

# ECMO

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**Cardiac Intensive Care** 





- 1) Understand what ECMO is
- 2) Understand what ECMO can do to prevent death
- 3) Be more comfortable in identifying which patients would benefit from ECMO therapy





- 1) Understand what ECMO is
  - Components of the circuit
  - What the circuit does
  - 2 main types of ECMO
    - VV ECMO
    - VA ECMO





- 2) Understand what ECMO can do to prevent death
  - Allows survival of the otherwise non-survivable
  - May minimize exposure to harmful effects of conventional therapy
  - May allow better rehabilitation and mobility





- 3) Be more comfortable in identifying which patients would benefit from ECMO therapy
  - Pts with reversible or treatable illnesses
  - Pts in whom the risk outweighs benefit





#### What is ECMO?

- ExtraCorporeal Membrane Oxygenation
- Extracorporeal life support (ECLS) is vaguely synonymous





#### What is ECMO?



## What is ECMO

- Cannulas; drainage and return
- Tubing
- Centrifugal pump
- Oxygenator





#### Cannulas





## Pump



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### Oxygenator



- Oxygenated blood
- Removes carbon dioxide





#### **Control Console**







## Types of ECMO

- Veno-venous (VV ECMO)
  - Removes blood pre-heart
  - Returns blood pre-heart
  - A lung before the lungs
  - Provides no cardiac support







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#### VV ECMO





https://www.mc3corp.com/crescent



## Types of ECMO

- Veno-arterial (VA ECMO)
  - Venous drainage
  - Arterial return
  - Bypasses the heart and lungs
  - Provides both cardiac and respiratory support





#### VA ECMO







## Why ECMO?

- What does it solve?
  - "how does it prevent death?"









## **Physiology Basics**

- Oxygen delivery
  - Oxygen carrying capacity (hemoglobin)
  - Effective oxygen loading (lung function)
  - Rate of blood flow (cardiac function)
- DO2~ CO (Hgb x SpO2)





## Oxygen Delivery

- DO2~ CO (Hbg x SpO2)
  - Failure of CO= cardiogenic shock
  - Failure of Hbg= hemorrhage, anemia
  - Failure of SpO2= respiratory failure





## Oxygen Delivery

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## **Respiratory Failure**

- Positive pressure ventilation
- Pulmonary vasodilators
- Paralytics
- Steroids
- Antibiotics
- Diuretics





### **Respiratory Failure**

- Positive pressure ventilation
  - Oxygen toxicity
  - Barotrauma
    - In ARDS survivors, long term lung function is most impaired in the most ventilated areas and most preserved where the disease was most prevalent







#### **Respiratory Failure**

- Paralytics
- Steroids
  - Deconditioning, immunosuppression, myopathy





## Cardiogenic Shock

- Inotropes
- Vasopressors
  - Increase cardiac workload, oxygen consumption
  - Flog a failing heart and expect recovery





## So Why ECMO?

- ECMO can provide a bridge across the previously non-survivable
- It can trade the (sometimes) lower risks of ECMO for the (sometimes) higher risks of mechanical ventilation
- It can allow rehabilitation and awakening to an extent not achievable while intubated





#### Who Benefits From ECMO?

- Primary principle of ECMO therapy
  - ECMO is always a bridge







#### **VV ECMO Indications**

- In hypoxic respiratory failure due to any cause (primary or secondary) ECLS should be considered when the risk of mortality is 50% or greater, and is indicated when the risk of 80% or greater.
  - 50% mortality risk can be identified by a PaO2/FiO2 < 150 on FiO2 > 90% and/or Murray score 2-3
  - 80% mortality risk can be identified by a PaO2/FiO2 < 80 on FiO2> 90% and Murray score 3-4
- CO2 retention due to asthma or permissive hypercapnia with a PaCO2 > 80 or inability to achieve safe inflation pressures (Pplat ≤ 30 cm HO) is an indication for ECLS.
- Severe air leak syndromes.

- ELSOnet.org





## VV ECMO indications

- Question #1: What will it bridge the pt to?
  - Recovery?
  - Decision?
  - Definitive therapy?
    - Lung transplant





### VV ECMO Indications

- "At present, ECLS cannot be considered standard of care in patients with respiratory failure...ECLS remains a temporary strategy to be considered on a case-bycase basis for rescue situations"
  - ECLS: the ELSO Red Book
    5<sup>th</sup> Ed. p.421





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## VV ECMO

- Benefits
  - Restored oxygenation and ventilation
  - Hemodynamic stabilization
  - Mobilization
  - Lung rest

- Risks
  - Indwelling lines
    - Infection
    - Thrombosis
  - Coagulopathy
    - Stroke
    - Site bleeds
  - Procedural
    - Vessel rupture







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#### Contraindications

- Absolute contraindications
  - None for VV ECMO





### Contraindications

- Relative contraindications
  - High bleeding risk; recent CNS hemorrhage
  - Comorbidities viz. terminal malignancy, advanced CNS injury, immunosuppression
  - Increased age (no strict cutoff)
  - MV with high Pplat and FiO2 more than 7 days





Efficacy and economic assessment of conventional ventilatory support versus extracorporeal membrane oxygenation for severe adult respiratory failure (CESAR): a multicentre randomised controlled trial

Giles J Peek, Miranda Mugford, Ravindranath Tiruvoipati, Andrew Wilson, Elizabeth Allen, Mariamma M Thalanany, Clare L Hibbert, Ann Truesdale, Felicity Clemens, Nicola Cooper, Richard K Firmin, Diana Elbourne, for the CESAR trial collaboration

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## VA ECMO Indications

#### Cardiogenic Shock

- Inadequate tissue perfusion manifested as hypotension and low cardiac output despite adequate intravascular volume.
- Shock persists despite volume administration, inotropes and vasoconstrictors, and intraaortic balloon counterpulsation if appropriate.
- Massive Pulmonary Embolism
- Refractory Septic Shock



## Cardiogenic Shock

- Question #1: what is it a bridge to?
  - Recovery?
  - Definitive therapy?
  - Decision?
  - Decompensated heart failure with no candidacy for Txplant or VAD may be a bridge to nowhere







#### HIGHLIGHTS

of the 2015 American Heart Association Guidelines Update for CPR and ECC

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Oklahoma Heart Institute all new. all heart.

#### Extracorporeal Techniques and Invasive Perfusion Devices

**2010 (Old):** There was insufficient evidence to recommend the routine use of ECPR for patients in cardiac arrest. However, in settings where ECPR is readily available, it may be considered when the time without blood flow is brief and the condition leading to the cardiac arrest is reversible (eg, accidental hypothermia, drug intoxication) or amenable to heart transplantation (eg, myocarditis) or revascularization (eg, acute myocardial infarction).

**2015 (Updated):** ECPR may be considered an alternative to conventional CPR for select patients who have a cardiac arrest and for whom the suspected etiology of the cardiac arrest is potentially reversible.

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## VA ECMO

- Benefits
  - Restores end-organ perfusion
  - Hemodynamic stability

- Risks
  - Stroke
  - Bleeding
  - Infection
  - Limb ischemia
  - "ECMO lungs"
  - North-South syndrome





#### **Take Home Points**

- ECMO provides a bridge out of an otherwise nonsurvivable situation
- Better to evaluate too early rather than late





#### Take Home Points

- As much as possible, have a viable exit strategy before cannulating
- The decision to cannulate is a highly individualized decision that must take into account a large number of potential risks and benefits







# Thank you!



