Pitfalls and how to avoid them

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Pitfalls victims?

WHO: all of us

WHEN: - Learning curve!
- “Don’t hurry!“

WHICH conditions:
- Poor windows
- Complex diseases/procedures
- Arrhythmias
- Extreme ages (children, old pts.)
WHY:

I. Technical errors

II. Choice of irrelevant parameters

III. Errors in interpreting results

EAE recommendations for training, competence, and quality improvement.

A. Poor imaging
How to avoid

• Change frequency!

• Use harmonics!
How to avoid

- Use respiratory cycle variations /apnea!
- Change patient’s position!
B. Inadequate imaging (2D)

A. Bad transducer position

B. Wrong M-mode cut
How to avoid

Go to the spine! ( “il appice di Pordenone “)

Short axis before M mode measurements!
Inadequate imaging (Doppler)

Best Doppler signal..

..NOT necessarily from the ideal 2D imaging point
The clearest signal ..

...could be not the good one..
Inadequate imaging (Doppler)

1. Bad sample volume position
   - valve/annulus artifacts
   - maximal velocity underevaluated (modified E/A)

2. Too large sample volume
   - wide velocity spectrum

3. Gain excess
   - may alter time and velocity measurements

4. Inadequate filters
   - wall/valve artifacts
   - falsely “reduced” durations
Inadequate imaging (Doppler)

5. Inadequate Doppler beam direction
   - maximal velocity underevaluated

6. Sweep
   - greater error probability (duration/PHT)

7. Number of cardiac cycles measured
   - errors: pts in atrial fibrillation
Inadequate imaging (Doppler)

8. Not using provocative maneuvers
   - Valsalva
   - respiratory
   - contrast

9. Ignoring audio signal

10. Lack of recording measurements
The chosen parameter - correctly calculated – does not really express, in that context, the severity of the condition.

-- **transmitral gradient** to evaluate severity of mitral stenosis in *Lutembacher syndrome*

-- **LV/Ao gradient** in aortic stenosis with low LV EF

-- **color** (semi quantitative) assessment of AR in *acute AR*
No endd. aortic turbulence ..

...but diastolic mitral regurge and brisk aortic PHT
In spite of correctly applying the technique, there are major (nonavoidable) disturbing factors.

*PAP calculation using Ao/PA gradient of a PDA (wrong angle, false > PAP)*

*Qp/Qs assessment of shunting if significant L/R regurge*

*Using PAT formula for PAP assessment in very severe PHT*
<table>
<thead>
<tr>
<th>Presiune medie cateterism</th>
<th>TAP (met.A)</th>
<th>Gradient diastolic max AP/VD (met B.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>40-45 mm (n:6)</td>
<td>-3.6 mm (-14, +8)</td>
<td>-12.3 mm (-21, -8)</td>
</tr>
<tr>
<td>45-50 mm (n:10)</td>
<td>-4.7 mm (-16, +3)</td>
<td>-11.9 mm (-22, -3)</td>
</tr>
<tr>
<td>&gt;50 mm (n:6)</td>
<td>-9.9 mm (-21, -5)</td>
<td>-16.4 mm (-29, -8)</td>
</tr>
</tbody>
</table>
III. Errors in interpreting results
1. Incorrect recognition of structures / waves / flows
   - Chiari network
   - protodiastolic gradients HCM
   - RA turbulence
   - paraseptal LA/RA flows versus shunting

2. Ignoring normal values range
   Don’t be ashamed to look in a manual!

3. Not using correction for:
   - BMI
   - cardiac frequency
   - position: Coanda effect
   - tricuspid PHT: 180-190/220

ASIA and Chiari network (no clots!)
Protodiastolic gradients
Er, Ar in outflow tract

LV-RA shunting (not tricuspid regurgitation)

L and R paraseptal flows – no shunting
Table 38–1. Normal Values of Doppler Parameters in Apparently Normal Prosthetic Valves

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Velocity (m/sec) $V_{\text{max}}$</th>
<th>Gradient (mm Hg) $\Delta P_{\text{max}}$</th>
<th>$\Delta P_{\text{mean}}$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mitrail Position</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Starr-Edwards (ball-in-cage)</td>
<td>1.9 ± 0.4</td>
<td>14.6 ± 5.5</td>
<td>4.6 ± 2.4</td>
</tr>
<tr>
<td>St. Jude Medical (bileaflet)</td>
<td>1.6 ± 0.3</td>
<td>10.0 ± 3.6</td>
<td>3.5 ± 1.3</td>
</tr>
<tr>
<td>Bjork-Shiley (tilting disc)</td>
<td>1.6 ± 0.3</td>
<td>10.7 ± 2.7</td>
<td>2.9 ± 1.6</td>
</tr>
<tr>
<td>Carpentier-Edwards (porcine bioprosthesis)</td>
<td>1.8 ± 0.2</td>
<td>12.5 ± 3.6?</td>
<td>6.5 ± 2.1?</td>
</tr>
<tr>
<td>Hancock (porcine bioprosthesis)</td>
<td>1.5 ± 0.3</td>
<td>9.7 ± 3.2</td>
<td>4.3 ± 2.1</td>
</tr>
<tr>
<td><strong>Aortic Position</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Starr-Edwards (ball-in-cage)</td>
<td>3.2 ± 0.6</td>
<td>38.6 ± 11.7</td>
<td>23.0 ± 8.8</td>
</tr>
<tr>
<td>St. Jude Medical (bileaflet)</td>
<td>2.4 ± 0.3</td>
<td>25.5 ± 5.1</td>
<td>12.5 ± 6.4</td>
</tr>
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<td>11.0 ± 2.3</td>
</tr>
<tr>
<td><strong>Tricuspid Position (Case Reports)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bjork-Shiley (tilting disc)</td>
<td>1.6</td>
<td>10.2</td>
<td>5</td>
</tr>
<tr>
<td>Porcine bioprosthesis</td>
<td>1.3 ± 0.3</td>
<td>7 ± 2</td>
<td>3 ± 2</td>
</tr>
</tbody>
</table>

(Data summarized from refs. 18, 55, 111, and 112.)

Ignoring normal values range
Coanda ef.: color underestimation of regurge

Mitral PHT formula used for tricusp area!
4. Ignoring the haemodynamic context:

Associated Lesions:
- transmitral gradient in associated regurge
- gradient in multiple stenosis (initial velocity high! : extended Bernoulli)

LV dysfunction:
- different significance of EF in severe mitral regurge
- E/A pseudonormalisation

Intracavitary/arterial pressures:
- HT: increased color area of mitral regurge
- PHT: no turbulent PDA flow
5. Recent therapeutic procedures
   - Diuretics
   - SR post electric conversion: absent or < “a”
   - stenting

6. Ignoring general biological context
   **Age**
   Fetal Echo - physiologic shunting
   - E/A < 1
   Elder pts: impaired relaxation

**Athletic heart**

**Hyperkinetic Syndrome**
   - Pregnancy
   - Anemia
   - Hyperthyroidia
CONCLUSIONS

TO AVOID PITFALLS we need:

• Good theoretical knowledge of US physics
• Solid practical training
• Clinical integration of data
• Patience