

**Indian Association of Cardiovascular Thoracic Anaesthesiologists (IACTA)**

**Indian College of Cardiac Anaesthesia (ICCA)**

**Fellowship of IACTA in Extra Corporeal Membrane Oxygenation**  
**(EICMO)**

**Course Curriculum, Syllabus, Examination pattern,**  
**Eligibility criteria and Exam protocol**

## **Introduction**

Extracorporeal membrane oxygenation (ECMO) procedures are technically complex, high risk, resource dependent and unpredictable in terms of volume and timing. Safe, economical and effective use of ECMO requires unique institutional resources and effective strategies to maintain optimal quality in the delivery of care. A pillar of quality care is the presence of an established and institutionally supported ECMO education and training program.

IACTA/ICCA has recognized the need for ECMO Fellowship in filling the shortage of trained, skilled and educated anaesthesiologists in our country. Through one year fellowship program, centers accredited by ICCA will be able to give focused training in the field Extra Corporeal Life Support (ECLS) and high level critical care. Thus, the twelve months Fellowship in ECMO is designed as a comprehensive educational and clinical training program to provide graduates the clinical expertise, scholarly, research experience, team leadership skills and supervisory proficiency expected of consultants and leaders in the field of ECLS.

**Duration of Fellowship:** 1year

**Course name:** Fellowship by IACTA in ECMO (FECMO)

## **Goals and Objectives of Fellowship in ECMO**

The goal of ECMO fellowship is to impart theoretical knowledge and practical skills of ECMO initiation and management. Following are the aims and objectives:

1. To find out appropriate candidacy for various types of ECMO and its risks and complications:
  - VV ECMO
  - VA ECMO
2. To acquire the ability to initiate and manage ECMO.
3. Be capable of constructing and priming an ECMO circuit.
  - Understand tubing size selection.
  - Be familiar with the different types of oxygenators available
  - Be able to choose an appropriate cannula size for a given patient like
    - Dual-lumen cannula
    - Single-lumen cannula: Venous / Arterial
4. Understand the anticoagulation strategies for patients requiring ECMO
  - Be able to initiate and manage anticoagulation for patients on ECMO
  - Understand coagulation assays used for patients on ECMO
  - Become familiar with special situations that may require changes in anticoagulation management (e.g., surgery, bleeding, thrombosis, DIC, etc.)
  - Have the opportunity to work closely with the transfusion medicine team
5. Acquire the ability to cannulate patients on to VV ECMO with a dual-lumen cannula using ultrasound and fluoroscopy guidance.
6. Understand and be able to construct, prime and initiate ultrafiltration and/or dialysis via the ECMO circuit.
  - Basic ultrafiltration
  - Dialysis using the ECMO circuit.
  - CRRT in tandem with ECMO
7. Create practice guidelines to assist with management of ECMO patients
  - Sedation
  - Ventilation
  - Coagulation
8. Complete project/manuscript related to ECMO by the end of academic year
9. Become familiar with ECMO transport.
  - Manage patients during transport.
  - Be capable of cannulating a patient at an outside institution.
10. Become involved in simulation.
  - ECMO simulation scenarios
  - Attend Lectures on ECMO
11. Be a member of the ECMO journal club and present at least one article every month
12. Lead ECMO meetings
  - Running the list of current patients on mechanical devices
  - Help maintain didactic schedule and speakers each week
  - Present 5-6 topics during the year (1 per month)
13. Attend high-impact national ECMO meetings to gain insight into current trends and future directions of mechanical support.

## Syllabus for FECMO

### **Introduction to ECMO:**

- History
- Risks and benefits
- Membrane gas exchange physics and physiology
- Oxygen delivery, content and consumption
- Shunt physiology
- Types of ECMO
- Future applications
- Research

### **Physiology of diseases treated with ECMO:**

- Respiratory failure
- Pulmonary embolism
- Sepsis
- Post cardiectomy
- Heart transplantation
- Cardiomyopathy
- Myocarditis
- Low cardiac output syndrome
- Refractory cardiogenic shock
- Cardiac arrest

### **ECMO selection criteria**

- Patient selection criteria
- Pre ECMO evaluation
- Contraindications

### **Physiology of Veno-arterial and Venovenous ECMO**

- Vessel cannulation
- Physiology
- Advantages and disadvantages

### **Blood Products and Coagulation**

- Blood products and interactions
- Coagulation cascade
- Blood surface interactions and coatings
- Heparin pharmacology
- SIRS
- Laboratory anticoagulation monitoring studies
- DIC
- Antifibrinolytics
- Protamine
- Recombinant clotting factors

## **A. ECMO Equipment and Circuit Components**

- ECMO circuit design
- ECMO circuit components (cannula, compliance chamber, pump, venous return monitor, saturation monitor, pressure monitor, heater, hemofilter, bubble detector, flow meter)
- Oxygenator function and blood gas control
- ECMO supply cart
- Other ECLS equipment (CVVH, plasmapheresis, etc.)

### **Cannulation and Initiation of ECMO support**

- Circuit priming
- Preparing the patient
- Initiating support

## **B. Daily Patient and Circuit Management on ECMO**

- **Patient**
  - Bedside care of the ECMO patient (eg. ambulation)
  - Fluid, electrolytes and nutrition
  - Respiratory (e.g. ventilator management, tracheostomy, extubation, etc)
  - Neurologic
  - Infection control
  - Sedation and pain control
  - Hematology
  - Cardiac
  - Psychosocial
  - Pharmacologic issues
  - Lab schedule
  - Documentation and orders

### **Circuit**

- Aseptic technique
- Pump and gas flow
- Pressure monitoring
- Blood product infusion techniques
- Circuit infusions
- Management of anticoagulation
- Circuit checks
- Hemofiltration setup

## **C. Emergencies and Complications during ECMO:**

- **Medical**
  - Intracranial and other hemorrhage
  - Pneumothorax and pneumopericardium
  - Cardiac arrest
  - Arrhythmias
  - Hypotension and hypovolemia
  - Hypertension
  - Severe coagulopathy
  - Seizures
  - Hemothorax and hemopericardium
  - Uncontrolled bleeding
  - Electrolyte imbalance
  - Renal failure

- **Mechanical**

- Circuit disruption
- Raceway rupture
- Cavitation
- System or component alarm and failure (pump, compliance chamber, venousreturn monitor, oxygenator, heater, flow sensor)
- Air embolus
- Inadvertent decannulation
- Clots

#### **D. Management of Complex ECMO Cases**

- Surgery on ECMO
- Postoperative bleeding
- Transport on ECMO (inter/intrahospital)

#### **E. Weaning off ECMO**

- Techniques and complications
- Clinical indications of pulmonary and cardiac recovery
- Pump and gas flow weaning techniques
- Ventilator changes during weaning
- Trial off
- Decannulation from low flow

#### **Decannulation**

- Personnel needed
- Medications required
- Potential complications
- Vessel ligation
- Vessel reconstruction
- Percutaneous approach
- Post-ECMO complications

#### **F. Outcome of ECMO Patients**

- Short and long-term outcomes
- Institutional follow-up protocol
- Literature review

#### **G. Echocardiography**

- TTE
- TEE
- Vascular ultrasound

#### **H. Ethical and Social Issues**

- Consent process
- Parental and family support
- Withdrawal of ECMO support

## **FECMO: Training Protocol**

During the period of fellowship, a gradually increasing responsibility (initially under supervision) is given to the candidate so that he/she acquires enough experience in intensive care management independently. The work of the candidate shall be supervised on a day to day basis by the consultants / faculty of the division. His posting should be regulated in such a way that he gets enough exposure to the various types of procedures, monitoring techniques, intensive care and other related clinical areas as defined in this curriculum. In addition, the candidate shall be exposed to clinical demonstrations, seminars, workshops, and journal club.

Major components of training in ECMO shall be:

- Theoretical knowledge
- Practical/ clinical skills
- Communication skills and attitude
- Training in research, presentations, publications

<b>ACTIVITY</b>	<b>PERIODICITY</b>	<b>METHOD</b>
Journal clubs	Bi-monthly	Faculty and Peer review
Seminars	Bi-monthly	Faculty and Peer review
Theory knowledge	Six monthly	Written tests
Clinical performance	Six monthly	Clinical exam
Procedures	Monthly	Log book
Research & presentation	Six monthly	Logbook & faculty peer view

**Monthly training program:** The following teaching program is prescribed for the course:

- Didactic lectures : Once a week
- Seminars : Once every alternative week
- Journal Club : Once every alternative week
- Bed side case discussion : 2-3 days/week
- Morbidity & mortality meeting : Once in two months

**Posting Schedule:** The candidate may be rotated in different departments so as to learn maximum from the respective experts.

- Cardiac ECMO or Cardiac ICU - 4 months
- Respiratory ECMO or Medical ICU - 2 months
- Transplant ICU or Casualty or Trauma ICU - 3 months
- Interventional procedures including Cath Lab – 1 month
- Cardiac OT & anaesthesia – 1 month
- Perfusion technology training – 2 weeks
- Specialty ICU training neonatal, paediatric & adult – 2 weeks

**List of procedures/skills to be performed**

<b>PROCEDURE/SKILLS</b>	<b>UNDER SUPERVISION</b>	<b>INDEPENDANTLY</b>
Percutaneous VV ECMO cannulation	10	1
Percutaneous VA ECMO cannulation	10	1
Renal replacement therapy on ECMO	10	
Bronchoscopy	10	5
Hemofiltration on ECMO	10	
Post heart transplant ECMO	5	
Post lung transplant ECMO	5	
TEE/TTE for ECMO cannulaplacement	5	5

**Library Facilities:** The center/institute should have access to at least two journals each of:

- Critical care
- Mechanical circulatory support

**Standard text books on ECMO:**

- ECMO Red book 5<sup>th</sup> Edition
- ECMO training Manual ELSO 4<sup>th</sup> Edition
- ECMO – Extracorporeal life support in adults by Fabio, Nicolo & Antonio
- Intensive care Medicine by Irwin & Rippe 7<sup>th</sup> edition
- Gravlee’s Cardiopulmonary bypass and mechanical support 4<sup>th</sup> edition



### **Guidelines for the Enrollment of Candidates**

**Eligibility Criteria:** The following are eligibility requirements for FECMO enrollment:

1. Candidate must be a life member of IACTA.
2. Candidates need to apply to the recognized Fellowship in ECMO centers of their choice and register for the course with ICCA.
3. The course of study shall be for a period of 1 academic year starting from 1<sup>st</sup> Jan to 31<sup>st</sup> Dec. of every year.
4. The list of FECMO centers and their contact details are put up on the IACTA website or can be found out from the ICCA / IACTA office
5. The FECMO recognized center should appoint the candidate based on the interview taken by the recognized ICCA/IACTA FECMO teacher along with hospital authorities.
6. The candidate needs to fill up the FECMO registration form upon joining the course and mail it to the ICCA office. The form can be downloaded from the IACTA website.
7. Appointment letter from the institute/hospital with the candidate's details should be mailed to the ICCA office. This letter should be signed by the teacher, head of department and also by the institute head.
8. The fee for registration for FECMO fellowship is Rs.12,000/- payable to IACTA. This should be paid to IACTA at the time of enrolment.
9. After completion of the fellowship, the candidate needs to get a certificate from the FECMO guide/teacher of the successful completion of one year of fellowship and a signed logbook by the teacher.
10. The candidate must have at least 85% of attendance during the fellowship (as certified by the examiner) to be eligible to take the exit exam.
11. Candidates should attend the academic activities of the department and also the academic program as conducted regularly by IACTA.
12. Candidate should have one publication and at least two presentations during the conferences of repute on subjects related to ECMO.
13. Candidate becomes eligible to take the FECMO exit exam after successful completion of the tenure of fellowship. To appear for the exit exam, the candidate need to pay an exam fee of Rs.12,000/- to IACTA along with the application form and certificate from the FECMO teacher/guide/HoD. Centralized exam will be conducted in every year by ICCA. The dates and schedule of the FECMO exit exam will be decided by ICCA office.
14. The candidates shall be paid a salary/stipend as per the rules of the institute/hospital where they are pursuing the fellowship course.

## Teacher / Examiner Certification

**Eligibility criteria:** Fellowship in ECMO teacher must fulfill the following minimum criteria:

1. The teacher must be a life member of IACTA.
2. The teacher should not any disciplinary action against him in past.
3. A postgraduate qualification (MD/DNB in Anaesthesia) from a recognized university/national board with at least 10 year experience in cardiac anaesthesia/critical care in a recognized major hospital or institute. Out of 10 years, at least 3 years should be in a cardiac anaesthesia teaching hospital. (teaching hospital is the one where a DM/DrNB/FNB/FIACTA course in cardiac anaesthesia is going on).
4. The center should have a minimum 40 cases per year with mechanical circulatory support/ECMO. They must devote most of their professional time in mechanical circulatory support/ECMO.
5. He/she must be competent in different clinical/administrative skills required for initiation and management of mechanical circulatory support/ECMO.
6. He/she must have the time and dedication to fulfill the teaching responsibilities.
7. The teacher must demonstrate commitment to training and practice by participating/ associating with regional, national or international CME's, seminars and conferences (preferably as a faculty) and associating with the regional, national or international mechanical circulatory support/ECMO.
8. He / she must exhibit active interest in medical research, scientific presentations or publications in or related to the field of mechanical circulatory support/ECMO.
9. Should have 5 publications in peer reviewed indexed journals as one of the first three authors or the corresponding author. Case reports / E journals are not acceptable. Out of the 5 papers, 2 papers should be related to mechanical circulatory support/ECMO. These are the publication criteria to begin with an intent to be reviewed depending on the number of applications for the FECMO teacher/examiner.
10. All supervisors from the centers which are recognized as centers for FECMO are automatically an examiner for the exit exam of Fellowship in ECMO examiner.
11. A person having at least 100 cases of ECMO and more than 15 experience in cardiac anaesthesia may be made examiner.

## **FECMO Exit Examination**

The examination shall consist of the following parts:

Theory and Practical (clinical examination & viva voce)

### **A) Theory: Duration: 3 hours Marks: 100**

The question booklet contain 10 questions of 10 marks each. These will be subjective questions related to the curriculum as mentioned in ECMO course along with clinical case scenarios.

**Preparation of the question paper:** The theory question paper will be prepared by Dean academics. He may take the help from the examiners of pool of examiners or anyone else. The Dean academics is supposed to maintain the secrecy of the question paper and should send to the exam center coordinator on day of exam.

### **B) Clinical examination & Viva voce: total 400 marks**

**One long case viva:** 100 marks

**Two short cases viva:** 150 marks

**Table viva 1:** 50 marks: Instruments: ECMO console, Centrimag, Oxygenators, cannulae Hemofilters

**Table viva 2:** 50 marks: Drugs, ABG, TEG/ROTEM, X ray, Echocardiography, Ultrasound

**Table viva 3:** 50 marks: Log book, Scientific presentations, Publications : 50 marks

**Logbook for exit exam:** The candidate should have a logbook with a minimum of **25 cases** and it should have a good mixture of all types of cases. Logbook should be signed by the supervisor and institute head.

### **Total marks (Theory + Practical) = 500 marks**

Candidates need to secure 50% marks in both theory and practical separately i.e. to pass the exam, candidate must secure 50 or above marks in theory and 200 or above marks in practical.

### **Selection of examiners for FECMO exit exam:**

The Dean academics will prepare the pool of the examiners and maintain the same. He shall propose the names to the core team for FECMO exit exam (Dean academics, Dean exam and Registrar). The decision of the core team will be presented to the Vice Chancellor by the registrar. After the approval of the Vice Chancellor, the names of the examiners will be finalized.

## **Award of FECMO Fellowship**

The candidates who have completed the course and passed the FECMO exam., will be awarded with the fellowship certificate during the convocation ceremony at the annual conference of the IACTA. The candidate scoring the highest marks will be awarded with the “IACTA President’s Award”.

**Application Forms Available on Website**

- a. Application form for center accreditation
- b. Application form for FECMO Teacher/Examiner
- c. Application form for candidate registration
- d. Application form for FECMO exit exam