Pediatric Echocardiography
The Segmental Approach

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Objectives

- Review pediatric echocardiogram protocol
- Understand basic views
- Knowledge of image display and orientation used in pediatric echocardiography
- Understand cardiac segmentation and sequential approach
- Understand non-standard views
Indications

- Cyanosis
- Murmur
- Failure to thrive
- Syncope
- Chest pain
- Cardiomegaly on chest x-ray
- Syndromes
  - Family history of inherited heart disease (i.e. Cardiomyopathy)
  - Certain Arrhythmias

- Kawasaki disease
- Endocarditis
- Rheumatic fever
- Myocarditis
- Pericarditis
- Systemic Lupus Erythematosus
- Chemotherapy and Radiation
- Pulmonary hypertension
- Indwelling catheters
Image Display

- Anterior and superior structures at top of screen
- Rightward structures on left side of display
  - Except in PLA \(x\) apex displayed to left of screen
- Apex of heart at bottom of screen in subcostal and apical views
- Complete sweeps
Image Display

- Dextrocardia
  - RIGHT side of screen in PSAX, Apical 4 Ch, and Subcostal transverse (long) axis is always the left side of the patient
  - Rotate transducer so notch is pointing to patient’s left
Imaging Planes

- Parasternal long and short axis
- Apical 4ch, 2ch, and 3ch
- Subcostal long and short axis
- Suprasternal long and short axis
- Right parasternal long axis
- High left parasternal long axis
Parasternal

- PLAx
  - Notch at 10 o’clock
  - Perpendicular to ventricular septum
  - Evaluate MV excursion
  - Aortic Annulus, Sinus, and ST junction measurements
  - Mitral-Aortic valve continuity (TOF vs. DORV)
  - Origins of great arteries
Parasternal

- PSAx
  - Transducer notch at 2 o’clock
  - Evaluate ventricular septum
  - Evaluate papillary muscles
  - En face of aortic valve
  - Orientation of great arteries
  - Assess coronary artery origins
  - Pulmonary artery branching
  - Patent Ductus Arteriosus
  - Occasionally evaluate atrial septal defect
Apical

- Apical 4 Chamber
  - Best view to determine position of cardiac apex in thoracic cavity
  - Notch at 2-3 o’clock position at apical impulse
Apical

- Apical 3 Chamber ("LV inflow/outflow")
  - Notch at 4 o’clock
  - Optimal interrogation of LVOT by doppler
  - Mitral-Aortic continuity
Apical

- Apical 2 Chamber
  - Notch at 12-1 o’clock
  - Quantification of LV function
  - Not always performed
Apical

- Ostium Primum Atrial Septal Defects
- Dilated coronary sinus
- Pulmonary veins
  - Look for color doppler coursing AWAY from heart as indication of anomalous drainage
Apical

- Left atrial membranes
  - Cor Triatriatum
  - Supravalvar Mitral Ring
  - Relationship relative to orifice of LA Appendage

- LVOT and Aortic Valve
  - HOCM, Aortic Stenosis

- AV Valve attachments to ventricular septum
  - AV Canal Defect Rastelli Classification, Ebstein’s Anomaly
Subcostal Short Axis

- Notch at 3 o’clock position
- Determination of Abdominal Visceral Situs
  - Transverse view
  - Location of liver, stomach, IVC, Aorta, occasionally spleen
Subcostal Short Axis

- Best view for ASD/PFO
  - Most perpendicular to atrial septum
- En face view of AV valves
- Ebstein’s Anomaly – degree to which anterior leaflet of TB extends to RVOT and creates obstruction
- Can see dilated coronary sinus
  - Suggests L SVC or Anomolous Pulmonary Veins
Subcostal short axis
Subcostal long axis

- Patency of IVC through liver
- Abdominal Descending Aorta – doppler interrogation
- Best view for sinus venosus atrial septal defects
  - Associated with PAPVR and AP collateral vessels
  - Perform sweep posterior and rightward to look for associated partial anomalous pulmonary veins
Right Anterior Oblique

- Halfway in between sagittal and coronal
- Notch at 1-2 o’clock
- Best view for seeing the 5 leaflets of common AV valve (Complete AV Canal Defect)
- RVOT and pulmonary infundibular area
  - TOF and PS
  - Usually most aligned with pulmonary outflow to get highest gradient across RVOT and pulmonary valve
Suprasternal

- Long Axis
  - Notch 1-2 o’clock
  - Aortic arch
  - Patent ductus arteriosus
  - Left SVC
Suprasternal

- Short Axis
  - Notch 3 o’clock
  - Arch sidedness
  - Branch PAs
  - Innominate Vein
  - SVC – important in patient with Fontan or Glenn/Hemi-Fontan
  - Pulmonary venous anatomy
Right Parasternal

- Notch at 12 o’clock
- Window mid to upper right sternal border
- Atrial septum – looking for sinus venosus defect
- Caval-caval view – SVC thrombus
- Ascending aorta – best view for aortic doppler
- Right upper pulmonary vein
  - Rotate to short axis – notch at 3 o’clock
Off the Beaten Path

- High Left Parasternal
  - Ductal arch view – important for evaluation of coarctation in neonates
  - Notch at 12 o’clock
  - Rotating to 3 o’clock may show a Left SVC and left sided pulmonary veins
A word about Color Doppler

• Color across both atrial and ventricular septums for defects
• Color at coronary artery origins
• Color on pulmonary veins as entering left atrium
• Color across all valves
Segmental Approach

- Van Praagh
  - 3 segments
    - Atria
    - Ventricular
    - Great Arteries
  - Accurate describe, document, and assess anomalies within and between structures of the heart without resorting to obscure terminology or complicated classifications based on embryology

- Andersen
  - Sequential Segmental Approach
    - Identifies morphologic and anatomic features specific to each segment
10 Steps of Segmental Approach
Atria

- Determine atrial situs (not cardiac position)
  - S, I, A
  - Corresponds with visceral situs
- Do not rely on venous connections
  - TAPVR, PAPVR, Bilateral SVCs, Interrupted IVC
Dextra What?

- Dextrocardia, Dextroversion, Dextroposition
  - Dextroposition – heart is positioned in right thorax, seen in setting of left congenital diaphragmatic hernia
  - Dextroversion – apex of heart is pointing to right, but situs solitus; usually associated with AV discordance
  - Dextrocardia – usually associated with atrial situs inversus
Atria

- Appendages
  - Most consistent structures
  - Right Atrial Appendage – broad based, triangular
    - Best seen in subcostal sagittal (short axis)
  - Left Atrial Appendage – finger-like projection, narrow
    - PSAX and Apical 4Ch

- Atrial Septum
  - Eustachian valve
    - Best seen in subcostal views
Ventricle

- Analysis of connection between ventricles and atria
- D, L
- AV valves follow ventricles
- Cardiac Crux
  - Area where walls of atria and ventricles intersect and Atrioventricular valves positioned on ventricular septum
Right Ventricle

- RV morphology
  - Coarse trabeculations
  - Moderator Band
  - Septal attachments of AV valve
  - Tripartite – inlet, trabecular, and conus
Left Ventricle

- LV morphology
  - fine trabeculations
  - No septal attachments of AV valve
Atrioventricular Valves

- Tricuspid valve
  - Septal attachment of septal leaflet
  - Hinge point of connection to ventricular septum is inferior to that of mitral valve
Atrioventricular Valves

- Mitral Valve
  - No septal attachments
  - Apical 4 Ch best view to determine size
  - PSAX and Subcostal sagittal view best to assess papillary muscles (parachute MV, cleft MV)
  - MVP best seen in PSLAx and Apical 4Ch
Great Arteries

- Connection between ventricles and great arteries
- S, I, D, L, A

Conotruncal anomalies
- Transposition (D- or L-TGA)
- Double Outlet (DORV)
- Truncus Arteriosus (single arterial outflow)