NUTRITION SUPPORT DURING EXTRACORPOREAL MEMBRANE OXYGENATION (ECMO) IN CRITICALLY ILL ADULT PATIENTS

Haley Murrell, March 19, 2015
Objectives

- Provide an overview of Extracorporeal Membrane Oxygenation (ECMO)
  - Definition
  - VA vs. VV - ECMO
  - History of use
  - ECMO and nutrition support

- Discuss research related to enteral nutrition tolerance during ECMO

- Discuss case study and nutrition recommendations
  - Review energy and protein requirements in the critically ill

- Provide conclusions about EN in ECMO patients
Extracorporeal Membrane Oxygenation

Definition:
• Mechanical device designed to temporarily support the failing heart or lungs\(^1\)

How it works:
• A centrifugal pump drives the blood from the patient through an external membrane oxygenator system (allowing CO\(_2\) and O\(_2\) exchange) and then re-infused blood to the patient

2 cannulation sites:
• Venoarterial ECMO (VA)
• Venovenous ECMO (VV)
## VA vs. VV ECMO$^{2,3}$

<table>
<thead>
<tr>
<th>Venoarterial</th>
<th>Venovenous</th>
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<tbody>
<tr>
<td>Femoral artery and vein cannulation sites</td>
<td>Internal jugular vein/right atrium and common femoral vein cannulation sites</td>
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<tr>
<td>Bypasses pulmonary circulation</td>
<td>Maintains pulmonary blood flow</td>
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<tr>
<td>Haemodynamic support</td>
<td>No haemodynamic support</td>
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<td>Cardiac indications: Refractory cardiogenic shock with an underlying potentially reversible heart condition, bridge to VAD or cardiac transplantation VV-ECMO</td>
<td>Respiratory indications: ARDS, graft dysfunction after lung transplantation</td>
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VA-ECMO vs. VV-ECMO

Figure 1. A schematic representation of peripheral VA (VA ECMO) and VV-ECMO. From Cove ME, MacLaren G. Clinical review: MCS for cardiogenic shock complicating acute myocardial infarction. Crit Care. 2010;14:235; originally published by BioMed Central with permission from MAQUET GmbH & Co. KG.
History of ECMO\textsuperscript{3,5}

- 1972: First successful VA ECMO case in adults
- 1979: NIH multicenter randomized trial of VA ECMO vs. conventional ventilation
- 1979: Developed concept of VV ECMO
- 1980s-1990s: Only case reports and small series in adults showed success – little use of ECMO in adults at this time
- 2009: CESAR trial: 180 patient multicenter randomized trial showed improvements in 6 month survival in ECMO group
- 2009-2010: ECMO use in H1N1 influenza
ECMO and Nutrition\textsuperscript{6, 7}

- Limited research regarding nutrition support and ECMO in adult patients
- Most large ECMO studies do not mention nutrition interventions
- Previously thought that haemodynamic alterations in VA ECMO decrease blood flow to the gut and can cause intolerance
- Supposed that paralysis and/or heavy sedation may have effected gut function in neonatal ECMO patients
- ECMO itself activates systemic inflammation
Nutrition Support During Extracorporeal Membrane Oxygenation (ECMO) in adults: a Retrospective Audit of 86 Patients

• Authors: Suzie Ferrie, Robert Herkes, Paul Forrest
Research: Intro

• Purpose:
  • Determine if enteral feeding is appropriate while on ECMO
  • Assess the frequency of EN intolerance
  • Identify barriers to nutrition delivery
  • Determine if a difference in tolerance exists between VA and VV ECMO

• Importance/Issue addressed:
  • Increased use of ECMO in adults with very few research regarding nutrition
  • Previously believed that ECMO may cause EN intolerance
Research: Methods

- Study design: Retrospective Audit
- Subjects: n= 86
  - 50 men: 36 women

- VA ECMO for cardiac indications (n=31)
  - Surgical cardiac failure
  - Medical cardiac failure
  - Chest trauma

- VV ECMO for respiratory indications (n= 55)
  - Influenza A (H1N1)
  - Infectious respiratory failure
  - Other respiratory failure
Research: Data Collection

- **Inclusion criteria:**
  - Patients on nutrition support receiving VA or VV ECMO in critical care unit at a large Australian referral hospital; those not on ECMO were excluded

- **Data collection methods:** retrospective data collection of total nutritional intake for each day of the first 2 weeks of ICU admission from all ECMO patients between 01/2007 and 07/2012

- **Analysis processes:**
  - SPSS
  - Student’s t test used to compare groups
  - Chi square to compare proportions
  - Significance set at p-Value <0.05
Research: Nutrition Considerations

- Needs calculated by ICU dietitian
  - Energy via the Schofield equation with stress factor (1.1-1.2)
  - Protein of at least 1.2 g/kg body weight
- Intolerance definition: 2 or more consecutive gastric aspirates of >200 mL with abdominal distension or discomfort
  - Prokinetic agents added per protocol
  - Supplemental PN considered on day 3 of intolerance
- Propofol: goal TF rates adjusted if propofol was providing >250 kcal/day or 15% of total requirements
Research: Results

Intolerance:

• 33 patients (38%) experienced feeding intolerance – 20 managed on prokinetic medications
  • VA ECMO: 45%
  • VV ECMO: 35%

• No significant difference in intolerance between VA and VV ECMO (p = 0.04)

• Patients tolerated an average of 79.7% of energy and 73.0% of protein goals

• Use of paralysis and sedation did not significantly affect feeding tolerance
Barriers to Nutrition Delivery

• Propofol use:
  • 72 patients (81.6%) needed TF adjustment to prevent overfeeding while on propofol

• Fluid Restrictions:
  • 68 patients (77.6%) required fluid restrictions which in turn restricted nutrition
Research: Results

VA vs. VV ECMO

• Intolerance did not differ between ECMO modes ($p = 0.04$)
• VV ECMO patients reached goal earlier than VA ECMO
• VV ECMO received less protein than VA ECMO
Fig. 1 Energy (note energy totals include calories from propofol) and protein intakes during ECMO.

* Significant difference between VA and VV groups, p<0.05
** Significant difference between VA and VV groups, p<0.01
*** Significant difference between VA and VV groups, p<0.001
+ Significant difference between energy and protein within VV group, p<0.05
++ Significant difference between energy and protein within VV group, p<0.01
Research: Conclusions

• Early EN can be initiated and EN tolerance can be achieved in ECMO patients
• Nutrition delivery can be limited by the use of propofol for sedation and fluid restrictions
• No differences in tolerance between VA and VV ECMO patients
# Research: Evaluation

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<tr>
<th>Strengths</th>
<th>Limitations</th>
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<tbody>
<tr>
<td>• Adequate total sample size</td>
<td>• Audit of only one hospital</td>
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<tr>
<td>• Assessed both VA and VV ECMO</td>
<td>• Retrospective</td>
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<tr>
<td>• Included propofol in nutrition delivery</td>
<td>• Did not include patient weights</td>
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Clinical Practice:

• Suggestions for future research:
  • Guidelines for estimation of energy and protein needs in ECMO
  • Nutrition in obese ECMO patient

• Take Home Message:
  • TF is appropriate in ECMO patients
  • No specific recommendations for this population – follow current ICU protocols with professional judgement
  • Monitor for intolerance
  • ECMO patients should not be excluded from the benefits of early EN in the setting of critical illness
References


Questions?