VA ECMO for Cardiogenic Shock

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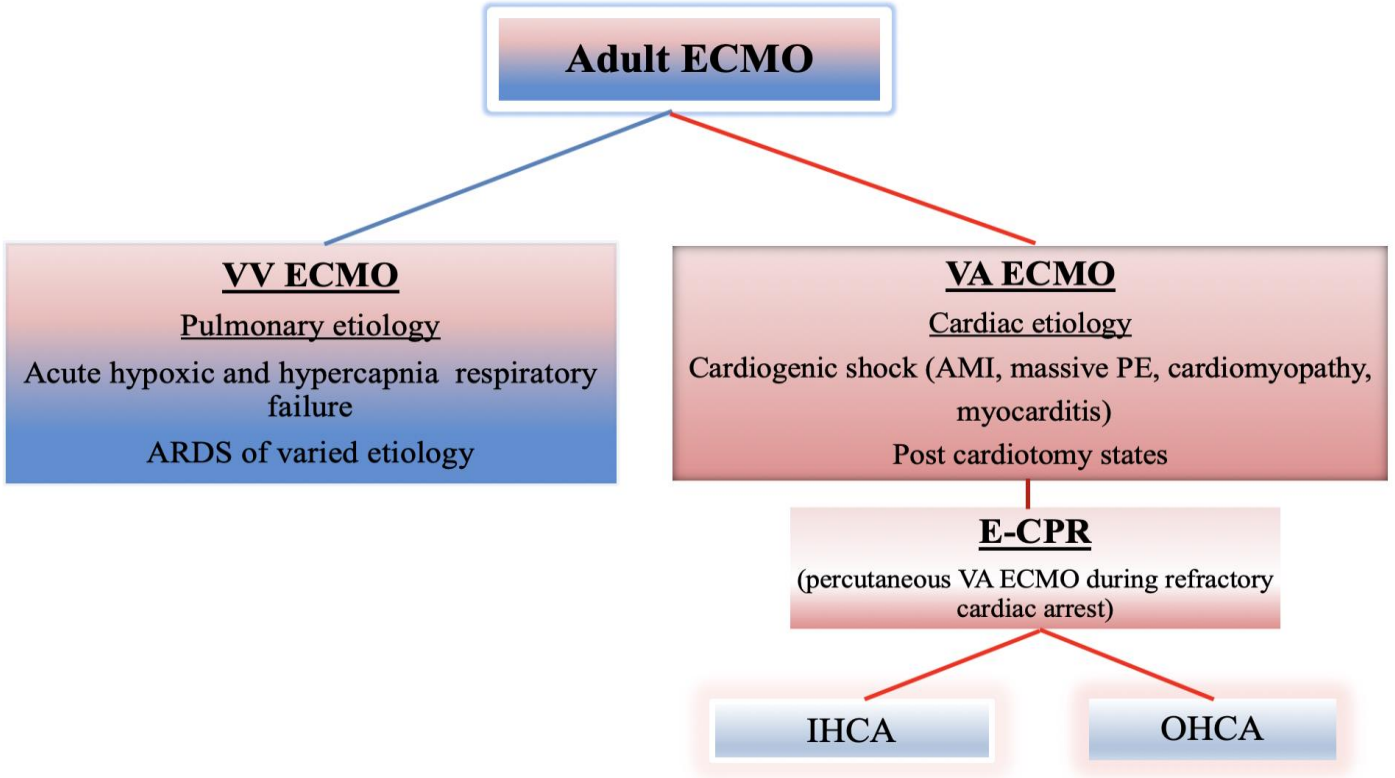
Disclosures

- Spouse – Consultant for Zoll Medical

- Off-label use of most ECMO devices >6 hours

What is ECMO?

- Extracorporeal Membranous Oxygenation



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ECMO Outcomes

ECLS Registry Report

International Summary

October, 2022

Report data through 2021

Extracorporeal Life Support Organization
3001 Miller Rd
Ann Arbor, MI 48103 USA

Overall Outcomes

	Total Runs	Survived ECLS		Survived to DC or Transfer	
Adult					
Pulmonary	44,454	29,504	66%	26,019	58%
Cardiac	39,659	23,763	59%	18,027	45%
ECPR	12,125	5,102	42%	3,684	30%

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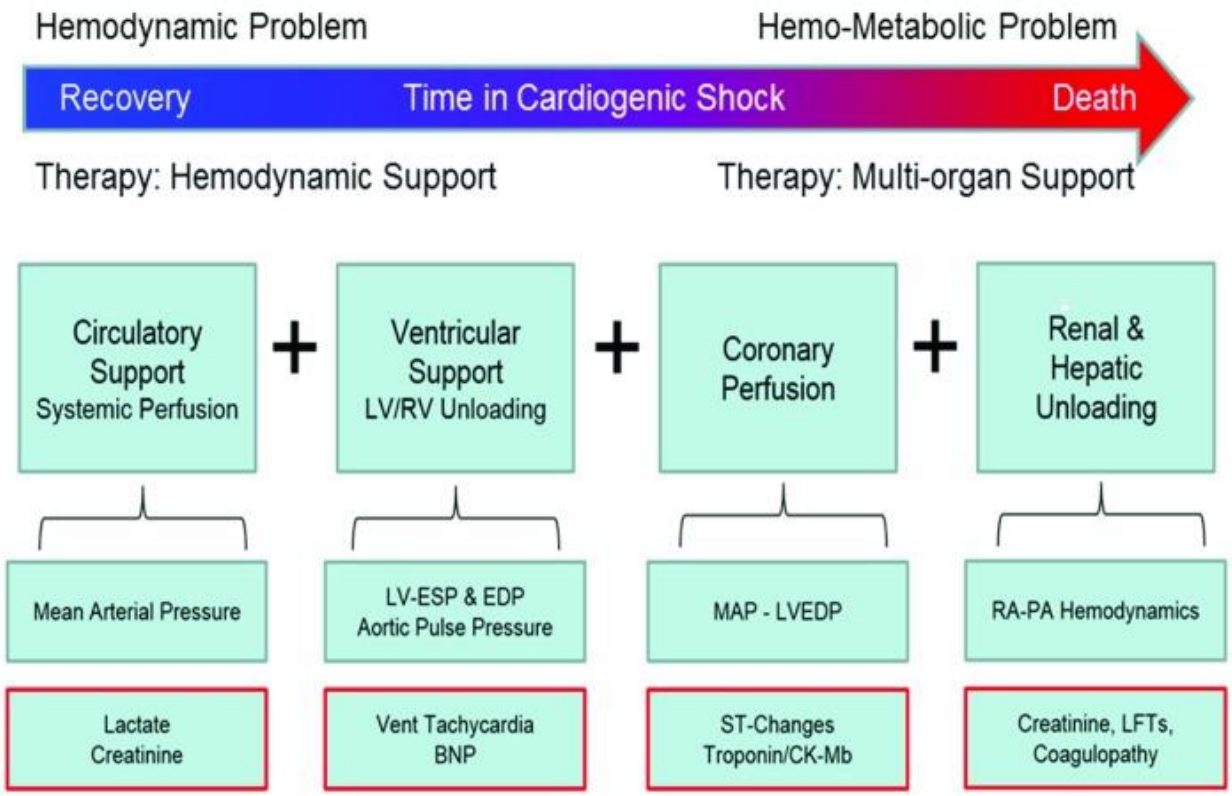
Evaluating the Need for tMCS



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Esposito and Kapur 2017 *F1000 Research*

General VA ECMO Criteria

Indications

- Refractory Cardiogenic Shock
  - Acute myocardial infarction
  - Acute decompensated heart failure
  - Myocarditis
  - Recurrent life threatening arrhythmia
  - Primary heart transplant graft failure
  - Sepsis-induced myocardial dysfunction – very controversial
  - Severe valvulopathy
  - Post-cardiotomy shock
  - Drug overdose (BB, CCB, Digoxin, Antidepressants)
- Massive PE
- Accidental hypothermia
- Cardiac Arrest/ECPR
  - More restrictive separate protocols exist

Contraindications

<u>Absolute</u>

- Anticipated lack of recovery without viable exit strategy

<u>Relative</u>

- Advanced age (generally >70-80)
- Acute aortic dissection
- Severe aortic regurgitation
- Inability to anticoagulate
  - CNS hemorrhage
  - Uncontrollable active bleeding
- Advanced Comorbidities
  - ESRD or Advanced Cirrhosis
  - Severe peripheral arterial disease
  - Irreversible neurologic impairment
  - Terminal malignancy
  - Major immunosuppression
  - Multisystem organ failure
  - Supermorbid obesity
  - Severe functional status limitation

Should the patient receive ECMO?

- Are there any contraindications?
- Is there biventricular failure?
  - Is the patient rescuable with less invasive forms of support?
- What stage of shock are they in?
  - How advanced is the organ dysfunction?
  - Has the patient failed a trial of basic medical therapy: Inotropes and/or afterload reduction
  - Is care futile?
- **What is the DESTINATION**?

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Think about the Destination

FAVORABLE

- Bridge to Recovery
  - Acute vs. Chronic Problem

- Bridge to Durable VAD
- Bridge to Heart Transplant
  - Age, Social Factors, RV & PVR status, Comorbidities, Functional Status

- (Bridge to Decision)

UNFAVORABLE

- Bridge to Nowhere
  - Complicated ethical situation

- Death due to progressive shock or ECMO complication

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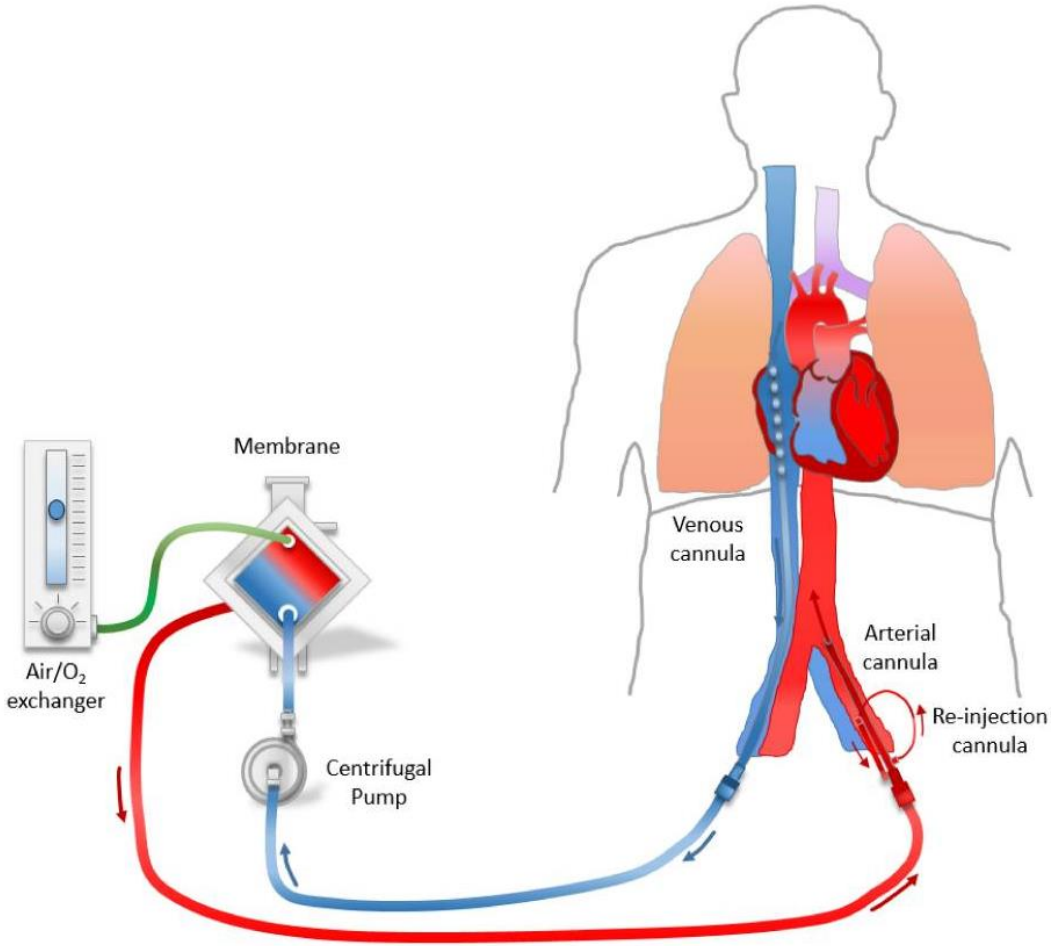
VA ECMO Circuit



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De Charriere et al. J Clin Med 2021

Oxygenator Gas Exchange

- Oxygenation determined by concentration of oxygen in the sweep gas ("F_dO_2")
  - Leave at 100% on VA ECMO (cannot create a right to left shunt)

- Removal of CO_2 / Ventilation determined by rate of sweep gas flow

Cannulae

<u>Sized based on flow needs:</u>

Arterial Cannula 15-20F

Venous Cannula 23-27F

Distal Perfusion 5-9F

<u>Approaches</u>

- Percutaneous (most common)
- Surgical Cutdown
- Central Cannulation

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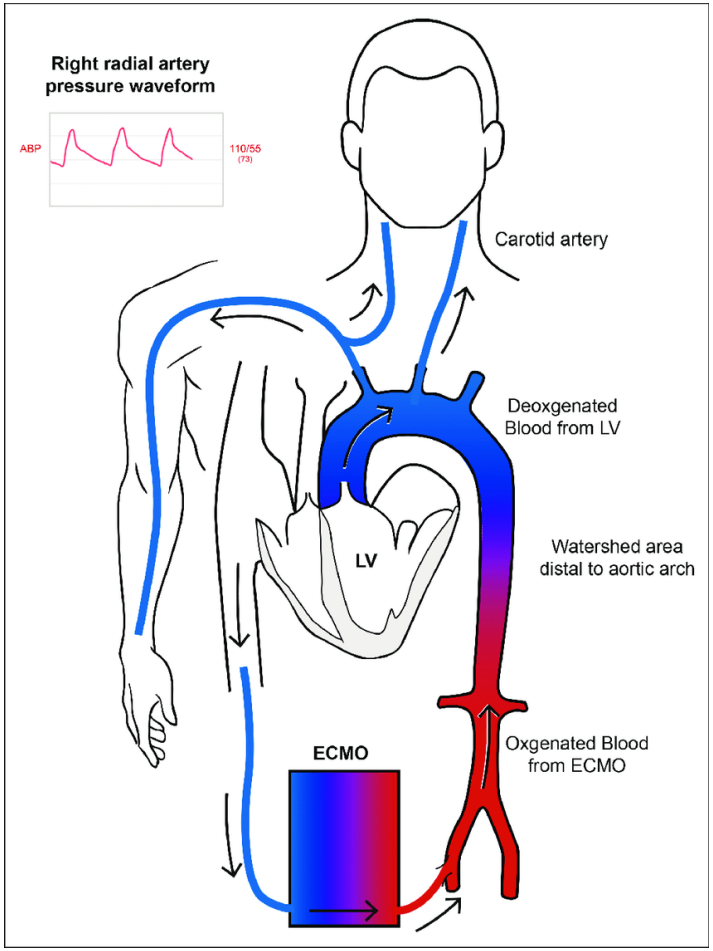
During Cannulation

- Heparinization after both vessels accessed
- Large fluid shifts cause transient electrolyte abnormalities and relative hypovolemia, often hypotension
- Manage with Volume Bolus +/- Vasopressor
- Emergency Drugs: Calcium, Epinephrine

Initial Set up

- Initial ECMO Flow: 2 x BSA (3-5L most adults)
- Initial Sweep (100% O_2) Flow = ECMO Flow
- Place right radial arterial line for hemodynamic and blood gas monitoring
- Monitor right hand pulse oximetry
- CXR for cannula position

Dual Circulation Physiology



- Mixing point in Aorta if there is native LV ejection
- If lungs bad + native LV ejection = North/South Syndrome (Differential Hypoxemia)
- If dual circulation exists, ventilator is still important!

Rao et al 2018. *Circulation Heart Failure*

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About Chatter/Chugging/Suckdown

- 3 signs:
  - Unstable circuit flows
  - Highly negative, unstable venous access pressure
  - Cannula tubing oscillations

- Causes
  - **Hypovolemia**
  - High intraabdominal pressure (ie. Gastric insufflation, coughing, straining, RP hematoma)
  - High intrathoracic pressure (hemo/pneumothorax, tamponade)
  - Improper venous cannula size or position
  - Tubing kinks

- Start with volume administration
  - May need to reduce pump RPM's to recover severe cases

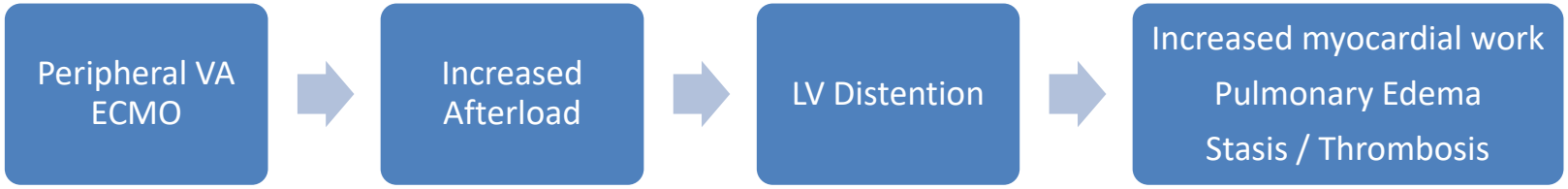
Next Steps

- MAP = 65-70 for Organ Perfusion
  - Arterial line often lacks pulsatility
  - Expect vasodilation (reperfusion cytokines)
  - Balance between ECMO Flow & Vasopressors
  - Avoid Hypertension (LV Afterload)
- Monitor Adequacy of Perfusion
  - Lactate Clearance
  - Mixed Venous Oxygenation > 65%
  - End Organ Function: Urine Output, Cr, LFT's

Next Steps

- Monitor Leg Perfusion
  - Distal perfusion catheter
- Anticoagulation
- Definitive therapy
  - Cath Lab for LHC / PCI?
- Decide on LV Venting Strategy

Left Ventricular Unloading



- Assess for LV and aortic root stasis on echo
- Aortic valve should open atleast every 4th beat
- Venting strategies
  - IABP
  - Percutaneous LVAD = “ECPELLA”
  - Atrial Septostomy
  - Direct LA (“LAVA” ECMO) or LV Drainage
  - Low Dose Inotrope

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Thank You

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