
- Filling pressures elevated
Transmitral gradient determines E wave.

Relaxation abnormal
Compliance abnormal
Filling pressures elevated

Oh et al JASE 1997

Animation from Steve Lester, Mayo Clinic
Animation from Steve Lester, Mayo Clinic
Table 4  LV relaxation, filling pressures and 2D and Doppler findings according to LV diastolic function

<table>
<thead>
<tr>
<th></th>
<th>Normal</th>
<th>Grade I</th>
<th>Grade II</th>
<th>Grade III</th>
</tr>
</thead>
<tbody>
<tr>
<td>LV relaxation</td>
<td>Normal</td>
<td>Impaired</td>
<td>Impaired</td>
<td>Impaired</td>
</tr>
<tr>
<td>LAP</td>
<td>Normal</td>
<td>Low or normal</td>
<td>Elevated</td>
<td>Elevated</td>
</tr>
<tr>
<td>Mitral E/A ratio</td>
<td>≥0.8</td>
<td>≤0.8</td>
<td>&gt;0.8 to &lt;2</td>
<td>&gt;2</td>
</tr>
<tr>
<td>Average E/e’ ratio</td>
<td>&lt;10</td>
<td>&lt;10</td>
<td>10–14</td>
<td>&gt;14</td>
</tr>
<tr>
<td>Peak TR velocity (m/sec)</td>
<td>&lt;2.8</td>
<td>&lt;2.8</td>
<td>&gt;2.8</td>
<td>&gt;2.8</td>
</tr>
<tr>
<td>LA volume index</td>
<td>Normal</td>
<td>Normal or increased</td>
<td>Increased</td>
<td>Increased</td>
</tr>
</tbody>
</table>

In patients without heart disease

Nagueh JASE 2016
46 year old woman palpitations
What are the filling pressures?

1. Normal
2. High
3. Low

Nagueh JASE 2016
SM
66 year old
Retired police officer
poorly controlled hypertension
Feels just fine, thanks
LAVi 35 cc/M2
No TR jet

E/A 0.5 + E 49 cm/s
LAVi 35 ml/M2
TR not present

Nagueh JASE 2016
What are the filling pressures?

1. Normal
2. High
3. Low
4. What do you mean by “filling pressures?” (i.e. none of the above)

LV Filling Pressures
The Different LA and LV

![Diagram showing LV Filling Pressures]

Courtesy: Chris Appleton, Mayo Clinic
The atrial kick: an example of intelligent design

CONTROVERSIES IN CARDIOVASCULAR MEDICINE

Is echocardiographic evaluation of diastolic function useful in determining clinical care?

Echocardiographic Evaluation of Diastolic Function Can Be Used to Guide Clinical Care

William C. Little, MD; Jae K. Oh, MD

In most patients with impaired relaxation pattern, the mean LA pressure is not elevated despite an increased LV end-diastolic pressure that is maintained by a vigorous atrial contraction.
52 year old man
*history of CAD admitted with HF*
Grade II DD
↑LAP
E/A <0.8+E> 50cm/s
OR
0.8<E/A < 2

1. Average E/e’>14
2. TR > 2.8 m/s
3. LAV>34 ml/m2

0 or 1 pos

Grade I DD
Normal LAP

1. Average E/e’>14
2. TR > 2.8 m/s
3. LAVI>34 ml/m2

0/1 pos

Only 2 of above parameters available

1/1 pos

Indeterminate DD Grade and LAP

Grade II DD
↑LAP

0.8<E/A < 2

2 or 3 pos

E/e’ 15
LAVI 33 ml/M2
TR 3.2 M/s

Based on 2016 ASE Diastolic Function Guidelines

Created by Michael Salerno MD,PhD

Grade II DD
↑LAP

E/A <0.8+E> 50cm/s
OR
0.8<E/A < 2

1. Average E/e’>14
2. TR > 2.8 m/s
3. LAV>34 ml/m2

0 or 1 pos

Grade I DD
Normal LAP

1. Average E/e’>14
2. TR > 2.8 m/s
3. LAVI>34 ml/m2

0/1 pos

Only 2 of above parameters available

1/1 pos

Indeterminate DD Grade and LAP

Grade II DD
↑LAP

0.8<E/A < 2

2 or 3 pos

E/e’ 15
LAVI 33 ml/M2
TR 3.2 M/s

Based on 2016 ASE Diastolic Function Guidelines

Created by Michael Salerno MD,PhD
E/e' 15
LAVi 33 ml/M2
TR 3.2 m/s

Grade II DD
↑LAP

E/A < 0.8 + E > 50 cm/s
OR
0.8 < E/A < 2

1. Average E/e'>14
2. TR > 2.8 m/s
3. LAVi>34 ml/m2

Only 2 of above parameters available

Grade I DD
Normal LAP

0 or 1 pos

2 or 3 pos

0/1 pos

1/1 pos

Indeterminate DD Grade and LAP

Based on 2016 ASE Diastolic Function Guidelines

Created by Michael Salerno MD, PhD
Diastolic Function in “Special” Populations
Table 6: Assessment of LV filling pressures in special populations

<table>
<thead>
<tr>
<th>Disease</th>
<th>Echocardiographic measurements and cutoff values</th>
</tr>
</thead>
<tbody>
<tr>
<td>AF[10,11]</td>
<td>Peak acceleration rate of mitral E velocity (&gt;=1,900 cm/sec²)</td>
</tr>
<tr>
<td></td>
<td>IVRT (&gt;=80 msc)</td>
</tr>
<tr>
<td></td>
<td>DT of pulmonary venous diastolic velocity (&gt;=220 msc)</td>
</tr>
<tr>
<td></td>
<td>E/EP ratio (&gt;=1.4)</td>
</tr>
<tr>
<td></td>
<td>Septal E/A ratio (&gt;=11)</td>
</tr>
<tr>
<td>Sinus tachycardia[11,44]</td>
<td>Mitral inflow pattern with predominant early LV filling in patients with EFs &lt;50%</td>
</tr>
<tr>
<td></td>
<td>IVRT (&gt;=70 msc) is specific (79%)</td>
</tr>
<tr>
<td></td>
<td>Pulmonary vein systolic filling fraction (0.8) is specific (88%)</td>
</tr>
<tr>
<td></td>
<td>Average E/e' &gt;14 (this cutoff has highest specificity but low sensitivity)</td>
</tr>
<tr>
<td></td>
<td>When E and A velocities are partially or completely fused, the presence of a compensatory period after premature beats often leads to separation of E and A velocities which can be used for assessment of diastolic function</td>
</tr>
<tr>
<td>HCM[10,108]</td>
<td>Average E/e' (&gt;14)</td>
</tr>
<tr>
<td></td>
<td>Ar-A (&gt;=30 msc)</td>
</tr>
<tr>
<td></td>
<td>TR peak velocity (&lt;2.8 m/sec)</td>
</tr>
<tr>
<td></td>
<td>LA volume (&lt;34 mL/m²)</td>
</tr>
<tr>
<td>Restrictive cardiomyopathy[19,107,108]</td>
<td>DT (&lt;=140 msec)</td>
</tr>
<tr>
<td></td>
<td>Mitral E/A (&gt;2.5)</td>
</tr>
<tr>
<td></td>
<td>IVRT (&gt;=60 msec has high specificity)</td>
</tr>
<tr>
<td></td>
<td>Average E/e' (&gt;14)</td>
</tr>
<tr>
<td>Noncardiac pulmonary hypertension[12]</td>
<td>Lateral E/e' can be applied to determine whether a cardiac etiology is the underlying reason for the increased pulmonary arterial pressures</td>
</tr>
<tr>
<td></td>
<td>When cardiac etiology is present, lateral E/e' is &gt;13, whereas in patients with pulmonary hypertension due to a noncardiac etiology, lateral E/e' is &lt;8</td>
</tr>
<tr>
<td>Mitral stenosis[110]</td>
<td>IVRT (&gt;=60 msec has high specificity)</td>
</tr>
<tr>
<td></td>
<td>IVRT/Trv (&lt;=4.2)</td>
</tr>
<tr>
<td></td>
<td>Mitral A velocity (&gt;1.5 m/sec)</td>
</tr>
<tr>
<td>MS[110,112]</td>
<td>Ar-A (&gt;=30 msc)</td>
</tr>
<tr>
<td></td>
<td>IVRT (&gt;=60 msec has high specificity)</td>
</tr>
<tr>
<td></td>
<td>IVRT/Trv (&lt;=5.8)</td>
</tr>
<tr>
<td></td>
<td>Average E/e' (&gt;14) may be applied for the prediction of LV filling pressures in patients with MR and normal EFs</td>
</tr>
</tbody>
</table>

A comprehensive approach is recommended in all of the above settings, which includes estimation of PASP using peak velocity of TR (at >2.8 m/sec) and LA maximum volume index (>34 mL/m²). Conclusions should not be based on single measurements. Specificity comments refer to predicting filling pressures >15 mm Hg. Note that the role of LA maximum volume index to draw inferences on LAP is limited in athletes, patients with AF, and/or those with mitral valve disease.

74 diabetic flash pulmonary edema
E 2.3 M/s
E/A 1.3
e’ 7 cm/s
E/e’ 20s
LAVi 40 cc
TR 3.6 M/s
Doppler Echocardiography for the Estimation of LV Filling Pressure in Patients With Mitral Annular Calcification

Muaz M. Abudiab, MD, Lakshmi H. Chebrolu, MD, Robert C. Schutt, MD, Sherif F. Nagueh, MD, William A. Zoghbi, MD

**FIGURE 3** Proposed Clinical Algorithm for Estimation of Left Ventricular Filling Pressure in Subjects With Mitral Annular Calcification

**Initial Cohort (n = 50):**
- Sensitivity: 81%
- Specificity: 100%
- PPV: 100%
- NPV: 67%

**Total Cohort (n = 71):**
- Sensitivity: 85%
- Specificity: 95%
- PPV: 97%
- NPV: 78%

- **Mitrail E/A**
  - < 0.8
  - 0.8-1.8
  - > 1.8

- **Normal LVFP**
  - Initial: 8/9 (89%)
  - Total: 12/13 (92%)

- **IVRT**
  - ≥ 80 ms
  - < 80 ms

- **High LVFP**
  - Initial: 10/10 (100%)
  - Total: 11/11 (100%)

- **Normal LVFP**
  - 4/9 (44%)
  - 9/14 (64%)

- **High LVFP**
  - 16/16 (100%)
  - 23/24 (96%)
Diastolic Function in MV Disease

- E wave reflects filling rate, not relaxation
- E wave is elevated because of
  a. high V wave
  b. low end systolic pressure (preload effect)
  c. high LA pressure
- E/e’ works better in presence of myocardial disease, less well in MVP
- PV flow parameters PA pressure are useful
- Combination of E wave and IVRT holds promise in MAC
The poignant story of how one man beat the odds and reversed advanced diastolic dysfunction !!!!