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## Applications of Extracorporeal Membrane Oxygenation (ECMO) in Surgery

Babu M.<sup>1\*</sup>, Ashok K.<sup>1</sup>, Nivedhini V.<sup>2</sup>, Thatiparthi Stephen<sup>2</sup> and Gautham B.<sup>2</sup>

<sup>1</sup>Department of Microbiology and Biotechnology, School of Basic Sciences, Bharath Institute of Higher Education and Research (BIHER), Chennai, Tamil Nadu, India

<sup>2</sup>Department of Biochemistry, Sree Balaji Medical College and Hospital, Bharath Institute of Higher Education and Research (BIHER), Chennai, Tamil Nadu, India

\*Corresponding Author

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**Abstract:** The Extracorporeal Membrane Oxygenation (ECMO) is a temporary mechanical support mechanism that handles the function of the heart and/or lung in patients with a number of heart and respiratory disorders. ECMO uses a pump which is attached in the neck or chest with tubing in huge blood vessels. It is most often seen in patients who recover from heart surgery, heart or lung transplants and cardiac aids or in battle with respiratory problems such as Chronic Obstructive Pulmonary Disease and acute respiratory distress syndrome. The machine has also been shown to be successful in people with respiratory dysfunction, including trauma, toxicity, post-operative conditions, and breastfeeding. Risks involve bleeding, blood clots, infection, etc., however, many adults and children who require ECMO will likely die without the device. While ECMO is not recent, the use and positive results during the global flu epidemic of 2009 were dramatically higher, as the advantages of ECMO were apparent in situations where conventional mechanical support of oxygen was not supported.

**Keywords:** Extracorporeal Membrane Oxygenation, Risk factors, Surgery, Respiratory disorders

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### Introduction

Oxygenation of the extracorporeal membrane (ECMO) of the artificial lung or heart is successfully used when chronically ill patients are deficient in all other means of cardiac and lung support (Zapol *et al.*, 1979; Barlett *et al.*, 1982; Brogan *et al.*, 2009; Brodie and Bacchetta, 2011; Combes *et al.*, 2018). It operates by briefly pulling the body's blood to enable the red blood cells to artificially oxygenate and the system to remove carbon dioxide. The care now supports critical

patients with pneumonia COVID-19 who are not sufficiently ventilated to maintain the levels of oxygen in their blood (Barlett *et al.*, 1976; UK Collaborative ECMO Trial Group, 1996; April, 2009; Gattinoni *et al.*, 2011; Zangrillo *et al.*, 2013). The Extracorporeal Life Support Organization (ELSO) is a global network of healthcare practitioners and scientists committed to developing and analysing new organ support treatments – like ECMO. ELSO captures a register

of patients worldwide who have received ECMO as part of their practise (Abrams *et al.*, 2014; Karagiannidis *et al.*, 2016). 55 per cent of the COVID-19 patients who received ECMO survived the disease as compared to patients who were not treated with this procedure (Mols *et al.*, 2000).

The UCSF also uses a more compact ECMO lightweight unit, which is sufficiently light to carry in ambulance or helicopter and allows ECMO relief in emergency situations (Kumar *et al.*, 2010). ECMO machines have been in use since the early 1970's and are often related to infants with respiratory failure. However, UCSF doctors started using the technology before and with a wide variety of patients in the attempt to save more lives than they used before. The use of ECMO at UCSF is distinguished by selected patients and the stage at which it is used (Bartlett *et al.*, 1986; Fiser *et al.*, 2001; Noah *et al.*, 2011; Fuehner *et al.*, 2012).

#### *Types:*

ECMO consists of several parts, including:

**Cannulae:** Large catheters (tubes) inserted into the blood vessels to remove and return blood

**Membrane oxygenator:** An artificial lung that oxygenates the blood (Peck *et al.*, 1997)

**Warmer and filter:** Machinery that warms and filters the blood before the cannulae return it to the body (Mielck and Quintel, 2005).

During ECMO, the cannulae pump blood that is depleted of oxygen (Sauer *et al.*, 2015). The membrane oxygenator then puts oxygen into the blood. Then it sends the oxygenated blood through the warmer and filter and returns it to the body (Combes *et al.*, 2012; Lafc *et al.*, 2014).

Two forms of ECMO are present - venous, supporting only the lungs and veno-arterial, supporting both the lungs and the heart. The ECMO circuit is interconnected to a patient by one to three cannulas (Ko *et al.*, 2002). A surgeon makes a minor slit, normally on the right side of throat, and feeds the tube into the vein through

the cut. Often a second tube is threaded into the carotid artery, which is another vessel in the neck by the same cut. Then the tubes are attached to a blood oxygenating pump (Thiagrajan *et al.*, 2009). Even other places, such as the atrium or aorta, are used to implant the tubing. Patients are normally sedated if ECMO is provided for the first time, but one of the aims associated with the treatment is to wake up them and to get them actively involved.

#### *When is ECMO used?*

- For people suffering from heart disease, lung insufficiency or cardiac operation.
- A bridge choice where doctors have to evaluate the condition of other organs, such as the kidney or brain, prior to cardiac or lung operation.
- Help in the heart catheterization laboratory during high hazard procedures.
- As a heart help system bridge, including the left ventricular aid device (LVAD).
- As a bridge for lung transplantation patients.
- The ECMO helps maintain tissue oxygenation, making the patient a successful transplant prospect.

#### *Procedure:*

The treatment of ECMO requires an operation. Sedation and treatment for pain and an anti-coagulant are provided to the patient to prevent blood coagulation. The ECMO catheters are placed into an artery or venous tract, assisted by the operating team (Biscotti *et al.*, 2015). An X-ray is then used to ensure that the tubes are placed rightly. Usually, an ECMO pump patient is also kept on a ventilator that assists the lungs in healing. During ECMO, specially trained nurses will monitor the patient, along with the surgeon and surgical team (Biancari *et al.*, 2020). Since patients are sedated and have a respiratory tube in place, additional feeding is given intravenously or by a nasal-gastric tube. Nutrition is supplied intravenously or through gastrointestinal conduit.

During ECMO, the patient can be given such medicaments including: heparin to avoid blood clots; antibiotics to prevent infections; movement and sleep-enhancement sedatives; diuretics to help the kidney get rid of water and electrolytes to enable the right mix of salts and sugars (MacLaren *et al.*, 2020). Multiple checks are normally carried out to ensure the readiness of the heart and lungs before ECMO treatment has been discontinued. The vessels will have to be fixed until the ECMO cannulas are removed. To close the spot where the tubes are located, the doctor uses small stitches. When ECMO is removed from the patients, they are kept on a ventilator (Zhan *et al.*, 2020; Li *et al.*, 2020).

#### *Risks:*

ECMO carries risks, including:

- Bleeding, because of the medicine used to prevent blood from coagulating in the tube.
- Infection at the locations at which the tubes penetrate the body.
- Problems of transfusion, as blood products are given to an ECMO human.
- Small air clots or tubular bubbles.
- The possibility of stroke is increased.

#### *Who needs ECMO?*

- Doctors put patients on ECMO because they have severe yet reversible complications related with heart or lung. ECMO assumes responsibility for the heart and lungs function. This provides an opportunity to recover.
- ECMO will also serve as a "bridge" before and after heart surgery procedures.
- ECMO is only needed under exceptional circumstances. In general, this has not been effective after other support initiatives. Without ECMO, the survival rate is about 20 per cent or lowers in such cases. The survival rate with ECMO can be up to 60%.

#### *Infants:*

Conditions which can include ECMO for infants:

- ✓ Syndrome of Air Disorder (difficulty breathing).
- ✓ Diaphragmatic congenital hernia (a hole in the diaphragm).
- ✓ Suction disease of meconium (inhalation of waste products).
- ✓ Hypertension of the lung (high blood pressure in the pulmonary artery).
- ✓ Respiratory failure severe pneumonia
- ✓ Heart arrest Heart Operating Sepsis

#### *Children:*

- If a child experiences pneumonia, ECMO may be necessary.
- High infections.
- Heart failures Congenital.
- Operation of the heart.
- Trauma and other situations.
- Suction of toxic substances into the lungs.
- The issue of asthma.

#### *Adults:*

In an adult, ECMO may include:

- ✓ Trauma to pneumonia and other emergencies.
- ✓ Extreme cardiac insufficiency.

#### *Advice for parents when their child is on ECMO:*

- An infant with ECMO can be emotional, sometimes traumatic, to parents, caregivers and families. There are many ups and downs in the experience.
- Take control of in the first place. Day after day, eat, sleep and get out. Parents will have to decide about the medical treatment of their kids.
- Parents should be involved in the care of their

kids. Most parents do not have medical education and find much of the medical terminology and knowledge difficult to learn. Many of your questions will be answered by hospital personnel.

- Speak to a social worker at a hospital, who can help relieve depression by discussing the problems.

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