

Searching for the Ideal Lung Replacement

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The evolution of mechanical cardiac support has been tremendous; nowadays for patients non-eligible for heart transplantation it is possible to offer long term support without pump failure, no major complications and good quality of life. The same cannot be said regarding the artificial support of the lungs.

It was in the early 70's when the idea of artificial lung support for patients in severe respiratory failure was conceived. In 1972 the first long term successful veno-venous ECMO was reported by Hill., *et al.* [1] using a Branson membrane lung in a patient with severe shock-lung syndrome. Although, ECMO technology has progressed significantly over the last 40 years and despite the important breakthroughs in the developing of new membranes and pumps, size of the different components, durability and biocompatibility of the current oxygenators do not allow patients to live in chronic respiratory support and the expectations achieved with the ventricular assist devices are still far away when we talk about long term mechanical respiratory support.

With the outbreak of N1H1 in 2009 the VV-ECMO therapy gained some popularity and the ELSO reported a rise of 400% cases/year from 2009 to 2012.

The treatment of respiratory insufficiency with VV –ECMO technology faces important challenges in the next future:

- The careful selection of ECMO candidates will reduce futile implantations, improve the cost-effective treatments and overall results. For Instance, the EOLIA study - "Extracorporeal Membrane Oxygenation for Severe Revere Respiratory Distress Syndrome" by Combes., *et al.* the Murray score in the CESAR Trial, and a study by Zapol., *et al.* suggest some guidelines and recommendations on using ECMO for treatment for patients with severe ARDS.
- Simple and easier ways of cannulation, to improve mobility of the patient while in ECMO support and also to facilitate initiation of the ECMO in elective or emergency scenarios.
- Membrane oxygenators and pump design - the new oxygenators are more efficient, more effective in gas exchange, cause less thrombocytopenia and the coated heparin surface has decreased significantly the rate of thrombosis. However, pre-and post-membrane pressures should be monitored as a signal of membrane failure; the difference pressure across the membrane may progress more rapidly than previously seen in the older silicone plastic membranes, resulting in the need for emergent membrane replacement.
- Anticoagulation, volume replacement and transport of patients with ECMO among others, are still a matter of concern and there is a lot of room for improvement on that areas. Found alternatives for anticoagulation treatment to avoid HIT and bleeding, paved the way of a new line of research. Ranucci., *et al.* [2] demonstrated the efficacy of bivalirudin compared to heparin. Less bleeding associated with bivalirudin, and the safety of bivalirudin as the sole anticoagulant for postcardiotomy ECMO; this has been proved in post-cardiotomy ECMO, still with some concerns and a word of caution. Policy of volume management and blood transfusions in VV ECMO should be addressed,

Brodie, *et al.* [3] for example, recommended using the same transfusion thresholds as those used in the care of patients with ARDS who are not being treated with ECMO.

The level of team expertise play an important role, the César Trial suggested that patients on ECMO do better at hospitals that are more experienced with this technology. Subsequent studies. like the study by Freeman, *et al.* [4] where the impact of ECMO patient volume on mortality in the pediatric and neonatal population was studied, supported this conclusion.

Future directions need to focus the research on the developing of low resistance membrane lungs, safe simple automated pumps and no thrombogenic materials to avoid anticoagulation [5-10].

A wearable artificial lungs for chronic pulmonary failure seems to be a difficult challenge but as Fridtjof Nansen said, "*The difficult is what takes a little time; the impossible is what takes a little longer*".

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