



Basic Training Requirement for doctors in conduct of Extracorporeal Membrane Oxygenation (ECMO)

Background

ECMO therapies are salvage life-saving therapies in critically ill patients with severe cardio-respiratory failure refractory to conventional life supporting therapies. There is increasing use of ECMO therapies among the ICUs in Hong Kong, especially after the emergence of H1N1 pneumonia. Yet, local documents addressing standards of ECMO therapies are scarce. Although international guidelines (1,2) stating the standards for a ECMO center exists, the training requirement for doctors who conduct ECMO therapies under the supervision of an ECMO program director are loosely defined.

This document addresses the need to provide recommendations on the basic training requirement for doctors under Hong Kong College of Anaesthesiologists who conduct ECMO therapies in an ECMO center with an appropriate ECMO program in place meeting the required standards.

The recommendations stated in this document do not imply independent practice of ECMO in a unit without appropriate ECMO program. A comprehensive ECMO program should address issues including organizational structure, staffing, physical facilities, equipment, staff training, continuing education, protocols, guidelines, and various quality assurance activities (1,2). The recommendations in this document address the very basic element required for the practice of ECMO therapies. However, the delivery of ECMO care should always be supervised and reviewed by an ECMO program director.

The doctors who fulfilled the stated basic requirement should pursue continuing education, clinical experience in ECMO, training recertification, and participation in quality assurance activities to fulfill the required standards stated in an ECMO program.

The required standards of an ECMO center are beyond the scope of this document. However, all the training requirements stated below should be undertaken in an ECMO center with the appropriate required standards. Reference to international standards for an ECMO center should be sought (1,2).

The Hong Kong College of Anaesthesiologists recognized that technologies in ECMO therapies are evolving and recommendations may change in accordance to changes in modern clinical practice.

Core Component of Basic Training of Doctors

The core components should consist of theory, water-drill, clinical simulation, and bedside experience.

1. Theory

Majority of topics covered in ECMO textbooks and reviews included pathophysiology and management related to neonatal and paediatric ECMO. One should aware that topics related to adult ECMO therapies represent a very small part of the whole discussion of ECMO therapies. Topics considered essential in the basic understanding of ECMO in adult include the followings:

- The history and development of Extracorporeal support
- Indication, contraindication and selection criteria in respiratory ECMO
- Indication, contraindication and selection criteria in cardiac ECMO
- Regionalization and Triage
- Physiology of extracorporeal life support
- The ECMO equipment: including the function and the design of circuit, cannula, oxygenator, pressure monitor, flowmeter, bubble detector, heater, etc.
- Blood Biomaterial Surface Interaction during ECLS
- Vascular access for Extracorporeal Support
- Daily patient and circuit management during ECMO
- Anticoagulation and bleeding during ECLS
- Sedation, analgesia, neuromuscular blockade and temperature control
- Medical complications while on ECMO
- Emergencies and complications while on ECMO
- Renal Supportive therapy during ECMO
- Plasmapheresis for ECMO patients
- Weaning, Trialling off, and decannulation in venovenous ECMO
- Weaning, Trialling off, and decannulation in venoarterial ECMO
- Post ECMO complication—Physical and Psychological aspects
- Ethical and social issues
- Transportation, retrieval and mobile ECMO

- ECMO administrative and Training Issues and sustaining Quality

The theory session can be taken in form of didactic lectures, e-learning and self-reading. Courses organized by Extracorporeal Life Support Organization (ELSO) and other well known international ECMO units are recommended.

2. Water drills

This training component adopts a form of deliberate practice training. These sessions emphasize the hands-on skills required, mainly on the circuit. The required task should be performed with strict adherence to unit protocol and should be done within a time constraint to meet the demand for dealing with various ECMO emergencies under time pressure. These sessions should be small enough so that each individual has hands-on experience. A full understanding of all possible circuit emergencies and appropriate intervention should be accomplished by the end of this session.

Sessions should include the followings:

- i. Priming of the circuit
- ii. Assembly and calibration of the system (console, circuit, oxygenator, cannulae, heater, pressure monitor, flow monitor)
- iii. Checking configuration, function of the ECMO circuit
- iv. Access and sample ports to the circuit
- v. Basic troubleshooting (e.g access insufficiency, come off bypass emergently per protocol, use of handcranking, management of venous/arterial air, change of circuit, accidental decannulation, etc)
- vi. Pigtail and stopcock changes
- vii. Assembly and administration of blood products and various infusions with the system

The frequency of the sessions should be related to the case volume of the ECMO unit. Given the current statistics, it is recommended that water drills sessions should be conducted at least once per year.

3. Clinical Simulation

Majority of ECMO complications represent low frequency but catastrophic events. Simulation based training is considered an efficacious way of teaching these low frequency catastrophic events. Emergencies ranging from common ones to rare

but highly catastrophic ones could be simulated through high fidelity mannequin. Examples of various clinical scenarios included hypotension, desaturation, severe bleeding from circuit and patient, overwhelming air in circuit/gas embolism, console failure/power failure, oxygenator failure, circuit thrombosis, cannula problems, circuit rupture, severe hypothermia and cardiac arrest. Clinical simulations not only provide opportunities to manage these rare scenarios in clinical context, it also represents an effective tool to explore issues including clinical knowledge, skills, team work, communication, assumptions and behaviors and provide opportunities for improvement.

The ECMO simulation training course is considered essential for the purpose of basic training. Simulation courses recommended included the ECMO simulation course organized by Hospital Authority, the ELSO course and the Alfred Course. It is recommended that the simulation courses should be attended at least once for purpose of basic training and it is desirable to attend the course in a periodic manner.

4. Clinical Experience

- Cannulation
 - ◆ A minimum of two cannulations performed under supervision is required for purpose of basic training in venovenous ECMO.
 - ◆ Basic training requirement refers to cannulation using single lumen cannula.
 - ◆ Skills in vascular ultrasound should be demonstrated for purpose of cannulation.
 - ◆ The insertion of Bicaval cannula, arterial cannula, reperfusion cannula is beyond the scope of basic training.

- Clinical Management

The basic training should included management of a minimum of two ECMO patients under supervision. Documentation showing a major involvement during the course of ECMO therapies, including cannulation, trouble shooting, management of complications, weaning, trialling off and decannulation, is required. Documentation showing the practice is under supervision is also required. Such practice should take place in an ECMO center with an appropriate ECMO program in place.

- Decannulation

A minimum of two decannulation performed under supervision is regarded as essential for purpose of basic training.

Endorsed by Board of ICM 24 Feb 2015

Endorsed by HKCA Council 19 Mar 2015

Reference

1. ELSO guidelines for ECMO centers.
<http://www.else.org/Resources/Guidelines.aspx>
2. Position Paper for the Organization of Extracorporeal Membrane Oxygenation Programs for Acute Respiratory Failure in Adult Patients. *AJRCCM* 2014; 180(5), 488-96
3. ELSO guidelines for training and continuing education of ECMO specialists.
<http://www.else.org/Resources/Guidelines.aspx>
4. ELSO guidelines. General management of all ECLS cases.
<http://www.else.org/Resources/Guidelines.aspx>
5. Recommendations for the Use of Mechanical Circulatory Support: Device Strategies and Patient Selection: A Scientific Statement from the American Heart Association. *Circulation* 2012; 126:2648-2667
6. ECMO Extracorporeal Cardiopulmonary Support in Critical Care (red book). 4th Edition.
7. ECMO Specialist Training Manual. Third Edition. ELSO.