Radiographic Evaluation of Aortic Insufficiency

Jesus Vazquez, Harvard Medical School Year III
Gillian Lieberman, MD
Plan of Attack

• Patient Presentation
• Radiographic Findings
• Summary of used and unused radiographic arsenal with their indications
• Evolving advances in cardiac imaging
Mr. R’s Headache

- 43 year old Male
- Two day History of:
  - Headache
  - Nausea
  - Vomiting
  - paraphasic errors
- **LP**: WBC 235, RBC 355, Protein 52, Glucose 61
- Sent for: CXR and CT
Radiographic Findings on Presentation

Lungs clear

Heart: normal size; Rotated left

Intraparenchymal hemorrhage

Images Courtesy of Dr. Applebaum BIDMC
Mr. R’s first 24 hours

- **Vitals:**
  - Fever 102F
  - SBP 170
  - HR 130

- **Deteriorating Neurologic exam**
  - Decreased Level of consciousness
  - Extensive Posturing on left
  - Withdrawl on Right

- **Repeat: CXR and CT**
Radiographic Findings on Day #2

Perihilar Opacities

Basilar Opacities

Hemorrhage into Right Ventricle

Images Courtesy of Dr. Applebaum BIDMC
Mr. R’s Care

- OR for hematoma evacuation
- Post-op: CPK 38 with elevated CK-MB
- Cardiology Consult for Suspected Septic Emboli
Differential Diagnosis of Cerebral Abscess

- Blood-borne metastases: Heart and Lung Most Common
- Direct extension from parameningeal sites (otitis, cranial osteomyelitis, sinusitis)
- Recent or remote head trauma
- Recent neurosurgical procedures
- Infections associated with cyanotic congenital heart disease
- Iatrogenic: Indwelling IV Catheter
- IV Drug Use
Etiologies of Aortic Insufficiency

- Intrinsic to the Aortic Valve
  - Congenital Bicuspid Valve
  - Rheumatic Endocarditis
  - Bacterial Endocarditis
  - Myxomatous valve with Cystic Medial Necrosis

- Primary Disease of Ascending Aorta
  - Dilated Aortic Annulus
    - Syphilitic Aortitis
    - Ankylosing Spondylitis
    - Reiter Disease
    - Rheumatic Arthritis
    - Marfan Syndrome
  - Laceration/Aortic Dissection
    - Deceleration trauma
    - Hypertension
Evaluation of Aortic Insufficiency
Clinical Findings

• Patient Presentations
  • Asymptomatic for many years
  • Physical Exam: Bisiferious Pulse, Water-Hammer Pulse, Quincke’s Pulse, Musset’s Sign, Muller’s Sign, Traube’s Sign, Duroziez’s Sign
  • Eventually CHF (PND, Orthopnea, DOE, pulmonary edema)

• Non-Radiologic findings
  • Wide Pulse Pressure
  • Bounding Pulses
  • Diastolic Blowing murmur: first early diastolic, then holodiastolic, and eventually softens/disappears as approach heart failure
  • S3
  • Systolic Ejection Murmur due to aortic distension from increased stroke volume
  • Austin Flint Murmur: mid diastolic murmur heard at apex
  • EKG: Evaluate LVH and coronary ischemia
Radiographic Evaluation

- **Chest X-Ray**: Gross identification of Cardiomegaly and Pulmonary involvement
- **Echocardiography**: Diagnosis, Etiology, Heart Morphology, and Severity
- **Angiography**: evaluation of volume and function when echo suboptimal
- **Cardiac Catheterization**: Prior to Surgery if patient is at risk for CAD
- **Exercise Testing**: assessment of functional capacity
Anatomy of the Aortic Valve

Visualizing a Normal heart on CXR

- Pulmonary Vessels
- Aortic Arch
- Left Ventricle

Classic CXR of Aortic Insufficiency

Pulmonary Edema

Prominent Aorta

Dilated Left Ventricle

Left Atrial Enlargement in Heart Failure

Acute AI

Chronic AI

Echocardiography

- Can be used to evaluate:
  - Valve Anatomy: thickening, vegetations, calcification, movement, and Valve Area
  - Aortic root dilatation
  - Wall thickness
  - Cavity Size
  - Cardiac Output
  - Semiquantitative measurement of regurgitation

- Weakness:
  - Acoustic windows
  - Semiquantitative measurements

Higgins, Charles B. Essentials of Cardiac Radiology and Imaging. J.B. Lippincott 1992
Angiography

- Increased Left Ventricle Cavity, EDV, ESV, Stroke Volume, and Aortic Dilatation
- Structural Abnormalities: Valve, Septum, or Bodies
- Regurgitation of Blood
  - Trivial: Contrast cleared with each systole
  - Moderate: incomplete clearance but without accumulation
  - Severe: Accumulation with each beat
  - Gross: Completely filled with first diastole

Higgins, Charles B. Essentials of Cardiac Radiology and Imaging. J.B. Lippincott 1992
Healthy Coronary Arteries

Surgical Indications for Aortic Valve Replacement

- NYHA functional Class III or IV symptoms With Normal systolic function (ejection fraction >0.50 at rest)
- NYHA functional Class II, III, or IV symptoms and with mild to moderate LV systolic dysfunction (ejection fraction 0.25 to 0.49)
- Patients with severe LV dilatation (end-diastolic dimension >75 mm or end-systolic dimension <55 mm), even if ejection fraction is normal

New York Heart Association Functional Classification
- Class I - No symptoms or minimal symptoms with ordinary physical activity
- Class II - Symptoms with ordinary activity; slight limitation of activity
- Class III - Symptoms with less than ordinary activity; marked limitation of activity
- Class IV - Symptoms with any physical activity, or even at rest
What Happened to Mr. R.?
Hospital Course

- He gradually became less responsive over the next week with worsening BP control and elevated temperatures
- CXR 10 days after admission
- Surgery Consulted But unable to assist because of therapeutic heparinization requirement
- Patient expired on hospital day 11

Images Courtesy of Dr. Applebaum BIDMC
Up-and-Coming Non-Invasive Studies
Computed Tomography

- Most Sensitive study for identifying calcification
- High accuracy in differentiating thrombus from tumor
- Contrast allows evaluation of: Chamber Volume, Chamber Shape, Wall Thickness, and Myocardial Mass
- Speed of study allows for lack of EKG gating
CT of Heart

- Dilated Ascending Aorta
- Dilated Left Ventricle
- Mild thickening of myocardium

MRI

- Simultaneous Structure and Function
- Accurate measurement of: EDV, ESV, EF, SV, CO, and Myocardial Volume
- Quantitative evaluation of regurgitation (flow vs. time)
- No difficulties with image plane
- Requires EKG gating (TR must equal R-R multiple)
MRI of Regurgitation

Images Courtesy of Dr. Averbach, BWH
Summary

- Aortic Insufficiency
  - Acute with drastic health changes
  - Chronic with an insidious onset

- Current Process of Diagnosis:
  1. Physical Exam
  2. CXR
  3. Echo with Doppler
  4. Aortogram
  5. Cardiac Catheterization

- Advances in CT and MRI are promising in filling wholes in non-invasive studies
References

- **Goldman: Cecil Textbook of Medicine, 21st ed**
- Lipton, M.J. Coulden, R. Valvular Heart DiseaseCardiac Radiology. 37 (2): 319-339 1997
- **Up To Date:** ACC/AHA guidelines for the management of patients with valvular heart disease: Aortic regurgitation
- **Up To Date:** Aortic Insufficiency
Acknowledgements

Many Thanks to:

• Larry Barbaras and Cara Lyn D’amour our Webmasters
• Dr. Applebaum (BIDMC)
• Dr. Averbach (BWH)
• Gillian Lieberman, MD
• Pamela Lepkowski
THE END