Cardiac Catheterization Curriculum for Fellows in Cardiology
Dartmouth-Hitchcock Medical Center Level 1 and Level 2 Training 2008-2009

I. Overview of Training in Cardiac Catheterization

Cardiac catheterization and angiography are essential components of a modern clinical cardiology practice. Full participation in the cath lab with performance and interpretation of catheter studies will be required of all cardiology fellows for 4 rotation blocks comprising Level 1 training (see American College of Cardiology COCATS 2, March 2002). Interested fellows may spend additional time in the cath lab during the third year to gain Level 2 training; the latter is required to qualify a trainee to perform independent diagnostic catheter studies upon completion. Expected case volumes are 150 cases for Level 1 training and 300 cases (total) for Level 2 training. The goal is for each fellow to develop (i) a clear understanding of the indications, limitations, risks and contraindications regarding diagnostic catheterization; (ii) basic skills in manipulation of catheters and associated equipment to optimize safe acquisition of angiographic and invasive hemodynamic data; (iii) clinical expertise in patient/case selection and in all aspects of peri-procedural patient management; and (iv) ability to interpret findings accurately and apply knowledge of the implications of the findings for medical, surgical, and catheter-based therapeutic options in a given patient.

II. Procedure Performance and Documentation

Learning to perform procedures safely in the cath lab is a central thrust of these rotations. Fellows will play the role of primary operator increasingly as they progress in training and experience. Primary operator status in our catheterization laboratory implies that the cardiology fellow will be permitted to perform and direct the sequence of events during the diagnostic study under the direct supervision of the responsible staff cardiologist. Decisions should include the choice of catheters, sequence of right and left heart hemodynamics, camera views for coronary arteriography and angiography. The fellow will be given as much opportunity as possible to manipulate the catheters and gantry into proper position, obtain the necessary hemodynamic assessments, and perform the contrast injections. Nevertheless, the safety of the patient and the accurate completion of the diagnostic study will always be paramount. It is expected that the supervising staff cardiologist will modify the primary operator structure as required to achieve an optimal outcome on each catheterization. Following each case, the fellow is expected to engage in independent interpretation of angiographic and hemodynamic data which is to be reviewed with the responsible attending.

The CardioMac database and report generator is used to generate a log of procedures for fellows. Information may be entered into the database by cath lab support staff and by attendings and fellows involved in cases. It is the responsibility of the fellow to check database entries pertaining to his/her performance of procedures for accuracy. The fellow will gain expertise at interacting with the database and will print out a log of his/her procedures to review with a supervising attending at the conclusion of each rotation block. Active awareness of the content of his/her procedure log should direct the
fellow to seek opportunities to participate in less frequently performed procedures (such as endomyocardial biopsy or pericardiocentesis) so that competence may be gained in these.

Case volume in the cath lab varies considerably from day to day, but after an initial period of observation in the first month it is expected that each fellow will participate in 4 procedures per day. This should allow for an ample case volume (80 per rotation). Noon conferences may occasionally interfere with the ability of the fellow to scrub in or complete some assigned cases. The fellow is urged to attend conferences as a priority over continuing or starting a routine catheterization. However, if the care of the patient would be jeopardized by the fellow’s absence or if the case offers a unique training experience, absence from noon conference may be allowed.

Fellows pursuing Level 2 training will be expected to demonstrate competence to perform independent diagnostic procedures by the completion of training. In addition, fellows involved in Level 2 training will be expected to gain experience in performing catheter procedures in emergent clinical situations such as acute ST elevation myocardial infarction (see also clinical duties as below).

III. Clinical Duties

Except when attending educational conferences or participating in ambulatory clinic, both Level 1 and Level 2 fellows will be expected to be present in the cath lab or its environs during normal working hours every weekday of the rotation. Fellows training in the cath lab become an integral part of the team which is performing a service for patients with a spectrum of clinical conditions. As such, it is expected that the fellow will perform pre-cath interviews and assessments of patients and obtain informed consent when this has not been accomplished by the fellow or staff on the clinical service. Regardless, the fellow should always review the chart and discuss concerns raised by the pre-cath assessment with the attending physician assigned to the case. In addition, bidirectional sharing of information with the cath lab technical and nursing staff is crucial for safe and efficient procedures.

Following performance of the procedure, post-procedure orders will generally be written by the fellow. As above, the fellow is expected to develop facility with the report generator and should assume responsibility for the timely completion of reports. The laboratory policy is that a completed chart note should be entered in the patient’s chart before the patient returns to the ward or Same Day area, and that final reports will be completed within one working day of the procedure. Review of the angiograms and hemodynamic findings in each case with the attending staff is expected before a report is completed.

Unless involved in another case, the fellow who performs a catheterization procedure is expected to actively manage any post-procedure complications which arise. This may include assisting with sheath removal/hemostasis and handling of vagal episodes in the cath recovery area, but should also extend to active participation in handling procedure-related problems after the patient has returned to the ward. In addition to the above clinical activities, fellows engaged in Level 2 training will be expected to gain expertise in peri-procedural and procedural aspects of care of hemodynamically unstable patients or those experiencing acute myocardial infarction. To facilitate such experience, a fellow in Level 2 training will be expected to be available by
pager from home for emergent cases on occasion—typically 2 weekend days and 1
weeknight per 4 week rotation. Such “cath lab call” is not to be performed concomitantly
with general on call duties, but overall duty hour limit guidelines are not to be violated by
the addition of this experience.

IV. Educational Goals and Objectives

At the beginning of each rotation, a checklist containing knowledge base
components and technical skills/procedures will be provided for the fellow to guide
his/her efforts during the rotation. Reading requirements on the checklist will address
both knowledge base components and technical skills. This same checklist will be
reviewed at the conclusion of the rotation as part of the evaluation as below. See
appended checklists.

A. Procedures: through formal instruction and experience in the cath lab,
fellows will develop and demonstrate competence in the following:

1. Block 1
   a) access of femoral artery and veil
   b) manual hemostasis of femoral access
   c) manifold use
   d) panning
   e) right heart cath via IJ
   f) left heart cath
   g) coronary angiography
   h) left ventriculography

2. Block 2
   a) closure device use
   b) right heart cath via femoral approach
   c) shot set-up, gantry manipulation

3. Block 3
   a) vasodilator challenge
   b) intracoronary vasoactive drug administration
   c) bypass graft angiography
   d) temporary pacing wire insertion
   e) pericardiocentesis

4. Block 4
   a) aortography
   b) peripheral angiography of renals, subclavians, iliacs
   c) introduction to IABP insertion/use

5. Blocks 5-8 (Level 2 Training)
   a) transseptal puncture
   b) radial and brachial artery access
   c) IABP insertion and use
   d) R & L cath in adult congenital disease
   e) catheter procedures in cardiovascular emergencies

B. Patient care: through formal training and direct experience, fellows will
devlop and demonstrate competence to deliver patient care that is
compassionate, appropriate and effective in treating patients in the following clinical settings:

1. chronic ischemic heart disease  
2. acute ischemic syndromes  
3. valvular and structural heart disease  
4. bleeding disorders and other complications associated with cardiac catheterization and drugs used in the procedures  
5. pre-procedure care including consultation and informed consent  
6. peri-procedural care of patients undergoing cardiac catheterization including post-procedural recognition and management of complications  
7. myocardial and pericardial diseases  
8. chest pain syndromes  
9. pulmonary hypertension  
10. intra-cardiac shunts and adult congenital heart disease  
11. post-CABG or other cardiac surgery

C. Medical knowledge: through reading of texts, use of online resources, and individual study, fellows will develop mastery of the core scientific literature of invasive cardiology and the application of this knowledge to patient care in the cath lab. Monthly didactic sessions on key topics in invasive cardiology will be held as part of the general core curriculum; fellows are expected to attend these regardless of rotation block. Specific content areas will include:

1. Level 1 Training (covered in blocks 1-4)
   a) Understand the indications for cardiac catheterization.  
   b) Understand the anatomy of and methods to access cardiac chambers and coronary arteries via the femoral, brachial, and radial access sites.  
   c) Understand basic principles of X-ray imaging, radiation protection, and radiation safety.  
   d) Understand coronary anatomy, its variations, and congenital abnormalities. Interpret coronary, ventricular, atrial, and aortic angiography and determine left ventricular ejection fraction.  
   e) Understand cardiac hemodynamics, including the measurement and interpretation of pressure, flow, resistance, and cardiac output in common forms of valvular, myocardial, pericardial and congenital disease.  
   f) Understand the complications of cardiac catheterization (e.g. hypotension, acute myocardial ischemia, congestive heart failure, renal failure, vascular complications, contrast reactions, retroperitoneal bleeding, and cardiac tamponade) and their management.  
   g) Select the optimal treatment modality (medical therapy, percutaneous coronary intervention, or surgery) for a given patient with understanding of the indications for and risks of each revascularization strategy.  
   h) Understand the indications for and complications of temporary
transvenous pacing.
i) Understand the indications for and complications of pericardiocentesis and recognize tamponade physiology.
j) Understand the indications for and complications of other laboratory procedures, such as endomyocardial biopsy, intra-aortic balloon counterpulsation, and retrieval of foreign bodies.
k) Understand the indications for and adverse reactions to drugs commonly used for invasive procedures, such as heparin, low-molecular-weight heparin, glycoprotein IIb/IIIa receptor antagonists, other antiplatelet drugs, thrombolytic drugs, vasopressors, vasodilators, and antiarrhythmic drugs.
l) Understand the indications for and complications of vascular closure devices.

2. Level 2 Training (covered in blocks 5-8)
a) Understand radiologic imaging, including design and operation of X-ray cineradiographic units, digital imaging and storage, radiation physics, factors influencing image quality, radiation quality assurance, and physiology of X-ray contrast media.
b) Understand the basic operation of physiologic recorders, pressure transducers, oximeters, and oxygen consumption measurement equipment.
c) Understand coronary physiology using techniques such as Doppler flow and fractional flow reserve.
d) Understand the indications for and methods of performing transseptal catheterization.

D. Practice-based learning: through longitudinal patient assessment, use of procedure logs, clinical mentoring and in sectional conferences, fellows will develop and demonstrate habits of continual critical review of outcomes and assimilation of new clinical and scientific literature which are incorporated into a continually improving clinical practice. Components will include:

1. regular reading of clinical and scientific literature pertaining to invasive cardiology
2. developing familiarity with online resources
3. regular participation in morbidity and mortality conference
4. maintenance of a personal procedure log with periodic critical review of patient outcomes

E. Interpersonal and communication skills: through clinical mentoring and self-appraisal, fellows will develop and demonstrate habits of effective, smooth and timely exchange of information with patients, families, colleagues and consultants. Specifically, fellows will:

1. sharpen and focus case presentations to colleagues and consultants in the cath lab setting
2. communicate effectively with cath lab support staff to ensure smooth and efficient case flow and safe patient care
3. facilitate decisions regarding procedures with patients through thorough, accurate and supportive discussion.
4. habitually and promptly convey procedure findings and results with patient families and referring clinicians.
5. maintain medical records including procedure reports and post-procedure orders in an accurate and timely fashion

**F. Professionalism: through clinical mentoring and self-appraisal, fellows will develop and demonstrate a professional approach to their work responsibilities, academic pursuits, and interactions with others.**

Specifically, fellows will:

1. maintain honesty and integrity at all times in dealing with other people and with scientific or clinical data
2. show appropriate respect for patients, families, colleagues, consultants, support staff and all members of the health care community
3. maintain confidentiality and privacy regarding patient-specific information
4. appreciate the effects of cultural and religious background on the patient’s approach and attitudes towards disease and decision-making about procedures
5. recognize ethical issues faced by patients and their care-givers, particularly in the settings of late stage chronic heart disease and abrupt-onset catastrophic cardiac disease

**G. Systems-based practice: through clinical mentoring, attendance at conferences, and self-study, fellows will develop awareness of the local, regional and global context in which invasive cardiac procedures are performed, and inform their use and conduct of procedures accordingly, providing for optimally effective and efficient use of health care resources.**

**In the cath lab, fellows will:**

1. recognize the roles of non-physician staff in patient and procedure flow and in general cath lab operations
2. learn the elements of requisite industry support for equipment and devices
3. develop an awareness of the economic impact of procedure-specific decisions

**V. Evaluations**

Upon completion of each rotation in the cath lab, the fellow will review his/her checklist and procedure log for the rotation with the cath lab training director or another responsible faculty member. A brief oral review of the rotation as experienced by the fellow, and of the fellow’s performance during the rotation will take place at that time. Arrangements for the fellow to make up any deficiencies noted will be made at this point. In addition, the fellow will be evaluated by multiple faculty members who had opportunity to work with the fellow during the rotation block. These written evaluations, entered electronically via the E*Value system, will include assessment of the core competencies and will become part of the fellow’s permanent record.
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