Curriculum for Advanced Training in Heart Failure, Transplantation, Mechanical Circulatory Support Devices and Pulmonary Artery Hypertension Fellowship Program

Educational Goals of the Advanced Heart Failure and Transplant Fellowship

The educational mission of the Advanced Heart Failure and Transplant Cardiology fellowship program is to train individuals who will practice the highest standards of advance heart failure management. The main objective is to provide an academically and clinically rigorous training program to give the trainee outstanding skills in advanced heart failure treatment, managing pre & post-cardiac transplant patients and cardiovascular research. The aim of the program is to provide the trainee with basic and clinical knowledge, procedural skills, clinical judgment, professionalism and interpersonal skills required as an advanced heart failure and heart transplant specialist. This training will prepare our fellow(s) to function not only as highly competent cardiologist and advanced heart failure specialists, but also as an accomplished clinical investigator in the field of cardiovascular and heart failure research.

Program Duration and Requirements

The fellowship program includes one trainee per year for a minimum of one-year period. The goals of the program also specifically include achieving high quality training in each of the areas as outlined in the Practice Guidelines for Evaluation and Management of Chronic Heart Failure in the Adult published by the ACC and AHA. The trainee (fellow) should be board eligible or board certified in internal medicine and board eligible or board certified in cardiovascular diseases; having successfully completed post-graduate training from an accredited residency and fellowship program.

Clinical Experience Overview

Following are the few basic patient characteristics which the advanced heart failure and transplant medicine fellow will encounter during the training:

1) Patients admitted with a diagnosis of advanced heart failure (as primary or secondary diagnosis).
2) Patients admitted to the hospital or in-hospital patients admitted for any reasons with clinical signs of advanced heart failure.
3) Patients enrolled in the advanced heart failure clinics, admitted with advanced heart failure or any other diagnosis in addition to advanced heart failure, for which in-patient cardiology consultation is requested by the primary team.
4) Patients admitted to the general cardiology in-patient service for whom specialized heart failure management or transplant evaluation is requested.
5) Patients admitted to non-cardiology services for whom in-patient cardiology consultation is requested for the primary diagnosis of heart failure and/or cardiomyopathy.
6) Patients admitted or referred for cardiac transplant evaluation.
7) Patients actively listed for cardiac transplantation, admitted with a primary cardiovascular or non-cardiovascular diagnosis.
8) Patient’s status post cardiac transplantation, admitted for post-transplant management.
9) Patients status post-cardiac transplant, followed as an out-patient in the heart failure and transplant clinics.
10) Patients referred for evaluation for mechanical assist device placement.

**Ambulatory Experience**

The goals of the ambulatory experience are to provide exposure to out-patient cardiology practice, including both consultative and continuity experiences, and to provide a means for clinical follow-up of patients recently discharged from the hospital. The out-patient experience is comprised of the Advanced Heart Failure, Transplant & Mechanical Assist Device Clinic. The fellow’s responsibility will be to participate in scheduled clinics and to assist in managing patients.

The patient population in the clinics provides a diverse experience in terms of gender, socioeconomic status and reason for referral. The spectrum of cases seen in these clinics also varies from routine management of common cardiology problems to management of patients with advanced heart failure. Furthermore, evaluation of eligibility for a cardiac transplantation and mechanical assist device implantation procedures, including pre & post-operative assessments, requirement for bi-ventricular pacing and defibrillators implantation, follow-up of recently discharged patients, and referrals for complex cardiology problems dealing with the failing heart are common in these clinics.

**In-patient Experience**

The in-patient Advance Heart Failure and Transplant Cardiology service will comprise of the heart failure/transplant attending, the advance heart failure and general cardiology fellow, physician assistants and nurse practitioners, and residents and medical students rotating through the service. The fellow will be caring for critically ill patients, educating and supporting patients and families, and interacting with a wide variety of medical experts in the fields of surgery, nursing, social work, biomedical engineering, and clinical research. This is a collaborative model in which essential elements of patient care are suggested and implemented by experts in their respective fields and integrated by the attending house staff and faculty.

**The goals for in-patient advance heart failure & transplant service are as follows:**

1. Stabilization of the patient’s acute situation
2. Appropriate assessment of the patient’s overall medical conditions and specific assessment of their cardiovascular condition
3. Delineation of a chronic care plan
4. Initiation of chronic care plan
5. Patient education in self-care and assessment
6. Communication with the referring physician

**Specialized Procedural Training Experience**

The goal of specializing in Cardiac Catheterizations is beyond the scope of this limited, but specialized training program. However, the fellow will be required to understand the appropriateness of procedure and indications for right4 and left heart catheterizations, right ventricular endocardial biopsy5, and be able to estimate the risk and benefits of the procedure performed for diagnostic reasons. As it is essential to understand hemodynamics in evaluation and management of heart failure patients, the trainee will have to develop a high level of competence in the interpretation of hemodynamic data collected by right heart cardiac catheterizations. Furthermore, the fellow
will need to be familiarized with the use of Intra-aortic balloon counter pulsation and all mechanical assist devices. The fellow will acquire sufficient exposure to the indications, performance and management of complications related to the above-mentioned procedures/devices. Fellows are expected to keep complete and accurate logs of their procedures during their training.

Research Experience

Advanced Heart Failure and Transplant trainees take an active role in both clinical and basic science research. Our program requires completion of either original research or substantial scholarly work related to heart failure, transplant or mechanical support devices, as a requirement for completing the fellowship training. Guidance in planning research directions with the trainee is provided by the cardiology faculty, and research is supervised directly by the individual mentor. While it is not expected that every fellow’s project will result in publishable work, it is expected that every fellow conduct and original research project with the guidance of appropriate faculty members. Furthermore, the fellow will continue to work on various multi-central trials or local ongoing projects as assigned by the heart failure faculty throughout the year. Fellow will be given allotted research discovery/work time at the discretion of project(s) need and program director.

The ACGME Core Competencies and Competency Components and Curricular Milestones for Level III Training in Advanced Heart Failure and Transplant Cardiology

1) **Patient Care:** Residents are expected to provide patient care that is compassionate, appropriate and effective for the promotion of health, prevention of illness, treatment of disease and care at the end of life.
   - Gather accurate, essential information from all sources, including medical interviews, physical examination, records, and diagnostic/therapeutic procedures.
   - Make informed recommendations about preventive, diagnostic, and therapeutic options and interventions that are based on clinical judgment, scientific evidence, and patient preferences.
   - Develop, negotiate and implement patient management plans.
   - Perform competently the diagnostic and therapeutic procedures considered essential to the practice of Cardiovascular Disease.

2) **Medical Knowledge:** Residents are expected to demonstrate knowledge of established and evolving biomedical, clinical and social sciences, and demonstrate the application of their knowledge to patient care and education of others.
   - Apply an open-minded and analytical approach to acquiring new knowledge.
   - Develop clinically applicable knowledge of the basic and clinical sciences that underlie the practice of Cardiovascular Disease.
   - Apply this knowledge in developing critical thinking, clinical and technical problem solving, and clinical decision-making skills.
   - Access and critically evaluate current medical information and scientific evidence and modify knowledge base accordingly.

3) **Practice-Based Learning and Improvement:** Residents are expected to be able to use scientific methods and evidence to investigate, evaluate, and improve their patient care practices.
   - Identify areas for improvement and implement strategies to improve knowledge, skills, attitudes, and processes of care.
   - Analyze and evaluate practice experiences and implement strategies to continually improve the quality of the practice of Cardiovascular Disease.
• Develop and maintain a willingness to learn from errors and use errors to improve the system or processes of care.
• Use information technology or other available methodologies to access and manage information and support patient care decisions and personal education.

4) **Interpersonal Skills and Communication:** Residents are expected to demonstrate interpersonal and communication skills that enable them to establish and maintain professional relationships with patients, families, and other members of health care teams.

- Provide effective and professional specialist consultation to other physicians and health care professionals and sustain therapeutic and ethically sound professional relationships with patients, their families, and colleagues.
- Use effective listening, nonverbal, questioning, and narrative skills to communicate with patients and families.
- Interact with consultants in a respectful and appropriate fashion.
- Maintain comprehensive, timely, and legible medical records.

5) **Professionalism:** Residents are expected to demonstrate behaviors that reflect a commitment to continuous professional development, ethical practice, an understanding and sensitivity to diversity and a responsible attitude toward their patients, their profession, and society.

- Demonstrate respect, compassion, integrity, and altruism in their relationships with patients, families, and colleagues.
- Demonstrate sensitivity and responsiveness to patients and colleagues, including gender, age, culture, religion, sexual preference, socioeconomic status, beliefs, behaviors and disabilities.
- Adhere to principles of confidentiality, scientific/academic integrity, and informed consent.
- Recognize and identify deficiencies in peer performance.
- Develop a clear understanding of the complex and challenging relationships in Cardiovascular Disease between clinician/providers, hospitals and industry; understand the inherent conflicts of interest in many relationships with industry and its representatives and develop strategies to ensure clear boundaries that are designed to uncompromisingly prioritize high quality patient care.

6) **Systems-Based Practice:** Residents are expected to demonstrate an understanding of the contexts and systems in which health care is provided and demonstrate the ability to apply this knowledge to improve and optimize health care.

- Understand, access, and utilize the resources and providers necessary to provide optimal care.
- Understand the limitations and opportunities inherent in various practice types and delivery systems, and develop strategies to optimize care for the individual patient.
- Given the high costs of many treatments, residents are expected to apply evidence-based, cost-conscious strategies to prevention, diagnosis, and treatment selection in Cardiovascular Disease.
- Collaborate with other members of the health care team to assist patients in dealing effectively with complex systems and to improve systematic processes of care.

**Principal Teaching/Learning Activities**

The following activities within the fellowship program provide learning and teaching opportunities for the trainee in Advanced Heart Failure and Transplant Cardiology.
Direct Patient Care

The collaborative relationship between attending physician and trainee in the delivery of patient care is at the core of this Program; the provision of high-quality patient care is the fundamental vehicle for teaching and learning of all the required competencies. In the development of educational objectives direct patient care is broadly and somewhat arbitrarily divided into those three loci of care where the particular skills required of the successful subspecialist in Advanced Heart Failure and Transplant Cardiology differ:

- Out-Patient Advanced HF, Transplant and MCSD Clinic (DPC-OP*)
- In-Patient Advanced HF & Transplant Service (DPC-H*)
- Cardiac Catheterization Laboratory (DPC-CATHL*)

Conferences

Teaching conferences are convened at the institutional, departmental and section level and all contribute to the educational experience of the trainee.

- Advanced Heart Failure Education Seminar Series held every Tuesday from noon to 1pm. **Attendance is mandatory.**
- Every Thursday afternoon at 3:00pm, we hold our Transplant and MCSD patient conference in concert with the transplant staff and cardiovascular surgeons. Cases are presented for discussion and agreement amount diagnostic and therapeutic options. **Attendance is mandatory.**
- Every Thursday at 2:00PM, we have inpatient rounds where the cardiology attending’s and support staff discuss all in-patients and their plan of care which transpired over the past week/weekend. **Attendance is mandatory.**

Competency Components and Curricular Milestones for Level III Training in Advanced Heart Failure and Transplant Cardiology **COCATS 4 Task Force 12: Training in Heart Failure**

**MEDICAL KNOWLEDGE**

Heart Failure

1. Know the principles of excitation-contraction coupling and the contractile apparatus of the cardiomyocyte.
2. Know the pathophysiology of heart failure, including such concepts as ventricular remodeling, neurohormonal activation, fetal gene expression, wall stress, signaling pathways (calcium, beta-adrenergic signaling, and nitric oxide), myocardial energetics, electrical and mechanical dyssynchrony, and the role of the extracellular matrix.
3. Know common genetic underpinnings of both dilated and hypertrophic cardiomyopathy, their clinical phenotypes, and the role of genetic testing for patients and their families.
4. Know important hemodynamic principles related to heart failure, including normal cardiac physiology, contractility, preload, afterload, and interpretation of pressure-volume loops and ventricular performance (Frank-Starling) curves.
5. Know the epidemiology and risk determinants of left ventricular dysfunction, ventricular hypertrophy, and heart failure (both with reduced and preserved ejection fraction), including incidence and prevalence overall and in special populations.
6. Know classification methods of heart failure including American College of Cardiology/American Heart Association stages, New York Heart Association classes, and INTERMACS (Interagency Registry for Mechanically Assisted Circulatory Support) profiles.
7. Know the risk factors, methods, and risk scores commonly used to stratify patients with heart failure, including their limitations, and how these methods are used to evaluate the need for advanced therapies.
8. Know the epidemiology and pathophysiology of acute systolic or diastolic heart failure, including new-onset and acute-on-chronic heart failure.
9. Know typical and atypical clinical presentations of patients with advanced heart failure (e.g., cachexia, worsening renal function, cognitive impairment, medication intolerance, ventricular tachycardia) and their management.
11. Know the pathophysiology, clinical presentation, and differential diagnosis of heart failure with preserved ejection fraction and its management.
12. Know the pathophysiology, clinical presentation, and methods of risk stratification of patients with hypertrophic cardiomyopathy and its management.
13. Know the distinguishing features of and appropriate diagnostic studies for specific etiologies of heart failure, including coronary artery disease, valvular heart disease, hypertension, myocarditis, infiltrative processes, toxins (e.g., illicit drugs), chemotherapy, pregnancy, congenital heart disease, radiation, pericardial processes, endocrinopathies, high-output states, stress cardiomyopathy, and inherited syndromes.
15. Know the evidence base, including randomized clinical trial data, supporting contemporary guideline-directed heart failure therapy.
16. Know the pharmacology of common inotropes and vasopressors used in the management of low-output heart failure and shock.
17. Know key principles regarding transitions of care between the outpatient and inpatient setting, and vice versa, including indications for hospitalization and readiness for discharge for patients with heart failure.
18. Know the role of assays for natriuretic peptide and other biomarkers in the management of patients with heart failure.
19. Know the utility of noninvasive imaging (e.g., echocardiography, nuclear cardiology, cardiac magnetic resonance imaging, and positron emission tomography) in assessment of patients with cardiomyopathy (including those related to valvular heart disease) and heart failure.
20. Know the strengths and limitations of common quality-of-life tools (e.g., Minnesota Living with Heart Failure and Kansas City Cardiomyopathy Questionnaire) used in patients with heart failure.
21. Know which lifestyle choices and comorbidities (e.g., obstructive sleep apnea, depression, anemia, diabetes, hypertension, renal failure) contribute to the development of or clinical instability of patients with heart failure, as well as potential management options for such comorbid conditions.
22. Know the roles of submaximal (including 6-minute walk) and maximal exercise testing, and cardiopulmonary stress testing in patients with heart failure.
23. Know the roles of implantable cardiac electronic device therapy in patients with heart failure, including cardioverter-defibrillators, pacemakers, and resynchronization devices.
24. Know the roles of coronary imaging, ischemia testing, viability testing, and revascularization in patients with heart failure.
26. Know the epidemiology and pathophysiology of the cardiorenal syndrome and its management.
27. Know the pathophysiology of cardiac dysfunction associated with cirrhosis and the hemodynamic consequences of portal hypertension.
28. Know the role of implantable technology to allow monitoring of patients with heart failure, including from afar (i.e., remote monitoring).
29. Know the definition of frailty, tools available for assessment of frailty, and how frailty influences diagnosis, prognosis, and candidacy for advanced therapies in patients with heart failure.
30. Know the roles of palliative and hospice care in patients with heart failure and the steps needed to implement them.
31. Know the role of endomyocardial biopsy in the evaluation of myocarditis and infiltrative cardiomyopathies.
32. Know the various chemotherapy agents associated with heart failure and the management of cardiac complications of chemotherapy.
33. Know the potential contribution of arrhythmias to development of heart failure and/or decompensation and appropriate pharmacological and ablation options for therapy.
34. Know the roles of exercise training and cardiac rehabilitation in patients with heart failure with or without pulmonary hypertension, cardiac transplantation, or mechanical circulatory support.
Pulmonary Hypertension

35. Know the World Heart Organization classification and etiologies of pulmonary hypertension.
36. Know the epidemiology, risk factors, prognostic factors, and natural history of pulmonary hypertension.
37. Know the functional classes and appropriate treatment of patients with each type of pulmonary hypertension.
38. Know the role of invasive hemodynamic assessment, including when to perform vasoreactivity testing to assess and manage patients with pulmonary hypertension, including pre- and post-capillary components.
39. Know the classes of medications available to treat pulmonary hypertension and their use alone and in combination, including management of side effects.
40. Know the roles of exercise and cardiopulmonary testing to assess and manage patients with pulmonary hypertension.
41. Know the indications for referral to a specialized pulmonary hypertension center.
42. Know the roles of balloon atrial septostomy, thromboendarterectomy, and lung transplantation in patients with pulmonary arterial hypertension.

Mechanical Circulatory Support

43. Know indications for and contraindications to both temporary and durable mechanical circulatory support for bridging and destination therapy.
44. Know the expected survival following use of durable mechanical circulatory support.
45. Know clinical determinants favoring mechanical circulatory support versus transplantation as durable strategies.
46. Know optimal anticoagulation strategies for patients with ventricular assist devices.
47. Know the management principles for patients with cardiogenic shock, including selection of temporary mechanical circulatory support.
48. Know the management principles and potential complications of extracorporeal membrane oxygenation.
49. Know the anatomic, surgical, and comorbid conditions that may impact mechanical circulatory support strategies in adult patients with congenital heart disease.
50. Know intraoperative and early postoperative complications of durable mechanical circulatory support.
51. Know the risk factors for and presentations and management of common complications of durable ventricular assist devices, including right heart failure, stroke, driveline infections, device thrombosis, hemolysis, gastrointestinal bleeding, and aortic insufficiency.
52. Know the risk scores that predict right heart failure in patients with left ventricular assist devices.

Cardiac Transplantation

53. Know the indications for and contraindications to heart transplantation.
54. Know when patients listed for heart transplant need mechanical circulatory support, and the potential benefits and complications of this type of therapy.
55. Know current United Network for Organ Sharing allocation listing policies for heart transplantation.
56. Know the expected short- and long-term survival rates following heart transplantation.
57. Know the role of multiorgan (e.g., heart-lung, heart-kidney, heart-liver) transplantation.
58. Know the principles of immunology that pertain to heart transplantation, including sensitization and histocompatibility.
59. Know and understand the efficacy, risks, and limitations of currently available methods for desensitization of patients awaiting heart transplantation.
60. Know the preoperative considerations applicable to potential heart transplant recipients.
61. Know the anatomic, surgical, and comorbid conditions that may impact transplant surgery planning and outcomes in adult patients with congenital heart disease, necessitating evaluation at a transplant center with expertise in these conditions.
62. Know the intraoperative and early postoperative complications of heart transplantation and their management.
63. Know the process by which the heart procurement team interacts with teams procuring other organs from donors.
64. Know the factors used to assess the suitability of a potential donor heart.
65. Know the mechanisms of action, side effects, and potential drug–drug interactions of immunosuppressant drugs.
66. Know how cardiac denervation impacts cardiac physiology, including response to exercise and pharmacological agents, and clinical manifestations of myocardial ischemia.
67. Know the risk factors for, clinical presentations of, and treatment for hyperacute, acute cellular, and antibody-mediated rejection.
68. Know the risk factors, clinical presentation, International Society for Heart & Lung Transplantation grading system, and strengths and limitations of diagnostic tools for cardiac allograft vasculopathy.
69. Know when to consider cardiac re-transplantation.
70. Know common post-transplant complications and how to monitor them in the outpatient setting, including hypertension, diabetes, malignancy, renal dysfunction, infection, obesity, and endocrinological and neurological sequelae.
71. Know the strengths and limitations of strategies used to detect and monitor transplant rejection.
72. Know the grades of acute cellular and antibody-mediated transplant rejection, based on interpretation of an endomyocardial biopsy.
73. Know the clinical presentation of common opportunistic infections in cardiac transplant recipients, as well as the potential for donor transmission of infectious organisms.

**EVALUATION TOOLS:** chart-stimulated recall, direct observation

**PATIENT CARE AND PROCEDURAL SKILLS**

**Heart Failure**

1. Skill to oversee genetic testing of patients with cardiomyopathy, including selection of patients and collaboration with genetic counselors.
2. Skills to optimize therapeutic regimens based on guideline-directed pharmacological and device-based therapies in stable patients with heart failure with reduced ejection fraction.
3. Skill to estimate the jugular venous pressure by clinical examination.
4. Skills to optimize a diuretic regimen in both the inpatient and outpatient settings.
5. Skill to decide whether and when to hospitalize patients with heart failure.
6. Skill to optimize pharmacological therapies in patients with decompensated heart failure, including adjustments after stabilization and prior to discharge.
8. Skill to select individualized diagnostic testing for patients with a new diagnosis of heart failure.
9. Skill to minimize the risk of hospital readmission following discharge for decompensated heart failure.
10. Skills to recognize and stabilize patients with cardiogenic shock.
11. Skills to recognize and stabilize noncardiogenic shock in patients with cardiomyopathy or a history of heart failure.
12. Skills to perform and interpret findings from right heart catheterization in patients with heart failure.
13. Skills to assess risk of patients with heart failure undergoing cardiac or noncardiac surgery, and to manage their hemodynamic status perioperatively.
14. Skills to perform and interpret cardiopulmonary stress testing.
15. Skills to initiate palliative and supportive care and to address symptoms and goals of care for patients with advanced heart failure across the care continuum.
16. Skills to manage supraventricular and ventricular arrhythmias in patients with stable or decompensated heart failure.
17. Skill to collaborate with cardiac electrophysiologists to stabilize patients with ventricular tachycardia storm complicating cardiomyopathy, heart failure, or mechanical circulatory support.
18. Skill to collaborate with cardiac surgeons, interventional cardiologists, or members of a structural heart care team to determine whether percutaneous or surgical valve intervention is necessary for patients with heart failure.
19. Skills to work effectively with experts in adult congenital heart disease to assess and manage patients with these conditions, including determining when to employ mechanical support or cardiac transplantation.
20. Skill to determine the indications for coronary revascularization in patients with ischemic cardiomyopathy.
21. Skills to interrogate implantable cardioverter-defibrillators, cardiac resynchronization pacemakers, and cardiac resynchronization-defibrillator devices in patients with cardiomyopathy and/or heart failure to determine the burden of arrhythmias, diagnostic information, and basic device functionality.
22. Skill to determine when patients are inotrope-dependent and to manage them in the outpatient setting.
23. Skill to work effectively with obstetricians in the care of pregnant patients with a cardiomyopathy and/or heart failure.
24. Skill to provide self-help tools to patients with heart failure to minimize the risk of decompensation.
25. Skills to educate heart failure patients about warning signs that signify or predict clinical instability, and to help them develop action plans in the event warning signs appear.
Pulmonary Hypertension

26. Skill to evaluate patients with pulmonary hypertension to determine etiology.
27. Skill to recommend the initial pharmacological regimen for patients with pulmonary arterial hypertension.
29. Skills to perform serial noninvasive assessments of right ventricular function and pulmonary arterial pressure and integrate these data in the management of patients with pulmonary hypertension.
30. Skills to detect clinical deterioration in patients with pulmonary hypertension and adjust treatment accordingly, including determining when hospitalization is necessary.
31. Skill to stabilize patients with acute right ventricular failure in the setting of pulmonary hypertension.

Mechanical Circulatory Support

32. Skill to identify appropriate options for temporary hemodynamic support for patients in cardiogenic shock.
33. Skill to identify appropriate candidates for durable ventricular assist devices.
34. Skills to interrogate, interpret, and manipulate pump parameters in patients with temporary and durable hemodynamic assist devices.
35. Skill to recognize the indications for total artificial heart or right ventricular assist device rather than left ventricular assist device alone.*
36. Skill to optimally set the speed of durable ventricular assist devices.
37. Skills to select and interpret noninvasive and invasive data to evaluate patients with temporary and durable ventricular assist devices (e.g., ramp study, aortic valve opening, or right ventricular assessment).*
38. Skills to identify and manage right heart failure in patients with left ventricular assist devices.
39. Skill to manage long-term durable mechanical circulatory support in the outpatient setting.
40. Skills to recognize and manage complications of durable mechanical circulatory support, including stroke, device thrombosis, right heart failure, hypertension, or arrhythmias.
41. Skills to recognize left ventricular recovery and assess patients with left ventricular assist devices for potential explanation.*
42. Skill to determine whether and when to hospitalize patients with durable ventricular assist devices.
43. Skill to select management options (including hospitalization and diagnostic investigation) for patients with durable ventricular assist devices and gastrointestinal bleeding.
44. Skills to collaborate with anesthesiologists and procedural specialists to optimize management during invasive procedures or noncardiac surgery in patients with continuous flow, durable ventricular assist devices.

Cardiac Transplantation

45. Skill to determine whether and when patients warrant cardiac transplantation.
46. Skill to recognize comorbidities that preclude cardiac transplantation.
47. Skill to recognize irreversible pulmonary hypertension that precludes isolated heart transplantation.
48. Skill to assess the suitability of a given heart for transplantation in a potential recipient.
49. Skills to adjust immunosuppressant therapy to minimize the risk of rejection, while balancing competing risks of infection, malignancy, renal failure, and other toxicities.*
50. Skill to collaborate with colleagues in the histocompatibility laboratory to assess a heart transplant recipient’s reactive antibody panel, preformed and post-transplant antihuman leukocyte antigen antibodies, and immunological compatibility with a donor heart.
51. Skill to manage heart transplant recipients in the immediate post-transplant period, including those with complications, in conjunction with a multidisciplinary team.
52. Skill to determine whether and when illness in heart transplant recipients requires hospitalization.
53. Skills to interpret with a pathologist the findings of endomyocardial biopsies to determine the need for treatment of acute cellular or antibody-mediated rejection, and oversee treatment.
54. Skills to collaborate with other members of a multidisciplinary team in managing common comorbidities and complications following heart transplantation, including hypertension, dyslipidemia, renal insufficiency, infection, and cancer.
55. Skills to collaborate with invasive and interventional cardiologists in the prevention, recognition, and treatment of transplant vasculopathy.
56. Skills to interpret noninvasive tests, including echocardiograms, gene expression profiling (e.g., Allomap testing), and other biomarkers to evaluate for rejection in heart transplant recipients.
57. Skill to perform endomyocardial biopsy to assess for transplant rejection.
58. Skill to prescribe therapies to prevent opportunistic infections, including Cytomegalovirus, Nocardia, and Pneumocystis Jiroveci pneumonia in heart transplant recipients.
59. Skill to oversee the use of immunizations in patients before and after cardiac transplantation.

**EVALUATION TOOLS:** chart-stimulated review, direct observation and multisource evaluation

**SYSTEMS-BASED PRACTICE**

1. Utilize appropriate care settings and teams for patients with various profiles and stages of heart failure before or after mechanical circulatory support or transplantation.
2. Incorporate risk/benefit analysis and cost considerations in diagnostic and treatment decisions, including the adoption of new technologies.
3. Utilize an interdisciplinary, coordinated team approach for patient management, including care transitions, palliative care, and employment-related issues.
4. Effectively utilize an interdisciplinary transitional-care approach to monitor the progress of ambulatory patients with heart failure to maintain stability and avoid preventable hospitalization.
5. Collaboratively work with all members of the advanced heart failure and transplant cardiology team, including cardiac surgeons, palliative care specialists, other medical consultants, nurses, nurse practitioners, physician assistants, social workers, dietitians, physical and occupational therapists, and pharmacists.
6. Identify the financial, cultural, social, and emotional barriers to successful outcomes after mechanical circulatory support or transplantation.
7. Effectively utilize an interdisciplinary approach to care for patients with or at risk of advanced heart failure, pulmonary hypertension, and mechanical circulatory support or cardiac transplantation.

**EVALUATION TOOLS:** chart-stimulated recall, direct observation and multisource evaluation

**PRACTICE-BASED LEARNING AND IMPROVEMENT**

1. Identify knowledge and performance gaps and engage in opportunities to achieve focused education and performance improvement.
2. Utilize decision support tools to access guidelines and pharmacological information at the point of care.
3. Incorporate feedback from faculty and staff to improve performance.
4. Develop habits of regular and critical reading of the heart failure/transplant literature to maintain current knowledge of the field and promote lifelong learning.

**EVALUATION TOOLS:** conference presentation, direct observation, faculty evaluation, reflection, and self-assessment.

**PROFESSIONALISM**

1. Show compassion for and effective management of end-of-life issues, including discussions of death and dying, across the spectrum of patients with heart failure, pulmonary hypertension, mechanical circulatory support, or heart transplantation.
2. Clearly and objectively discuss available therapies for advanced heart failure, including palliative care, mechanical circulatory support, or transplantation.
3. Interact respectfully with patients, families, and all members of the healthcare team, including ancillary and support staff.
4. Demonstrate high ethical standards, including the recognition and management of overt and more subtle potential conflicts of interest, when making diagnostic or therapeutic decisions.

**EVALUATION TOOLS:** conference presentation, direct observation, multisource evaluation, reflection, and self-assessment.
INTERPERSONAL AND COMMUNICATION SKILLS

1. Communicate with and educate patients and families across a broad range of cultural, ethnic, and socioeconomic backgrounds.
2. Engage in shared decision making, including the potential role of palliative care and discussing the risk of death, with patients and their families considering mechanical circulatory support and/or transplant.
3. Effectively lead the interdisciplinary heart failure team to promote comprehensive and balanced decision making with respect to the selection of mechanical circulatory support versus heart transplantation.
4. Skill to discuss the potential for donor transmission of infectious agents to the recipient, and ability to use a shared decision-making approach with recipients when assessing a donor at risk.
5. Skill to provide emotional support to patients and their families before and after mechanical circulatory support or cardiac transplantation.

EVALUATION TOOLS: direct observation and multisource evaluation.

*Additional competencies that extend beyond the core expectations and that may be achieved by some advanced heart failure and transplant cardiology (AHFTC) specialists based on career focus, either during or following formal AHFTC fellowship training.
During fellowship duration, fellow will be expected to have read pertinent literature listed as follows:

**GUIDELINES AND POLICY STATEMENTS:**

**American College of Cardiology/American Heart Association**


   [http://circ.ahajournals.org/content/early/2013/06/03/CIR.0b013e31829e8776](http://circ.ahajournals.org/content/early/2013/06/03/CIR.0b013e31829e8776)

3) Prevention of Heart Failure: A Scientific Statement from the American Heart Association Councils on Epidemiology and Prevention, Clinical Cardiology, Cardiovascular Nursing, and High Blood Pressure Research; Quality of Care and Outcomes Research Interdisciplinary Working Group; and Functional

   [http://circ.ahajournals.org/cgi/reprint/CIRCULATIONAHA.107.188965.pdf](http://circ.ahajournals.org/cgi/reprint/CIRCULATIONAHA.107.188965.pdf)


6) Transitions of Care in Heart Failure: A Scientific Statement From the American Heart Association on behalf of the American Heart Association Complex Cardiovascular Patient and Family Care Committee of the Council on Cardiovascular, and Council on Quality of Care and Outcomes Research, Circ: Heart Failure. 2015;8:384-409
   [http://circheartfailure.ahajournals.org/content/8/2/384.full](http://circheartfailure.ahajournals.org/content/8/2/384.full)

**ACC/AHA and ESC**

   [http://circ.ahajournals.org/cgi/reprint/114/7/700](http://circ.ahajournals.org/cgi/reprint/114/7/700)

2) The Role of Endomyocardial Biopsy in the Management of Cardiovascular Disease: A Scientific Statement from the American Heart Association, the American College of Cardiology, and the European Society of Cardiology. Circ 2007;116:2216-2233
   [http://circ.ahajournals.org/cgi/reprint/CIRCULATIONAHA.107.186093.pdf](http://circ.ahajournals.org/cgi/reprint/CIRCULATIONAHA.107.186093.pdf)

**ACC/AHA and Heart Rhythm Society**

1) ACC/AHA/HRS 2008 Guidelines for Device-Based Therapy of Cardiac Rhythm Abnormalities


3) Resynchronization Therapy for Heart Failure (2005)
Heart Failure Society of America


International Society for Heart and Lung Transplantation


KEY ARTICLES:

Acute Heart Failure


3. Can We Predict and Prevent the Onset of Acute Decompensated Heart Failure? Eugene E. Wolfel Circulation 2007;116;1526-1529 http://circ.ahajournals.org/cgi/content/full/116/14/1526

4. Transition From Chronic Compensated to Acute Decompensated Heart Failure: Pathophysiological Insights Obtained From Continuous Monitoring of Intracardiac Pressures. Michael R. Zile, MD; Tom D. Bennett, PhD; Martin St. John Sutton, MD; Yong K. Cho, PhD; Philip B. Adamson, MD; Mark F. Aaron, MD; Juan M. Aranda Jr,MD; William T. Abraham, MD; Frank W. Smart, MD; Lynne Warner Stevenson, MD; Fred J. Kueffer, MS, MD; Robert C. Bourge, MD. Circulation 2008, 118:1433-1441 http://circ.ahajournals.org/content/118/14/1433


Arrhythmias and Implantable Devices

   http://circ.ahajournals.org/cgi/reprint/2/1/72.pdf

   http://circjournal.ahajournals.org/cgi/reprint/2/3/197.pdf

   http://circ.ahajournals.org/cgi/reprint/108/9/1044.pdf


   http://eurheartj.oxfordjournals.org/content/28/21/2568.full.pdf


    http://content.onlinejacc.org/cgi/content/full/54/18/1683

    http://www.onlinejacc.org/content/51/23/2241


Biomarkers


2. Rapid measurement of B-type natriuretic peptide in the emergency diagnosis of heart failure.
Cardiac Surgery in Heart Failure Patients


Cardiac Transplantation (Also see ISHLT guidelines and articles under "Immunosuppression")


Clinical Assessment


Disease Management and End-of-Life Care


4. Muscle oxygen transport and utilization in heart failure: implications for exercise (in)tolerance
http://ajpheart.physiology.org/content/ajpheart/302/5/H1050.full.pdf


6. Efficacy and Safety of Exercise Training in Patients With Chronic Heart Failure: HF-ACTION Randomized Controlled Trial. Christopher M. O’Connor, MD, David J. Whellan, MD, MHS, Kerry L. Lee, PhD, Steven J. Keteyian, PhD, Lawton S. Cooper, MD, MPH, Stephen J. Ellis, PhD, Eric S. Leifer, PhD, William E. Kraus, MD, Dalane W. Kitzman, MD, James A. Blumenthal, PhD, David S. Rendall, PA-C, Nancy Houston Miller, RN, BSN, Jerome L. Fleg, MD, Kevin A. Schulman, MD, Robert S. McKelvie, MD, PhD, Faiez Zannad, MD, PhD, and Ileana L. Piña, MD, for the HF-ACTION Investigators. JAMA.2009;301(14):1439-1450.


http://circ.ahajournals.org/cgi/content/extract/120/25/2597


Epidemiology and Risk Factors

1. Prevention of heart failure: a scientific statement from the American Heart Association Councils on Epidemiology and Prevention, Clinical Cardiology, Cardiovascular Nursing, and High Blood Pressure Research; Quality of Care and Outcomes Research Interdisciplinary Working Group; and Functional Genomics and Translational Biology Interdisciplinary Working Group. Schochen DD, Benjamin EJ, Fonarow GC, Krumholz HM, Levy D, Mensah GA, Narula J, Shor ES, Young JB, Hong Y; American Heart Association Council on Epidemiology and
http://circ.ahajournals.org/cgi/reprint/117/19/2544.pdf


http://tinyurl.com/743opgb

Hypertrophic Cardiomyopathy


http://www.geraldlawriemd.com/sections/hocm/Clinical_Cardiology_HOCM.pdf

Imaging


Immunosuppression

http://circ.ahajournals.org/cgi/reprint/110/24/3734.pdf

http://circ.ahajournals.org/cgi/reprint/110/25/3858.pdf

http://circ.ahajournals.org/cgi/reprint/111/1/113.pdf

http://circ.ahajournals.org/cgi/reprint/111/2/230.pdf

Mechanical Circulatory Support


Mechanical Circulatory Support: Post-operative Management


Mitral Regurgitation


Other Causes of Cardiomyopathy


3. Diagnosis and management of the cardiac amyloidoses. Falk RH. Circulation. 2005;112:2047-60. http://circ.ahajournals.org/content/112/13/2047.full


Pulmonary Hypertension


Right Heart Failure


3. Recent Advances in Pulmonary Hypertension - Clinical Diagnosis of Pulmonary Hypertension Jonathan D. Rich, MD; Stuart Rich, MD. Circulation. 2014; 130: 1820-1830 http://circ.ahajournals.org/content/130/20/1820.short

4. Contemporary Reviews in Cardiovascular Medicine Pulmonary Hypertension Due to Left Heart Disease. M. Barry A. Borlaug BA Circulation.2012; 126:975-990