Interventional Cardiology Fellowship Program

General Overview

The goal of our interventional cardiovascular program is to prepare trainees to function at a high level of clinical performance in interventional cardiology. This includes the development of appropriate clinical judgment in selecting patients for cardiovascular interventional procedures and a high level of technical skill in performing them. This overall goal has four components:

1) To understand the effectiveness and limitations of coronary, peripheral vascular and structural heart interventions in order to select patients and procedure types appropriately.
2) To achieve the appropriate cognitive knowledge and technical skills needed to perform interventional procedures at the level of quality attainable through the present state of the art.
3) To foster an attitude of life-long learning and critical thinking skills needed to gain from experience and incorporate new developments.
4) To understand and commit to quality assessment and improvement in procedure performance.

Our training program does not operate in isolation. Cardiac and endovascular interventions are only some of the therapeutic techniques applicable to the management of patients with coronary artery, valvular and peripheral arterial disease. Thus, their application must be selected within the context of all potential cardiovascular therapeutic strategies and must utilize information from all available cardiovascular diagnostic techniques. The training program is integrally affiliated with, and a component of our comprehensive ACGME accredited cardiovascular medicine training program.

Program Structure

Faculty: Our faculty includes three interventional cardiologists and one invasive non-interventional cardiologist. All faculty are full-time and are committed to the teaching program.

Program Director and Faculty:
Our Program Director, Dr. Giorgio Gimelli, is board certified in Cardiovascular Medicine and Interventional Cardiology. He completed his training in 1999, and has been a fully affiliated faculty member of the overall cardiovascular training program at our institution since 2001. He is responsible for the administration of the cardiac catheterization laboratory, the overall teaching program, quality control, and trainee evaluation. Dr. Amish Raval and Dr. Kurt Jacobson are the other key faculty members and are board certified in cardiovascular medicine by the ABIM. Our faculty have expertise in all aspects of diagnostic procedures, including the evaluation of coronary, valvular, congenital and cardiomyopathic disease, and are familiar with complex hemodynamics in patients with all types of heart disease.

Associated Faculty
Drs. Maryl Johnson and Walter Kao are heart failure specialists and perform a large number of endomyocardial biopsies in our laboratory.
Drs. Girma Tefera, Margaret Schwarze and John Hoch are vascular surgeons with expertise in endovascular procedures who provide our trainees with additional exposure to diagnostic and interventional peripheral vascular procedures.

**Facility and Environment:** Our four cardiac catheterization laboratories are fully equipped and staffed in accordance with the *American College of Cardiology/Society for Cardiovascular Angiography and Interventions Clinical Expert Document on Cardiac Catheterization Laboratory Standards*. Digital radiographic image acquisition, as well as digital-image road mapping capability are available in all four laboratories, and image quality and radiation exposure are regularly monitored by appropriate support personnel. High quality physiologic monitoring and recording equipment are present in all laboratories, as well as equipment for the assessment of fractional flow reserve and intravascular ultrasound. The cardiac catheterization laboratory has on-site access to all core cardiology services, cardiac surgery, anesthesia, vascular and interventional radiology and vascular surgery. A brand new, state-of-the-art hybrid cath lab is used for structural heart and vascular procedures.

**Patient Mix**
Our trainees are exposed to a full spectrum of cardiac ischemic syndromes, including, but not limited to, stable and unstable angina, acute myocardial infarction and cardiogenic shock, as well as to a wide range of valvular and peripheral arterial disease. The trainee’s experience includes interventions in native coronary arteries and surgically placed coronary bypass grafts. Experiences is gained with the placement and management of intra-aortic balloon pumps and percutaneous left ventricular assist devices (TandemHeart), as well as in complex endovascular procedures in limb, renal and carotid arteries.

**Program Procedure Volume**
We perform a minimum of 800 coronary interventions per year, including a large number of primary angioplasties for acute myocardial infarctions, as well as at least 200 peripheral interventions per year. To date, 250 TAVI procedures have been performed at our institution with a 0.5 percent 30-day mortality.

**Conduct of Training**
The interventional cardiology fellow operates under the supervision of and reports directly to the interventional faculty member attending any given procedure. All procedures are performed under this faculty member’s direct supervision, and the nature of the trainee’s participation in a given procedure varies depending on the procedure complexity and the trainee’s experience level. Fellow are allowed an increasing amount of independence as their skills develop.

For general concerns regarding cath lab operations, the fellowship training program, or any personal concerns or difficulties that might affect the fellow’s performance or educational experiences, the fellow communicates directly with the program director, Dr. Gimelli.
Requisite participation in a procedure includes the following elements:

**Pre-procedural evaluation**

For patients referred for diagnostic or interventional procedures from the ward cardiology service or the cardiology consult service, or for patients admitted electively through the procedure service, a complete pre-operative assessment including a history and physical examination is obtained and recorded by the diagnostic cardiology fellow assigned to the case, and reviewed with the attending cardiologist prior to the procedure. Particular attention should be placed on details in the history and/or physical which may place the patient at increased risk for the procedure (for example, peripheral vascular disease, renal insufficiency, history of heart failure). The attending cardiologist performs a limited history and physical examination, and discusses discrepancies with the fellow. Pertinent laboratory values (chemistry and hematology values) are checked, and abnormal values are communicated to the attending cardiologist. The fellow is responsible for obtaining informed consent for the procedure. Procedure service nurses will often assist with obtaining consent from elective outpatients. This is a courtesy designed to enhance workflow, not an obligation on their part. Ultimate responsibility for consent resides with the fellow and attending faculty.

The indications for the procedure and the anticipated technical details are discussed with the attending cardiologist prior to the case being initiated. On rare occasions, scheduling conflicts may result in an interventional fellow assisting with a procedure on a patient previously evaluated and consented by another fellow. In this situation, the new fellow is responsible for familiarizing him/herself with the patient’s history and physical exam as previously recorded, and repeating the key positives of the physical exam as well as reviewing laboratory studies. Again, the indications for the procedure and the anticipated technical details are to be discussed with the attending cardiologist prior to the case being initiated.

Emergency cases referred for diagnostic or interventional catheterization procedures may be evaluated and consented for the procedure by the ward or consult fellow or faculty. Consent for interventional procedures cannot be obtained by housestaff or medical students. In this situation, the interventional cardiology fellow is responsible for familiarizing him/herself with the patient’s history and physical exam as previously recorded.

**Performance of the procedure by the trainee**

Interventional cardiology fellows have already achieved Level 2 training during their core cardiovascular fellowship. They will assume greater participation in interventional procedures as experience is gained and eventually perform as primary operators, although it has to be stressed that all procedures will be performed under the direct supervision of the attending cardiologist.

Vascular access alone may be obtained independently by the trainee at the discretion of the catheterization laboratory director and attending cardiologist. Difficulties with access (i.e. lack of success obtaining access after three attempts or difficulty advancing a guidewire) will require the presence of the attending cardiologist under any circumstance, and further attempts at access should be abandoned until the attending is in the room. Hemostasis (by direct compression or vascular closure device) is often done by a catheterization laboratory or procedure service nurse, but the interventional fellow involved in the case, along with the
attending cardiologist, remains ultimately responsible for hemostasis. Hemostasis-related complications should be reported immediately to the responsible cath lab faculty.

Post-procedure Care
The trainee is actively involved in post-procedural management both in and out of the cardiac catheterization laboratory. After the procedure, a preliminary catheterization report should be included in the patient’s chart. The electronic catheterization report should be completed immediately after the case (ideally before the patient leaves the laboratory), and the key findings of the diagnostic or therapeutic procedure should be discussed with the attending cardiologist. The trainee should monitor the patient’s status and be available to respond to any adverse reactions or complications that may arise, including hemodynamic instability, vascular complications, heart failure, renal failure, bleeding, myocardial ischemia or change in mental status.

Complications should be immediately reported to the appropriate cath lab faculty member (regardless of the service of origin of the patient, or the temporal relationship between the complication and the procedure). A complication form (available from the procedure service nurse) should be completed. Following resolution of the complication (or hospital discharge), a complication note may be required. The cath lab director reviews the complication form, and if a dictated complication note is required, the fellow will be notified. This one or two paragraph note should include the following elements:
1) a succinct description of the patient’s presentation
2) a list of the procedures performed, with relevant procedural details (i.e. access site)
3) a description of the complication
4) any patient or procedural risk factors predisposing towards the complication
5) any preventative measures taken before, during or after the procedure designed to mitigate this risk
6) description of the management of the complication
7) the outcome, including any long-term sequelae (or absence of sequelae)

Complications are entered into the cath lab database and discussed at the monthly Quality Assurance Conference.

Additional responsibilities of the interventional fellow include rounding on the patient at the conclusion of the work day. This requirement applies to inpatients on both the procedure and ward services, as well as patients on non-cardiology services. An exception is outpatients discharged from the APC. Post-operative rounding and documentation on these patients is provided by the procedure service nurses and attendings. However, the involvement of the fellow in the post-operative care of these patients may be requested in the event of complications.

Conferences
Trainees must attend a weekly cardiac catheterization conference and a monthly joint cardiology/cardiovascular surgery conference. The weekly conferences will include core curriculum, as well as case presentations and journal club presentations. The core curriculum reflects the recommendations of the Society for Cardiovascular Angiography and Interventions (www.scai.org). During case presentations, hemodynamic and angiographic data are discussed in context with history, physical exam and non-invasive findings. Indications, complications
and management strategies are discussed. A regular morbidity and mortality conference is held separately on a monthly basis. Interventional fellows are also required to attend weekly TAVR conferences and monthly Cath Lab Ops conferences. Trainee attendance at weekly Cardiology Grand Rounds, other core conferences, VA cath conferences, cardiovascular research and journal club conferences is strongly encouraged.

Research
Participation in clinical research is an integral component of achieving competence in the rapidly evolving field of interventional cardiology. Our interventional cardiovascular program has an active clinical research program, and our trainees are directly involved in the conduct of research, including participation in multi-center clinical trials. Trainees are involved in the conduct of and enrollment of patients in clinical trials, and participate in data analysis and presentation.

Goals and Objectives
Faculty evaluations, global evaluations, self assessment and informal feedback and simulation are the means used to evaluate the successful acquisition of the skills needed to achieve Level 3 training in Interventional Cardiology. Formal performance feedback is collected at the end of each month. Valuable individual point-of-care feedback from faculty is given to fellows on a continual basis as they practice their procedural skills working side-by-side with faculty on a daily basis in the cath lab.

Listed below are the goals of the interventional cardiovascular fellowship:

1) Medical Knowledge
By the end of their training, the fellow will demonstrate mastery of competence in the following:

- **Anatomy**: Cardiac, vascular and coronary anatomy, including anatomic variants and congenital abnormalities.
- **Physiology**: Basic circulatory physiology, coronary and peripheral vascular physiology, myocardial blood flow regulation, myocardial physiology and metabolism.
- **Vascular biology and pathology**: Normal vascular structure and function, response to injury, mechanisms of atherosclerosis and mechanisms of restenosis.
- **Pathophysiology**: Myocardial ischemia and infarction, myocardial reperfusion, circulatory shock, anaphylaxis and cardiac arrhythmias. Occlusive peripheral arterial disease, aortic dissection, penetrating aortic ulcers and intramural hematoma. Arteritis, vasospastic disorders, leg and foot ulcers. Carotid and renal artery stenosis.
- **Pharmacology**: Anticoagulants, antiplatelet drugs, thrombolytic drugs, X-ray contrast agents, myocardial inotropes, vasopressors, vasodilators, antiarrhythmic drugs and drugs affecting lipid metabolism. Peripheral arterial thrombolysis.
- **Radiology imaging and radiation safety**: Principles of X-ray imaging, quantitative coronary angiography, operation of cinefluorographic X-ray equipment, digital video
imaging systems, radiation biology and radiation protection.

- **Intravascular imaging and vascular physiology**: Principles of intravascular ultrasound imaging and Doppler coronary flow velocity measurements.
- **Non-invasive imaging**: Interpretation and selection of appropriate non-invasive vascular imaging.
- **Interventional device design and performance**: Device material and characteristics.
- **Clinical management strategies**: Performance and limitations of interventional devices, spectrum of coronary ischemic syndromes and peripheral arterial disease, results of interventional cardiology trials, management of acute hemodynamic alterations and mechanical pharmacological circulatory support.
- **Complications of the procedure and their management**: Hypotension, acute myocardial ischemia, congestive heart failure, renal failure, vascular complications, contrast reactions, retroperitoneal bleeding, and cardiac tamponade. Complications of peripheral vascular interventions.

### 2-3) Patient Care and Practice-Based Learning and Improvement

Patient care and direct practice-based learning occurs in the context of the initial evaluation of patients undergoing endovascular interventional procedures, in the cardiac catheterization laboratory suite, as well as post-procedurally. The nature of a trainee’s participation in a given case varies depending on the procedure’s complexity and the trainee’s experience.

**The trainee’s goals are to demonstrate competence in the following:**

- Pre-procedural evaluation to assess appropriateness and to plan procedure strategy.
- Personal performance of the case’s critical manipulations under the direct supervision of a program faculty member. The faculty member who takes overall responsibility for the case must be immediately available to supervise the trainee’s actions and to take over the performance of the case any time it is in the best interest of the patient.
- Active involvement in post-procedural management both in the catheterization laboratory at the conclusion of the case and in the inpatient unit or holding area afterward. This includes assessing for possible adverse outcomes, managing access sites and managing anticoagulation issues.
- Active involvement in procedure reporting and the process of ensuring quality.
- Maintenance of a portfolio of novel and advanced interventional procedural techniques integrated with current available literature, to be used for presentation and review.

**Core procedure capability and technical skill acquired by the trainee**

- Conventional balloon coronary angioplasty
- Coronary artery stents
- Primary angioplasty for acute myocardial infarction
- Atherectomy techniques (laser, rotablator)
- Intravascular ultrasound
- Intra-aortic balloon counter pulsation and other techniques of circulatory support
4) Interpersonal and Communication Skills
Level 3 trainees assume progressive responsibilities for the conduct of the interventional procedure, as well as of the interactions with patients and their families across a broad range of socioeconomic and cultural backgrounds. They become more involved in the discussion of the results of the study with other medical providers, becoming capable of acting in a consultative role to referring primary care physicians and cardiologists, as well as to cardiothoracic and vascular surgeons.

5) Professionalism
The fellow further develops the concepts of professional behavior acquired during the core cardiology training, and continues to interact with the multiple different types of providers in a large cardiac catheterization laboratory that include clerical staff, technicians, nurses, faculty, and other senior fellows. Formal conferences on professionalism are held regularly.

The trainee will
- Demonstrate empathy, sensitivity and compassion as a physician
- Demonstrate high standards of ethical behavior
- Understand the ethical aspects of the relationship with industry
- Refine her/his understanding of the elements of patients’ rights and confidentiality

6) Systems Based Practice
The trainee further develops her/his appreciation of the role of the cardiac catheterization laboratory in a system of health care delivery, eventually understanding the role of the laboratory in the context of the needs of a large inpatient hospital system. They continue to gain deeper appreciation of procedural indications as well as of their cost effectiveness, as well as of diagnostic and procedural coding.

During their training the fellows attend formal practice improvement conferences and also engage in specific practice improvement projects. These include a cardiac catheterization laboratory quality improvement initiative with reporting to the ACC National Cardiovascular
Data Registry (ACC-NCDR™), participation in the University of Wisconsin Level 1 Heart Attack Program, and the development of a chest pain center in our emergency medicine department.