INTERNATIONAL SOCIETY FOR HEART AND LUNG TRANSPLANTATION (ISHLT)

MECHANICAL CIRCULATORY SUPPORT CORE COMPETENCY CURRICULUM (ISHLT MCS CCC)

FORTH EDITION

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ISHLT MCS COUNCIL

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ISHLT MCS CCC: LIST OF CONTENTS

I. INTRODUCTION AND OVERALL GOALS

The purpose of this compendium is to provide a curriculum of core competencies in mechanical circulatory support. The ISHLT Academy provides a concise synopsis of clinical *knowledge* and associated essential professional *skills* to facilitate the mastery of all surgical, medical and nursing aspects involved in the care of patients receiving mechanical circulatory support devices.

This compendium does not replace a textbook, but intends to provide an outline of essential topics and aims to assist with detailed review. This should be of benefit for both seasoned clinicians and current trainees. The former may find selective revision of complimentary areas in mechanical circulatory support useful, whereas the latter may benefit from a more complete review of all topics during fellowship or other subspecialty training in mechanical circulatory support.

Inevitably, some overlap of clinically related aspects may have occurred. Extensive referencing should assist selective review of published evidence for each topic.

The core curriculum should also serve programs providing mechanical circulatory support with a tool to review their standards of care, develop protocols and implement guidelines established in mechanical circulatory support systems.

Wherever possible, specific learning objectives have been defined.

The educational workforce of the Mechanical Circulatory Support Council of ISHLT hopes that this compendium will prove to be useful. We would welcome constructive feedback to further develop its scope and accuracy.

Overall Learning Objectives

To assist practitioners in developing improved competence and professional performance in their ability to:

1. Risk stratify patient with advanced heart failure in order to assess MCS surgical and medical risks and optimally time mechanical circulatory support (MCS) implantation.
2. Recognize the medical and social factors which impact patient outcomes during short- and long-term MCS.
3. Recognize the various types of MCS support available for patients with advanced single or biventricular heart failure and the technological differences that may impact pump selection and patient/device management.
4. Optimize MCS implantation techniques and patient/pump management during the index admission intensive care unit and inpatient general care periods.
5. Manage patients and the MCS during outpatient long-term support with an understanding of interventions that can reduce patient- and device-related adverse events during MCS.
6. Diagnose and manage common clinical dilemmas and adverse encountered after MCS.

Learning objectives covered in this document complement the MCS portion of the curriculum of an ACGME accredited advanced heart failure and transplant fellowship in the U.S., which is required for American Board of Internal Medicine sub-specialty certification. As fellows gain experience and demonstrate growth in their ability to care for patients, they will assume roles that permit graded and progressive responsibility for patients with MCS.

MCS Guidelines

The executive summary of the 2013 International Society for Heart and Lung Transplantation Guidelines for Mechanical Circulatory Support was released electronically in January 2013 with publication of the Executive Summary in the February Journal of Heart and Lung Transplantation (Feldman DA, Pamboukian SV, Teuteberg JJ, et al J Heart Lung Transplant 2013; 32:157-187..

The complete Guidelines consist of 5 separate Task Forces:

Task force 1: Patient selection
Task force 2: Pre-operative optimization
Task force 3: Intra- and post-operative management
Task force 4: Inpatient management
Task force 5: Outpatient management

II. REVIEW OF THE CURRENT STATE OF MCS AND DEVICES FOR TEMPORARY AND PERMANENT CIRCULATORY SUPPORT

Learning Objectives for the Current State of MCS

1. Understand the indications for temporary and permanent MCS and the different types of devices available for support.
2. Distinguish the basic technological differences between different temporary and permanent MCS systems and the levels of support provided by each. Review the MCS technology in development
3. Understand the differences between bridge to transplant, bridge to recovery and destination therapy
4. Understand the application and prognostication of INTERMACS Patient Profiles
5. Summarize outcomes and adverse events for current devices among the various implant strategies
6. Understand the mortality associated with cardiogenic shock (INTERMACS profile 1-2) and the device strategies available for single and biventricular failure with shock.
7. Review the components and operation of extracorporeal membrane oxygenation
8. Understand the outcomes and adverse events for patients who require support with ECMO
9. Understand the outcomes and adverse events for patients who require support with TAH

Selected References for the Current State of MCS

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III. PATIENT SELECTION

Learning Objectives for Patient Selection

1. Understand the variability in short- and long-term patient survival following MCS support and the importance of a multidisciplinary assessment of preoperative patient risk.
2. Understand the difficulties in prognostication of end-stage heart failure and survival on MCS.
3. Identify several means of estimating prognosis in end-stage heart failure and operative risk with MCS.
4. Understand the preop, intraop, and postoperative contributors to RV dysfunction
5. Apply risk modeling and imaging techniques to assess the possibility of RV dysfunction
6. Recognize the limitations to current imaging and risk prediction models of RV failure
7. Understand the importance of improving RV function in the preoperative setting
8. Identify other comorbidities and patient characteristics that may impact short- and long-term survival after MCS implant
9. Learn the importance of identifying and addressing renal and hepatic dysfunction prior to MCS
10. Understanding important preoperative optimization interventions to minimize MCS operative risks
11. Identify the triggers for MCS referral

Selected References for Patient Selection

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IV. SURGICAL CONSIDERATIONS

Learning Objectives for Surgical Considerations

1. Understand criteria used to determine best patient-pump match - role of body habitus, prior surgery, right heart function and end-organ among others.
2. Determine optimal pump placement, outflow graft anastomosis creation and tunneling of driveline
3. Learn standard and minimally invasive /off-pump techniques for VAD implantation
4. Learn alternative techniques for VAD implantation in challenging clinical scenarios
5. Learn different techniques for intraoperative hemodynamic support (CPB vs. ECMO vs. off-pump)
6. Recognize intra-operative hemodynamic and ventilatory goals
7. Learn optimal technique for separation from cardiopulmonary bypass - role of TEE and hemodynamics in determining best use of inotropic, pressor and pulmonary vasodilator therapies.
8. Learn to identify patients that will benefit from temporary mechanical right heart support.
9. Learn techniques for temporary mechanical right heart support (temporary RVAD, ECMO).
10. Understand indications for concomitant surgical procedures with particular attention to the tricuspid and aortic valves and patent foramen ovale. Learn to balance risk and benefit of concomitant surgical procedures.
11. Determine the risk and utility associated with concomitant operative procedures
12. Understand the potential risks associated with untreated aortic valve insufficiency at the time of VAD implantation
13. Learn to understand strengths and weaknesses of current devices. Optimize device selection for particular patient characteristics.

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V. POST-OPERATIVE CARE

Learning Objectives for Post-operative Care

1. How to assess the "fitness" of the right ventricle after surgery. This will include physiologic, anatomical and bedside clinical assessments.
2. Determine when to initiate anticoagulation, what type and how much after surgery. Adjustments in anticoagulation related to special considerations in unique patient populations and types of pumps will be covered.
3. Develop a deeper understanding of the advantages and limitations of the common imaging modalities and their clinical applications in postoperative VAD patients.
4. Development of a global treatment strategy to prevent, or consequently treat right ventricular dysfunction and failure after implantation of a left ventricular assist device.

VI. TRANSITION TO HOME

Learning Objectives for Transition to Home

Teaching/patient assessment:

1. Outline an approach to teaching MCS-related skills to patient, caregiver(s) and community
2. Learn methods to evaluate effectiveness of training

Outpatient management

1. Outline approaches to clinic structure
2. Summarize approach to outpatient visits
3. Highlight and review approaches to relevant long-term medical issues faced by MCS patients
4. Describe shared care models and discuss collaborative patient management between implanting and supporting centers in the community
5. Overview of pediatric management strategies

Quality of Life, functional capacity and end of life

1. Summarize measures of quality of life and functional capacity relevant to the MCS patient
2. Outline approaches to end-of-life discussion and care of the MCS patient
3. Describe pediatric quality of life with MCS.
4. Discuss quality of life of caregivers.

Selected References for Transition to Home

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VII. LONG-TERM MANAGEMENT OF PATIENTS AND COMPLICATIONS

Learning Objectives for Long-term Management

The Outpatient Clinic: Critical Clinical Assessments for Success

1. Understand the importance of echo, laboratory, and clinical follow-up during long term MCS support.
2. Understand the challenges of measuring blood pressure in the outpatient setting and risks associated with hypertension during VAD support.

3. Identify and respond appropriately to common alarms encountered on Device interrogations.

LVAD Infections

1. Understand the impact of infectious complications on the long term outcome of implantable VAD therapies.
2. Understand diagnostic strategies available for diagnosis of device related infections.
3. Become familiar with latest definitions of device-related and device-associated infections included in the guidelines of infection manegement
4. Learn the common pathogens involved in device-related infections
5. Understand medical and surgical therapies available for the prevention and management of devicerelated infections

Bleeding Complications after VAD Support

1. Understand the frequency, timing, and etiologies of bleeding complications after MCS implant
2. Understand the frequency and etiology gastrointestinal bleeding in recipients of continuous flow VADs
3. Understand the entity "acquired von Willebrand's disease" and its potential role in the genesis of occult gastrointestinal bleeding
4. Understand new algorithms for the diagnosis and management of recurrent gastrointestinal bleeding as it relates to imaging (nuclear, endoscopy), antiplatelet and anticoagulation therapies and role of adjuvant therapies like estrogen, octreotide and dDAVP for patients with occult (non-upper, non-lower) gastrointestinal bleeding.

Pump Thrombosis

1. Learn what is known regarding blood-device surface interactions
2. Comprehend the reported incidence of VAD thrombosis in major clinical trials
3. Understand medical and surgical factors that can predispose to the development of VAD thrombus
4. Understand options for the diagnosis of VAD-related thrombus vis-à-vis thrombus location
5. Learn the utility of rump test in identifying pump related issues
6. Understand options for management from anti-thrombotics to thrombolytics, pump exchange and transplantation
7. Acquaint themselves with a working algorithm for the diagnosis and management of pump thrombus

Stroke

1. Understand the frequency, timing, and etiologies of stroke complications after MCS implant
2. Understand the risk factors associated with strokes in recipients of continuous flow VADs.
3. Understand the importance of adequate blood pressure management in stroke prevention
4. Learn the importance of adequate postoperative anticoagulation management in preventing stroke events.
5. Understand algorithms for manageing varous types of strokes (ischemic vs. bleeding).
6..Learn optimal anticoagulation strategies in patients with varous types of stroke

Aortic Insufficiency in LVAD Recipients

1. Gain an understanding of the high-flow/low perfusion constellation of LVAD associated aortic insufficiency
2. Understand the prevalence and impact of de novo aortic insufficiency in continuous flow VAD recipients.
3. Acquaint themselves with the potential etiologic factors involved in the development of aortic insufficiency including pre-existing AI, outflow conduit placement, aortic valve fusion and lack of pulsatility and valve opening

4. Understand important patient management strategies that may impact AI development
5. Understand surgical options for the treatment of pre-existing AI at the time of LVAD implantation.
6. Understand indications and medical and surgical options for the management of de novo aortic insufficiency after MCS implant including blood pressure control, percutaneous devices and TAVR, and reoperation.

Arrhythmia and LVAD

1. Understanding the prevalence of atrial and ventricular tachyarrhythmias in LVAD patients,
2. Learning the risks associated with atrial and ventricular tachyarrhythmias
3. Therapeutic options, and the role of ICD, CRT in these patients.
4. The role of ablation in LVAD patients

Myocardial recovery during LBVAD support

<u>Suggested References for Long-term Management</u>

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Pump Thrombosis

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Aortic Insufficiency

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