Imaging of Constrictive Pericarditis

Ian R. Drexler, MD, MBA
Alan C. Legasto, MD
James Gruden, MD
Disclosures

- Ian Drexler, MD has nothing to disclose
- Alan Legasto, MD has nothing to disclose
- James Gruden, MD has nothing to disclose
Introduction
The Pericardium

- Consists of a fibrous (parietal pericardium) and serous (visceral pericardium) sac
- Has an average of 20-25 mL physiologic fluid, though can vary 20-60 mL in the normal adult
- Stabilizes heart in position
- Physical barrier protecting heart from infection
- Helps maintain pressure-volume relationship between cardiac chambers
- May be partially or completely absent
Constrictive Pericarditis

- Constrictive pericarditis (CP) results in diastolic heart failure
- Inflammation and fibrosis of the pericardium lead to its noncompliance and impaired ventricular diastolic filling
- Common etiologies: Infection (viral, bacterial), post-cardiac surgery, radiation, and idiopathic
- Less common causes: Fungal infection, uremia, trauma, drugs, and myocardial infarction
Constrictive Pericarditis

- Classic clinical presentation: Signs of right heart failure, including lower extremity edema, hepatomegaly, and ascites
- Physical exam may demonstrate jugular venous distention
- EKG findings are not diagnostic, with most common finding of non-specific ST-T wave abnormalities
- May have elevated creatinine and liver enzymes (especially alkaline phosphatase)
Radiographs
Findings on Chest Radiograph

- Look for pericardial calcification (only in 20-30% of cases)
- Most common extra-cardiac finding is a pleural effusion
Chest Radiograph: Example

- Anteroposterior chest radiograph demonstrates inferior pericardial calcification (arrow)
Chest Radiograph: Example

- Lateral radiograph from the same patient demonstrates inferior and posterior pericardial calcification (arrow)
Findings on CT

- Pericardial calcification
- Pericardial thickening (≥ 4 mm thickness)
  - May be limited to the right side of the heart or even a small area
- Decreased right ventricular (RV) volume
- May see leftward convexity of the interventricular septum (more apparent on a EKG-gated CT)
- Dilated IVC (> 2.5 – 3 cm diameter), hepatomegaly, and ascites may be seen
Axial CT shows dense calcification of the inferior pericardium
MRI
Findings on MRI

- Pericardial thickening and enhancement can be found in patients with CP
- Higher degrees of pericardial enhancement shown to be associated with favorable response to anti-inflammatory medications
- May see an early diastolic septal bounce and respirophasic septal shift on cine imaging
MRI: Delayed Enhancement

- Short axis FIESTA images (A & B) with corresponding delayed enhancement images (C & D) demonstrate circumferential pericardial thickening with associated pericardial enhancement.
MRI: Septal Motion on Cine Images

- Four-chamber MRI cine shows early diastolic interventricular septal bounce
MRI & Echo: Septal Motion Abnormality

Exaggerated interventricular septal mobility in another patient is seen on both four chamber cine MRI and transthoracic echo images.
During free breathing in patients with CP, there is increasing ventricular coupling, or ventricular interdependence.

Ventricular interdependence is termed as such because flow into one ventricle (e.g., the LV) affects flow into the other ventricle (e.g., the RV).
During inspiration, intrathoracic pressure drops → more blood can enter the right-sided chambers.

- Normally, the pericardium is compliant so the LV can expand.
- In CP, increased right-sided pressures and decreased left-sided filling in inspiration lead to exaggerated septal movement leftward.
MRI: Myocardial Tagging

- 2 methods
  - SPatial Modulation of Magnetization (SPAMM)
  - Delay Alternating with Nutations for Tailored Excitation (DANTE)

- A grid is applied on the image at the start of a cine sequence, and follows the contour of the myocardium as it moves
Looking at the inferior LV wall, there is little change in the tagged grids between end-diastole and end-systole, indicating adhesion between pericardium and underlying myocardium, consistent with CP.
# CT vs MRI

<table>
<thead>
<tr>
<th>CT</th>
<th>MRI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pros</strong></td>
<td><strong>Pros</strong></td>
</tr>
<tr>
<td>o Easily detects calcification</td>
<td>o Allows for detection of interventricular septal wall motion abnormalities</td>
</tr>
<tr>
<td>o Can assess pericardial thickening</td>
<td>o Can evaluate for pericardial thickening and delayed enhancement</td>
</tr>
<tr>
<td>o IV contrast not necessary</td>
<td></td>
</tr>
<tr>
<td>o Fast</td>
<td></td>
</tr>
<tr>
<td><strong>Cons</strong></td>
<td><strong>Cons</strong></td>
</tr>
<tr>
<td>o Non EKG-gated Chest CT unable to assess for septal wall motion abnormalities</td>
<td>o Poor calcification detection</td>
</tr>
<tr>
<td></td>
<td>o Difficult for patient (long exam with breath holds)</td>
</tr>
<tr>
<td></td>
<td>o Requires IV gadolinium</td>
</tr>
</tbody>
</table>
Example 1
Example 1

PA and lateral radiographs demonstrate pericardial calcification along the inferior and left heart borders, compatible with constrictive pericarditis.
Example 2
Example 2

Inferior pericardial calcifications are easily identified on PA radiograph, but pericardial calcifications along right heart border are better seen on CT.
Example 3
Example 3

Four chamber and short axis cine MRI images show a prominent diastolic interventricular septal bounce (solid arrow) and limited excursion of the RV free wall (dashed arrow), compatible with constrictive pericarditis. Also note the bilateral pleural effusions (*)
References

- Czum JM, Silas AM, Althoen MC. Evaluation of the Pericardium with CT and MR. ISRN Cardiol 2014;2014(c):1–11.