

## **20 Questions: ECMO**

**By: Gregg A. Jones, MD**

1. What is ECMO?
2. What are the two most commonly used types of ECMO?
3. What are the indications for use of ECMO?
4. You told me the indications, but what does ECMO actually treat?
5. Is ECPR (refractory arrest, "ECMO Alert") different than ECMO?
6. What hospitals in the west metro have an ECPR program?
7. You respond to a call at a nursing home for an 88-year-old male that is unresponsive. When you arrive, you are unable to palpate a pulse. While you are preparing to start chest compression, your partner places the patient on the monitor. When you perform a rhythm check, you notice ventricular fibrillation. After giving epinephrine and defibrillations, you start transporting to the nearest hospital. Is this patient a good candidate for eCPR?
8. Is there a prehospital protocol for ECPR (refractory arrest, "ECMO Alert") activation when I am taking a patient to one of the hospitals with an ECPR program?
9. ECMO kinda sounds like cardiac bypass used in open-heart surgeries, is it the same?
10. What are the risks associated with ECMO?
11. You respond to a call at a first floor apartment for a 58-year-old female that is unresponsive. Her son was sitting next to her when she became unresponsive and started CPR. When you arrive, you are unable to palpate a pulse. While you are preparing to start chest compression, your partner places the patient on the monitor. When you perform a rhythm check, you notice ventricular fibrillation. After giving epinephrine and defibrillations, you start transporting to the hospital. Based on what you know, is this patient a good candidate for ECPR (refractory arrest, "ECMO Alert")?
12. Are there other hospitals performing ECMO and where should I take a patient if I think they qualify for ECPR (refractory arrest, "ECMO Alert")?
13. If I am on scene for a V fib cardiac arrest, should I stay and play or load and go? The reason I asks is sometimes the ED nurses get upset if I only have one IV.

14. Why are the first 16 minutes of a cardiac arrest so important?
15. I heard EMS is starting ECMO in the streets in cities like Paris, when will we start doing that?
16. I understand that we can potentially use ECPR (refractory arrest) for cardiac arrests in V fib and V tach, why can't we use it for asystole?
17. You respond to a call at a lake front beach for a 28-year-old male that is unresponsive. When you arrive, you are unable to palpate a pulse. The patient's friends tell you he was enjoying some alcoholic beverages and was under the water for a longtime. His friends pulled him to the shore. You direct your partner to start chest compression while you place an IO. Your friendly neighborhood firefighter places a king airway and starts bagging the patient. You perform a pulse check, and notice a good pulse. You and your partner start transporting to the hospital. Is this patient a good candidate for ECPR (refractory arrest, "ECMO Alert")?
18. You respond to a call at a call at a marathon for a 38-year-old male that collapsed at mile 14. When you arrive, you are unable to palpate a pulse. While you are preparing to start chest compression, your partner places the patient on the monitor. When you perform a rhythm check, you notice ventricular fibrillation. After giving epinephrine and defibrillations, you start transporting to the nearest hospital. Is this patient a good candidate for ECPR (refractory arrest, "ECMO Alert")?
19. You respond to a call at a dialysis center for a 75-year-old female that is unresponsive. They collapsed just prior to starting their dialysis run for the day. When you arrive, you are unable to palpate a pulse. While you are preparing to start chest compression, your partner places the patient on the monitor. When you perform a rhythm check, you notice ventricular fibrillation. After giving epinephrine and defibrillations, you start transporting to the nearest hospital. Is this patient a good candidate for ECPR (refractory arrest, "ECMO Alert")?
20. I know there is a protocol or guideline for ECPR (refractory arrest, "ECMO Alert"), but what is it again? And what is my role as a prehospital provider?

## **Answers to the Questions**

1. ECMO is an acronym that stands for **E**xtra**c**orporeal **M**embrane **O**xygenation. It is basically a pump that circulates blood through an artificial lung to provide oxygenation. This can support the lungs or the lungs and heart. This technique started in the 1950s to bypass damaged and diseased lungs in infants.

2. Veno-venous (VV) ECMO and Veno-arterial (VA) ECMO. VV ECMO is used to replace the lungs but still uses the heart as a pump for the blood. VA ECMO replaces both the heart and the lungs and ECMO works as the pump.

3. There are many uses of ECMO, and trials are ongoing as we discover more ways to use ECMO. Here are some of the known uses:

Refractory Ventricular Fibrillation cardiac arrest (VFIB arrest)

Pulmonary embolism with shock

Massive Overdose

Amniotic fluid embolism following pregnancy

Hypothermia and Hypothermic cardiac arrest

Drowning

ARDS

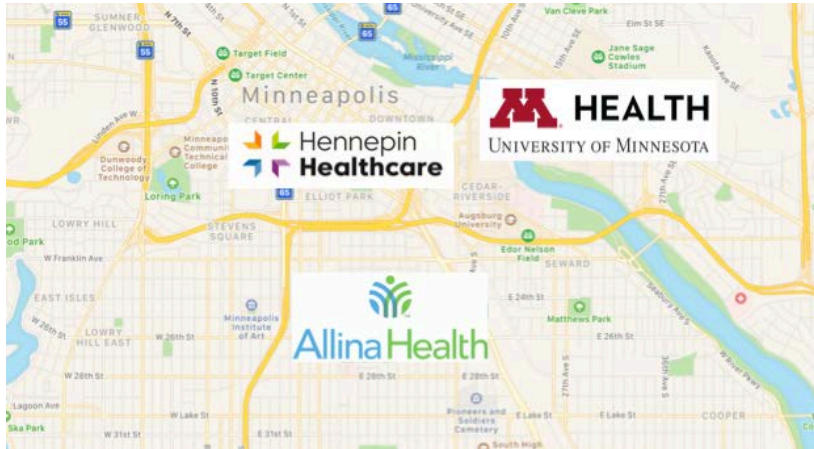
4. ECMO does not actually “treat” anything. ECMO is used as a bridge to fix the actual problem. ECMO buys you time to figure out what is killing your patient. In some cases it buys the patient time to heal. Sometimes, our patient’s lungs just need a break. For example, when used during refractory Vfib arrest treatment, it allows us to support the patient and oxygenate the brain while we take the patient to the cath lab to hopefully unblock one of the coronary arteries. It acts as a bridge, and buys more time to solve the problem.



5. No, ECPR (refractory arrest, “ECMO Alert”) is ECMO. Specifically, it is ECMO used when someone is in cardiac arrest. There are other uses of ECMO that does not require the patient to be in cardiac arrest, such as profound lung pathology. ECMO is just the tool used in ECPR (refractory arrest, “ECMO Alert”).

6. There are three places to take ECPR (refractory arrest, “ECMO Alert”) patients in the west metro: HCMC, University of Minnesota and Abbott Northwestern. Outside of the

immediate metro area, the Allina system is initiating ECMO at both Mercy and United hospitals.



7. No, this patient would not be a good candidate for ECPR (refractory arrest, “ECMO Alert”). The patient is excluded due to age and residing in a nursing home. As a reference, ECMO for any indication is not recommended for patients older than 75 years old.

8. Yes there is a protocol:

#### **Inclusion Criteria**

- Age 18-75 years old
- Initial shockable rhythm (VF/VT/AED advised shock)
- Witnessed arrest by bystanders or prehospital personnel
- Suspected cardiac cause of arrest
- Body habitus allows LUCAS CPR (must be used for transport)
- FULL CODE

#### **Exclusion Criteria**

- Permanent resident of a skilled nursing facility (i.e. nursing home)
- Known pre-existing organ failures or co-morbidities that would prevent a return to independent living such as:
  - End-stage kidney disease
  - End-stage liver disease
  - End-stage heart failure
  - Advanced cancer (i.e. metastatic cancer)

9. No, ECMO and bypass are not the same. They have similar functions, but are operationally very different.

This is bypass:



And this is ECMO:



10. There are some concerning risks and downsides associated with ECMO and eCPR:

Bleeding

Trauma to vessels

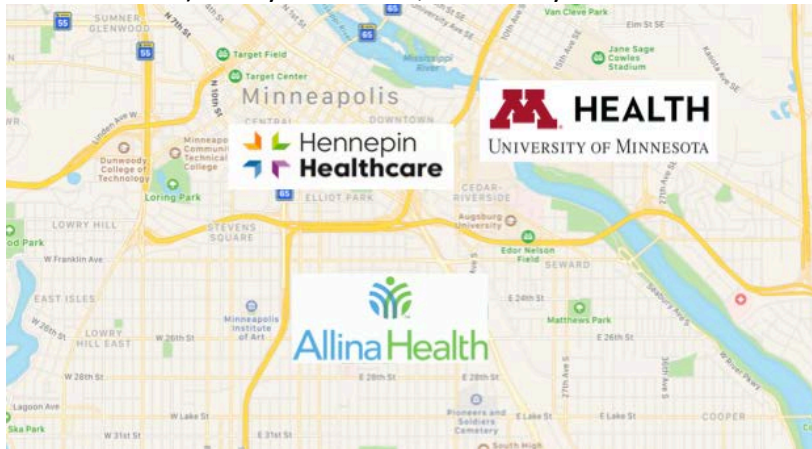
Needle sticks and exposures to healthcare workers during cannulation

Can be confusing and overwhelming to patient's family  
Very resource intensive and expensive

But there are benefits as well: Increased neurologically intact survival from cardiac arrest!

11. Yes, this patient does not have any obvious exclusion criteria. Her arrest was witnessed, bystander CPR was started and she fits into the age ranges.

12. Yes there are other hospitals using ECMO for the other indications listed above, however; there are only 3 in the west metro using ECMO for ECPR (refractory arrest, "ECMO Alert"). They are HCMC, University of Minnesota and Abbott.

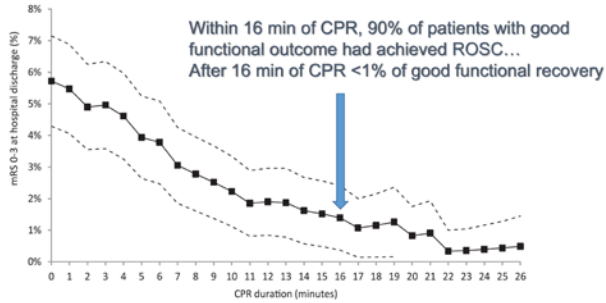


13. You should load and go as soon as you think a patient would benefit from ECPR (refractory arrest, "ECMO Alert"). The quicker they can be placed on ECMO, the quicker their brain is being perfused. The goal is to have ECMO flow in less than an hour. The first 16 minutes of a cardiac arrest are very important making time a valuable thing. Research shows that the majority of patients with good neurologic outcomes are those that obtain ROSC after 16 minutes. This is where the theorized benefit of ECPR (refractory arrest, "ECMO Alert") comes into play. It is a bridge that can lengthen that timeframe.

14. The first 16 minutes of a cardiac arrest is very important. Research shows that the majority of patients with good neurologic outcomes after a cardiac arrest obtain ROSC within 16 minutes. ECMO and ECPR (refractory arrest, "ECMO Alert") are for those that don't obtain ROSC in the first 16 minutes. This is why the goal is to keep scene time less than 18 minutes. Therefore, if no ROSC after 2 shocks, transport immediately.

**Duration of Resuscitation Efforts and Functional Outcome After Out-of-Hospital Cardiac Arrest**

**When Should We Change to Novel Therapies?**  
 Joshua C. Reynolds, MD, MS; Adam Frisch, MD, MS; Jon C. Rittenberger, MD, MS;  
 Clifton W. Callaway, MD, PhD *Circulation*. 2013;128:2488-2494



15. Maybe...but not today.



ECMO being performed at the Louvre



ECMO being performed at subway station

16. Generally we think of V fib and V tach as potential cardiac causes of cardiac arrest. For ECPR (refractory arrest, “ECMO Alert”) to be effective, there needs to be something to fix in the cath lab such as a blocked coronary artery. Asystole, along with other causes of arrest, are less likely to be cardiogenic. Other types of arrests that are excluded are traumatic arrest and police arrests.

17. No. You have already achieved ROSC. This patient may ultimately be placed on ECMO, but to support his lungs after drowning. A few days after drowning, patients can have worsening lungs and may be placed on VV ECMO. If he were to lose pulses again, then you can consider ECPR (refractory arrest, "ECMO Alert") as he does not have any exclusion criteria.

18. Yes, this patient would be great for ECPR (refractory arrest, "ECMO Alert")!

19. No, this patient has end-stage-renal-disease and is on dialysis so this would exclude her from ECPR (refractory arrest, "ECMO Alert").

20. Here is the protocol:

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### **Standing Orders**

If no pulse after 2 shocks, immediately begin to initiate transport to Refractory Arrest Receiving facility

Radio to WMRCC, "ECMO Alert, transporting to [HOSPITAL NAME], ETA is XX minutes."

When feasible, inform any family members of situation using provided script.



Secure patient into LUCAS device, place on stretcher

Obtain IV access, if it has not already been done, while providing 2 minutes of continuous CPR

During CPR:

- Administer Epinephrine 1mg IV/IO every 3-5 min, for a max of 3 doses
- Administer 300mg IV/IO once, then re-dose additional 150mg IV/IO once after four minutes of continuous CPR

Reassess and confirm Pulseless VT/VF then attempt defibrillation using the following guidelines.

a. Monophasic defibrillator:

Shock at 360 Joules

b. Biphasic defibrillator:

Device specific, but typically between 120-200 Joules

If device specific wattage is unknown, shock at 200 Joules

c. Immediately resume CPR for two minutes.

H. Once en route to receiving facility, administer 2 amps of Bicarb IV/IO

I. If ROSC is achieved while en route, continue to initial facility without changing plan.  
Patient may re-arrest or have severe hypotension still requiring specialized ECMO support.