Hemodynamics of Constrictive Pericarditis and Restrictive Cardiomyopathy

Morton J. Kern, MD
Chief, Medical Health Care Group
VALBHCS
Professor of Medicine
University California Irvine
Orange, California
Disclosure:

Morton J. Kern, MD

Within the past 12 months, the presenter or their spouse/partner have had a financial interest/arrangement or affiliation with the organization listed below.

<table>
<thead>
<tr>
<th>Company Name</th>
<th>Relationship</th>
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<tbody>
<tr>
<td>Abbott St. Jude Medical Inc.</td>
<td>Speakers’ Bureau</td>
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<td>Philips Volcano Therapeutics</td>
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<td>Abiomed</td>
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<tr>
<td>Opsens</td>
<td>Consultant</td>
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<tr>
<td>Acist Medical</td>
<td>Consultant</td>
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</tbody>
</table>
Pericardial Anatomy

- Superior reflexion
- Fibrous pericardium
- Parietal layer of serous pericardium
- Pericardial cavity
- Visceral layer of serous pericardium (epicardium)
- Myocardium
- Endocardium
- Heart wall
- Heart chamber

Pericardium

Heart
Pericardial Pathoanatomy detection

TEE w thickened, fibrotic pericardium

Axial CT scan w calcification

Axial CT scan w pericardial thickening

MRI w pericardial thickening

Circ Cardiovasc Imaging. 2018;11:e007878
# Treatment for Acute and Recurrent Pericarditis

<table>
<thead>
<tr>
<th>DRUG</th>
<th>DOSE</th>
<th>DURATION</th>
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<tbody>
<tr>
<td>Aspirin</td>
<td>750-1,000 mg every 8 h</td>
<td>1-2 weeks</td>
</tr>
<tr>
<td>Ibuprofen</td>
<td>600-800 mg every 8 h</td>
<td>1-2 weeks</td>
</tr>
<tr>
<td>Colchicine</td>
<td>0.5-1.2 mg in one or divided doses</td>
<td>3 months</td>
</tr>
<tr>
<td>Aspirin</td>
<td>750-1,000 mg every 8 h</td>
<td>Weeks-months</td>
</tr>
<tr>
<td>Ibuprofen</td>
<td>600-800 mg every 8 h</td>
<td>Weeks-months</td>
</tr>
<tr>
<td>Indomethacin</td>
<td>25-50 mg every 8 h</td>
<td>Weeks-months</td>
</tr>
<tr>
<td>Colchicine</td>
<td>0.5-1.2 mg in one or divided doses</td>
<td>At least 6 months</td>
</tr>
<tr>
<td>Prednisone</td>
<td>0.2-0.5 mg/kg/daily</td>
<td>Months</td>
</tr>
<tr>
<td>Anakinra</td>
<td>1-2 mg/kg/daily up to 100 mg/daily</td>
<td>Months</td>
</tr>
<tr>
<td>Rilonacept</td>
<td>320 mg once, then 160 mg weekly</td>
<td>Months</td>
</tr>
<tr>
<td>Azathioprine</td>
<td>1 mg/kg/daily up to 2-3 mg/kg/daily</td>
<td>Months</td>
</tr>
<tr>
<td>Methotrexate</td>
<td>10-15 mg weekly</td>
<td>Months</td>
</tr>
<tr>
<td>MMF</td>
<td>2,000 mg daily</td>
<td>Months</td>
</tr>
<tr>
<td>IVIGs</td>
<td>400-500 mg/kg/day</td>
<td>5 days</td>
</tr>
</tbody>
</table>

**Pericardiocentesis**

**Pericardial window**

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**Active inflammation**

- Yes → Anti-inflammatory therapy as first line, pericardiectomy for refractory cases
- No → Pericardiectomy
Dynamic Respiratory Variation of Chamber Filling In Constrictive Pericarditis
Waveforms of Constrictive Physiology

Dip/Plateau of RV/LV, large Y descent, blunted x, x′

Constriction:
Y dip and diastolic plateau

Normal RA

Constriction:
RA: Steep y descent, blunted x, x′

Vaitkus, Circulation 1996
Ventricular Interdependence

RV/LV Discordance
Constriction

RV/LV Concordance
Restriction

Ventricular Pressures with Respiratory Variation

Concordant = Restrictive
Discordant = Constrictive physiology
Differentiation Metrics of Constriction and Restriction
### Comparison of Traditional and Dynamic Criteria for Constrictive Pericarditis

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>PPV</th>
<th>NPV</th>
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</thead>
<tbody>
<tr>
<td><strong>Traditional</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LVEDP-RVEDP &lt;5mmHg</td>
<td>60</td>
<td>38</td>
<td>4</td>
<td>57</td>
</tr>
<tr>
<td>RVEDP/RVSP &gt;1/3</td>
<td>93</td>
<td>38</td>
<td>52</td>
<td>89</td>
</tr>
<tr>
<td>PASP &lt;55mmHg</td>
<td>93</td>
<td>24</td>
<td>47</td>
<td>25</td>
</tr>
<tr>
<td>LV RFW &gt;7mmHg</td>
<td>93</td>
<td>57</td>
<td>61</td>
<td>92</td>
</tr>
<tr>
<td>Resp. △ RAP &lt;3mmHg</td>
<td>93</td>
<td>48</td>
<td>58</td>
<td>92</td>
</tr>
</tbody>
</table>

| **Dynamic Respiratory**         |             |             |      |      |
| PCWP/LV >5mmHg                  | 93          | 81          | 78   | 94   |
| LV/RV interdependence           | 100         | 95          | 94   | 100  |
LV function: Constrictive Pericarditis Versus Restrictive Cardiomyopathy

LV relaxation (tau) is abnormal only in restriction.

Garcia MJ et al. JACC 2016:67:2061
Hemodynamic Findings in Effusive-Constrictive Pericarditis

A

RA
LV
RV

B

RA

C

IP
RA

D

RA
IP

Anand D. Shah et al. JCIN 2016;9:e167-e168
Waveforms of Tamponade vs Constrictive Physiology

Tamponade:
Both x and Y descent blunted

Constriction:
X blunted, Y dip exaggerated = diastolic then plateau
Differentiation of Constriction and Restriction: Sorting Complex Hemodynamics

Lab/ECG/X-ray
- Nonspecific

Advanced cardiac imaging
- Echocardiogram
  - ↑ Pericardial thickness
  - Pericardial calcification
  - Pericardial effusion
  - ↑ Imaging correlates of ventricular interdependence
  - Pericardial inflammation
- Cardiac MRI
  - Bialtrial enlargement
  - Systolic and diastolic dysfunction
- Cardiac CT
  - Pulmonary hypertension
  - Tissue characterization abnormalities

Invasive hemodynamics
- Discordant respirophasic ventricular pressure changes
- Concordant respirophasic ventricular pressure changes