Objectives
Understand the various imaging techniques of aorta and valve
Review the Normal Anatomy
Review the imaging presentation of the pre- and non-operative
Review the post-operative imaging

Aortic Valve

Advantages
- No radiation
- Multiplanar anatomy
- Flow quantification
- Functional analysis
- About the same cost/charge as Echo

Disadvantages
- Time
- Processing of data
- Limited to planes of data acquisition
- Pacemakers, other contraindications for MR
- Limited evaluation of prosthetic valves

Anatomy: MR Sequences
- HASTE (Black Blood Static Sequence) –
  - Breath Hold
  - Transaxial
  - Coronal
  - Sagittal
- FISP (Bright Blood Static Sequence) –
  - Axial
All EKG-gated.

Function: MR Sequences
- Bright Blood Cine –
  - Cine GRE (TurboFLASH, fast SPGR, TFE/FFE)
    - Rely on TOF effects, use inflow enhancement for image contrast.
    - Blood pool to myocardial CNR can degrade with short TR’s.
    - Breath hold
Routine Cardiac Scan Planes

- Vertical (2-chamber) long axis
- Horizontal (4-chamber) long axis (stack)
- Short axis (stack)
- Aortic valve
  - Aortic cross-section (flow quantification)
- Pulmonic valve
  - Pulmonic cross-section (flow quantification)

Phase contrast Imaging

- Phase shift are proportional to velocity in direction of gradient
- Signal is velocity encoded
  - Gray no velocity
  - White movement in one direction
  - Black movement in opposite direction
- VENC – maximum velocity
  - Peak velocity
- \( \rho = 4(v_p)^2 \)

Flow Quantification

- Image plane perpendicular to aorta (flow of blood)
  - Approximately 1 cm above the valve
  - Phase contrast images should look black (left)
  - If image white (right) then repeat sequence by increasing the velocity scale to 300.

CT of Cardiac Valves

- Advantages
  - Anatomic evaluation
  - Wide range of multiplanar capabilities
  - Functional analysis
  - Flexibility in post processing
  - Pacemakers and prosthetic valves
  - May not need to Cardiac Gate for evaluation

- Disadvantages
  - Radiation
  - No flow quantification
  - Irregular rhythm
  - Cannot be performed on all scanners

Aortic Valve
Aortic Stenosis

Types

- Calcific AS – process similar to atherosclerosis
- Bicuspid AS – Most common in younger individuals (<65 years); 2 to 3% of population
- Rheumatic AS – Uncommon, associated with Mitral disease.

Aortic Stenosis

Scale -300 to 300

Velocity >= 4.0 m/s

Gradient >= 40 mmHg

V = 2.9 m/s
Grad = 34 mmHg

V = 1.9 m/s
Grad = 14 mmHg

Bicuspid Aortic Valve

Valve Area

Area < 1.0 cm²
Bicuspid Aortic Valve

Coartation

Sub-aortic Membrane

Aortic Regurgitation

Area = 0.25 cm²

Regurgitant fraction ≥50 %
Regurgitant orifice area ≥0.30 cm²
Percutaneous Valve Repair

- Aortic Measurements
  - Measured at the valvular attachments
- Femoral vessels
  - Minimum diameter
  - Plaque burden

Valve Measurements

Aortic Dissection

Marfan’s Syndrome

Post-Operative Evaluation

- General surveillance
  - Prosthetic valve function
  - Abnormal prosthetic valve echo
  - CT
  - Fluoroscopy
- Post-operative Evaluation
  - Peri-valve breakdown
  - Abscess
Prosthetic Valves

- Valve Failure
  - Tearing or breakage of components
  - Thrombus
  - Gradually from calcifications or thrombus formation
- Prosthetic valve endocarditis
  - Due to peri-operative contamination or hematogenous spread.
  - PVE occurring after 60 days

CT of St. Jude’s Mitral Valve

CT of Medtronic-Hall Aortic Valve

Fluoroscopy of Aortic Valve

120 degrees

St. Jude’s Mitral Valve
- Open <15 degrees
- Closed 120 degrees

CT of St. Jude’s Aortic Valve
Conclusion

- Echocardiography remains the backbone of valvular imaging
- Advances in MR and CT
  - Functional analysis
  - Anatomic analysis
- Valve Repair and replacement has increased
  - Knowledge of Postoperative normal
  - Knowledge of Postoperative complications