Cath Lab Essentials: ‘Pericardial effusion & tamponade’
Acknowledgments

- No financial disclosures
Case

A 52-year-old man with a 3-day history of progressively worsening dyspnea on exertion to the point that he is unable to walk more than one block without resting. He has had sharp intermittent pleuritic chest pain and a nonproductive cough. He is taking no medications.
Case

- Temp is 37.7 °C (99.9 °F), blood pressure is 88/44 mm Hg, pulse is 125/min, and respiration rate is 29/min; BMI is 27. Oxygen saturation is 95%.

- Pulsus paradoxus is 15 mm Hg. JVP is 12 cm H₂O. Cardiac examination discloses muffled heart sounds with no rubs. Lung auscultation reveals normal breath sounds and no crackles. There is 2+ pedal edema.
ECG-electrical alternans
Chest X-ray
Question

What is the most appropriate treatment?

A. Dobutamine to increase BP
B. Broad spectrum antibiotics
C. Pericardiocentesis
D. Surgical pericardiectionomy
Echocardiogram: RV collapse in diastole

- Most commonly involves the RV outflow tract (more compressible area of RV)
- Occurs in early diastole, immediately after closure of the pulmonary valve, at the time of opening of the tricuspid valve
- When collapse extends from outflow tract to the body of the right ventricle, this is evidence that intrapericardial pressure is elevated more substantially

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https://www.youtube.com/channel/UCPgiLkxUt7WX8VrZ9g0wQ
Subcostal view
M-mode

Beginning of systole

ES DC

RV wall

Pericardial space

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M-mode

Beginning of systole

ES DC
Pericardial Effusion

- Can occur rapidly or slowly
- Pulmonary compression—cough, dyspnea, and tachypnea
- Phrenic nerve compression—hiccups
- Heart sounds distant, muffled
- Slow fluid build-up; no immediate effects;
- Rapid fluid build up --> compression of heart --> tamponade

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Cardiac Tamponade

- Compression of heart
- Occur acutely (trauma) or sub-acutely (malignancy)
- Symptoms: chest pain, confusion, anxious, elevated CVP/JVD, restless, muffled heart sounds
- Later: tachypnea, tachycardia, and decrease CO, and pulsus paradoxus
- With slow onset: dyspnea may be only symptom
- If rapid compression: Medical Emergency
The X-Ray on the left shows a normal heart. On the right, the heart is enlarged.

Original heart size

Excess pericardial fluid
<table>
<thead>
<tr>
<th>Grade</th>
<th>Pericardial Volume (mL)</th>
<th>Cardiac Index</th>
<th>MAP</th>
<th>CVP</th>
<th>HR</th>
<th>Beck's Triad</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>&lt;200</td>
<td>Normal or ↑</td>
<td>Normal</td>
<td>↑</td>
<td>↑</td>
<td>usually not present</td>
</tr>
<tr>
<td>II</td>
<td>≥200</td>
<td>↓</td>
<td>Normal or ↓</td>
<td>↑ (≥12 cm H$_2$O)</td>
<td>↑</td>
<td>May or may not be present</td>
</tr>
<tr>
<td>III</td>
<td>&gt;200</td>
<td>↓↓</td>
<td>↓↓</td>
<td>↑↑ (≤30–40 cm H$_2$O)</td>
<td>↓</td>
<td>Usually present</td>
</tr>
</tbody>
</table>

Increased venous pressure
Decreased arterial pressure
Muffled heart sounds
Swinging heart-Electrical alternans
Pulsus Paradoxicus >20mmHg drop

RA pressure = Pericardial pressures with blunted wave forms
1. Dyspnea: from hypoxia, decreased CO and decreased lung expansion.

2. Retrosternal chest pain that increases when patients are supine and decreases when leaning forward because of compression of the heart

3. Cough, hoarseness, or hiccups caused by mechanical compression of nerves of the esophagus, bronchi, and trachea

4. Weakness, fatigue, and malaise resulting from decreased cardiac output

5. Vague gastrointestinal complaints because of visceral congestion and venous stasis
Nursing Care

1. Monitor for dysrhythmia which may result of myocardial ischemia from epicardial coronary artery compression.

2. Monitor the BP every 5 to 15 minutes during acute phase.

3. Monitor for pulsus paradoxus via arterial tracing or during manual BP reading. Monitor for increased JVP.

4. A drop in urine output indicates decreased renal perfusion as a result of decreased stroke volume secondary to cardiac compression.

5. Assess level of consciousness for changes that may indicate decreased cerebral perfusion.
Technologist: Equipment required Pericardiocentesis

1. Pericardiocentesis kit (contains equipment to perform drain placement via Seldinger technique)
   - If kit unavailable: 18ga spinal needle, 20mL syringe
   - Can also use micro puncture needle and kit
2. Ultrasound/echocardiogram if available; or,
3. Equipment ready to measure pericardial pressure if needed
4. Swan Ganz catheter to measure chamber pressure

- A Seldinger technique pericardiocentesis set (Wood set by Cook Critical Care Co.)-calsprogram.org
Technologist: Patient preparation- subxyphoid approach

1. Bed to 30-45° angle if patient condition allows (brings heart/pericardium closer to anterior chest wall)
2. Skin prep with iodine or chlorhexidine, followed by sterile drape
3. Consider sedation or local anesthesia but do not delay procedure
4. Continuous monitoring (BP, HR, sPO2, etc) during procedure. Art-line preferable, but do not delay procedure.
5. Atropine may be helpful to prevent vasovagal reaction
Pericardial pressure is an external pressure which pushes on the cardiac chambers. An effusion is equally distributed and thus equalize filling/diastole pressures across chambers. Therefore no gradient for flow exists except during atrial contraction. In early diastole filling does not occur = absence of the y descent.

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Case

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Pericardiocentesis

Femoral artery pressure

inspiration

expiration
RA- mean pressure 18 mmHg
RV – diastolic pressure 18-20 mmHg
PA – diastolic pressure 18-22 mm Hg
Mean PCW 18-20 mmHg
Removal of 60 ml of pericardial fluid - RA and pericardial pressures are equal and falling
Removal of 120 ml of fluid – pericardial pressure < RA pressure
Femoral artery pressure – no pulses paradoxus

Mean RA pressure = 10 mm Hg after 240 ml fluid removed
Pericardial effusion — impending tamponade
Removed 3ml of pericardial fluid and then added 3ml of agitated saline in pericardial space…but before that the needle had entered the RV
Now increased pericardial effusion...fall in HR and BP...loss of consciousness...TAMPONADE...imminent death
Removal of bloody pericardial fluid
Pericardial drain in place...more fluid removed...patient doing well and talking one hour after procedure
Seen under fluroscopy after pericardiocentesis

Initial Pericardiocentesis

What is seen after Pericardiocentesis
End — questions?

Thanks!