

CURRICULUM IN INTERVENTIONAL CARDIOLOGY

Educational Goals

The educational goals of this program are to train fellows in a specialized cardiovascular disease area requiring technical, educational and research skills involved in interventional cardiology. The knowledge base for interventional cardiology has become increasingly well-defined as a result of unparalleled programs in basic and clinical research in atherosclerosis, coronary disease, cardiomyopathy and valvular heart disease. Our educational goals for training in interventional cardiology are aligned with and guided by the recommendations of the ACC/SCAI/ AHA task force on optimal adult interventional cardiology training programs as follows:

1. To understand the effectiveness and limitations of coronary interventional procedures in order to select patients and procedure types appropriately.
2. To achieve the appropriate cognitive knowledge and technical skills needed to perform interventional cardiac 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.

All trainees must be skilled in obtaining a history and physical examination of the cardiovascular system, specifically as it relates to the performance of procedures, management of the patient during the procedure and also post-procedural follow-up. All trainees must be familiar with the role of aging and psychogenic factors in the production of symptoms, as well as emotional and physical response of the patient to cardiovascular disease. In addition, trainees must be familiar with specific pathophysiology as it relates to the development of cardiovascular disease particularly that of acute coronary syndromes and their management in the cardiac catheterization laboratory.

The trainee must also have experience acting as a consultant to general cardiologists and to surgeons as it relates to the performance of procedures and the management of patients who have undergone interventional procedures or require cardiac surgical procedures.

The trainee must become well educated in the pathogenesis, pathology, risk factors, natural history, diagnosis, physical examination and noninvasive laboratory methods, medical and surgical management, complications and prevention of cardiovascular conditions, including coronary artery disease, hypertension, valvular disease, congenital heart disease, arrhythmias, heart failure, cardiomyopathy, and involvement of the cardiovascular system by systemic disease, infective endocarditis, diseases of the great vessels and peripheral blood vessels, diseases of the pericardium, pulmonary heart disease, the interaction of pregnancy and cardiovascular disease, cardiovascular

complications of chronic renal failure, as well as traumatic heart disease and cardiac tumors.

Training in Intensive Care of the Interventional Patient

The training will include day-to-day experience, under supervision, of patients undergoing interventional procedures. This training will be obtained in the coronary care unit, the cardiovascular intensive care unit, the coronary intermediate care unit and in the catheterization laboratory. The trainee will learn the indications, risks and benefits of cardiac surgery, coronary angioplasty and other interventions, such as coronary stenting, rotational atherectomy, intracoronary and intracardiac ultrasound, flow-wire and pressure wire measurements in the coronary arteries, and Valvuloplasty of the mitral, aortic and pulmonary valves as well as percutaneous closure of intracardiac defects. In addition, the trainee will gain experience in all phases of cardiac rehabilitation, as it relates to the post-procedural care.

Training in Ambulatory, Outpatient and Follow-up Care

Continued responsibility for outpatient cardiovascular patient management and consultation will occupy one-half day per week for 12 months at the Center for Cardiovascular Medicine at Hermann Hospital. Trainees will be exposed to a wide range of patients, from adolescence through senility, with a full spectrum of cardiovascular diagnoses, and this will include specifically post-surgical patients, post-interventional patients and adult patients with congenital heart disease, as well as patients with cardiovascular problems related to pregnancy.

Principle Teaching Method

During the time spent in training in interventional cardiology, the trainees will be taught principally by their supervising attending cardiologist, for whom they act as junior consultants under supervision, as well as private attending cardiologists who have a clinical appointment at the University of Texas. Trainees will gain instruction and experience during the clinical portions of the interventional rotation, as well as active participation under supervision while in the cardiac catheterization laboratory.

Additional teaching will occur through the didactic lectures and conferences. These are structured on a weekly basis and include: 1) the Hemodynamic Conference, 2) the Cardiac Catheterization Conference, 3) the Cardiology and CORE Lecture Series, 4) the Journal Club. These constitute an important component of the academic and didactic training, and the attendance is obligatory. It is important and strongly encouraged for the trainees to be involved in continuous self-study during his or her training, with the realization that this must be a lifelong commitment. All fellows receive a copy of

Cardiovascular Medicine, Editors: Willerson and Cohn. Other recommended texts are cited below.

The Interventional Cardiology Core Curriculum is consistent with the recommendations of the ACC/SCAI/AHA Guidelines for the structure of an optimal adult interventional cardiology training program as follows:

- **Anatomy:** Cardiac, vascular and coronary artery anatomy, including anatomic variants and congenital abnormalities.
- **Physiology:** Basic circulatory physiology, coronary 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.
- **Hemostasis:** Intrinsic and extrinsic coagulation cascade and platelet physiology.
- **Pathophysiology:** Myocardial ischemia and infarction, myocardial reperfusion, circulatory shock, anaphylaxis and cardiac arrhythmias.
- **Pharmacology:** Anticoagulants, antiplatelet drugs, thrombolytic drugs, X-ray contrast agents, myocardial inotropes, vasopressors, vasodilators, antiarrhythmic drugs and drugs affecting lipid metabolism.
- **Radiology imaging and radiation safety:** Principles of X-ray imaging, quantitative coronary arteriography, operation of cinefluorographic X-ray equipment, operation of digital video imaging systems, radiation biology and radiation protection.
- **Intracoronary imaging and coronary physiology:** Principles of intravascular ultrasound imaging and Doppler coronary flow velocity measurements.
- **Interventional device design and performance:** Device materials and characteristics.
- **Clinical management strategies:** Performance and limitations of interventional devices, spectrum of coronary ischemic syndromes, results of interventional cardiology clinical trials, management of acute hemodynamic alterations and mechanical and pharmacological circulatory support.

The specific content of the Interventional Cardiology Core Curriculum for Academic years 2001-2002 and 2002-2003 is listed in the appendix.

Educational Content, CCU

Since the interventional fellow will have completed his or her training in a full cardiology fellowship, the interventional trainee will work together with and act as junior consultant for interventional cases with the cardiology fellow in the Coronary Care Unit. More specifically, the interventional fellow will be supervised by the attending cardiologist on the interventional service on a full-time daily basis, in terms of the interaction with the

house staff in the coronary care units and other attending physicians. Interventional fellows will gain full experience in the evaluation and management of patients with acute coronary syndromes, unstable angina, and acute myocardial infarction and other complications. Particularly, this will include invasive management of acute myocardial infarction, including angiography during acute myocardial infarction, thrombolysis intravenously and thrombolysis in the cardiac catheterization laboratory, mechanical and pharmacologic methodologies for inotropic support, temporary pacing, hemodynamic monitoring during and after the procedure and intra-aortic balloon pumping. The fellows will also gain knowledge and experience in placement of coronary stents, intracoronary ultrasound, rotational atherectomy, use of the Possis device in clot extraction, use flow and pressure wires, valvuloplasty and percutaneous closure of intracardiac defects (e.g. PFO, ASD). In addition, the trainee will gain experience in stenting, balloon angioplasty, atherectomy and ultrasound of peripheral arteries. The fellows will also gain experience in the evaluation and management of patients with all other cardiovascular disorders that are not interventional in nature and require medical or other therapy.

The catheterization laboratory team consists of five interventional cardiologists and 20 other clinical faculty who operate within the teaching hospital and function as supervisors in the cardiac catheterization laboratory. In addition, there are three general cardiology fellows who rotate through the catheterization laboratory. The interventional fellow, while working under supervision from interventional attending cardiologists, will function as a junior interventional consultant for the cardiology fellows who work in the catheterization lab. Although the fellow's primary responsibility is for patients in the cardiac catheterization laboratory, he or she will continue to be involved in the preoperative assessment and postoperative care of all patients in whom they are involved in a procedure capacity. In addition, there is a 24-hour call system in place for the interventional cardiology service, consisting of an interventional attending cardiologist and also an interventional cardiology fellow. The interventional training program includes interaction of the interventional fellow and the interventional fellow with a cardiology consultant who is responsible for the consult service in the hospital. Typical consultations are referred from General Internal Medicine and Family Practice and the General Cardiology Service. The reasons for the consultations cover a broad spectrum of cardiovascular conditions and will require analysis as to whether or not these can best be managed and diagnosed with noninvasive methods or invasive methods. These are also consultations with Cardiovascular Surgery, both preoperatively and postoperatively for management by specifically also to help determining whether or not interventional cardiology is an appropriate option for patients who have been proposed for medical management or for cardiac surgery.

Call responsibilities will include as part of the 24-hour coverage for the interventional service on-call responsibility of one night in three under the supervision of interventional faculty and in no instance will the number of hours worked per week exceed 80 hours. In addition, the schedule will be made out in such a fashion that every interventional fellow is assured 24 hours of time off during every seven-day period.

Ancillary Educational Materials

1. *Cardiovascular Medicine*, Editors: Willerson and Cohn; Churchill Livingstone
2. *Heart Disease*, Editors: Braunwald; Saunders
3. *Cardiac Catheterization, Methods, Diagnosis, and Therapy*, Editors: Peterson and Nicod; W.B. Saunders
4. *Textbook of Cardiovascular Medicine*, Editors: Topol; Lippincott-Raven
5. *Interventional Cardiology*, Editor: Eric Topol
6. *The Practice of Interventional Cardiology*, Editors: John H.K. Vogel and Spencer B. King

Journals:

1. *Catheterization and Cardiovascular Diagnosis*, Editor: Chris White
2. *Circulation*, Editor: J.T. Willerson
3. *Journal of the American College of Cardiology*, Editor-in-Chief: Anthony DiMaria

Methods for Evaluation of Interventional Fellows

Interventional fellows will be evaluated by the interventional supervisor and attending in the cath lab. The supervising faculty will seek the opinions of other interventional attending cardiologists. Specific areas which will be addressed in the interventional evaluation will include 1) appropriate clinical skills as they relate to interventional cardiology, 2) technical skills and procedural decision making, 3) interpersonal catheterization and consultative skills, 4) all other aspects of cardiological patient care, and 5) personal and professional ethics.

Methods for Evaluations of the Rotation

Each fellow is asked to complete an evaluation form for both the supervising faculty and the rotation. Please see the attached form. In addition, all of the teaching faculty and the rotations will be evaluated by the trainees in the annual evaluation of the program by the fellows.

Curriculum for Interventional Cardiology

The principal goal for the interventional rotation is described as a third-level for training in cardiac catheterization, as set out by the ACC/SCAI.AHA Guidelines, *Journal of the American College of Cardiology*, 1999: 31, pp. 2141-2147. This level of training will relate specifically to fellows in interventional cardiology. The interventional trainee will undergo supervised training in pre-procedure, procedural and post-procedural management of interventional patients in the following areas:

Firstly, the trainee will become familiar with all aspects of routine balloon angioplasty and its complications. This will also include peripheral interventions performed with balloon angioplasty. The trainee will undergo supervised training in the performance of all aspects of coronary and peripheral stenting and management of complications as they relate to coronary stenting. The trainee will also undergo training so as to become familiar with aspects of pathophysiologic mechanisms involved in restenosis. In addition, the trainee will become familiar with all aspects of complex angioplasty and supported angioplasty and all aspects of extracorporeal perfusion, both as they relate to angioplasty and to cardiac surgery. Also, the trainee will be conversant with the various access routes for the performance of these procedures. As well, the trainee will become familiar and expert in the performance of rotational atherectomy in all its aspects. The trainee will also become familiar with all aspects involved in the expert performance of intravascular ultrasound procedures.

In addition to the above, the trainee will develop a knowledge base in specific pharmacologic issues that relate to interventions. These include 2b, 3a platelet receptor physiology, heparin, and other agents. Also, the trainee will become familiar with gene transfer mechanisms and the emerging literature in molecular biology, both as it relates to pathophysiological mechanism of coronary disease as well as mechanism of restenosis.

Principal Teaching Methods

In the initial weeks of training, the fellows will assist the teaching interventional cardiologist. The interventional trainee will be given a reference text for interventional cardiology at the beginning of his or her training period.

Pre-Intervention Assessment: The fellow assigned to the intervention of any case will review all pertinent pre-procedure patient data, laboratory studies and all other tests that have been performed. The fellow will also obtain informed consent for the procedure and discuss the procedure in detail with the patient, as well as perform a full history and physical on the patient. The fellows are expected to be familiar with all aspects of patient's background prior to the intervention.

Performance of the Interventional Procedure. After the initial supervision period, the fellows are allowed and expected to perform the majority of the procedure under supervision of an attending interventional cardiologist at a level appropriate to their development as an interventional cardiologist. There will always be one-to-one supervision during the procedure, and if at any time the fellow is unable to perform at an appropriate level, the performance of the procedure will be assumed immediately by the interventional cardiologist.

Data Analysis and Report Generation. The trainee will document the clinical data on the patient's chart, as well as on the database which is routinely kept in the cardiac catheterization laboratory. The films will be reviewed with the interventionalist cardiologist in digital form immediately after the performance of the procedure.

Patient Follow-Up. The interventional fellow is expected to participate in appropriate patient follow-up in-hospital as well as outpatient follow-up, which will occur at the Hermann Center for Cardiovascular Medicine. It is expected that during the 12 month rotation, the trainee will be involved in longitudinal follow-up of interventional patients so as to gain experience in the longer term outcome of procedures.

Catheterization Conference. The catheterization conference is conducted weekly and the trainee will participate in and function as a consultant for the angiography fellow and will also participate directly in case presentations and presentation of appropriate research data.

Educational Content

General. The trainee will become familiar with all aspects of pharmacologic intervention as they relate to the interventional patient. These include platelet inhibitors, all anticoagulants and thrombolytic drugs, as well as beta blockers, calcium channel blockers and nitrates as they relate to the catheterization laboratory. As well, the trainee will become familiar with emerging data as they relate to radical scavengers, leukocyte inhibitors and gene transfer technologies.

Coronary and Peripheral Angioplasty. The trainee will become familiar with all aspects of the performance and management of complications of routine coronary and peripheral angioplasty. This includes both elective and complex and multivessel interventions, as well as other mechanical interventions for acute myocardial infarction. This will include the management of restenosis, the management of chronic total occlusions, perfusion angioplasty and supported angioplasty, as well as protected angioplasty.

Ancillary Devices. The trainee will become familiar with new device technologies and will receive full exposure and training to rotational atherectomy, clot extraction technology (Possis device) and also all aspects of intravascular ultrasound.

Percutaneous Closure of Congenital Heart Defects. The trainee will become familiar with the indications for and technique of percutaneous intracardiac defect closure (ASD, PFO). He or she will become familiar with the technical aspects of TEE or intracardiac echo guidance of these procedures.

Valvuloplasty. The trainee will become familiar with and be involved in the training necessary for the performance of aortic and mitral balloon valvuloplasty as well as pulmonary valvuloplasty.

Individual Clinical Case Load. The average caseload per month per cardiology fellow is approximately 50 to 75 cases. Typically, the average interventional trainee at the end of a year will have performed more than 300 to 400 coronary interventions. All interventional trainees will have performed more than 250 coronary interventions per year.