

Cardiology Fellowship Manual

Goals & Objectives -Cardiac Imaging-

Pediatric Cardiology Fellowship
CARDIAC IMAGING
Goals & Objectives

General Objective

The Cardiac Imaging rotation is structured to permit a trainee entering the cardiology fellowship program to progress over three years to the point where they can competently and independently interpret a transthoracic echocardiogram (level II ACC/ASE training) and perform and interpret transesophageal echocardiograms. The primary goals of the rotation are to provide optimal echocardiographic training to ensure 1) the trainee possesses the knowledge and skills for practicing pediatric cardiology and 2) the basic imaging requirements for pediatric cardiology board eligibility are met. Basic skills for conducting and interpreting cardiac magnetic resonance imaging, computed tomography imaging, and fetal echocardiography will also be developed.

There is direct patient care experience during an imaging rotation. This includes acquisition of images and discussion with families and patients about the ramifications of disease.

The objective of non-invasive cardiac imaging rotations is to achieve clinical competence in imaging. Specific skills that will be acquired are an understanding of cross-sectional and segmental anatomy and cardiac physiology including both intra- and extra- cardiac morphology, an understanding of the indications, limitations and contraindications to imaging modalities, performance of imaging techniques including 2-dimensional ultrasound, Doppler echocardiography, transesophageal echocardiography, fetal echocardiography, MR scanning, 3-dimensional reconstruction of MR and CT images, and understanding of imaging protocols. Most echocardiograms will be performed during the echocardiography rotations. However, some will also be performed during on-call hours on an emergent basis. As part of this objective, the fellow should perform a sufficient number of transthoracic echocardiograms and transesophageal echocardiograms to achieve primary goals 1 and 2 (above) during the three years of training. In addition, the fellow should become familiar with and have a basic understanding of MR and CT imaging, and should participate in the imaging and reconstruction of 15 MRI/CT scans and 25 fetal echocardiograms during the 3 years of training under the joint supervision of the faculty of the Imaging Section of the Division of Cardiology.

Fundamental to the rotation are responsibilities relevant to clinical service, medical records documentation, and conferencing. These include (but are not limited to) the following (*Patient Care, PC; Interpersonal & Communication Skills, IPCS; Systems-Based Practice, SBP; Medical Knowledge, MK; Professionalism, P*):

First Year Rotations Objectives

1. To learn the operations of the Echocardiography Laboratory. To learn the general pediatric echocardiographic approach to the patient (segmental, acoustic windows, imaging planes, sweeps).

3. Demonstrate the ability to independently acquire basic cardiac ultrasound and Doppler images from the parasternal, apical, subcostal locations and suprasternal notch.
4. Obtain images of a complete transthoracic study on a patient with known uncomplicated cardiac condition within 30 minutes (e.g., oncology, transplant)
5. Obtain images of a complete transthoracic study on a patient with unknown but simple diagnosis in 45 minutes (e.g., normal, VSD, ASD)
6. To learn the basic anatomy, ultrasound, and Doppler principles.

Fundamental to the rotation are responsibilities and duties relevant to clinical service, medical records documentation, and conferencing. These include (but are not limited to) the following (*Patient Care, PC; Interpersonal & Communication Skills, IPCS; Systems-Based Practice, SBP; Medical Knowledge, MK; Professionalism, P*): Become familiar with the laboratory protocol for performance of a complete transthoracic echocardiogram (*PC; SBP*)

Responsibilities / Duties

1. Become familiar with the laboratory protocol for performance of a complete transthoracic echocardiogram (*PC, SBP*)
2. Become familiar with the most common ultrasound machine controls and their purpose. (*SBP*)
3. Become familiar with functions of machine - enter face page, 2-D, Doppler, color, settings for optimum images, end study, edit, save study (*SBP*)
4. Maintain machine and probes in a safe and clean condition (*SBP*)
5. Know normal cardiac structures and normal physiology - normal flows and pressures and how they are obtained by echo (*MK; SBP*)
6. Know how to calculate and interpret Bernoulli equation (*MK; SBP*)
7. Identify VSD - anatomy, location, size (how to quantitate), predict if restrictive, predict pulmonary pressure (*MK; PC*)
8. Identify ASD - location - primum, secundum, sinus venous, and quantify size and hemodynamic implications (*MK; PC*)
9. Accurate evaluate valvular disease by 2D imaging and complete Doppler interrogation (*MK; PC*)
10. Know how calculate, obtain, and interpret continuity equation (*MK; SBP*)
11. Participate in monthly echo quality assurance conference (*IPCS; SBP; P*)
12. When on-call, perform echocardiograms with assistance of senior fellow on-call and/or echocardiography staff physician on call if available. (*IPCS; SBP; P*)
13. Read - **Echocardiography in Pediatric and Adult Congenital Heart Disease** (Eidem) (*MK*)
 - Chapter 1 Principles of Cardiovascular Ultrasound
 - Chapter 2 Practical Issues Related to the Examination, Anatomic Image Orientation, and Segmental Cardiovascular Analysis

OR

Read - **Echocardiography in Pediatric and Congenital Heart Disease** (Lai)

Chapter 1 Ultrasound Physics

Chapter 3 Nomenclature and Segmental Approach to Congenital Heart Disease

Chapter 4 The Normal Pediatric Echocardiogram

Chapter 6 Hemodynamic Measurements

Chapter 7 Echocardiographic Evaluation of Systolic Function

Other resources for reading

The Echo Manual. 3rd Ed; Jae Oh.

Moss and Adams. 8th Ed. Shaddy, Feltes

Feigenbaum's Echocardiography, 7th Ed. Armstrong and Ryan

Textbook of Clinical Echocardiography; 4th Ed; Otto.

Fellows are highly encouraged to read daily from textbooks and relevant medical literature, with recommended progression from 2D and anatomy topics, to more complex cardiac function and Doppler topics. Questions based on individual reading are encouraged.

14. Attend Imaging conferences on Tuesday, Wednesday, and Thursday mornings. (*PC; IPCS; MK; SBP; P*)
15. Become familiar with the finances of imaging procedures (processes of costs/charges/billing) (*SBP*)

Second Year Rotations

Objectives

1. To focus teaching on finer details of transthoracic echocardiography.
2. Obtain and interpret complete diagnostic study in patients with moderate and complex heart disease.
3. Demonstrate the ability to make essential adjustments to optimize TTE image acquisition.
4. Demonstrate the ability to interpret echocardiograms with complex abnormalities, and appropriately relate those results to referring physicians and laboratory faculty in a timely fashion.
5. Begin using references available for grading severity of all varieties of cardiac pathology.
6. Begin developing a working knowledge of basic TEE cardiac anatomy.
7. Become familiar with principles of stress echo wall motion interpretation.
8. To learn the basics of MRI and CT imaging.
 - a) Learn indications/limitations of cardiac MR and CT
 - b) Learn ventricular volumetry, flow, and function and extracardiac vascular anatomy

- c) Learn cross-sectional planes, basic steady state free precession and spin echo differences
- d) Scan delays, bolus track
- e) Radiation risks

Responsibilities / Duties

1. Refine details of echocardiographic examination. *(PC; SBP)*
2. Completely and accurately formulate electronic report. *(SBP)*
3. Consistently review previous studies and make meaningful comparisons when preparing preliminary echo reports *(PC; IPCS; MK; SBP)*
4. Provide preliminary interpretation - hemodynamic and/or anatomic abnormalities after review with the attending *(PC; IPCS; MK; SBP)*
5. Gain a basic understanding cardiac hemodynamics and its assessment by Doppler techniques. *(MK; SBP)*
6. Obtain a basic understanding of digital echocardiography, including acquiring, optimizing, storage and retrieval of digital dynamic and static images. *(MK; SBP)*
7. Learn to perform ventricular volumetry and flow analysis from MR images using dedicated software *(PC; IPCS; MK; SBP)*
8. Meet with the Imaging Attending to prepare echocardiography images in advance of Monday Cardiac Care Conference. *(PC; IPCS; MK; SBP; P)*
9. Attend Imaging conferences on Tuesday, Wednesday, and Thursday mornings. *(PC; IPCS; MK; SBP; P)*
10. Read - **Echocardiography in Pediatric and Adult Congenital Heart Disease (Eidem)** *(MK)*

- Chapter 33 Intracardiac and Intraoperative Transesophageal Echocardiography
- Chapter 6 Abnormalities of Atria and Atrial Septation
- Chapter 11 Ventricular Septal Defects
- Chapter 7 Atrioventricular Septal Defects
- Chapter 15 Tetralogy of Fallot
- Chapter 18 Truncus Arteriosus
- Chapter 19 Patent Ductus Arteriosus and Aortopulmonary Window
- Chapter 16 d-Transposition of the Great Arteries
- Chapter 17 Double Outlet Right and Left Ventricle
- Chapter 12 Univentricular Atrioventricular Connections
- Chapter 8 Ebsteins Malformation and Tricuspid Valve Disease
- Chapter 9 Echocardiographic Assessment of Mitral Valve Abnormalities
- Chapter 30 Evaluation of Prosthetic Valves
- Chapter 27 Evaluation of the Transplanted Heart
- Chapter 24 Pericardial Disorders
- Chapter 28 Pulmonary Hypertension

OR

Read - **Echocardiography in Pediatric and Congenital Heart Disease (Lai)**

- Chapter 40 Transesophageal Echocardiography
- Chapter 11 Anomalies of the Atrial Septum
- Chapter 12 Anomalies of the Ventricular Septum
- Chapter 15 Common Atrioventricular Canal Defects
- Chapter 22 Tetralogy of Fallot
- Chapter 24 Transposition of the Great Arteries
- Chapter 25 Double Outlet Ventricle
- Chapter 20 Hypoplastic Left Heart Syndrome
- Chapter 27 Functionally Univentricular Heart pg. 459-466
- Chapter 13 Tricuspid Valve and Right Atrial Anomalies
- Chapter 14 Mitral Valve and Left Atrial Anomalies
- Chapter 27 Functionally Univentricular Heart pg. 467-471 (post-operative assessments)
- Chapter 35 Restrictive Cardiomyopathy and Pericardial Disease pg. 609-615
- Chapter 44 Echocardiographic Assessment of Pulmonary Arterial Hypertension

11. Read –Cardiac MRI in Congenital Heart Disease-Edited by Mark Fogel, 2011.

Fellows are highly encouraged to read daily from textbooks and relevant medical literature with recommended progression from 2D and anatomy topics, to more complex cardiac function and Doppler topics. Questions based on individual reading are encouraged.

12. Learn transesophageal echocardiography technique and imaging views. *(PC; MK; SBP)*
13. When on-call, perform echocardiograms with assistance of echocardiography staff physician. *(PC; IPCS; MK; SBP; P)*
14. Assist in MRI scanning on Tuesdays and Thursdays *(PC; IPCS; MK; SBP)*
- a) Assess patient history, develop questions and protocol
 - b) Perform basic ventricular volumetry, flow, and function analysis
 - c) If there are no MRI scans, perform transthoracic echocardiography in Echocardiography Laboratory.
15. Become more familiar with the finances of imaging procedures (processes of costs/charges/billing) *(SBP)*

Third Year Rotations

Objectives

1. To build upon the knowledge and skill acquired in First and Second Year Rotations.
2. To teach the technical approach to the transesophageal echocardiographic examination.
3. To teach intermediate MR skills and basic fetal cardiac imaging skills.

Responsibilities / Duties

1. Perform all transesophageal echocardiograms during the rotation *(PC; IPCS; MK; SBP; P)*
2. Continue to develop the ability to triage appropriateness of requested specific imaging type requested by referring physicians, and then effectively communicate recommendations for supplemental techniques or alternate imaging modality when appropriate. *(PC; IPCS; MK; SBP; P)*
3. Continue developing expertise in cardiac ultrasound imaging techniques, as well as non-ultrasound modalities available in refining the nature of suspected pathology *(MK)*
4. Begin incorporating recommendations into preliminary reports based on references available for guiding use of echocardiography in the diagnosis and surveillance of chronic cardiac disease. *(PC; IPCS; MK; SBP)*
5. Use suitable resources available for preparing high-level discussion of assigned topics. *(IPCS; MK; SBP; P)*
6. Discuss Flow analysis, scanning protocol generation, phase velocity assessment and 3D reformatting of MR with the MR Imager attending during MR scans *(IPCS; MK; SBP)*
7. Meet with Imaging Attending to prepare images in advance of Monday Cardiac Care Conference. *(IPCS; MK; SBP; P)*
8. Attend Imaging conferences on Tuesday, Wednesday, and Thursday mornings. *(PC; IPCS; MK; SBP; P)*
9. **Echocardiography in Pediatric and Adult Congenital Heart Disease (Eidem)**
(MK)
Chapter 13 Abnormalities of Right Ventricular Outflow
Chapter 14 Abnormalities of Left Ventricular Outflow
Chapter 20 Abnormalities of the Aortic Arch
Chapter 5 Anomalies of the Pulmonary and Systemic Venous Connections
Chapter 25 Vascular Abnormalities
Chapter 22 Hypertrophic Cardiomyopathy
Chapter 23 Additional Cardiomyopathies
Chapter 2 Practical Issues Related to the Examination, Anatomic Image Orientation and Segmental Cardiovascular Analysis

OR

Echocardiography in Pediatric and Congenital Heart Disease (Lai)

- Chapter 16 Anomalies of the Right Ventricular Outflow Tract and Pulmonary Valve
Chapter 19 Anomalies of the Left Ventricular Outflow Tract and Aortic Valve
Chapter 21 Hypoplastic Left Heart Syndrome
Chapter 9 Pulmonary Venous Anomalies
Chapter 10 Systemic Venous Anomalies
Chapter 18 Abnormalities of the Ductus Arteriosus and Pulmonary Arteries

Chapter 29 Congenital Anomalies of the Coronary Arteries
Chapter 30 Vascular Rings and Slings
Chapter 37 Kawasaki Disease
Chapter 33 Dilated Cardiomyopathy and Myocarditis
Chapter 34 Hypertrophic Cardiomyopathy
Chapter 35 Restrictive Cardiomyopathy and Pericardial Disease
Chapter 36 Other Anomalies of the Ventricular Myocardium
Chapter 28 (pages 476-482) Cardiac Malpositions and Heterotaxy Syndrome
Chapter 27 (pages 462-463) Functionally Univentricular Heart

10. For MR: Cardiac MRI in MRI in Congenital Heart Disease-Edited by Mark Fogel, 2011.
11. If no MRI scans on Tuesday/Thursday, perform transthoracic echocardiography in Echocardiography Laboratory.
12. Fellows are highly encouraged to read daily from textbooks and relevant medical literature with recommended progression from 2D and anatomy topics, to more complex cardiac function and Doppler topics. Questions based on individual reading are encouraged.
13. Know the finances of imaging procedures (processes of costs/charges/billing) (*SBP*)

ASSESSMENT (Fellows)

Fellows will be given verbal feedback on their performance by the faculty throughout the rotation, in particular at the mid-point of the rotation. Final evaluations by each imaging attending will be based on the general ACGME competencies of patient care, medical knowledge, practice-based learning and improvement, interpersonal and communication skills, systems-based practice, and professionalism. A formal written evaluation will be performed and available for review in portfolio.

ASSESSMENT (Program)

Fellows will assess the rotation overall as well as their attending physicians. These will be written evaluations, which will be shared with the Fellowship Program Director. Feedback from the fellows will allow for correction of any perceived deficiencies in learning opportunities on this rotation.

Participating Faculty:

Ben Acheampong, MD, MPH; Jason Cole, MD; Jonathan Cramer, MD; Jason Christensen, MD; Scott Fletcher, MD; Trey Jantzen, MD; Sara Swanson, MD, PhD; Jennifer Winter, MD; Anji Yetman MD

There are 2 faculty members assigned to the echocardiography lab daily. The faculty member assigned to Echo-1 duties will be the attending of record on all of the fellow's procedures and will have primary supervisory responsibility for the cardiology fellow on rotation that day.