Contemporary Clinical Pearls in Physical Diagnosis: A Multi-Media Look at Actual Findings & Sounds, Hemodynamics, and What the Literature Has to Say

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Cardiac Exam Competency?

Vukonovic-Criley JM, et al. Arch IM 2006;166:610
Outline

• Auscultation
  – Gallops
  – Murmurs

• Inspection (Venous pressure)
  – Heart failure

• Palpation (Arterial pulse)
  – Pulse pressure
  – Valsalva
  – VADs
  – Precordium
Auscultation
Doppler aortic jet velocity correlated with systolic murmur intensity \( (P = .003) \) and timing \( (P = .0002) \), a single second heart sound \( (P = .01) \), and carotid upstroke delay \( (P < .0001) \) and amplitude \( (P < .0001) \). Only carotid delay associated with outcome in multivariate analysis.

The murmur can matter

Tavel ME. Circulation 2006;113:1255-1259
Do Gallops Really Reflect Hemodynamics?

## Gallops and Predictive Value

### Test Characteristics of Computerized Heart Sounds Detection

<table>
<thead>
<tr>
<th>S3 and/or S4</th>
<th>EDP &gt; 15</th>
<th>EF &lt; 50%</th>
<th>BNP &gt; 100</th>
</tr>
</thead>
<tbody>
<tr>
<td>PPV</td>
<td>68%</td>
<td>42%</td>
<td>75%</td>
</tr>
<tr>
<td>NPV</td>
<td>73%</td>
<td>88%</td>
<td>53%</td>
</tr>
<tr>
<td>Accuracy</td>
<td>71%</td>
<td>67%</td>
<td>63%</td>
</tr>
</tbody>
</table>

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*Marcus GM, et al. JAMA 2005;293:2238-2244*
The Prognostic Power of an S3

Drazner MH, NEJM 2001;345:574

Venous pulse
Heart failure is a clinical diagnosis

**Major criteria**
- Orthopnea / PND
- Venous distension
- Rales
- Cardiomegaly
- Acute pulm edema
- JVD > 16 cm
- HJR
- Circulation time > 25 s

**Minor criteria**
- Ankle edema
- Night cough
- Exertional dyspnea
- Hepatomegaly
- Pleural effusion
- Tachycardia (>120)
- Decreased VC
- Wgt loss w/ CHF tx

\[ \text{CHF} = 2 \text{ major or 1 major} + 1 \text{ minor} \]
### Accuracy of Physical Findings for Elevated LV Filling Pressure

<table>
<thead>
<tr>
<th>Finding</th>
<th>Sensitivity</th>
<th>Specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rales</td>
<td>15 - 65%</td>
<td>90%</td>
</tr>
<tr>
<td>Edema</td>
<td>25 - 67%</td>
<td>95%</td>
</tr>
<tr>
<td>Orthopnea</td>
<td>90%</td>
<td>95%</td>
</tr>
<tr>
<td>Elevated JVP</td>
<td>80%</td>
<td>90%</td>
</tr>
</tbody>
</table>
### Variable Correlation Between Estimated JVP and Measured RAP

<table>
<thead>
<tr>
<th>Study</th>
<th>Correlation Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eisenberg (1984)</td>
<td>55% agree within 3 cm</td>
</tr>
<tr>
<td>Ducas (1983)</td>
<td>86% agree within 5 cm</td>
</tr>
<tr>
<td>Cook (1990)</td>
<td>$R = \sim 0.70$</td>
</tr>
<tr>
<td>Connors (1983)</td>
<td>43% concordance with low, normal, high</td>
</tr>
</tbody>
</table>

*McGee SR, AHJ 1998;136:10*
The Prognostic Power of JVD

Drazner MH, NEJM 2001;345:574

Hemodynamic Profiles and Outcomes for 500 Patients Hospitalized on a HF Service

Rapid Clinical Assessment

- **Congestion**
  - orthopnea/PND
  - dyspnea on minimal exertion
  - rales, JVD, edema, ascites
  - Valsalva “square wave”

- **Hypoperfusion**
  - sleepy, “depressed”
  - cool extremities
  - renal insufficiency
  - narrow pulse pressure

Netter 1983
## Assessment of Hemodynamic Status

<table>
<thead>
<tr>
<th>Congestion</th>
<th>Low Perfusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td></td>
<td>Warm &amp; Dry</td>
</tr>
<tr>
<td></td>
<td>(Low Profile)</td>
</tr>
<tr>
<td></td>
<td>Warm &amp; Dry</td>
</tr>
<tr>
<td></td>
<td>(Low Profile)</td>
</tr>
<tr>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td></td>
<td>Warm &amp; Wet</td>
</tr>
<tr>
<td></td>
<td>(Complex)</td>
</tr>
<tr>
<td>YES</td>
<td>Cold &amp; Dry</td>
</tr>
<tr>
<td></td>
<td>Cold &amp; Wet</td>
</tr>
</tbody>
</table>

- **A**: Warm & Dry
- **B**: Warm & Wet
- **C**: Cold & Wet
- **L**: Cold & Dry

**Orthopnea / PND**
- **JV Distension**
- **Hepatomegaly**
- **Edema**

**Elevated PA systolic**
- **Valsalva square wave**
- **Rales (rare in chronic heart failure)**

**Narrow pulse pressure**
- **Cool extremities**
- **Sleepy / obtunded**
- **Hypotension w/ ACEI**
- **Low serum sodium**
- **Azotemia**

Adapted from Stevenson
Assessing Volume Status at the Bedside

- PCW/RA ratio > 2 in most patients
- JVP < 10 usually implies PCW < 22
- Adjust therapies to keep JVP < 7-8
- Average diuresis approx. 4 L
- Allow time to mobilize fluid reservoirs

*Drazner et al., JHLT 2000*
Measuring Venous Pressure

The Angle of Louis

Not a very good reference point…

ESCAPE Trial
Physical Exam versus PA catheter guided management in Advanced HF

Days alive and out of hospital

Cumulative proportion

Number of days not dead or hospitalized (days well) during 180 days

ESCAPE Investigators, JAMA 2005
Arterial pulse
Aorta and Pulsatile Load

[Diagram showing the differences between young, elastic vessels and old, inelastic vessels in terms of stroke volume, aorta, resistance arterioles, and pressure (flow).]

- **Young, elastic vessels**:
  - Systole: Stroke volume increases, aorta expands, resistance arterioles change.
  - Diastole: Stroke volume decreases, aorta contracts, resistance arterioles change.
  - Pressure (flow) shows a peak during systole.

- **Old, inelastic vessels**:
  - Systole: Stroke volume increases, aorta expands, resistance arterioles change.
  - Diastole: Stroke volume decreases, aorta contracts, resistance arterioles change.
  - Pressure (flow) shows increased systolic and decreased diastolic.

[Note: The diagram illustrates how the properties of young, elastic vessels differ from those of old, inelastic vessels, affecting blood flow and pressure.]
Increased vascular stiffness leads to increased endsystolic stiffness
Pulse pressure and CV events

**Total Mortality**

- < 25: 10
- 30: 20
- 40: 30
- 50: 40
- 60: 40 (P < 0.00001)
- > 65: 40

**Recurrent MI**

- < 25: 7
- 30: 10
- 40: 15
- 50: 20
- 60: 25
- > 65: 30 (P < 0.00001

*Mitchell, Circ 1997;96:4254*
**Phase I:** Increase in systolic pressure with initial strain due to increase in intrathoracic pressure

**Phase II:** Decrease in stroke volume and pulse pressure and reflex tachycardia with continued strain due to decrease in venous return and increase in vascular resistance

**Phase III:** Brief, sudden decrease in systolic pressure due to sudden decrease in intrathoracic pressure

**Phase IV:** Overshoot of systolic pressure and reflex bradycardia due to increased venous return and decreased systemic vascular resistance

**FIGURE 11-14** The normal Valsalva response.

Absent overshoot
EF <50%

Square response
PCW > 22

Absent overshoot
EF <50%

Square response
PCW > 22
Valsalva and hemodynamics


Heartmate II LVAD

Continuous Flow...no pulse?

- Axial flow pump, simple blood path minimizes hemolysis/clotting
- Weighs only 375 gm, 4 cm x 6 cm
- Flows up to 10 L/min
Measuring Blood Pressure in a CF VAD Patient

CO, cardiac output; PP, pulse pressure; BP, mean blood pressure
Pump Flow Waveform

- Red circle: represents ventricular diastole
- Yellow circle: represents ventricular systole
Aortic valve opening by pulse pressure

![Bar chart showing the percentage of aortic valve opening across different ranges of pulse pressure.](image)

- '0-14 (10.2) mmHg: 24%, N = 92
- '15-24 (19.3) mmHg: 65%, N = 139
- '25-34 (29.1) mmHg: 79%, N = 87
- '35-69 (42.3) mmHg: 98%, N = 48

Range of Pulse Pressure (mmHg)
Ventricular interdependence in RV failure

RV Function and Mortality

\[ \chi^2 = 23.6 \]
\[ p < 0.00001 \]

De Groote et al. JACC 1998; 32:948
Why do it?

- Patients expect it
- Doctors exam patients
- Inexpensive
- Establishes diagnosis
- Guides management
- Has prognostic power
- You don’t need a doctor to order a test
Thank you