



ECLS for the Emergency Physician

Key Article

- Swol J, Belohlavek J, Brodie D, et al. Extracorporeal life support in the emergency department: A narrative review for the emergency physician. *Resuscitation*. 2018; 13:108-117.

Introduction

- When treating patients with either respiratory or cardiac failure, the emergency physician may use HFNC, NIV, intubation with mechanical ventilation, and pharmacologic therapy with vasoactive agents.
- What happens when these therapies fail?
- ECLS is becoming increasingly more available to emergency physicians
- Though it requires extensive training and a dedicated team, ECLS can bridge critically ill ED patients until more definitive care can be provided
- European Resuscitation Guidelines 2015 recognizes ECPR as a rescue therapy for refractory OHCA
- AHA Guidelines are a bit more cautious regarding recommendation for ECPR given paucity of data

Description

- Provides temporary support of circulation and/or gas exchange to replace heart or lung function as a bridge to recovery
- V-A ECLS
 - Aimed at supporting cardiac or combined cardiopulmonary failure
 - Typically, blood is drained via a femoral or IJ venous cannula, pumped through a membrane oxygenator (removes CO₂, provides O₂, temperature control), then returns oxygenated blood through a femoral arterial cannula
 - Can provide partial or full cardiopulmonary support up to about 10 L/min
- V-V ECLS
 - Aimed at respiratory support in which cardiac function is not severely compromised
 - A dual lumen can be placed in the R IJ
 - Alternatively, two single lumen cannulas can be placed in the IJ and femoral vein or both femoral veins
 - Blood is drained through the femoral venous cannula, circulated through the oxygenator, and returned to the venous system through the R IJ cannula or the second femoral venous cannula
 - Can provide partial or full pulmonary support with blood flow up to 6 L/min
- (V-AV ECLS: a hybrid mode that combines both V-A and V-V)

Indications

- ED conditions characterized by acute cardiac or pulmonary failure and are expected to be reversible

- V-A ECLS
 - Refractory cardiac arrest (despite resus measures)
 - Cardiogenic shock
 - Massive PE (shock or refractory to lytics)
 - Cardiodepressant overdose (beta or calcium channel blocker)
 - Hypothermia
 - Refractory arrhythmias or electrolyte disturbance (hyperkalemia)
 - Sepsis with related severe cardiomyopathy
- VOV ECLS
 - Pulmonary contusion
 - ARDS
 - Near drowning
 - Fat or amniotic fluid embolism
 - Air embolism
 - Major airway injury or obstruction
 - Profound anaphylaxis with failure to ventilate

Contraindications

- Unwitnessed cardiac arrest
- Prolonged transport or interval without CPR
- Severe irreversible brain injury
- Advanced malignancy with limited life expectancy
- Conditions incompatible with life
- End-stage cardiac or pulmonary failure without possibility of transplant or VAD
- Advanced age?

Cannulation

- Most challenging aspect of ED initiated ECLS
- Very important to maintain quality of CPR if doing for ECPR while cannulation is occurring
- Two approaches: percutaneous insertion or surgical cutdown - depends on experience of operator, the patient, and any other anatomic or functional factors
- Percutaneous cannulation
 - The preferred technique for most applications
 - Performed using the Seldinger technique
 - Typically takes about 20 minutes +/-
 - Bleeding complications lower, no need for vessel ligation, infection rates lower
 - Ultrasound typically used to locate vessels and assist cannulation
 - Can result in distal limb ischemia
 - Need to ensure distal perfusion of the cannulated extremity
 - Usually a 4-9 French cannula or introducer is used
 - Accessed percutaneously using US guidance
- Choice of site depends on whether doing V-A or V-V
- Following cannulation, ECLS is initiated with the circuit
 - Circuits include centrifugal pumps with low hemolytic potential, membrane oxygenators, heat exchangers
 - Circuits can be primed with crystalloids prior to initiation of ECLS
 - Typically, a perfusionist will manage the circuit

Anticoagulation

- Heparin is typically administered (100 IU/kg) once cannulation occurs and ECLS is initiated
- Need to maintain anticoagulation during ECLS, except in the setting of hemorrhagic shock
- Anticoagulation usually monitored with ACT or aPTT
 - ACT goal of 160-220
 - aPTT goal of 45-55 seconds

Complications

- Cannulation-related
 - Major vessel perforation
 - Pseudoaneurysm
 - Retroperitoneal hemorrhage
 - Distal limb ischemia
- Circuit-related
 - Hemolysis
 - Inadequate drainage
 - Malfunction of oxygenator or pump
- Hemorrhage
 - ICH
 - Retroperitoneal
 - GI
 - Pulmonary
 - Cannula site bleeding
- Other
 - Thromboembolism (arterial or venous)
 - Hypoperfusion
 - LV distension and pulmonary edema
 - Cannula site infection or catheter related blood stream infection

Organization of an ECLS Team

- Composition of team will be dependent on site – available resources
- Policies should be established on indications, contraindications, clinical management, troubleshooting, transport, equipment maintenance, and follow-up of patients
- All staff members should be trained in emergency procedures in the event of sudden circuit failure or other complications
- Cardiac surgery? Vascular Surgery? Emergency Nursing? Emergency Provider? Perfusionist? Others?