BRIAN HOUSTON: Extracorporeal Membrane Oxygenation or ECMO really comes in two flavors. One is called Veno-Venous or VV-ECMO and one is Veno-Arterial or VA-ECMO. They both are essentially a similar setup but employed in different ways.

So VV-ECMO is where you take blood out of the patient and you run it through an oxygenator or an artificial lung. And then you run it back into the patient, and you let the patient's heart do the pumping work of that blood. These are for patients where their lungs aren't working.

So they have acute respiratory distress syndrome or very bad pneumonia, something we think that's going to get better. We can support the oxygenation of blood with VV-ECMO for a time. And then as their lungs improve, we're able to separate the patient from VV-ECMO.

VA-ECMO is where we take the blood from the patient, oxygenate it, and then put it back into an artery, thereby bypassing the heart and the lungs completely. So these are for patients who have cardiac failure, sometimes cardiac and pulmonary failure together-- similarly used in patients where we think that there's a chance they can recover or we can bridge them to some other sort of support. So VV-ECMO-- the short of it, VV-ECMO for patients with pulmonary failure, VA-ECMO cardiac failure.

What's changed in ECMO, one, is like all other technology, miniaturization. So just like our cell phones used to be the size of a brick and now are the size of a deck of cards or smaller-- ECMO, the machines, the pumps, the oxygenators-- everything is getting smaller. This allows us first to employ it in an ICU room or in an emergency department, even sometimes in an ambulance, But also some centers are starting to experiment with going to get patients in the field. So patients who aren't even a health care setting, put them on ECMO and bring them back.

There are some ECMO machines that are the size of a lunchbox now, which are still being worked on and perfected. But that's been the growing edge of ECMO the technology. I think the other edge of technology is we're learning who best to use it in. So we kind of know that we can do it. And now we need to know in whom we should do it. And that's where we're still learning a lot.

Two broad indications, so one are patients who have not had cardiac arrest, but have organ failure-- so either pulmonary or cardiac. These are patients who are not getting better. They're getting worse. They need support. And we think that they-- their organ will either improve on its own or that we can use ECMO as a bridge to get us to something else.

For lung it could be lung transplant. For heart it could be heart transplant or a more durable sort of pump, like what we call an LVAT, a Left Ventricular Assist Device. Here at MUSC, within the last year, we actually have had a patient who bridged with ECMO to a left ventricular assist device and is now at home walking around doing well.

So that's the first big classification of patients. The other classification is patients after cardiac arrest. So these are patients who either are actively arresting or have arrested and we're trying to resuscitate them-- so resuscitation ECMO. I think this is one of the larger growing edges of the field, you know, where we can learn a lot.

There have been studies recently. I saw a study out of Dusseldorf, where they took 135 patients who had been out of hospital cardiac arrest-- so 135 of them, I think 115 qualified-- and they put them on ECMO. They were referred to an ECMO hub in the city of Dusseldorf from 17 centers. Out of those 115 patients 38 of them survived.

And that doesn't sound great, but we have to keep in mind that the out of hospitals cardiac arrest survival rate in the United States is less than 8%. So that's a significant increase. It's over 35%. And so the question is, which of those 115 patients were the right 115 patients to put on ECMO? Because there is significant risk and cost.

When a patients on ECMO they have to be on a blood thinner to prevent the blood from clotting in the tubes or in the pump or the oxygenator So there's a risk of bleeding. It's an abnormal state of blood flow.

So our body is used to blood flowing in a pulsatile manner and not going through a big high-speed centrifuge, basically, the pump that we use to drive the blood. That can be hard on the blood. And it's hard on the body.

And so the risk of bleeding-- what we worry about, brain bleeds in particular is not insignificant-- risk of stroke as well given the clotting risk. And then anytime you have tubes in the body, there's a risk of infection. So the longer the patients days on ECMO, the more risk there is of an intravascular infection, which is often devastating.

You know, I think one of the larger risks is just that there is no other side to the bridge. You know, if you always think of ECMO as a bridge, it's bridge to recovery or a bridge to a more durable type of support. It's sometimes hard to know when you're deciding to put the patient on ECMO is this a patient who's going to recover or is this the patient who's going to be a candidate for something like a lung transplant, a heart transplant, or a left ventricular assist device. And so we're working in the heat of the moment with a very sick patient with incomplete information.

And I think that's something we as a medical community are getting better at. It's even harder in the setting of a cardiac arrest. The information is more incomplete. And our crystal ball is very fuzzy. Who's going to survive a cardiac arrest if you put them on ECMO and who's not?

And you see most of our ECMO is pre-cardiac arrest. So these are patients who we have a more complete information on. We think we have a reversible cause.

And one of the more common reasons for me is a heart failure cardiologist is to see ECMO employed is a case of myocarditis. So this is an inflammatory condition of the heart that you can get-- kind of scarily enough-- after the common cold. It can cause severe heart failure to come on acutely, but what's unique about myocarditis is it often recovers. And so if you can bridge the patient through that time of severe heart failure with ECMO and they recover, they might walk out of the hospital. We've had cases like this in the last year, where folks are coming into-- walking in the clinic and see us when they were almost in cardiac standstill, no cardiac activity at all during their time on ECMO.

What we're learning more and more through the studies is the earlier you can deploy ECMO the better. And that's whether it's in patients pre-cardiac arrest or during cardiac arrest. So pre-cardiac arrest-- if we wait while the patient sitting there in heart failure or pulmonary failure until they have other organs failing-- kidney failure, liver failure, they have cerebral problems-- it's often too late. The ECMO will not support or salvage those organs as well.

So for an outsider referring, if you're seeing a patient there that's in heart failure, that all your medicines aren't working, think of us and think of ECMO early rather than late. Similarly, if we cross that boundary into kind of resuscitation ECMO or ECMO during cardiac arrest, the studies tell us early deployment-- patients who are younger and patients who don't have signs of organ malperfusion-- so a sign that their arrest has been going on a long time. So early deployment is a key.

With ECMO it really takes a village to support a patient with ECMO and to keep a program going and successful. So first off, you have to have people that deploy the ECMO or put it in. At MUSC we both have cardiothoracic surgeons who are experienced in this. And more recently, our international cardiologist have gotten involved. And they are exclusively now the people that put ECMO it.

This is nice because there's no surgery required. It's all done with needles, wires, and tubes. It's a little gentler for the patient. We think there's a lower risk of trauma to the vessels, but we have but we have both resources available.

And then you have to have someone to take care of the patient afterwards. And here we take a multi-disciplinary team approach. So the patient's seen by surgeons, the heart failure cardiologists, sometimes pulmonologist-- if it's VV-ECMO or the patient also has pulmonary failure-- and anesthesia and critical care doctors pretty much every day.

And then you have to have someone to be on the other side ready to catch the patient, meaning ready to take care of what happens after ECMO. If that's recovery, that's great. But if it's not you have to have an option, heart transplant, lung transplant, LVATs. And we have all three options available at MUSC.