

Extracorporeal membrane oxygenation (ECMO)

Family information guide



**Peyton Manning
Children's Hospital**

Ascension St. Vincent

What is ECMO?

ECMO stands for ExtraCorporeal Membrane Oxygenation. It is a therapy that uses a heart-lung machine to do the work of the lungs and sometimes the heart. This maintains blood flow and oxygen to the vital organs, like the kidney, while the heart and/or lungs rest and recover. ECMO therapy uses an artificial lung outside of the body to provide oxygen and remove carbon dioxide (lungs), and a pump to relieve the stress on the heart. ECMO therapy can be very helpful but it is not a cure for a heart or lung condition. Your child can be on ECMO from days to weeks.

Who needs ECMO?

Patients who need ECMO have a severe lung and/or heart condition that has not responded to standard ventilator support, oxygen and medications. Most infants and children who require ECMO usually have one of the following problems:

- Meconium aspiration syndrome
- Sepsis (infection)
- Persistent pulmonary hypertension (PPHN)
- Congenital diaphragmatic hernia
- The need for heart support after open-heart surgery
- Pneumonia (bacterial or viral)

Because ECMO is not a cure, it is offered only to patients whose lung and/or heart disease is considered reversible.

What's next...

ECMO cannulas (which look like very large IVs) are placed in the patient's neck and/or groin vessels. There are some cases where they are placed directly into the patient's heart. The exact placement of the cannulas will depend on your child's diagnosis, age and body type. This procedure is called cannulation, and is performed in your child's room or in the operating room. Your child will be given pain medicines and sedation during the procedure.

Types of ECMO

There are two types of ECMO support:

- **Venoarterial ECMO (VA ECMO)** is used when the heart and lungs need support. The blood is drained from a very large vein, then oxygenated and returned through a very large artery. This type allows the heart and lungs to rest and get better.
- **Venovenous ECMO (VV ECMO)** is used for lung support only when the heart is still working well. The blood is drained from a very large vein, then oxygenated and returned through the same vein or another vein. This type allows the lungs to rest and get better.

Both types of ECMO provide oxygen in the blood to the organs and the body tissues. Once there is enough blood flow through the ECMO pump, the ventilator may be changed so the lungs and/or heart can rest.

Complications

Bleeding — Your child's blood must be kept from clotting while it goes through the ECMO machine. Heparin or another type of blood thinner is given to prevent clotting. Despite careful monitoring, bleeding can occur. Some sites of bleeding are:

- Cannulation site
- Surgical sites
- IV sites
- Brain (more common in babies)
- Abdomen

Infection — Whenever a cannula is inserted into a blood vessel, there is an increased risk of infection.

Blood clots within the circuit — During ECMO, small clots can get into the ECMO circuit. We carefully monitor the clots hourly. Some clots may require us to come off of ECMO briefly to change out a part of the circuit.

Equipment failure — Although every safety measure is taken, the ECMO circuit can malfunction or fail. Your child may need to be removed from the machine while the problem is corrected, and then placed back on ECMO.

What will my child look like?

Your child's appearance may be overwhelming at first. You will see one or more cannulas placed into major blood vessels:

- Infant cannulas typically will be in the right side of the neck.
- Larger children may require additional cannula(s) in the groin.
- Cardiac patients who are placed on ECMO in the operating room following heart surgery will use the same chest cannulas they had during the surgery.

There will also be a breathing tube (ET or endotracheal); IV lines to administer medications and monitor blood pressure; possibly chest tubes; a catheter to collect urine; a tube in the mouth to remove extra fluids from the stomach; and EKG pads to monitor the baby's heart rhythm.

Over the first days your child may become very swollen, especially in their head and face. This is due to being on the ECMO circuit and not moving around on their own. (It is usually harmless and disappears within a few days after being removed from ECMO.)

They will have nutrition provided by an intravenous (IV) line. As soon as the patient tolerates, tube feedings into the stomach of breast milk or formula are started.

Daily care

We encourage the family to touch and talk to the patient if they tolerate it. Quiet times are set up in the afternoon where the lights are dimmed and there is minimal touch from the staff.

Parents and grandparents are allowed to visit 24 hours a day. All other healthy visitors may visit between 8:30 a.m.-8:30 p.m. No more than three people are allowed at the bedside at one time.

Parents and families play an important role in a child's care and recovery. Some things you can do to help with the child's care:

- Provide special toys, comfort items and pictures of family.
- Family's touch and voice are important.
- Siblings can draw or color pictures to display at bedside.
- Take care of yourself. Make sure you eat well and rest.
- Keep a journal and take pictures of their progress if it helps you.
- When you are away from the bedside you can call at any time.
- There will be daily rounds every morning with the nurse, respiratory therapist, ECMO specialist, doctor, nutritionist, pharmacist and anybody else who is caring for your child. Please ask questions. We will be discussing the plan for the day.
- Ventilator and heart medications are turned down slowly as the ECMO pump starts to support the organs.
- Your child will receive a daily chest X-ray. Infants will receive a daily or every-other-day head ultrasound to monitor for bleeding.
- Blood samples will be drawn from your child's IV and the ECMO circuit frequently to monitor how well they are tolerating ECMO, and how fast the blood is clotting.
- Your child will require several blood product transfusions.

- We ask family members to be very cautious of the cannulas. These cannulas are in large blood vessels and it does not take much force to dislodge them. Do not be offended if the ECMO specialist is very protective of this area. It is their job to ensure the safety of your child and the cannulas.
- Your child will have continuous medications for pain and sedation due to the large amount of stimulation from the equipment and the care required from the staff.
- If your child can tolerate it, we will have them awake while on ECMO. This means you can bring in some of their favorite things for them to do or watch.

How long are they on ECMO?

The length of time a patient spends on ECMO depends on three factors:

- Their age
- The original illness
- Any complications

A steady decrease in the amount of ECMO support while maintaining good oxygenation and blood pressure is an important sign of improvement.

Once your child is ready to be removed from the ECMO machine, the surgeon will perform another operation to remove the cannulas, which we call decannulation. Normally the neck cannulas will be kept in place for up to 24 hours once the ECMO pump is discontinued if on VA (venoarterial) support. This support is for heart and lungs. When it is apparent they do not need ECMO, the surgeon will decannulate. This usually occurs at your child's bedside in the pediatric intensive care unit.

They will still need ventilator and other support for a period of time after the cannulas are removed.

ECMO is complete. What's next?

If your child is a newborn ...

- They will stay in the PICU until cannulas are removed, and they are stable enough to transfer back over to the Newborn Intensive Care Unit (NICU).
- Once in the NICU, they will be weaned off of the ventilator. Once they are on a nasal cannula or breathing room air, they can start bottle or breastfeeding.
- Some babies are slow to begin eating, and this can be very frustrating for parents. If this happens, it may mean only that the baby has been sick. They have to build up their energy level to take enough to gain weight.
- When they go home, most babies seem to show no effect from being extremely sick at birth, but some may not behave like healthy newborns right away. Some are less active and do not hold their heads up well. This is described as being “floppy,” but is usually temporary.

The same process occurs with children in the PICU in regard to weaning them off of the ventilator. We slowly wean down their sedation and then start back on feedings.

There will be follow-up care with pediatricians or any other specialists whom your child encountered in the hospital.

What did you say?

You will hear a lot of different words while you are in your child's room. Do not be afraid to ask the ECMO specialist, nurse or doctor if you need more of an explanation.

ABG (arterial blood gas) = a small amount of blood that is drawn from your child or ECMO circuit, and tested to see the amount of oxygen and carbon dioxide it contains. It tells how well the ECMO circuit and/or ventilator is working.

ACT (activated clotting time) = a test that shows how long it takes for blood to form a clot. It helps us make changes with the heparin infusion on the ECMO circuit.

Aorta = the large artery that carries blood that is oxygenated from the heart to the body. This vessel is cannulated directly in heart patients who need ECMO support.

Atrium (right) = a chamber in the heart that receives the deoxygenated blood from the body before it would travel to the lungs to be oxygenated. This chamber is where the venous cannula will be placed to draw out blood to the ECMO pump.

Cannula = a plastic catheter/tube placed into the body that is used for removal or administration of fluid.

Cannulate = to insert a cannula into a part of the body, such as a vein or artery.

Cardiac = refers to the heart.

Carotid artery = a large artery in the neck, which carries blood from the heart to the brain. The ECMO cannula can be placed here and used to return blood from the circuit to the body.

Chest tube = a tube that is placed into the space between the lung and chest wall, which gets rid of air or fluid. Used to treat pneumothorax (collapsed lung).

Cryo or cryoprecipitate = plasma blood product that contains large concentrations of clotting factors.

Decannulate = to remove a cannula.

Echocardiogram (ECHO) = a machine that uses high-frequency sound waves (ultrasound) to image the heart and evaluate heart function.

ECMO flow = the amount of blood pumped through the ECMO machine each minute.

ECMO pump = pump that controls ECMO flow and moves blood through the circuit.

Edema = swelling, extra fluid in the tissues.

Endotracheal tube (ET) = a breathing tube placed into the trachea and attached to the ventilator.

FFP or fresh frozen plasma = liquid portion of human blood that contains normal concentrations of coagulation factor.

Hemofilter = a filter in the ECMO circuit where blood flows through and waste products and water are removed. Helps to pull off fluid from patient.

Head ultrasound = sound wave test that checks for abnormal bleeding in the cranium or head.

Heparin = a drug used to prevent the blood from clotting during ECMO.

Jugular vein = large vein in the neck that carries blood from the brain to the heart. The ECMO cannula is placed here frequently and used to draw blood from an ECMO patient.

Oxygenator = the artificial lung that adds oxygen and removes carbon dioxide.

Platelets = cells in the blood that aid in clotting ability.

Pneumothorax = escape of air from the lung into the space between the lung and chest wall, usually resulting in lung collapse.

Pulmonary hypertension or persistent pulmonary hypertension of the newborn (PPHN) = high blood pressure in the blood vessels of the lungs make it hard for the blood coming from the heart to enter the lungs. This causes the blood to go past the lungs and not receive oxygen.

Packed red blood cells (PRBC) = Red blood cells that have been separated from whole blood for transfusion purposes.

Sepsis = an infection in the blood.

Sweep flow = amount of flow of oxygen going to the oxygenator.

Veno-arterial ECMO (VA) = gives heart and lung support.

Veno-venous ECMO (VV) = gives only lung support.

Ascension St. Vincent ECMO team

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