Nutrition in ECMO

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ECMO – What now!?

KEEP CALM
AND
FEED
THE ECMO PATIENT

Despite the fact that little is known about nutritional strategies for adult ECMO patients!

Neither overcomplicate nor oversimplify
ECMO

- Extracorporeal membrane oxygenation (ECMO)
- Venovenous (VV) ECMO
- Venoarterial (VA) ECMO

- Also referred to as ECLS (Extracorporeal Life Support)

- Cardiopulmonary bypass circuit for temporary life support for severe cardiac and/or respiratory failure.

- VA and VV ECMO blood is drained from the venous system and oxygenated outside of the body.

- VV ECMO – blood is returned to the venous system
- VA ECMO – blood is returned to the arterial system
ECMO and Nutrition

Common questions ask:

- Exact effect of the ECMO system on human gut function?
- Enteral or Parenteral nutrition?
- Requirements of this patient population?
- Specific types of nutrients?
ECMO and Nutrition

ECMO patients are often critically ill (CI)
- CI patients in ICU
  - Develop increase metabolic activity
  - Elevated catabolism of protein
  - Insulin resistance (stress hyperglycemia)
  - Negative nitrogen balance

IF Enteral/Parenteral feeding insufficient:
- Deficiency accumulates
- Contributes to lean tissue wasting
- Consequently adverse outcomes

Many years ago CI infants on ECMO had the highest rates of whole body protein breakdown ever recorded
- CI Adult ECMO patients will also suffer protein breakdown
- The exact degree
A.S.P.E.N. Clinical Guidelines: Nutrition Support of Neonates Supported with Extracorporeal Membrane Oxygenation

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Table 2. Nutrition Support Recommendations in Neonates Supported with Extracorporeal Membrane Oxygenation (ECMO) Guideline Recommendations Grade

1. Nutrition support should be initiated expeditiously in neonates treated with ECMO. D

2. Neonates treated with ECMO have protein requirements of up to 3 g/kg/d. D

3. Energy requirements in neonates treated with ECMO are equivalent to healthy subjects. D

4. Enteral feedings should be initiated when the patient on ECMO has clinically stabilized. D
ECMO Clinical Guidelines (Nutrition)

- A.S.P.E.N Clinical Guidelines available on: Nutrition support of Neonates Supported with ECMO
- Unfortunately no guidelines yet for adults
- Several retrospective or observational studies – mostly small
- No randomised interventional studies on nutrition support in adult ECMO
ECMO and Nutrition

Studies on porcine models showed:

- Increased gut barrier dysfunction
- Bacterial translocation

Let’s look at a few studies.....

- Retrospective
- Chart Review 27 pts on V-V ECMO and EN
- Average time on ECMO was 8.7 ± 3.6 d
- 26/27 pts received EN via gastric feeding tube alone or with PN
- 18 received only EN; remainder received supplemental PN
- HOB > 15 degrees unless prone (feeds continued prone)
- Prokinetic (erythromycin) used in first 24 hrs in 75%; within 48 hrs in 95% of pts
- No intestinal ischemia, GI bleeding, or other complications were noted from early EN
Retrospective audit 2007-mid 2013
86 patients reviewed
55 on VV-ECMO, 31 on VA-ECMO
All patients commenced on enteral nutrition
Overall average 80% of goal tolerated every day in the first two weeks on ECMO
10% of patients needed TPN for more than 3 days
Patients who were started on feeding earlier tended to tolerated full goal nutrition
ECMO Literature


- Retrospective Chart Review 2005-2007
- 48 Patients treated with ECMO
- 35 had V-A ECMO; 13 had V-V ECMO
- Mean nutritional adequacy for all was 62% (SD 19%)
- Nutritional adequacy was 55% during and 71% after ECMO removal
- Survivors did not achieve better nutritional adequacy than non survivors

- Prospective Observational Study over 1 yr
- All seven adult pts receiving V-A ECMO for severe hemodynamic failure included
- EN with energy target of 25 kcal/kg/d to be reached over 4 days
- More than 70% nutrition tolerance achieved in first week for all pts
- No serious adverse events attributed to EN
Feeding challenges with ECMO patients

- Loss of nutrients in the circuit (as with CRRT)
- Micro porous membrane of oxygenator can be “blocked” by IV lipids (literature on neonates)
- Altered gut motility and permeability
- Reduced gut perfusion
- Reduced gut absorption

- Problems with the earlier style of micro porous membrane oxygenators
- Not seen with the new generation of diffusional (polymethylpentene) oxygenators
Feeding challenges with ECMO patients

- About 10 years ago enteral feeding was often withheld in ECMO patients in certain centres due to the belief that there was an increased risk for splanchnic ischemia.

- Studies showed that enteral nutrition within the first 24-36 hours is safe and well tolerated in adults.

- Also proposed previously that enteral nutrition in VA ECMO unsafe compared to VV ECMO.

- Placement of PEG tubes as ECMO patients on anti-coagulation therapy.
Altered gut function in ECMO due to:

- Heavy sedation and paralysis (sometimes)
- Inflammatory effects on the gut function?
- Altered gut perfusion due to the non-pulsatile flow of ECMO to the microcirculation
- Hemodynamic failure – hypotensive and compromise of the splanchnic perfusion
- ECMO initiation can lead to oxygenation and hemodynamic unloading improving blood gases
- Lower risk for GIT hypoperfusion, mesenteric ischaemia, abdominal distension, diarrhoea
ECMO and Nutrition

How much and when?

- Indirect calorimetry (IC) considered the GOLD STANDARD for determining Resting Energy Expenditure (REE)
- IC – measurements of oxygen consumption (Vo2), carbon dioxide production (Vco2) and minute volume
- Often confined to research settings
- Where possible ALWAYS IC first
- IC not really possible / accurate in ECMO
- The CO2 is removed across the extracorpeal membrane and cannot be identified by the calorimeter
- Instead – predictive equations (less accurate)
ECMO and Nutrition

Indirect Calorimetry

- Some consider this gold standard for ICU patient
- But need steady state in patient at ‘rest’
- Steady state condition is aimed at obtaining gas exchange measure at respiratory level of metabolic cellular events
- Steady state conditions altered by CRRT and ECMO
  - Body Temperature
  - Acid-base status
  - Bicarbonate containing IVF may alter pCO2
  - Extracorporeal removal of CO2
ECMO and Nutrition

- The MEEP study
  - Measuring Energy Expenditure in ECMO Patients

- Aim
  - To describe a calculation to set nutrition targets for ECMO patients (energy/calories)
  - Going to combine IC with elimination by the lung assist system (oxygenation and CO2)
Current practices

- General consensus is to follow existing guidelines for nutrition support in critically ill adult patients
  - A.S.P.E.N guidelines
  - ESPEN
  - Canadian guidelines for nutrition support in critically ill adults
The usual applies to ECMO patients:
- Prevent overfeeding
- Be aware of challenging patient populations
  - Chronically critically ill
  - Obesity
- Obese patients
  - High protein, hypocaloric feeding to preserve lean body mass, mobilise adipose tissue and minimise overfeeding
  - 2-2.5g protein/kg Ideal body weight (IBW)
ECMO CI patients require:

- Full & complete nutritional assessment (overweight, underweight)
- EN preferred route – if safe
- Early EN if hemodynamically safe or stable: within 24-48hrs
- EN includes oral / tube / sip feeding
- PN or SPN when failing to establish EN
  - Timing of PN / SPN crucial
- Prokinetics
- ADEQUATE PROTEIN
- Dietitian will calculate and advise on appropriate feeding formulas / sip feeds / nutritional recommendations
Our Current Practices

- Follow existing guidelines on nutrition in critical illness
- Often start with enteral nutrition first line (SPN if necessary)
- We use a very specific lipid emulsion due to less blockage of membranes
- Enteral nutrition as soon as possible and safe (wean Parenteral Nutrition)
- Avoid large volumes of enteral feed
- Aim for minimum of 1.5g protein/kg – usually higher if possible
  - CRRT
  - Obese
The End and Thank You