EXTRACORPOREAL MEMBRANE OXYGENATION(ECMO)

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ABSTRACT

Extra Corporeal Membrane Oxygenation (ECMO) is a lifesaving technique used to support patients with severe heart and/or lung dysfunction which provide systemic perfusion and gas exchange allowing the heart and/or lungs to rest and recover or to bridge a patient to a different modality of support or to transplantation. This method allows the blood to "bypass" the heart and lungs, allowing these organs to rest and heal.

Keyword: Extra Corporeal Membrane Oxygenation (ECMO), cardiac and pulmonary support,blood

1. INTRODUCTION

Dr. Robert Bartlett is known around the world as the Father of ECMO for his pioneering work in developing ECMO.

In the early 1970s ECMO research began with adults, but quickly turned to newborns with breathing problems. Dr. Bartlett successfully treated the first newborn in 1975 in Irvine, California. He continued to develop ECMO and brought the program to the University of Michigan in 1980.

Eventually ECMO expanded to the pediatric population and then to adults. First neonatal ECMO case was in 1995 and our first adult case was in 1997 at University of Iowa Hospitals & Clinics.2

Extracorporeal Membrane Oxygenation (ECMO) and Extracorporeal Life Support (ECLS), a broader term used synonymously, both include various modalities of temporary mechanical cardiopulmonary assistance used to support patients with severe heart and/or lung failure which is unresponsive to optimal conventional care.1

2. WHAT IS ECMO MACHINE?

The ECMO machine replaces the function of the heart and lungs. An ECMO machine can help save a person’s life, but it does not treat the disease or injury that lead to the heart and lung failure. An ECMO machine simply provides support for a person while the healthcare team works on treating the underlying disease or injury (such as an infection) or until organs for transplant become available.3

In extracorporeal membrane oxygenation (ECMO), blood is pumped outside of the patient body to a heart-lung machine that removes carbon dioxide and sends oxygen-filled blood back to tissues in the body. Blood flows from the right side of the heart to the membrane oxygenator in the heart-lung machine, and then is rewarmed and sent back to the body.4

3. TYPES

3.1. Venous-Venous ECMO

Venous-venous ECMO (VV ECMO) provides pure respiratory support through blood oxygenation and carbon dioxide (CO2) removal. It does not provide circulatory support.

3.2. Veno-Arterial ECMO

Veno-arterial ECMO (VA ECMO) is similar to the heart-lung machine and provides cardiac and pulmonary support for patients in cardiogenic shock.5

4. DURATION OF ECMO SUPPORT

Each patient is different and will require different amounts of time to be on ECMO depending on heart and lung diseases or injuries. Some patients are able to come off ECMO after less than 24 hours, and some patients need to be on ECMO for over 30 days. Most commonly, patients are on VA ECMO for 5-10 days and VV ECMO for 10-14 days but these are just averages.11 Unfortunately, some people do not improve enough to be taken off the ECMO machine.3
5. CLINICAL INDICATIONS FOR INSTITUTION OF ECMO SUPPORT

VA-ECMO
- Weaning from cardiopulmonary bypass after cardiac surgery
- Bridge to cardiac transplantation
- Acute myocarditis
- Intractable arrhythmia
- Post-cardiac arrest (as part of advance life support)
- Local anaesthetic toxicity
- Pulmonary Hypertension

VV-ECMO
- Any potentially reversible acute respiratory failure
- ARDS. Associated with pneumonia (viral or bacterial)
- Failed lung transplant graft
- Trauma (pulmonary contusion)
- Pulmonary embolism (if acceptable cardiac function)

6. CONTRA INDICATIONS

6.1. Contra indications to all forms of ECMO
- Any condition or organ dysfunction that would limit the likelihood of overall benefit from ECMO such as severe, irreversible brain injury or untreated metastatic cancer
- Patient has contra indications to anticoagulation therapy
- Limited vascular access

VA-ECMO
- Severe aortic regurgitation
- Aortic dissections

VV-ECMO
- Severe pulmonary hypertension
- Severe left or right heart failure
- Cardiac arrest

7. PROCEDURE

ECMO requires a surgical procedure but it is usually done in a patient’s room. A surgeon, assisted by an operating room team, inserts the ECMO catheters into either an artery or veins. An x-ray is then taken to ensure the tubes are in the right place. Usually a patient on the ECMO pump will also be on a ventilator, which helps the lungs to heal.

While on ECMO, the patient will be monitored by specially trained nurses and respiratory therapists, as well as the surgeon and surgical team. The patient may be given certain medications including: heparin to prevent blood clots; antibiotics to prevent infections; sedatives to minimize movement and improve sleep; diuretics to help the kidney get rid of fluids; electrolytes to maintain the proper balance of salts and sugars; and blood products to replace blood loss. Since the patient will be sedated, supplemental nutrition will be provided either intravenously or through a nasal-gastric tube.

The ECMO pump pulls blood that has no oxygen attached from a vein and pushes it into the machine’s artificial lung, or oxygenator. That’s where carbon dioxide is removed from the blood and oxygen is added. There’s a color change as the darker blood with no oxygen turns bright red when oxygen is attached to it. As the red blood leaves the oxygenator it is warmed before returning to the patient.

Discontinuing ECMO requires a surgical procedure to remove the tubes. Multiple tests are usually done prior to the discontinuation of ECMO therapy to confirm that your heart and lungs are ready to do its function. Once the ECMO cannulas are removed, the vessels will need to be repaired. This can be done either at the bedside or in the operating room. The doctor will use small stitches to close the spot where the tubes were placed. The patient will be asleep and monitored for this process. Even though the patient is off the ECMO, the patient may still need to be on a ventilator.

8. COMPLICATION

8.1. Bleeding:
Because of the blood thinning medication that patients need while on ECMO, they can start bleeding in different parts of their body.

8.2. Kidney Failure:
Patients who are on ECMO sometimes do not get enough blood flow to their kidneys. This can cause their kidneys to stop working, known as “acute renal failure.”
8.3. Infection:
The tubes from the ECMO machine go from outside the patient’s body directly into their bloodstream. This increases the risk for infection

8.4. Leg Damage:
Some patients are connected to the ECMO machine through a vein or artery in the groin (top of the leg). In some cases, this can impair the blood flow down that leg, and the tissue in the leg can die.

8.5. Stroke:
In patients on ECMO, certain areas of the brain may not get as much blood flow as they need because of small blood clots. This can cause a stroke.3

9. Survival Rate
In experienced ECMO centers, approximately 25% of patients will improve and recover without ECMO, while 75% of patients will require ECMO. Among those who require ECMO, 60% to 70% will survive.9

10. ECMO Specialist Nurse
ECMO specialist nurse is responsible for ensuring the safe management of the ECMO circuit, which includes the titration of blood flow and sweep gas flow to achieve oxygen and carbon dioxide targets, titrations of blood flows and sweep gas flows to facilitate exercise and the management of emergency situations should they arise. The advantage of the ECMO specialist with a nursing background is their ability to provide 24-hour care managing all aspects of patients’ needs, including administration of medication, and to have the technical skills and knowledge to safely manage the ECMO circuit with perfusion backup for the more complicated aspects of circuit management.10

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References


