

Cardiac Imaging for the rest of us

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Educational Objectives

- Describe the different imaging modalities useful for the heart
- Address strengths and weaknesses of each
- Normal Radiographic Anatomy of the Heart
- Analytical approach to the Chest X-ray
- Strengths and weaknesses of Cross-Sectional Imaging
- Analysis of imaging in selected cardiac diseases
- Examples of cardiac diseases in cross-sectional imaging

Cardiac Imaging

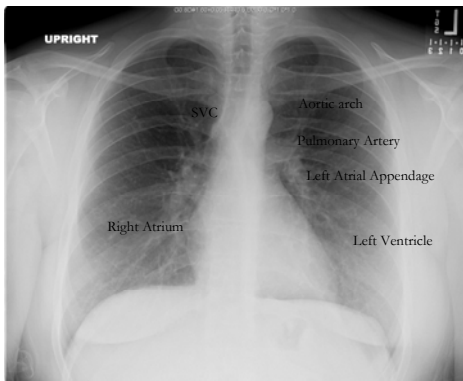
- Chest radiography
- Echocardiography
- Nuclear cardiology
- Cardiac and coronary angiography
- CT
- MRI

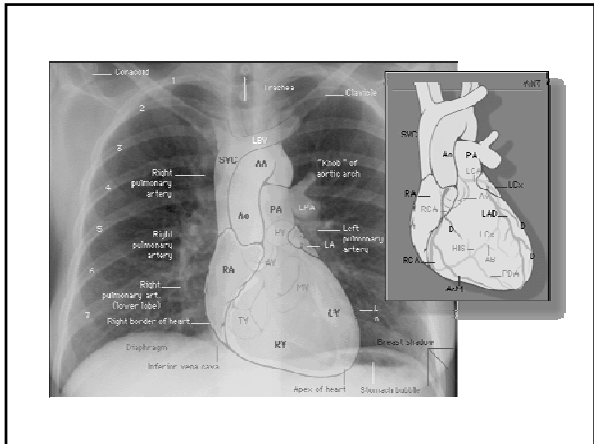
Cardiac Imaging

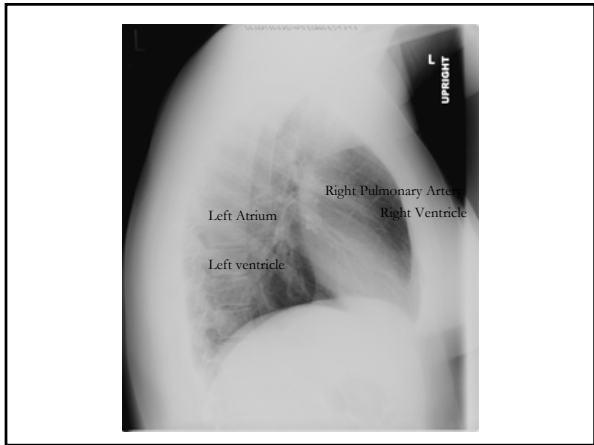
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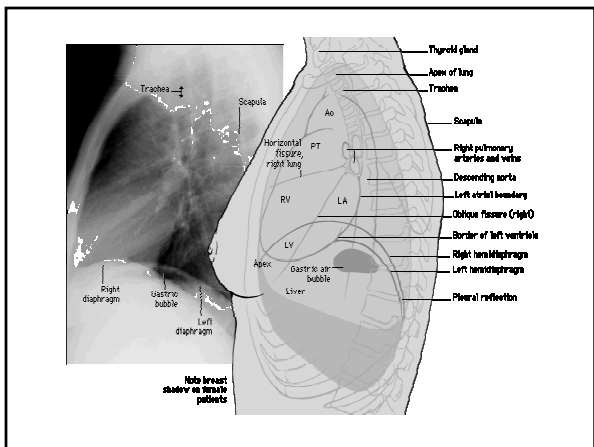
Cardiovascular imaging

- Chest Radiography: Initial imaging modality of choice
- CT and MRI: Evaluation for aortic pathology, cardiac morphology, intracardiac masses and thrombi, pericardial disease, now ARVD.
- With EKG gating, information about wall motion and valvular pathology
- CT-coronarography
- MRI: Ischemia, Infarction, Infiltration



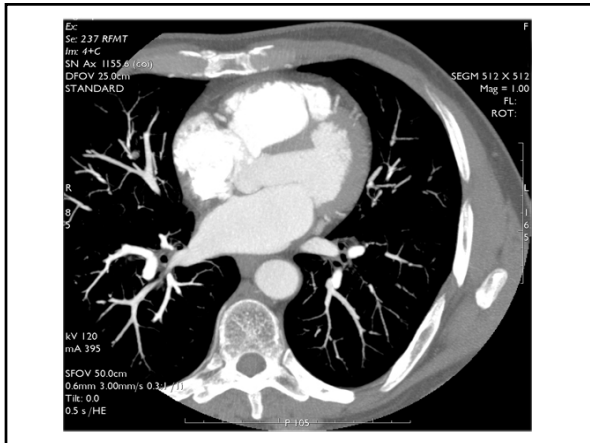


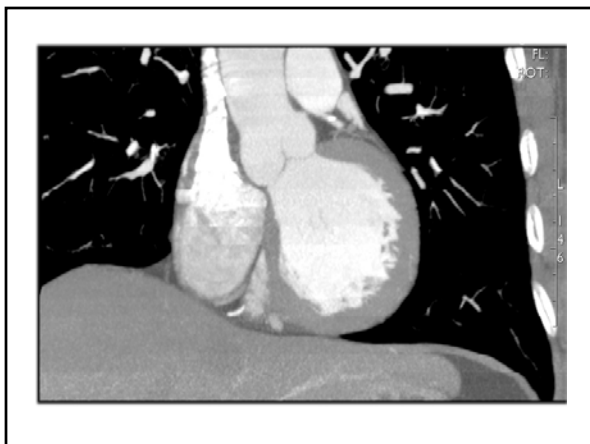


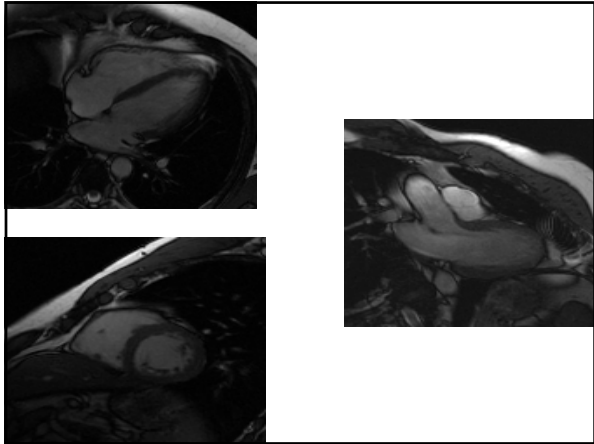


Chest Radiography

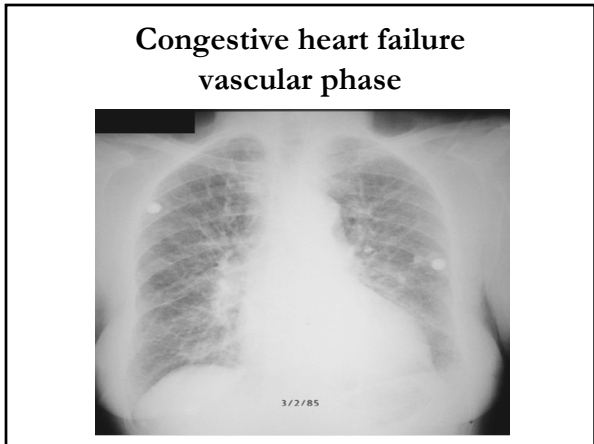
- Size - cardiothoracic ratio should not exceed 0.5 on an erect PA radiograph or 0.6 on a portable or AP radiograph
- Shape - Changes in shape suggest underlying disease processes - “water bottle” configuration with pericardial effusion or generalized cardiomyopathy
- Contours - “moguls” of the heart: aortic knob, main PA, left atrial appendage
- Pulmonary Vascularity: accessory but helpful hints, increased vs. decreased, ASD, VSD,







Shortness of breath.



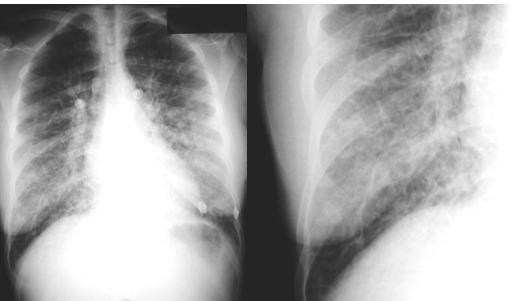
Findings:

- Enlarged heart
- Vascular markings are more prominent in upper lung fields

CHF

- Enlarged heart
- Kerley lines- septal edema
- Blunting of costophrenic angles from pleural effusion
- Cephalization / redistribution to upper lobes
- Fullness of the hilum
- Vascular (redistribution), interstitial (poorly defined vessels, Kerley lines) and alveolar (patchy lung opacity - perihilar -"butterfly" pattern) phases
- Onset and resolution can be rapid

CHF - interstitial phase



CHF- alveolar phase



Dyspnea and systolic aortic murmur.

Aortic Stenosis



Findings:

- Left heart apex displaced to the left, posteriorly or inferiorly
- Pulmonary edema

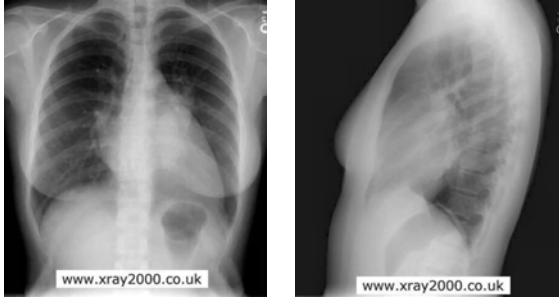
Findings: LV enlargement

- Pressure overload (HTN, aortic stenosis) and volume overload (VSD, aortic or mitral regurgitation), wall abnormalities (hypertrophic cardiomyopathy)
- CXR cannot reliably distinguish between LV dilatation and hypertrophy

Aortic Stenosis

- Valvular (most common)
 - Degenerative leaflets in patients
 - Bicuspid
 - Rheumatic
- Subvalvular
 - Idiopathic hypertrophic subaortic stenosis (IHSS)
 - Congenital
- Supravalvular (rare)
 - Williams syndrome (unusual facies, mental retardation, hypercalcemia)
 - Rubella

Rheumatic heart disease.



Findings:

- Left atrial appendage prominence
- Splaying of the carina
- Double density along the right heart border
- Left bronchus is displaced posteriorly

Findings: LA Enlargement

- Valvular disease (mitral stenosis/ regurgitation), shunts (left-to-right or right-to-left shunts & admixture lesions), masses (myxoma of LA).

Patient undergoing a barium examination.

Pulmonic Stenosis



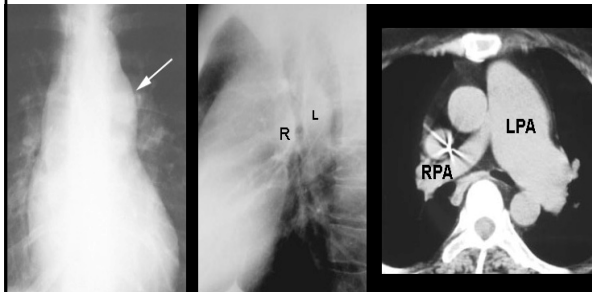
Findings:

- Enlarged main pulmonary artery
- Enlarged left pulmonary artery (jet stream effect)
- Normal to decreased peripheral pulmonary vasculature

Enlarged main PA

- Postenotic dilatation
- COPD
- PA hypertension
- Left-to-right shunts

Pulmonary Stenosis



Pulmonary Stenosis

- Pulmonary stenosis: valvular, subvalvular (infundibular), or supravalvular -- associated with obstruction to right ventricular outflow.
- Valvular pulmonary stenosis (> 90% of pulmonary stenosis). The pulmonary valve may be bicuspid or dysplastic, as seen in Noonan syndrome.
- Isolated subvalvular pulmonary stenosis (uncommon) - usually is associated with a VSD, such as in tetralogy of Fallot.
- Supravalvular pulmonary stenosis: often associated with rubella syndrome and Williams syndrome

Pericardial Effusion



Findings:

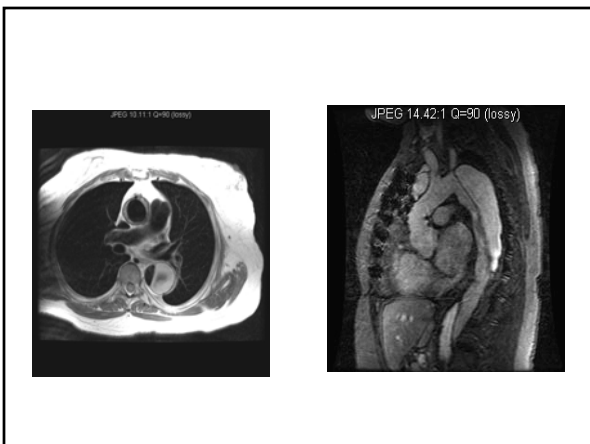
- Globular enlargement of the heart, “water-bottle” configuration
- Classic differential of pericardial effusion or cardiomyopathy

Pericardial Effusion

- An accumulation of fluid within the pericardial sac. Many causes including uremia (renal failure), collagen - vascular disease, infections (TB), malignancies, or pericarditis.
- Diagnosis can be confirmed by echocardiography or CT
- Clinically: Muffled heart sounds, Low voltage on EKG

**Patient with
hypertension and chest
pain radiating to the
back.**





Findings:

- Mild dilatation of the ascending aorta with localized narrowing of the distal aortic arch and mild dilatation of the descending aorta: “inverted figure of 3”
- Left ventricle hypertrophied and the pulmonary blood flow is normal.
- inferior aspects of posterior ribs 3 to 12 bilaterally are notched.

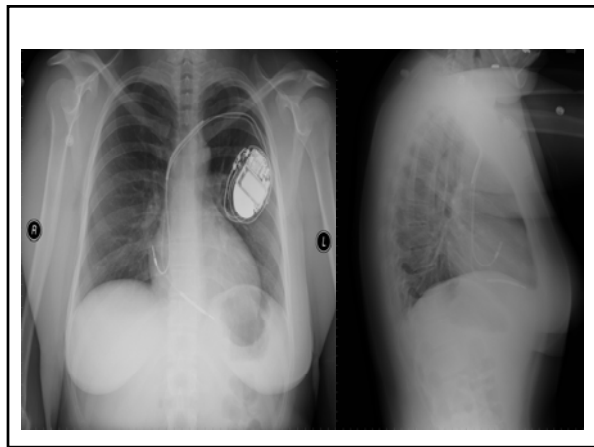


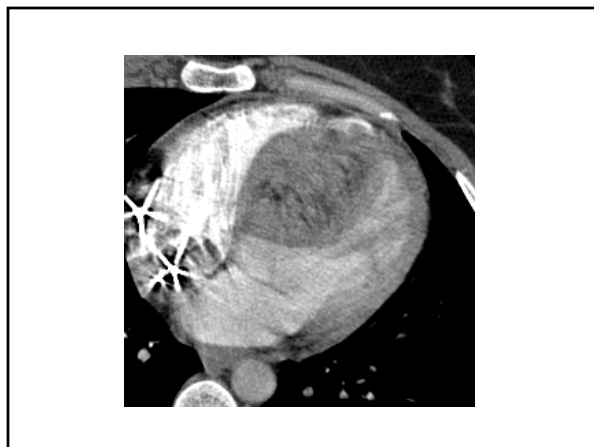
Coarctation of the aorta

- Congenital abnormality with narrowing of the aorta most commonly found just distal to the origin of the left subclavian artery (juxtaductal).
- Rib notching: pressure erosion by the enlarged and tortuous intercostal arteries in the costal sulcus of the ribs and provide collateral blood flow to circumvent the stenotic aortic segment.
- Rib notching implies long-standing obstruction and is not typically seen before age 10.

**36 year old female with
pleuritic CP.**

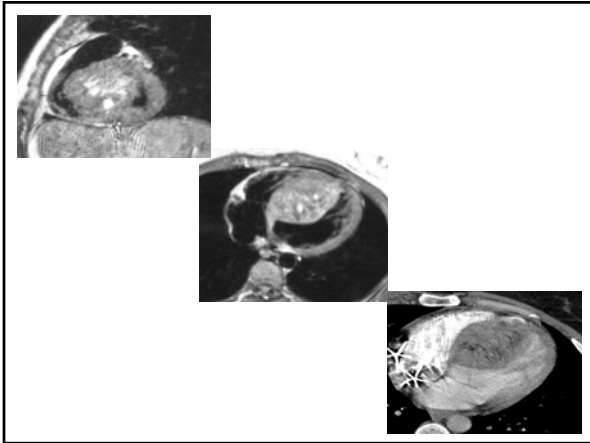
**S/p pacemaker 4
months ago.**

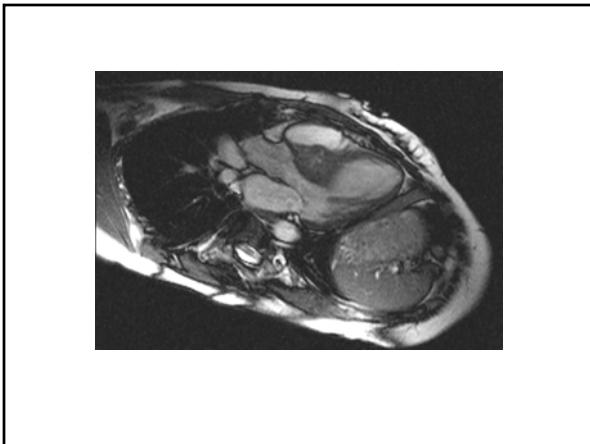




Findings:

- CT: demonstrates globular enlargement of the interventricular septum with multiple areas of low density
- MR: demonstrates a smooth, heterogeneous interventricular septal "mass"





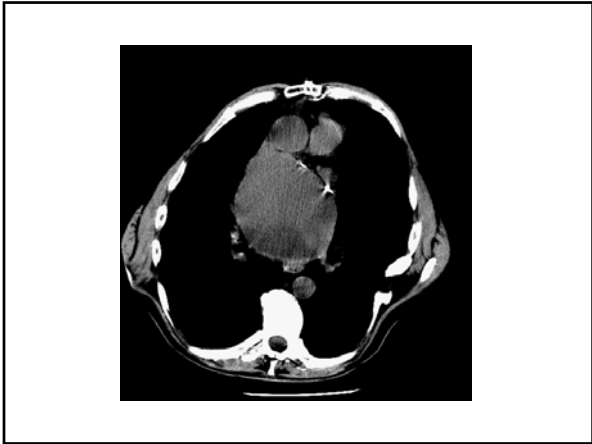
Hypertrophic Cardiomyopathy

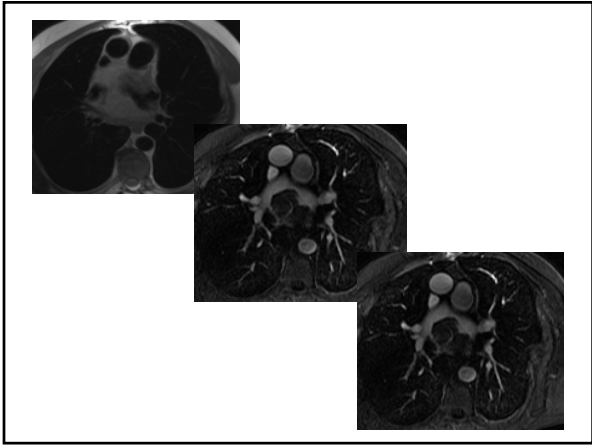
- 2 basic types: concentric hypertrophy and asymmetrical septal hypertrophy (idiopathic hypertrophic subaortic stenosis)
- Autosomal dominant with 0.2% prevalence
- Presentation – Family history, new murmur, arrhythmia, heart failure, sudden death; most common cause of sudden cardiac death in young

**Status post heart
transplant.**

Recurrent pneumonias.







Findings:

- CT: demonstrates an enlarged left atrium with contains a low density focus
- MRI: demonstrates an irregular shaped “mass lesion” which is high intensity on T1 weighted imaging and does not enhance on postcontrast imaging

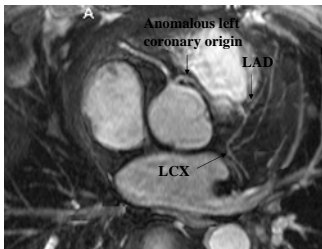
Left Atrial Thrombus

- Common source of thromboemboli
- Appearance on CT depends on age of thrombus but NO contrast enhancement on CT or MRI

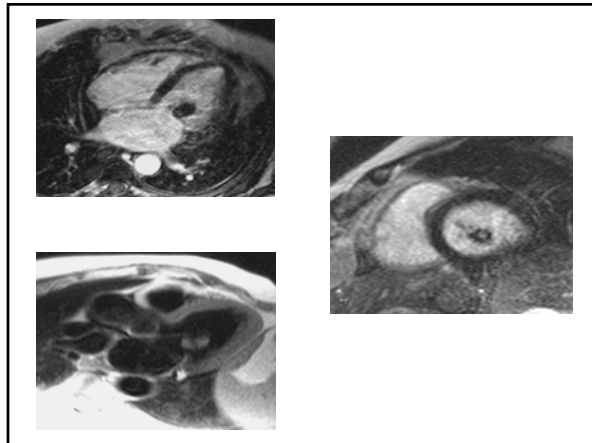
Other applications of Cardiac MRI

- Differentiation of myocardial ischemia from infarction
- Spatial assessment of infarcted myocardium: segmental and transmural
- Evaluation of infiltrative disorders of the myocardium: AVRD, sarcoidosis, amyloidosis.
- Congenital cardiovascular anomalies

Anomalous Left Coronary Arteries



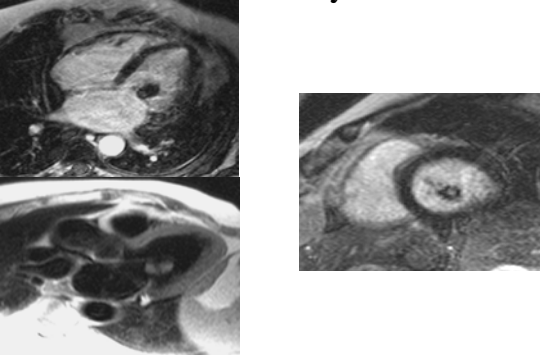
**Shortness of breath,
especially when lying
down, light-headedness
and feeling of chest
palpitations.**



Findings:

- Small, polypoid mass associated with the mitral valve that is hypointense on spoiled gradient echo sequences and isointense on double inversion recovery sequences
- Cine clip demonstrates prolapse of the mass into the left ventricle

Mitral Valve Myxoma

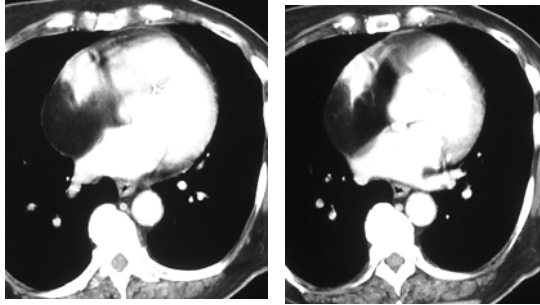


Myxoma

- Most common primary cardiac tumor
- Women > Men; 30 – 60 years
- Presentation –
 - Shortness of breath, orthopnea, paroxysmal nocturnal dyspnea
 - Arrhythmias are rare
- Associated with Carney complex in 7%
 - Breast fibroadenomas and pituitary adenomas
 - Hyperpigmentation and endocrine hyperactivity
 - Testicular neoplasms
- Treatment – Surgical excision

SVC syndrome.

Lipomatous Hypertrophy of the InterAtrial Septum



Findings:

- CT: lobular hypodense “mass-like” appearance of the interatrial septum
- MR: “mass-like” appearance in the interatrial septum following fat signal intensity. There is no enhancement with contrast. Compression of the SVC is seen.

LHIAS

- Wedge shaped enlargement of the interatrial septum
- Contains mature adipose cells, fetal fat cells or brown fat
- Increased risk with age and body mass; corticosteroid therapy
- Presents with arrhythmias and SVC syndrome
- Treatment: observation, weight loss, cessation of steroids, excision in cases of persistent obstruction

Chest Pain



In summary...

- Chest radiograph:
 - Ddx cardiac vs pulmonary
 - To direct additional evaluation
- CT:
 - pericardium, aorta, pulm.arteries, coronary
- MRI:
 - Great vessels, Ischemia vs. Infarct, Valves, Coron. Anoml
- Nuclear Medicine:
 - MPI, CAD, EF, wall motion

- www.emedicine.com
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