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Mission Statement

The goal of this educational program is to provide practicing physicians and physicians-in-training the knowledge and clinical skills to effectively recognize, characterize, and manage or appropriately triage patients with vascular diseases in clinical practice. Our expectation is that non-compartmentalized approaches to systemic vascular diseases and promulgation of science and technology will result in improvements in individual patient care and overall public health.
Level 1 Training
Vascular Medicine

Components of Training

Physicians engaged in endovascular treatment of patients with vascular diseases need cognitive and technical skills to best manage patients with pathology in multiple vascular beds. It is our perspective that successful management of disease in one vascular bed positively affects other beds and is in the best interest of overall patient care. Considering this, the primary goal of Level 1 training in vascular medicine is to provide trainees with the broad-based skills to effectively recognize and treat patients with global vascular disease to effectively complement their practice in cardiovascular medicine. The training will consist of a dedicated month on the vascular surgery service and a second month of total experience embedded within the fellowship structure. Upon completion of training, the trainee will be expected to have detailed knowledge of patient selection, indications, limitations, alternative treatments, and understanding of longitudinal management of patients with a myriad of vascular disorders. It is not expected that this level of training will suffice for independent management of complex vascular patients (more appropriate for levels 2, 3, and 4 training pathways). We believe that the vascular medicine training experienced by all general cardiology fellows will positively impact public health by extending capacity to screen and triage vascular patients in multi-regional settings across the United States.

The following document describes aggregate experience (>6+ months; 2+ months in vascular medicine, vascular surgery, and vascular imaging; 4+ months in cardiovascular catheterization and endovascular interventional laboratories) for cardiology clinical fellowship trainees in peripheral vascular medicine. The expectations for these rotations are:

1. Fellows appreciate prevalence and recognize vascular diseases within the cardiology patient population
2. Fellows appropriately select diagnostic and risk stratification tests
3. Fellows learn the natural history and treatment options for various vascular disease states
4. Fellows are equipped with basic management skills for patients with vascular disease
5. Fellows demonstrate appropriate decision skills for timing to triage patients to a vascular medicine specialist.

Cardiovascular fellow’s clinical training will include, but is not limited to:

A) Patient care – This program’s emphasis is on global vascular patient management, in context of the inpatient/outpatient consultative experience. A patient will be assessed by chief complaint, but a full vascular history and exam is compulsory for all patients given typical comorbidities and disease overlap in this patient population. Focused secondary prevention for cardiac and cerebrovascular prevention is of upmost importance in a
population of patients with phenotyped arterial atherosclerotic vascular disease in other distributions. The fellow in training will receive guidance in management of vascular risk factors and comorbidities. The fellow will learn appropriateness of patient selection for vascular interventional procedures, including indications, limitations, potential complications, and alternative treatment methods for patients with vascular diseases. Importantly, the patient will develop expertise in longitudinal patient management. It should be emphasized that patients with vascular diseases need long term clinical followup and vascular care.

*Vascular Medicine rotation (1 month during second or third year of fellowship)* –
The focus of the vascular medicine training is 3-fold: (1) develop a fund of knowledge and cognitive skills to recognize, assess, and provide basic management of patients with vascular disease, (2) become familiar with vascular diagnostic tests available, (3) learn to appropriately triage patients to vascular specialists. It should be re-emphasized that the vitally important task of perioperative consultation of vascular surgical patients (as well as vascular patients having other surgical procedures) will be a broad experience throughout the fellowship program, including the vascular medicine rotation.

**The key elements of the structure of the dedicated month on the vascular service include the following:**

Each week, the cardiology fellow would be assigned to the following activities, with the day depending on the schedule for that week, to optimize the experience.

A portfolio of accomplishments (see separate documentation tool) will be identified at the completion of the vascular medicine rotation as evidence of fellow participation and achievement. Each fellow is responsible for completing the portfolio statement at the completion of the vascular rotation.

**Professionalism, Medical Knowledge and Patient Care**

**Monday:** 7-11 am teaching conferences, afternoon, observing and reading vascular lab studies. Cardiology fellows will be asked to present two cases during the month rotation as part of their participation in the didactic sessions.

**Tuesday to Friday,** assigned OR cases according to case mix for observation

AAA, open and EVAR, leg bypass, carotid endarterectomy; to observe femoral artery exposure, and help close incisions

Participate in interventional procedures as scheduled in interventional radiology.

In addition to above, fellows will be instructed in the use of simulator to practice carotid stent and renal stent simulations
Fellows will attend the multidisciplinary vascular medicine clinic directed by Dr. Craig Thompson and Dr. Richard Powell as scheduled during the month rotation.

**Practice-Based Learning and Improvement**

*Risk factor modification* - The cardiology fellow will receive extensive training in vascular risk factor modification throughout the general fellowship in multiple venues and rotations, including management of hypertension, diabetes, hyperlipidemia, smoking, and hypercoagulable states as part of the didactic conference schedule.

**Communication and Systems-Based Practice**

In addition, cardiology fellows would make daily rounds with the inpatient vascular surgery team and engage in consultation as requested.

*Perioperative cardiac management* - Patients with known vascular disease have higher peri-operative morbidity and mortality than those who do not. It is therefore vitally important that the cardiologist in training have adequate exposure and mentorship to learn risk stratification for vascular patients having major and minor non-cardiac surgery as well as understanding differential risk in vascular surgical procedures. Perioperative cardiac consultation is a robust experience throughout the DHMC cardiology general fellowship, particularly in the outpatient clinic and inpatient consultation services. During the vascular medicine rotations, particular focus will be placed on risk stratification and periprocedural cardiac management of patients having vascular surgical or peripheral endovascular procedures.

*Vascular diseases* - The general cardiovascular fellow should receive training in the evaluation and management of a variety of arterial, venous, and lymphatic diseases during the vascular medicine rotation. These pathologies include:

**Connective Tissue Disease and Vasculitis**

*Vasospasm*

*Chronic Venous Disease and Lymphedema*

*Venous Thromboembolism*

*Thrombophilia*

*Unusual Vascular Disorders*

*Peripheral Arterial Disease*

*Acute Vascular Problems/occlusion*

*Aneurysms*

*Dissection*

*Renal and Mesenteric Disease*

*Carotid Artery Disease and Stroke*

*Patient Selection and Diagnosis for Endovascular Procedures*

*Diseases of the Aorta*
B) **Noninvasive vascular assessment** – the cardiovascular fellow will have a minimum of 4 weeks dedicated to noninvasive vascular assessment technologies. This includes standard non-invasive vascular laboratory (ankle-brachial, toe-brachial, TcPO2 evaluation, pulse volume recording, and doppler ultrasound acquisition, interpretation, and analysis). In addition, the fellow will be trained in basic acquisition techniques and interpretation of magnetic resonance angiography (MRA) and computed tomographic angiography (CTA) of source images and 3D reconstruction of multiple vascular distributions.

C) **Invasive vascular assessment** -

*Cardiovascular Catheterization rotation (4 months)* – during these rotations, the cardiovascular fellow should have exposure to non-cardiac angiography (e.g., pulmonary angiography, aortography, first order aortic vessel angiography [e.g. renal, iliac, subclavian], second order branch vessels [e.g. internal mammary cannulation and imaging). In addition, the fellow will have exposure to more advanced non-coronary imaging techniques including lower extremity runoff angiography, carotid and intracerebral angiography, rotational angiography with reconstruction techniques, and digital subtraction. The minimum exposure is 25 patients in whom the fellow has longitudinal involvement in care from pre-procedure planning through hospital discharge. The peripheral vascular experience for level 1 training during the cardiovascular catheterization rotation is meant to supplement cognitive aspects of patient management upon completion of training, but will not qualify the trainee to independently perform noncardiac angiography. Additional training in this regard will be available based on trainee interests.

*Vascular access* – techniques in simple and complex retrograde common femoral access; brachial artery access, and radial artery access, including distinctions in remote catheterization from these access points. The fellow will acquire experience in utilization of multiple arterial closure devices and other hemostatic methods, as well as tips for troubleshooting and preventing vascular complications.

*Cardiovascular Hemodynamic Assessment and Imaging* - Trainees will gain detailed working knowledge of cardiovascular catheterization laboratory including principles of hemodynamic waveform acquisition and analysis, anticoagulation and antiplatelet analysis, digital X Ray imaging and archiving, and radiation physics and safety. Advanced techniques in digital subtraction angiography, fluoroscopic roadmapping, rotational angiography, and 3-dimensional angiographic reconstruction will be emphasized during this training period.

*Peripheral vascular angiography* – the fellow will have broad based exposure to nonselective and selective angiography (and venography) utilizing a broad array
of catheter and wire platforms in multiple vascular distributions, including: arch vessel and upper extremity, aorta, coronary and cardiac chambers, pulmonary, mesenteric, renal, iliofemoral, superficial femoral, popliteal, and tibial (below knee) vessels. The expectation is that the fellow will have mastery of vascular anatomy and invasive imaging methods upon completion of training.

**Current Vascular Program Initiatives**

*Stroke prevention and management* – Patients with known atherosclerotic disease have a particularly high lifetime risk for poor cerebrovascular outcomes. Considering this, it is vitally important that physicians with expertise in vascular medicine and endovascular therapies focus on risk factor modification and secondary pharmacologic prevention strategies where appropriate, as well as have training in patient selection, evaluation, and procedural methods that could potentially improve outcomes. Cardioembolism and extracranial carotid disease are major current clinical and investigational areas for such technologies. Carotid stenting with distal embolic protection, is currently approved by the Food and Drug administration for symptomatic patients with high grade extracranial carotid disease who are high risk for standard carotid endarterectomy. The Interventional Cardiology team and Vascular surgery teams at Dartmouth closely collaborate and are both active in evaluating carotid stenting in patients who are not at high surgical risk as well in the context of multiple clinical trials and registries. We expect that carotid stenting will continue to evolve to the dominant form of carotid revascularization.

The interventional cardiology group in collaboration with the cardiovascular imaging and stroke programs, is active in atrial septal defect and patent foramen ovale closure, for stroke prevention. Currently, we are engaged in the Closure I clinical trial evaluating the Starflex PFO closure device and the MIST II trial, evaluating PFO closure in patients with severe migraine/aura symptoms. Our current structural heart closure devices include Cardioseal, Starflex, and Amplatzer.

For patient’s who develop acute stroke during cardiac or vascular interventional procedures, we have developed a clinical pathway, with close collaboration and support from our colleagues in the acute stroke team/stroke neurology and interventional neuroradiology, in which our three groups collapse into one team for acute imaging, thrombolysis and/or embolectomy/intervention as appropriate. Though thankfully these circumstances are rare, we believe strongly that this multidisciplinary approach is optimal care for these grave circumstances and may serve as a model for other stroke programs nationally.

We are active in arch vessel intervention (subclavian, innominate) and branch vessel (vertebral, internal mammary bypass) for patients with vertebral or coronary steal as well.

*Aortic diseases and Aneurysmal Diseases*– We are actively involved in the Dartmouth Thoracic Aortic Center (Dr. Tony DiScipio – Cardiothoracic Surgery; Dr Mark Fillinger – Vascular Surgery; Drs. Craig Thompson, John Butterly, John Robb, and Bob Palac – Cardiology and Vascular Medicine) in the evaluation and management of aneurysmal,
dissection, and other disorders of the Thoracic aorta. This is a novel, multidisciplinary clinical approach for patients with Thoracic Disorders. The vascular interventional fellow will assess these patients in the clinic setting and help orchestrate treatment decisions and longitudinal followup. In addition, the fellow will be an active participant in the Thoracic Aortic Center’s monthly clinical conference. In addition, we have been evaluating aortic stenting as a therapy for aortic coarctation.

We are currently developing local and regional screening strategies for abdominal aortic aneurysmal disease. These efforts are underway and a collaborative effort directed by Drs. Robert Zwolak (Vascular Surgery) and Craig Thompson (Interventional Cardiology and Vascular Medicine). It is anticipated that this will include a staged risk screening paradigm for patients have endovascular/cardiovascular catheterization procedures and those patients at higher risk in the clinic setting. Our expectation is that the vascular interventional fellow will be engaged in application of these screening programs with the faculty.

We are active in endovascular management and endograft solutions to patients with vascular aneurysms, predominantly in the non-aortic vascular beds. The vascular interventional fellow can have exposure with our vascular surgical team, who we consider to be world leaders, in advanced imaging/reconstruction, and virtual procedure planning, patient selection, and endograft techniques for patients with aortic aneurysmal diseases.

Mesenteric and Renovascular Diseases – We are exceptionally active in aggressive screening strategies, imaging, and catheter-based interventional techniques for renovascular diseases. It is apparent that significant disease overlap occurs in our patients with known coronary artery disease. We frequently screen by non-invasive methods (duplex doppler, MRA, CTA) or as an adjunctive to cardiac catheterization, patients with unexplained chronic renal failure, multidrug resistant hypertension, or cardiac disturbance syndromes (e.g., pulmonary edema not explained by coronary disease or systolic dysfunction). Renovascular disease is among the most apparent in complicating management and prevention strategies for cardiovascular and cerebrovascular outcomes in patients with vascular diseases. We actively are engaged in research in this area, recently completing the RAIDER (Renal Artery stenosis noninvasive Doppler ER study) clinical trial evaluating doppler flowwire interrogation of renal disease. We are currently developing protocols for innovative MRA techniques for improved and more accurate assessment of not only renal stenosis, but renal function and response to revascularization (Drs. Justin Pearlman, Craig Thompson – Cardiology; Dr. Brian Remillard – Nephrology).

Lower extremity peripheral arterial diseases – we are exceptionally active in clinical, noninvasive, and invasive assessments of patients with lower extremity peripheral arterial diseases and utilize virtual all technologies approved and in development for these applications. Specialty and interest in our program is for applications of technologies and techniques for endovascular treatment and recanalization of chronic total occlusions. Clinical assessment of patients with PVD and medical management are emphasized in
this program. Fellows are taught methods of historical and exam assessment, indications for revascularization, considerations for surgical versus percutaneous revascularization. Patients vary from those having no symptoms and managed medically to severe lifestyle limiting claudication to critical limb ischemia who may receive percutaneous revascularization or surgical referral. The fellow learns to consider for hybrid procedures also (catheter revascularization and limited amputation for example, femoral endarterectomy with iliac stent as another). Research opportunities are robust in lower extremity ischemic disease management and range from re-clinical and clinical device testing, advanced imaging and image co-registration, to more basic and translational science with Angiogenesis Research Center.

_Venous diseases_ – venous thromboembolic diseases are a leading cause of morbidity and mortality in the United States. Post thrombotic syndrome is a common chronic ailment post DVT. The Vascular Intervention fellow with gain experience in clinical management of post thrombotic syndrome, clinical exam and discrimination between primary and secondary venous diseases, interventional pharmacology, and thrombolysis/thrombectomy in multiple vascular distributions. Elective rotations will be available for thrombophilias in collaboration with our Hematology division.

**Structure of Training Program**

_Vascular Medicine and Cardiovascular Interventional Faculty_

Craig A. Thompson, M.D, MMSc., Director Cardiovascular Catheterization Laboratories

*Board Certifications:*
  - Endovascular Intervention
  - Vascular Medicine
  - Interventional Cardiology
  - Cardiovascular Diseases
  - Internal Medicine

John F. Robb, M.D., Director, Cardiovascular Intervention

*Board Certifications:*
  - Interventional Cardiology
  - Cardiovascular Diseases
  - Internal Medicine

Nathaniel W. Niles, M.D.

*Board Certifications:*
  - Interventional Cardiology
  - Cardiovascular Diseases
  - Internal Medicine

Bruce J. Friedman, M.D.

*Board Certifications:*
**Interventional Cardiology**  
**Cardiovascular Diseases**  
**Internal Medicine**

John E. Jayne, M.D., Director, Interventional Cardiology Fellowship Program  
*Board Certifications:*  
- Interventional Cardiology  
- Cardiovascular Diseases  
- Internal Medicine

Bruce D. Hettleman, M.D.  
*Board Certifications:*  
- Interventional Cardiology  
- Cardiovascular Diseases  
- Internal Medicine

Aaron V. Kaplan, M.D., Director, Interventional Cardiology Research  
*Board Certifications:*  
- Interventional Cardiology  
- Cardiovascular Diseases  
- Internal Medicine

Michael Simons, M.D., Section Chief, Cardiology and Director, Angiogenesis Research Center  
*Board Certifications:*  
- Nuclear Medicine  
- Cardiovascular Diseases  
- Internal Medicine

Justin D. Pearlman, MD, ME, PhD, Director, Advanced Imaging Center  
*Board Certifications:*  
- Cardiovascular Diseases  
- Internal Medicine

**Facilities**

**Dartmouth-Hitchcock Medical Center (DHMC)** is New Hampshire's only academic medical center. Internationally renowned, nationally ranked, and regionally respected, we integrate high-quality patient care, advanced medical education, and translational research to provide a full spectrum of health care.
DHMC is located on a 225-acre campus in the heart of New Hampshire's Upper Connecticut River Valley in Lebanon. In August 2004, the New Doctors Office Building opened, increasing the campus by 40%.

**Dartmouth-Hitchcock Medical Center is made up of:**

- Mary Hitchcock Memorial Hospital,
- the Dartmouth-Hitchcock Clinic (a network of more than 900 primary and specialty care physicians located throughout New Hampshire and Vermont),
- Dartmouth Medical School
- VA Medical and Regional Office Center in White River Junction, VT.

**Catheterization Laboratories:**

**Overview**

The cardiac catheterization laboratory provides the region’s highest level of diagnostic and treatment options in interventional cardiology and endovascular intervention. The laboratory is staffed 24 hours a day to handle emergency and emergent procedures for local patients as well as for those transported from regional community hospitals by our advanced response team, DHART.

The laboratories comprise six rooms in total, four dedicated for cardiac and endovascular catheterization and two for electrophysiology. All rooms are capable with digital image processing, pulsed and variable rate fluoroscopy, assuring room flexibility to accommodate various procedures. A Heartlab system for digital image acquisition and archiving enables all catheterization and echocardiography images to be viewed from any location within DHMC. The cardiac invasive laboratories perform more than 4000 procedures each year, including cardiac and vascular interventional cases in excess of 1600 per year. Case volume has been increasing at a rate of 10-20% every year.

**Catheterization Lab: Services Offered**

The Catheterization Lab at DHMC combines highly skilled staff and state-of-the-art equipment in offering the region’s highest level of diagnostic and therapeutic options in interventional cardiology. In addition to offering standard-of-care technology,
ongoing clinical trials at DHMC may allow appropriate patients to benefit from new
devices and medications under evaluation in the Catheterization Lab.

The Cardiac Catheterization Laboratories operate 24 hours a day for emergency and
urgent procedures.

- **Acute MI Management Protocol**: An aggressive program of angioplasty for
  acute myocardial infarction and acute coronary syndrome has been developed
  by DHMC Cardiology and is supported by the Dartmouth-Hitchcock Advanced
  Response Team (DHART).

**Routinely Performed Procedures** in DHMC's Catheterization Lab include:

**Diagnostic Cardiac Procedures**

- Right and left heart catheterization
- Coronary Angiography
- Bypass Graft Angiography
- Ventriculography
- Atriography
- Aortography
- Pulmonary angiography
- Venography
- Intravascular and intracardiac ultrasound
- Transseptal catheterization
- Anterograde, retrograde, and contralateral femoral access, radial, brachial, popliteal,
  axillary vascular access
- Vascular cut downs
- Oxygen consumption
- Ergonovine challenge
- Vasodilator challenge for pulmonary hypertension
- Pressure wire and doppler flow wire measurements
- Endomyocardial biopsy
- Electromechanical mapping
- Cardiac fluoroscopy

**Cardiac Interventional Procedures**

- Coronary Angiography
- Coronary Stenting
- Graft stenting
- Distal protection
- Rotational atherectomy
- Directional atherectomy
- Cutting balloon angioplasty
- Rheolytic thrombectomy
- Coronary and graft brachytherapy
- Aortic, mitral, pulmonic and tricuspid valvuloplasty
- Alcohol septal ablation
Intraaortic balloon pump
Cardiopulmonary bypass
Temporary pacemaker placement
Pericardiocentesis
Percutaneous pericardial window
Foreign body removal

**Congenital Interventional Procedures**

Septostomy
PDA Closure
ASD/PFO closure
Coil embolization
Pulmonary angioplasty
Coarctation angioplasty
Valvuloplasty

**Peripheral Procedures**

Vascular closure and repair

Peripheral angiography, nonselective and selective in all vascular distributions

Vascular closure and repair

Pseudoaneurysm thrombosis

Peripheral intravascular ultrasound

Digital quantitative angiography

Rotational angiography with 3D reconstruction

Vascular stentgrafts, aneurysm repair

Endovascular PTA, stenting, thrombectomy, thrombolysis, rotational and laser atherectomy, and plaque excision in a variety of vascular distributions

Percutaneous pulmonary embolectomy

Foreign body retrieval

**Catheterization Lab: Equipment and Facilities**
A brief history of the Catheterization Laboratories

The Cardiac Catheterization Laboratories were established in 1960 and since this time case volume has grown exponentially. Initially diagnostic catheterization for coronary, valvular, congenital, heart disease and cardiomyopathy was offered. In 1983 coronary intervention in the form of coronary angioplasty was introduced. In 1986 balloon valvuloplasty was introduced. In 1988 intervention for congenital heart disease was introduced. Coronary atherectomy and stenting were introduced in early 1990’s. Since then a steady stream of technological advances have been incorporated into the cardiac catheterization laboratories.

The Catheterization Laboratories Today

The cardiac catheterization laboratories at Dartmouth-Hitchcock Medical Center employ the latest technologies to ensure better patient outcomes. As new devices and technologies are introduced in the market, we analyze which systems will provide our staff and patients with the best results.

Today, the cardiac catheterization laboratory includes state-of-the-art hemodynamic systems, circulatory support devices, and intravascular and intracardiac ultrasound. A computerized report generator, a robust catheterization laboratory data base (>30,000 patients) and inventory system are coupled with rigorous outcome monitoring to provide the data needed to manage a high-quality invasive cardiology program. Using these technologies, we are able to provide point of care testing for arterial blood gases, electrolytes, ionized calcium, glucose, lipids, activated clotting time, anti-factor Xa, and platelet aggregation.

Finalization of the cardiovascular catheterization laboratories expansion will occur in June 2006. Four rooms will be dedicated to cardiac and vascular intervention and two rooms for electrophysiology procedures. All laboratories are cine/digital capable with digital image processing, pulsed and variable rate fluoroscopy, assuring room flexibility to accommodate various procedures.

Peripheral vascular procedures will be focused in a Phillips Allura Exper FD 20 room with full vascular capabilities, including roadmapping, digital processing, digital
subtraction angiography, rotational angiography with 3D reconstruction, and bolus chase. Similar capabilities are available in the other catheterization rooms with the Allura Exper FD 10 system.

Technologic infrastructure includes state-of-the-art hemodynamic monitoring systems, circulatory support devices, state-of-the-art electrophysiologic mapping and ablation instruments, intravascular and intracardiac ultrasound, flowwire, and pressure wire. On site testing for arterial blood gases, electrolytes, ionized calcium, glucose, lipids, activated clotting time, and platelet aggregation is immediately available. Computerized report generator, a robust catheterization lab data base and inventory system are coupled with rigorous outcome monitoring to provide the data needed to manage a high quality invasive cardiology program. The catheterization laboratory staff is professional, highly trained, and dedicated to high quality care. A majority of staff have critical care experience, and all staff are trained in ACLS and BLS. Combined procedures are performed in conjunction with the echo and electrophysiology laboratories.

The Dartmouth Advanced Cardiovascular Imaging Center

The Dartmouth Advanced Imaging Center (DAIC) consists of approximately 12,000 sq ft expandable space dedicated to research and development of Advanced Medical Imaging, located directly below the clinical imaging at the Dartmouth Hitchcock Medical Center.

Planned modalities include a new whole body 1.5 Tesla MRI Excite twin gradient cardiac magnetic resonance imaging system, a 3.0 T MRI, cardiovascular CT, electron paramagnetic resonance imaging, ultrasound and Positron Emission Tomography (PET), paired with micro-imaging capabilities.

The Center will apply multi-disciplinary teams to problems in cardiovascular imaging, cancer, brain, and breast imaging. Specific targets include very early detection and accurate image-based treatment guidance for heart disease and cancer. A particular group of interest is patients at risk due to exposure to secondhand smoke. The new imaging capabilities of the DAIC will enable molecular imaging, the identification of changes in gene expression at the molecular level, accurate treatment delivery with molecular targeting to maximize benefit and minimize any side effects, and new minimally invasive image-guided and/or activated treatments and cures.

Angiogenesis Research Center

The Angiogenesis Research Center (ARC) conducts a comprehensive research program encompassing basic, pre-clinical and clinical research designed to discover and understand the basic mechanisms underlying blood vessel formation (angiogenesis) and to develop novel therapeutic strategies for treatment and prevention of ischemic heart and vascular diseases. The program integrates research and development efforts in basic molecular and cell biology in conjunction with an extensive animal physiology program which provides a variety of models for testing and analysis of promising small molecules or molecular targets. An ongoing, active and comprehensive clinical program allows
immediate testing of promising therapeutic modalities in patients with coronary disease. These activities are supplemented by an imaging program that focuses on physiologic assessment of tissue function and perfusion.

This comprehensive approach to the study of coronary angiogenesis has already allowed Center investigators to discover and test a number of unique molecules which play an important role in the control of heart vessel development, to develop several novel animal models of cardiac angiogenesis, and to organize and conduct the first Phase I/II clinical trial of coronary angiogenesis in the United States.

The ARC staff includes 8 faculty members and 21 post-doctoral fellows, research associates and graduate students. The Center maintains close research links with Sections of Cardiology, Vascular Surgery and the Department of Radiology with faculty and fellows in these Departments playing an active and important role in the Center's activities. In addition, many research activities include close collaborations with Dr. Mark Post's laboratory at the University of Maastricht.

The ARC activities are supported by a number of grants from the National Institutes of Health, American Heart Association, private foundations and research agreements with biomedical and pharmaceutical companies.

The ARC maintains a regular series of Vascular Biology Seminars and Work in Progress (WIP) meetings.

**Patients**

Dartmouth Hitchcock Medical Center receives patients from a large region (New Hampshire, Vermont, Maine, New York, Massachusetts) as well as national referral. The regional “catch” area population is ~1.5 million. The cardiology and vascular medicine section of internal medicine has >16,000 outpatient visits/year and the catheterization laboratory performs > 4,000 diagnostic + interventional procedures per annum. The fellow will be exposed to a broad variety of vascular diseases and clinical complexity. It is expected that the fellow-in-training will easily surpass the minimum requirements suggested by the Core Cardiology Training in Adult Cardiovascular Medicine (COCATS) recommendations for level 3 training in endovascular intervention (below):
Duration of Training

6+ aggregate months (2+ months in vascular medicine/vascular surgery/vascular imaging electives and 4+ months cardiovascular/endovascular catheterization and interventional laboratories). Additional time may be orchestrated on an individual basis based on fellow’s interests in further subspecialization, research, etc.
Content of Conferences

Typical conference schedule for the fellow includes:

Monday – vascular surgery case conference and didactic lecture
Wednesday – Interventional Cardiology and Vascular Interventional Case Conference
(with monthly morbidity and mortality)
Thursday – Vascular Biology Seminar (Angiogenesis Research Center)
  - Cardiovascular Grand Rounds
Friday – Cardiology Clinical Conference
Monthly – Thoracic Aortic Center Clinical conference

Didactic sessions (incorporated in the Monday and Wednesday morning conferences)
with the fellow-in-training include:

Vascular Biology
Connective Tissue Disease and Vasculitis
Vasospasm and Upper Extremity Disorders
Chronic Venous Disease and Lymphedema
Venous Thromboembolism
Thrombophilia
Vascular Laboratory: Arterial Testing
Vascular Laboratory: Venous Testing
Perioperative Management of Vascular Surgery
Unusual Vascular Disorders
Clinical Evaluation of Peripheral Arterial Disease
Epidemiology and Natural History of Peripheral Arterial Disease
Treatment of Peripheral Arterial Disease
Acute Vascular Problems
Aneurysms
Dissection
Renal and Mesenteric Disease
Carotid Artery Disease and Stroke
Patient Selection and Diagnosis for Endovascular Procedures
Endovascular Technical Issues I: Catheters, Diagnostic Angiography
Endovascular Technical Issues II: Wires, Balloons, Stents
Aortoiliac Intervention
Diseases of the Aorta
Endovascular Treatment of Renal and Mesenteric Occlusive Disease
Carotid Angioplasty/Stenting
Endovascular Treatment of Lower Extremity Occlusive Disease
Catheter Directed Thrombolytic Therapy
Endovascular Treatment of Venous Disease
Complications of Endovascular Procedures
Trainee Evaluation

The trainee will receive feedback from Dr. Catherwood on a quarterly basis and have opportunity to offer constructive feedback for program development.