

Melanie Cole, MS (Host): Welcome to podcast series from the specialists at Penn Medicine. I'm Melanie Cole. And today, we have an ECMO panel for you with Dr. Asad Usman, he's an Assistant Professor of Clinical Anesthesiology and Critical Care at Penn Medicine; and Dr. Christian Bermudez, he's the Director of Thoracic Transplantation and the ECMO Program at Penn Medicine.

Doctors, thank you so much for joining us today. Dr. Bermudez, I'd like to start with you. ECMO has been a mainstay at Penn Medicine for at least a decade. Tell us what's changed in that time and the indications for ECMO, a little bit about the history and where it stands now for use.

Dr Christian Bermudez: First of all, good afternoon, Melanie and Asad. It's a pleasure being here with you today to talk about our passion on ECMO. Your question is excellent, Melanie, to start this podcast. We're now more than 50 years of the first use of ECMO, and a lot has changed since then, especially over the last 15 years in which a significant improvement of the technology has been incorporated with new centrifugal pumps, better oxygenators, and better cannulas that allow us not just to support a wider variety of patients, but also for longer periods of time.

So regarding your question, what has changed in terms of the indications, I want to say that it was being used for a number of pulmonary and cardiac conditions.

Today, we use it on the cardiac side for patients presenting in shock after an acute myocardial infarction. We use these also in patients with acute or chronic cardiomyopathies like myocarditis or chronic heart failure that are acutely decompensated. We also use it for patients that present to the emergency department in cardiac arrest when we're not able to get them out of the arrest with success. And more recently, also, we've been using it for patients that present with acute pulmonary embolism.

Now, aside from the cardiac conditions, ECMO is frequently use for patients in advanced lung conditions that are not responsive to medical treatments or the standard ventilator treatment, this is what we call in general ARDS or acute respiratory stress syndrome. It's also being used more frequently now as a bridge to lung transplantation.

Penn has been an avid user of this technology. Now, we have performed close or a little bit more than 1200 ECMO supports over the last 15 years. We're now doing around 200 to 250 cases of ECMO support, depending on the year, at our institution. It's important to understand that it's not just been at Penn. The use of

this technology has increased worldwide, and we have a very clear data from ELSO, the Extracorporeal Life Support Organization, a registry with more than 200,000 patients worldwide with about 15,000 to 16,000 patients supported every year with this technology. So again, it's a very important part of what we do today, especially in the use in critical patients.

Host: Such an exciting time, Dr. Bermudez. And Dr. Usman, ECMO is integrated into many aspects of the transplantation continuum and thus, many of the issues and concerns for the transplant community continuum. Can you tell us where the ECMO Program is going in these sensitive areas, what's happening now or soon at Penn Medicine to improve organ survival and the patient experience, for example, and compare a little bit for us the outcomes of patients supported with ECMO who are bridged to transplantation versus bridged to an LVAD prior to transplant. Tell us a little bit about how all this comes together.

Dr Asad Usman: Fantastic. This is such a great panel. Thank you so much again, Melanie and Dr. Bermudez, for having me. It's an honor for me to be in this group that we have at the University of Pennsylvania. I initially trained at the University of Michigan where I did my undergraduate training.

And ECMO, for the community providers, is a support tool that allows us to totally reanimate patients. We take some of the most critical patients that exist in the healthcare system and enable them to achieve an endpoint, both recovery and potentially transplant. And patients otherwise would have been deemed non-salvageable.

For me, particularly, the great thing is that I get to work with fantastic colleagues and great mentors, like Dr. Bermudez. And as Dr. Bermudez has just mentioned, the indications for ECMO are broad. They encompass very, very sick patients. And oftentimes, you have to use ECMO to resuscitate patients who may need transplantation. The challenge becomes when you have patients at outside hospitals or inside your hospital that may not necessarily meet the exact criteria for transplantation, they run out of time.

So, the real key areas that ECMO has been advancing, in particular for transplant, has been allowing us time and ability to introduce therapies that can get these patients to the finish line of transplantation. Now, we have options both for on the cardiac side, as you mentioned, the left ventricular assist device, as well as heart transplantation, and on the pulmonary side, lung transplantation.

So, the things that are happening now at Penn Medicine to improve organ survival and the patient experience is what we call ECMO 3.0. What we're

building at Penn is the next frontier. We are using ECMO in patients who are awake, rehabilitating them. We have great physical therapists that are ambulating our ECMO patients.

Now, you have to remember patients who are ambulating on ECMO, have zero cardiac function or zero lung function. For all intents and purposes, if they did not have that machine, they would have passed away. And that's why one of the well-known ECMO conferences is called the Reanimate Conference. You're totally reanimating these individuals. Many of these patients are able to talk, communicate with their family, and participate in their clinical care and decision-making, which oftentimes in some of these critical patients, you don't have that luxury.

And the future looks very bright for mechanical circulatory support. ECMO in particular is one of the strongest tools that we have. And just to give you a glimpse of what we're doing in the future, we are not only using ECMO for patients who are bridging to transplantation or recovery but we are entering into an era where we can use it for normothermic regional perfusion, which is a technology that allows us to resuscitate not only the patients, but the organs that they're going to receive.

Dr Christian Bermudez: Asad really summarized it very well where we are today on ECMO as, a bridge to transplant. But I want to reinforce concept. It has become a really important tool in transplantation. The way the organs are allocated today, and this has changed over the last five to eight years, is that these organs are going to the sickest patients, both on the cardiac side, meaning heart transplant, and also on the lung side, meaning the lung transplantation.

So in general, the organs are allocated for patients that are really, really sick. And for that reason, ECMO has become a very important tool. On the cardiac side, for heart transplantation, we do have left ventricular assist devices. Supporting the right ventricle with the use of an Oxy-RVAD can be a very important point, especially in patients with advanced lung conditions or in patients with right ventricular failure.

We do have other axial-flow pumps that allow us, aside from ECMO, to support this patient. ECMO is a great tool, for example, as a way to transfer when both ventricles are failing, or when there is a cardiac hypertrophy that doesn't allow other type of devices to be used. A lung transplant is the only option. So, it becomes really, really important.

Today, we're able to support patients up to six months (as we learned during the COVID pandemic), on ECMO, until they recover enough to be transplantable.

So, a very important field in the area of transplantation, not just to take the patient from their critical condition to transplant, but also to allow us to recover organs in patients, so again, very important tool in the field of transplantation, and a lot of things coming in this area.

Host: This episode is so exciting for other providers to hear all of this great work. Now, Dr. Bermudez, ECMO is evolving rapidly, as you just said. Speak about some of the technologies or approaches that have been introduced at Penn Medicine in recent years. Devices that are being partnered with ECMO for better outcomes to serve the affected patient population, the design of the equipment, what's changed. I mean, now there's bicaval dual-lumen catheter (BCDL), catheter inflow and outflow ports at a single site. There's all these really fascinating, exciting things happening. Speak about some of those.

Dr Christian Bermudez: As you mentioned, the technology has evolved in many other areas of medicine. From the ECMO perspective, there are two or three points that are critical. First of all, the pumps have evolved. Now, we have these centrifugal pumps that produce very little effect on the blood with low rates of blood destruction or platelet destruction. We have different technologies at Penn, excellent technologies that allow you to support patients for prolonged periods of time.

But also aside from the improvement of the evolution of the pumps, the evolution of the oxygenators being critical, the fiber-made oxygenators are the ones that have allowed us to increase the oxygenation of the blood. And those are much more reliable than they used to be 15 years ago with polymethylpentene fibers that are very, very reliable. Aside from the oxygenator, the cannula improvement has been critical. They've become smaller. We have now cannulas that we can provide ECMO with only one cannula instead of two. We have also improved the way we cannulate patients, understanding, for example, and Dr. Usman can expand a little bit on this.

Host: Dr. Usman, we touched briefly on the teamwork and the multidisciplinary nature of ECMO. You mentioned it briefly before. I'd like you to expand on this topic for us and who do you work with within the community setting and in your practice on a typical day? Where are your patients arriving from? Speak about all of this multidisciplinary and interdisciplinary approach that you have with ECMO.

Dr Asad Usman: So, we have a very, very wide catchment. During the pandemic, we actually expanded our catchment to basically the entire eastern board of the United States. We had consults for ECMO and ECMO evaluation all the way down to Florida, Tennessee. On the transplant side, recently, we had evaluations for patients in Hawaii and even in Mexico. And so, we work with both our local community and national community.

We work in a multidisciplinary nature. Both Dr. Bermudez and I have access to some of the top minds internationally in ECMO and mechanical support. Our colleagues are visiting us, evaluating how our program is and learning from us. We are one of the best ECMO programs in the country, as rated by the Extracorporeal Life Support Organization.

Internally, we have a very strong team approach. I am an anesthesiologist, Dr. Bermudez is a cardiac surgeon. We work hand in hand in taking care of these ECMO patients. But beyond the clinicians and the physicians, we have a multitude of nurse practitioners, ECMO specialists, we have perfusionists. As well as other colleagues from cardiology, advanced lung disease, nutrition, pharmacy. And so, all of us work together, both clinically and having meetings to optimize and improve our ECMO program on a day-to-day basis. Our patients are arriving from all over the state, both from Pennsylvania, from New Jersey, Delaware, as well as from New York. That's where the majority of our patients are, but that doesn't limit us from accepting patients from further beyond that.

Dr Christian Bermudez: I would like to expand a little bit more on that because for people listening to this podcast, it's important to understand that this technology has really been very unique in allowing multidisciplinary collaboration. The reality is that not just internally, but also the collaboration worldwide, has been impressive.

I'm not sure people are familiar with the concept that close to 17,000 or 18,000 patients were supported with this technology during COVID pandemic, around 11,000 in the US. This was actually very important to rescue many of these patients that deteriorated during the COVID pandemic. That made us really work very close together, not just regionally, but nationally, to improve the way we're providing care to our patients.

Host: I would like to give you each a chance for a final thought. And Dr. Usman, starting with you, what would you like some of the key takeaways to be

from the program at Penn Medicine and the ECMO program? What's going on that's so exciting in the field, where you see it going?

Dr Asad Usman: One of the key highlights that I'd like to emphasize is our mobile ECMO program that was spearheaded initially eight to nine years ago by Dr. Jack Gutsche and Dr. Vernick with the support of everybody else at the University of Pennsylvania. That program has an excellent survival rate that exceeds the ELSO average for veno-venous ECMO. And this program is unique, because we get referrals from outside hospitals and we will evaluate those patients and actually fly out to those hospitals to help put these patients on ECMO and then bring them back. Oftentimes, we get calls from other hospitals and they are at the end of their rope. These patients are near death and they need help. They cannot transport these patients. The real beauty of **mobile** ECMO is that we can implant it at the bedside very rapidly and help some of these outside hospitals get those critically ill patients transported over. And that ability to act critically with a timely fashion and get to the bedside right away helps us take care of some of the most critical patients in our region.

Host: Dr. Bermudez, last word to you. If physicians want to reach out to the Penn ECMO Program, who would they contact and what are your final thoughts on this episode today?

Dr Christian Bermudez: If any physician from anywhere in the country would be interested in contacting us, the best way to do this is to call the Penn Transfer Center, 215-662-3555, and ask to get in touch with the person on-call for the ECMO program, or the shock program, or the Lung Rescue Program. We have these three programs that funnel finally to the ECMO program. So, any of those programs would be happy to communicate with you and direct you appropriately.

Now, to finalize my comments on ECMO, I want to say that we're really excited at Penn to provide the highest level of care possible in this area. We also enjoy educating not just our group here at Penn, but also the region. We have a symposium that we do every other year, the so-called Penn ECMO Symposium, because we believe that this is an important strategy, an important tool, to help patients in critical conditions. And we're really excited to see how this field has moved forward and we're expecting much more to come.

Host: Thank you both so much for joining us and sharing your incredible expertise with us today. To refer your patient to Dr. Bermudez or Dr. Usman at Penn Medicine, please call our 24/7 provider-only line at 877-937-PENN. Or you can submit your referral via our secure online referral form by visiting our

website at [pennmedicine.org/referyourpatient](https://www.pennmedicine.org/referyourpatient). That concludes this episode from the specialists at Penn Medicine. I'm Melanie Cole. Thanks so much for joining us today.