Adult Extracorporeal Life Support (ECLS)

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Disclosures

None
ECMO = ECLS

“A technique of life support that involves a continuous external circuit containing a mechanical pump and a membrane oxygenator through which the patient’s blood is circulated to accomplish gas exchange with or without augmentation of systemic perfusion.”
Two Basic Types of ECMO

1. Veno-venous (V-V) ECMO – supports the lungs (gas exchange)

2. Veno-arterial (V-A) ECMO – supports the heart and lungs (perfusion and gas exchange)
The ECMO Circuit

Components

1. Cannulas
2. Tubing
3. Pump
4. Oxygenator with O2 Blender
5. Heat Exchanger
The ECMO Circuit

Cannulation

- Central (open chest)
- Femoral artery and vein (percutaneous or open)
- Internal jugular vein (percutaneous or open)
- Subclavian/axillary artery (open)
- Dual lumen veno-venous cannulas (percutaneous IJ)
The ECMO Circuit

Pumps
• Centrifugal
• Flow dependent on rpm’s, preload, afterload
• Up to 8 lpm with no resistance, usually 4-5 lpm in practice
The ECMO Circuit

O2 Blender and Oxygenator

• Oxygenation depends on flow rate (cannula size)
• CO2 removal depends on sweep gas rate (gas/blood flow ratio)
History of ECLS

- 1953 First successful extracorporeally-assisted heart operation (Gibbon)
- 1954 Cardiac surgery via cross circulation (Lillehei)
- 1972 Use of extracorporeal support in the ICU (Hill)
- 1975 Infant ECMO support for meconium aspiration (Bartlett, baby Esperanza)

Dr. Robert H. Bartlett
The Father of ECMO
History of ECLS

- 1985 “Randomized play-the-winner” neonatal ECMO trial (Bartlett)
- 1989 Two-phase RCT Neonatal ECMO trial (O’Rourke)
- 1996 UK Collaborative (Neonatal) ECMO Trial Group
- 2009 (Adult ECMO) CESAR Trial (Peek)
History of ECLS

2018 “EOLIA” Trial
EOLIA Trial Commentary (2018, NEJM, Hardin)
• 28% of control group crossed over to ECMO, with 57% mortality
• “The routine use of ECMO in patients with severe ARDS is not superior to the use of ECMO as a rescue maneuver in patients whose condition has deteriorated further.”
EOLIA Trial Commentary (2018, NEJM, Hardin)

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PHI ECMO Volume (through Sept 2018)

- 2010: 5
- 2011: 33
- 2012: 44
- 2013: 56
- 2014: 65
- 2015: 75
- 2016: 101
- 2017: 127
- 2018: 94
PHI Indications for VV ECMO

Severe refractory potentially reversible respiratory failure
• Hypoxic respiratory failure when mortality risk > 80%, identified by PaO2/FiO2 < 100 on FiO2 > 90% and Murray score > 3.
• CO2 retention on mechanical ventilation
• RESP Risk Class I, II, or III
The RESP Score

The RESP Score has been developed by ELSO and The Department of Intensive Care at The Alfred Hospital, Melbourne. It is designed to assist prediction of survival for adult patients undergoing Extra-Corporal Membrane Oxygenation for respiratory failure. It should not be considered for patients who are not on ECMO or as substitute for clinical assessment.

For more information see:

The patient's RESP Score is -1

Age (years):
18-49
50-59
≥60

Immunocompromised

Mechanical ventilation prior to initiation of ECMO
<48 hours
48 hours - 7 days
>7 days

Acute Respiratory diagnosis group
Viral pneumonia
Bacterial pneumonia
Asthma
Trauma/burn
Aspiration pneumonitis
Other acute respiratory diagnosis
Non-respiratory and chronic respiratory diagnoses

Central nervous system dysfunction
Acute associated (non-pulmonary) infection
Neuro-muscular blockade before ECMO
Nitric oxide use before ECMO
Bicarbonate Infusion before ECMO
Cardiac arrest before ECMO
PaCO₂ ≥75 mmHg / 10kpa
Peak inspiratory pressure ≥42cmH₂O
PHI Indications for VA ECMO

Acute circulatory failure with reversible etiology
  • Severe cardiogenic shock despite inotropes with/without mechanical support
  • Acute reversible right heart failure (including PE)
  • Cardiopulmonary support during high risk interventions
  • Failure to wean from cardiopulmonary bypass
  • Profound vasodilatory septic shock
The patient's SAVE Score is -9

**Diagnosis:**
- Myocarditis
- Refractory VT/VF
- Post heart or lung transplantation
- Congenital heart disease
- Other diagnoses

**Age (years):**
- 18-35
- 36-52
- 53-62
- ≥63

**Weight (kg):**
- <65
- 65-89
- ≥90

**Cardiac:**
- Pulse pressure pre ECMO ≤20 mmHg
- Diastolic BP pre ECMO ≤40 mmHg
- Pre-ECMO cardiac arrest

**Respiratory:**
- Peak inspiratory pressure ≤20 cmH2O
- Intubation duration pre ECMO (hrs)

**Renal:**
- Acute renal failure
- Chronic renal failure
- HCO3 pre ECMO ≤15 mmol/L
- Other organ failures pre ECMO:
  - Central nervous system dysfunction
  - Liver failure
PHI Indications for E-CPR

- Refractory cardiopulmonary arrest in previously healthy patient with limited comorbidities and arrest time <60 minutes
- Refractory cardiopulmonary arrest post-cardiotomy
- ETCO2>18 after 8 minutes CPR
PHI Contraindications for ECMO

- Irreversible or untreatable heart/lung disease
- Severe PVD or other access issues
- Irreversible comorbidity (malignancy, end stage lupus, etc)
- Mechanical ventilation at high settings >7 days
- CNS injury or intracranial hemorrhage
- Refusal of blood products
- Poor functional status
- Patient has contraindication for anticoagulation
- Thrombolytics received <48hrs
- Severe hepatic failure unless transplant candidate
- RESP risk >IV
- Unwitnessed arrest, unknown downtime
- Prolonged CPR >60 minutes
<table>
<thead>
<tr>
<th></th>
<th>PHI ECMO Outcomes</th>
<th>September 2018</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>PAH Survived ECMO Run</td>
<td>ELSO July 2018</td>
</tr>
<tr>
<td>Respiratory</td>
<td>66%</td>
<td>66%</td>
</tr>
<tr>
<td>Cardiac</td>
<td>58%</td>
<td>55%</td>
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<tr>
<td>ECPR</td>
<td>39%</td>
<td>38%</td>
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ECMO Survival to Discharge

Remember
~60% for veno-venous (respiratory failure),
~40% for veno-arterial (circulatory failure),
~30% for E-CPR
Ethical Considerations

- Not always clearly evidence-based practice (E-CPR)
- High morbidity
- Strain on families, in addition to the patients
- Possibility of “bridge to nowhere”
- Cost
- Consumption of other resources
According to ELSO guidelines, an absolute contraindication to ECMO for respiratory failure is:

a) Age > 80
b) Malignancy with life expectancy ≤ 12 months.
c) Refusal of blood products
d) AIDS with active opportunistic infection
e) All of the above
f) None of the above
f) None of the above!

“According to the current ELSO guidelines, there are no absolute contraindications for respiratory ECLS, only considerations of its risk/benefit balance to be evaluated on a case-by-case basis.”

Lorenzo Del Sorbo, MD, Eddy Fan, MD, PhD
Thank You!