CT Findings of Pericarditis with MR Correlation

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CT Findings of Pericarditis with MR Correlation

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Outline

• Background and purpose
• Clinical presentation of pericarditis
• Pericardial anatomy and function
• Imaging findings of pericarditis
• Natural history
• Etiologies
• Cases from our institution
Financial Disclosures

The authors do not have a financial relationship that may have a direct or indirect interest in the content.
Background and Purpose

- Pericarditis is a nonspecific response to varied etiologies causing pericardial inflammation
- 5% of patients admitted to the emergency department with non-ischemic chest pain
- Italian study estimated incidence of acute pericarditis to be 27.7 per 100,000
- 1% prevalence in autopsy studies indicates pericarditis may frequently be subclinical
- Acute pericarditis in approximately 0.1-0.2% of hospitalized patients
- Consequently, pericarditis is not uncommonly found on emergency department CT scans for pulmonary embolism
- Purpose of this presentation is to increase radiologists’ awareness of pericarditis, particularly when reading chest CTs for acute chest pain, leading to earlier detection, determination of the etiology, and delivery of the appropriate management.
Clinical manifestations of pericarditis

• Nonspecific early clinical manifestations
• Chest pain (>95% of cases) - sudden onset in anterior chest, sharp, pleuritic, radiates to trapezius ridge, improved with sitting and leaning forward
• Pericardial friction rub
• ECG changes - diffuse ST elevation or PR depression
• Pericardial effusion - (estimated at about 60% in one study, with cardiac tamponade present in 5%)
• Diagnosis is usually clinical and is supported by serologic markers of inflammation -At least 2 of the above findings should be present to make the diagnosis
• Etiology specific findings:
  infectious- fever, leukocytosis
  viral - flu-like respiratory or gastrointestinal symptoms
  autoimmune, granulomatous, or neoplastic - specific to underlying disorder
Pericardial anatomy

- Pericardial sac envelops the heart, proximal ascending aorta, pulmonary trunk, and small portion of the pulmonary veins
- Pericardial sac is anchored inferiorly to the central tendon of the diaphragm and anteriorly to the sternum via the sternopericardial ligament
- Both fibrous and visceral layer have a thickness of about 0.5-1.0 mm
- Contains about 20-25 mL of plasma ultrafiltrate
Pericardial anatomy

2 major pericardial sinuses - Transverse sinus (2) and Oblique sinus (7)

Several pericardial recesses - can pool pericardial fluid
Superior aortic recess (1)
Right pulmonic recess of transverse sinus (2)
Left pulmonic recess of transverse sinus (3)
Postcaval recess (4)
Right pulmonary recess (5)
Left pulmonary recess (6)

Coronal chest CT w/ contrast show a small amount of fluid pooling in the transverse sinus (arrow) in a patient without pericardial pathology.
Pericardial function

• Minimizes ventricular dilation, impedes pathologic overdistension, mainly of thin-walled right atrium and ventricle
• Protects the heart by production of fluid and surfactants
• Limits displacement of heart in mediastinum
• Slight negative pressure of pericardial cavity - pericardium functions as a pressure transducer between the heart and the remainder of the chest
• Ventricular coupling - result of ventricles being surrounded by relatively inelastic pericardium
Natural history

- Pericardial inflammation results in formation of fresh highly vascular granulation tissue accompanied by variable amounts of pericardial fluid accumulation.
- Commonly benign, most patients respond well to NSAIDs, but up to 30% of patients will have recurrent bouts of pericardial pain.
- Often accompanied by some degree of myocarditis - negative prognostic indicator.
- May progress to chronic sclerosing pericarditis, characterized by fibroblasts and collagen deposition leading to constrictive pericarditis.
- Risk of constrictive pericarditis is low following idiopathic pericarditis (<0.1%) but is relatively frequent following radiation and in purulent and tuberculous pericarditis.
- 12% develop symptomatic pericardial effusion rarely with cardiac tamponade.
Imaging

- TTE is the typical initial imaging modality in many cases is insufficient to make the diagnosis.
- Typically imaging is not required due to self-limited nature of disease process.
- CT and MRI are reserved for patients with atypical clinical features, protracted disease course, or possible progression to constrictive physiology.
- Acute pericarditis usually results in minimal pericardial thickening and pericardial effusion is small if present.
- When an effusion is associated with malignancy, pericardial nodularity may be observed on both CT and MRI.
- Pericardium is normally a relatively avascular structure, so enhancement on both MRI and MDCT is best seen in late venous or later phases.

Chest CT in a patient with acute pericarditis demonstrating a small pericardial effusion and subtle pericardial enhancement (arrow).
Pericarditis on Chest Radiography

- Typically normal
- Patients with substantial Pericardial effusion (>200mL) may exhibit an enlarged cardiac silhouette
- Oreo cookie sign
- Pericardial calcification seen in 50% of constrictive pericarditis

Oreo cookie sign: lateral chest radiograph and sagittal CT in the same patient show a radiopaque layer of fluid (arrow) separates the relatively radiolucent pericardial fat and epicardial fat.
Computed Tomography

- Pericardial inflammation seen as uniform pericardial enhancement and thickening, with or without pericardial effusion
- Superior to MRI in detecting pericardial calcification which can be seen with chronic or prior pericarditis
- Chronic pericarditis - pericardial layers tend to be irregularly thickened and effusions may be loculated due to the presence of adhesions

Pulmonary embolism CTA:
- Small pericardial effusion and pericardial fat stranding
- Pericardial calcifications (arrows) in this patient with chronic pericarditis
MRI

- Normal pericardium appears as a thin band of low signal intensity on T1, T2 weighted black blood FSE, and SSFP images due to fibrinous structure with low water content.

- Pericardium more apparent at the right ventricular free wall, right atrioventricular groove, inferior aspect of the left ventricle, and left ventricular apex.

- Fat and fluid makes visualization of the pericardium easier.

- Tissue characterization with MRI is superior to CT and echocardiography - can demonstrate myocardial involvement.

- High sensitivity for distinguishing constrictive pericarditis from restrictive cardiomyopathy.

- Evaluates for signs of tamponade and constriction.

- Cine images can show tethering of the pericardium.

4-chamber LGE (left) demonstrating pleural and pericardial enhancement and SSFP short axis cine (right) demonstrates tugging of the diaphragm on systole, suggesting adhesion.
Etiologies

Causes may be infectious/inflammatory, neoplastic, post cardiac injury, drugs/toxins, radiation, trauma, metabolic, vascular, or idiopathic

- **Infectious/inflammatory**
  In developed countries most cases are presumed to be viral in origin (80%-85%)
  Tuberculosis and HIV are major causes in developing countries
  HIV - Prior to widespread availability of antiretroviral therapy, pericardial disease was the most common manifestation of AIDS

- **Malignancy**
  Responsible for about 5% of acute pericardial disease
  Most commonly from lung cancer, breast cancer and lymphoma
  Can result in nodular contour of pericardium

- **Systemic disorders**
  Collagen Vascular Disease - most likely to occur in SLE and Rheumatoid arthritis
  Uremia - pericarditis in about 6%-10% of patients with advanced renal failure who are not being dialyzed, can occur in acute or chronic renal failure
  Inflammatory bowel disease, Whipple disease

Enhancing mass (arrow), pericardial enhancement and thickening in a patient found to have an epithelioid hemangioendothelioma
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ED Pulmonary embolism CTA: moderate to large pericardial effusion with intermediate attenuation indicative of exudative effusion and a 3 cm soft tissue attenuation lesion along the inferior interatrial septum (arrow).

Cardiac MRI performed two days later: enhancing soft tissue mass (arrow) infiltrating the right atrium and IVC. Pericardial effusion and enhancement consistent with malignant pericarditis. Patient was found to have an epithelioid hemangioendothelioma.
Etiologies

- **Post myocardial injury**
  - Pericarditis occurs in approximately 10% of patients shortly following myocardial infarction - Greater risk with large transmural infarct and in those who do not receive thrombolytic therapy
  - Trauma and surgery may also lead to pericarditis

- **Drugs/toxins** - list is long
  - Drugs that induce lupus-like syndrome - procainamide, tocainide, hydrazine, isoniazid, methyldopa, phenytoin
  - Doxorubicin, daunorubicin
  - Penicillins may cause hypersensitivity pericarditis

- **Radiation**
  - Most cases following radiation for Hodgkin lymphoma or breast or lung cancer
  - Can occur when dose exceeds 40 Gy
  - Can occur decades after treatment
  - Pericardial thickening limited to radiation field
Case 1

64 year old presenting to the emergency department with leg swelling and shortness of breath

Chest CT with contrast demonstrates a small pericardial effusion with mild fat stranding

Pericardium demonstrates late gadolinium enhancement
Case 1

T1 pre and post contrast images demonstrate pericardial enhancement.

Septal flattening consistent with constrictive physiology seen on cine images.
Case 2

57 year old male with a history of sarcoidosis who presented to the emergency department complaining of chest pain exacerbated with breathing, recent international flight.

PE CT shows trace pericardial thickening. Recommended considering pericarditis if clinically appropriate.

MR follow up demonstrates circumferential pericardial late gadolinium enhancement.
Case 3

60 year old male with pneumonia. Note the new effusion, stranding, and "split pericardium" sign indicating pericardial thickening.

Patient was diagnosed with subacute pericarditis linked to an episode of chest pain 3-weeks earlier and started on indomethacin.
Case 3

Short axis CT reformat does not demonstrate septal flattening. Looking for septal flattening can clinch the diagnosis of constriction but is not sensitive on single-phase CT.
Case 4

Initial CTA (left) demonstrates a pericardial effusion. Follow CT PE 3 weeks later demonstrates resolution of effusion, but pericardial thickening and inflammatory stranding persist. Pericarditis was suggested on CT and MRI was ordered.
Case 4

Follow up MRI showed circumferential pericardial enhancement. No evidence of constrictive physiology.
References


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