Pericardial Diseases

Constriction vs Restriction

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ASE Board Review 2017
Echo Evaluation of Pericardial Diseases

- Constriction vs Restriction
  - Typical Constriction
  - Effusive CP
  - Transient CP
  - CP and Tricuspid Regurgitation
- Multi-modality Imaging
  - Cases
- Tamponade
Restriction vs Constriction

Paradoxical DHF or HFpEF

No paradoxical
No variation
Decreased Inspiration
Concordant

Pulse
Diastolic Filling
Decreased Relaxation (e’)
HV reversal
LV/RV SP

Paradoxical Variation
ParadoxicalExpiration
Discordant

Diagnosis should be based on their characteristic HEMODYNAMICS
Mayo *Echo Diagnostic Criteria*

- **Septal motion abnormality**
- **MV Flow Velocity**
  - Restrictive (E/A >1)
- **Hepatic Vein Diastolic reversal with expiration**

Sensitivity 87 %
Specificity 91 %

Welch et al Circ Imaging 2014
Hemodynamics of Myocardial Disease
Concordant change in PCWP and LVDP

Hatle et al. Circ 1989
Constrictive Pericarditis

1. Dissociation between intrathoracic and intracardiac pressures

2. Interventricular Dependence
Hemodynamics in Constriction

Intracardiac pressure $\Delta <$ intrathoracic pressure $\Delta$

Interventricular dependence
Constriction

Abnormal septal motion

Interventricular Dependence

“Consider constriction if there is septal motion abnormality in patients with HF and preserved EF (HFpEF)”
Mitral Annulus Tissue Velocity

Constriction vs Myocardial Disease

"Mitral medial annulus velocity ≥ 8 cm/s suggests CP in pts with HF and normal EF"
Normal vs RCM vs CP
Medial Mitral e’ velocity

Normal

Medial e’ 13 cm/s

RCM

Medial e’ 3 cm/s

CP

Medial e’ 14 cm/s
Illustrative Cases
27 yo man with fatigue and dyspnea

- Sep. 2015... Flu-like symptoms, treated with inhaler
- Oct. 2015... Pre-syncopy and palpitation
  - Pericardial rub
  - Pericardial effusion on Echo
  - Treated with Ibuprofen 2400 mg/d, Colchicine 0.6 mg BID
- Not feeling better and CRP 60
- Underwent pericardial window
27 year old man underwent a window
Referred to Mayo

- Pericardial fluid … studies were negative
- Not feeling better
- RUQ abdominal pain and fatigue
- U/S… Enlarged gallbladder and liver
27 yo man after pericardial window

Hepatic Vein
Expiratory Diastolic Flow Reversal

Mitral Inflow

Mitral e’ = 15 cm/sec

1 = CT  2 = MRI  3 = Cath  4 = Pericardiectomy
71 yo man with RUQ discomfort and dyspnea 2 years after CABG

- Physical Examination
  - JVP elevation
  - Prominent S3
  - Peripheral edema

- CT was obtained: Calcified Pericardium
71 yo man with calcified pericardium
Referred for Pericardiectomy

- Cardiac Cath
  - Normal Coronaries
  - Elevated RAP, RVEDP, LVEDP
  Equalized LV/RV EDP
71 year old man with calcified pericardium
Referred for Pericardiectomy

Mitral inflow
E = 0.8  A = 0.2

Medial e’ = 3 cm/s
Lateral e’ = 4 cm/s

What would you do next?
1 = Pericardiectomy
2 = HF Medical Rx
3 = Myocardial Biopsy
4 = MRI
71 year old man with calcified pericardium

MRI: Patchy myocardial delayed enhancement and increased wall thickness

Cardiac Amyloidosis
Constriction vs Restriction
Traditional Hemodynamic Diagnostic parameters

Constrictive Pericarditis in the Modern Era
Novel Criteria for Diagnosis in the Cardiac Cath Laboratory
(Talreja, Nishimura, Oh, Holmes. Jan. 2008 JACC)

Restriction (RMC)

Concordant change

Constriction

Discordant change
An e-mail from a junior staff at a major MC 52 year old man waiting for heart transplantation (Had Echo, MRI, and cardiac cath performed)

Medial e’ = 20 cm/sec

Dx= RCM

Diastolic Reversal Flow with Expiration
What would you recommend?

1. Being a junior staff, keep quiet
2. Believing in Echo-Doppler, un-list him and further evaluation
3. Proceed with transplantation
Explanted Heart
77 yo man with severe aortic stenosis
tAVR and PM implantation
77 yo man with severe aortic stenosis
TAVR and PM implantation & RV Perforation

Pericardiocentesis yielded 125 cc of bloody fluid
77 yo man with severe aortic stenosis
Increasing dyspnea 2 months after pericardiocentesis
Effusive-Constrictive Pericarditis

Interventricular Dependence

Expiratory diastolic flow reversal
Cardiac Magnetic Resonance Imaging Pericardial Late Gadolinium Enhancement and Elevated Inflammatory Markers Can Predict the Reversibility of Constrictive Pericarditis After Antiinflammatory Medical Therapy

A Pilot Study

DaLi Feng, MD; James Glockner, MD, PhD; Kyehun Kim, MD; Matthew Martinez, MD; Imran S. Syed, MD; Philip Araoz, MD; Jerome Breen, MD; Raul E. Espinosa, MD; Thoralf Sundt, MD; Hartzell V. Schaff, MD; Jae K. Oh, MD

Baseline

Medical RX

3 Months

Circulation Oct 3rd 2011
Transient Constrictive Pericarditis

One week of Steroid Rx
## Transient Constriction

<table>
<thead>
<tr>
<th></th>
<th>Reversible (N=14)</th>
<th>Persistent (N=15)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td>54 ± 17</td>
<td>59 ± 16</td>
</tr>
<tr>
<td><strong>LVEF</strong></td>
<td>57 ± 3</td>
<td>60 ± 3</td>
</tr>
<tr>
<td><strong>E’ (cm/sec)</strong></td>
<td>12 ± 1</td>
<td>11 ± 1</td>
</tr>
<tr>
<td><strong>Steroid Rx</strong></td>
<td>71 %</td>
<td>53 %</td>
</tr>
<tr>
<td><strong>Pericardium</strong></td>
<td>3.8 ± 0.6 mm</td>
<td>4.0 ± 0.6 mm</td>
</tr>
<tr>
<td><strong>DE Pericardium</strong></td>
<td>4.4 ± 0.4 mm</td>
<td>2.1 ± 0.4 mm</td>
</tr>
<tr>
<td><strong>Grade 3-4/4 DE</strong></td>
<td>93 %</td>
<td>33 %</td>
</tr>
<tr>
<td><strong>Sed rate</strong></td>
<td>45 to 4</td>
<td>25 to 20</td>
</tr>
<tr>
<td><strong>CRP</strong></td>
<td>75 to 2</td>
<td>14 to 15</td>
</tr>
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</table>
35 yo man presents with dyspnea and fever
BP 80/40 mmHg
Echo guided Pericardiocentesis

Chest wall

79%

Subcostal

Location

18%

3%
35 yo man with tamponade and fever
TEE after pericardiocentesis
Heart failure with ascites and leg edema

1= Severe TR
2=Constriction
3= TR + CP
4= TR and RV dysfunction
Annulus Reversus
Severe TR and CP

Medial e’ = 12 cm/sec

Lateral e’ = 9 c/sec
Constriction or Myocardial Disease?

**Diagnostic Algorithm**

- **Mitral inflow E/A >0.8 + Dilated inferior vena cava**
  - Yes
  - **Ventricular septal motion abnormality with respiration**
    - Yes
    - **Medial e' 12 cm/s**
      - Constrictive pericarditis*
    - No
    - **Medial e' 5 cm/s**
      - **Further imaging or cardiac**
    - **Medial e' 6-8 cm/s**
      - Mixed constriction/restriction
    - **Medial e' <6 cm/s**
      - Restrictive cardiomyopathy
  - No
  - **Constriction/restriction unlikely**

- **Medial e' 5 cm/s**

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*Syed, Schaff, Oh. Nature Review Sep 2014*
In the modern era, multimodality imaging is essential in the diagnosis and management of pericardial syndromes. Echocardiography is the initial test for most pericardial syndromes, including acute pericarditis, recurrent pericarditis, and CP. CMR and CT can usually be added when there is complexity not handled by echocardiography or technically limited windows or when tissue characterization is needed, such as with edema and inflammation.
Echocardiography for Pericardial Diseases

Cyst

Tamponade

Constriction
Cardiac CT for Pericardial Diseases

Absent Pericardium
Cardiac MRI for Pericardial Diseases

Interventricular Dependence with typical septal motion

Extensive pericardial enhancement & adjacent left pleural
Illustrative Cases
47 year old man

- Chest pain
- Not exertional
- Normal Examination
47 year old man with chest pain
Absent pericardium

- Usually left side
- Heart shifted to left
- Mostly asymptomatic
- Strangulation can happen
Congenital Absence of the Pericardium

Snoopy Sign
Pericardial Cyst
A large pericardial cyst
46 year old male smoker presents with chest pain to a local ED

- Chest pain for 5 hours
- Stable and unremarkable examination
- ECG shows ST elevation
- STEMI was activated

PR depression
46 year old man with ? STEMI

MRI with Delayed Enhancement

Pericardial Inflammation
Acute Pericarditis

Management Recommendation

• Nonsteroidal anti-inflammatory (NSAID) agent for 1 month: ASA (1.5-2 Gr/d), Ibuprofen (2.5-3 Gr/d), Indocin (25-50 mg tid or qid)

• Colchicine for 3 months
  0.6 mg twice a day
  17% vs 38% Recurrence rate

• Avoid steroid if possible

• Avoid vigorous exercise for 1-2 months
A 63-year-old man with several cardiac risk factors but without a history of coronary artery disease presented to the emergency department with chest pain. A normal coronary angiogram, no cardiac enzyme elevation, elevated ESR, and small pericardial effusion were noted.

The ST elevation from baseline (Figure 2) then gradually subsided, and diffuse PR-segment depression with mild ST elevation (1 mm) was observed. These findings helped distinguish early repolarization from the isoelectric line in pericarditis since the ST elevation returned to the isoelectric line in the former but remained elevated in the latter.
51 year old with SLE and BP 150/115
57 year old male with STEMI
Thrombolysis and Stent
Hypotensive and tachycardic

1. Dopamine
2. IABP
3. Fluid
4. Surgery
57 year old man with STEMI

Hepatic vein diastolic reversal with expiration

RV Diastolic Collapse
Tamponade Physiology

- Pressure
  - Rapid effusion
  - Slow effusion

- Volume over time
  - Limit of pericardial stretch
  - Critical tamponade

NEJM 349: 684, 2003

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66 year old woman with dyspnea
Gastro-pericardial fistula

Pneumo-pericardium
Thank you for listening!
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