Constrictive Pericarditis Pitfalls in MR Diagnosis

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Goal

- To review the imaging criteria of constrictive pericarditis
- To discuss the diagnostic pitfalls & technical challenges
- Tricks to improve diagnosis
- Future directions

Disclosures

- None
Introduction

- **Definition**: diastolic fxn impaired by thickening or fibrosis
  - usually identified by echo
  - most common indication for evaluation by MR

- **Clinical presentation**
  - confused w/ restrictive CMP, heart failure, & hepatic dis
  - symptoms & signs of right heart failure (not d/t left heart dysfxn or valve dis)

- **Causes** → TB mc cause worldwide
  A series from Mayo Clinic examined 143 surgical patients 1993-1999
  - idiopathic (49%)
  - iatrogenic , including prior pericardiotomy (30%)
  - radiation (11%)
  - other (10%): viral pericarditis, conn tiss dis, uremia, neoplasm

MR Technique

- **Morphology**
  - T2 - Black blood imaging – double inversion recovery ...
    - Black blood imaging - Double inversion recovery single shot – Haste ,
  - T1 weighted : not routinely performed – precontrast VIBE

- **Function**
  - Cine Balanced steady state free precession (bSSFP),
  - cine Turbo Flash - True FISP
  - Tagged myocardium - not routinely performed

- **Enhancement**
  - 3D … (VIBE,  
    - Timing needs to be optimized

- **MR Signal Intensity of Pericardium:**
  - double inversion recovery sequences → Intermediate
  - T2-weighted → Lower than H2O
  - SSFP → Low signal

- **Respiratory maneuvers**
  - Real time SSFP
Diagnostic Hallmark

- **Pericardial thickening** with or without calcifications in setting of suggestive clinical signs & symptoms
  - Thickening difficult to detect by echocardiography
  - Thickness abnormal when > 3mm; only 1/3 Ca++
  - CT > MR for identifying Ca++
  - MR > CT: distinguishing tiny effusion vs smooth thickening
MR Pericardial Thickness

Diagnostic Pitfalls

- Detecting calcification
- Not every thickening causes compressive physiology
- SSFP $\rightarrow$ black outline $\rightarrow$ difficult to exclude smooth thickening
- Susceptibility artifact $\rightarrow$ simulates calcium or thickening
Morphologic Findings of Constriction

- Elongated “tubular” or “Bullet-shaped ventricles
  - not always present
  - Pitfall: restrictive CMP

- Straightening of septum
  - Pitfall: pulm hypertension

- Dilated atria & IVC
  - Pitfall: many causes of Right-sided heart failure

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Morphologic Findings of Constriction

- Contour deformity
  - RV free wall or atrioventricular groove
  - Rarely RVOT → subpulmonic stenosis
  - absent in malignant pericardial thickening w/ constrictive physiology

- Pericardial adhesions
  - Pitfall: can be present w/o constrictive physiology
  - hard to detect
Morphologic Findings of Constriction

- Contour deformity
  - Usually RV free wall, atrioventricular groove, or rarely RVOT
  - Absent in malignant pericardial thickening with constrictive physiology

- Poor relaxation
  - Rarely RVOT
  - Subpulmonic stenosis
Cardiac tamponade

- Caused by:
  - Large pleural effusion
  - Blood
  - Rarely air

- Early diastolic notching
  - Atrium or ventricle
  - hard to detect

- Treatment → pericardial window / drain
Morphologic Findings of Constriction

- Dilated IVC & hepatic veins
- Nutmeg liver
  - Passive congestion
- Ascites & anasarca
- Pleural effusions
- Cardiac cirrhosis
- All above also
  - Restrictive CMP
  - Tricuspid regurgitation
  - Pulm HTN
  - RV systolic failure
Effusive Constrictive Pericarditis

- Effusive constrictive pericarditis
  - Acute to subacute pericarditis $\rightarrow$ fat stranding
  - Small or large pericardial effusion
  - Visceral pericardium compresses the heart
  - No significant relief with pericardiotomy $\rightarrow$ needs –ectomy
  - Can be reversible
  - Caused by infection, lupus, radiation, collagen vascular dis
Constrictive Pericardial Metastases

- Can occur: sarcoma, melanoma, & breast ca
  - Nodular thickening → protrude into epicardial fat
  - No fat stranding
  - Enhance
  - RV & /or RA compression
Enhancement-Technique

- Contrast-enhanced MR clearly separates fluid from pericardial thickening
Enhancement-Technique

- Enhancement can be subtle when chronic & independent of the severity of constriction
Enhancement-Technique

- Enhancement increases with time
  - scan with 10 min delay (more important for CT)

Images:
- after 10-15 sec
- After 90 sec
- After 5 min
Functional Analysis

- Poor relaxation on diastole
  - Diagnostic dilemma: restrictive CMP
    - Also dilemma with echocardiography
  - Myocardial tagging
    - Systole: slippage between the myocardium & pericardium
    - Absent when pericardial adhesions exist
Mimicker – Cardiac Tamponade

- Diastolic notching & RV or RA flattening
Septal Bouncing

- Septal bouncing or paradoxical septal motion
  - Bowing of septum towards LV
  - Both 2 chamber short axis & 4 chamber views
Ventricular Interdependence

- Absent in restrictive CMP

- RV free wall cannot expand
- In early diastole RV pressure exceeds LV press
- $\rightarrow$ septum bounces towards the LV
Pitfall: Septal Bouncing w/o Constriction

- Pressure overloads
  - Pulmonary Hypertension
    - End systolic bounce
- Volume overload state
  - Diastolic bounce
    - Pulmonic regurgitation
    - Aortic regurgitation
Respiratory Maneuver

- Ventricular interdependence becomes more pronounced with inspiration
- Inflow to the RA & RV increases with inspiration

Septum flattens with inspiration
Respiratory Maneuver

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Respiratory Manuever

Courtesy of Travis L. Henry, MD
Respiratory Maneuver

Courtesy of Travis L. Henry, MD
Take home points

- Not every morphologic change is consistent with constriction → diagnosis made in conjunction with other imaging modalities and clinical findings

- Pericardial enhancement increases with time
  - Scan 10 minutes post injection

- Septal bounce occurs with BBB, pulm HTN, RV volume overload, e.g. pulmonary regurgitation

- Inspiration makes septal bouncing more pronounced (due to ventricular interdependence)
  - Real-time imaging
Thank you

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