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Conceptual Paper

ECMO how Bridge to the Transplantation Pulmonary Pushing the Limits

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Lung transplantation is already an established treatment for patients with some terminal chronic diseases. Since the first transplant in 1983 by Cooper, more than 30,000 have been done in the world [1]. The number of candidates is much greater than the number of organs available, which makes waiting list times long with consequent deterioration and high risk of perioperative morbidity and mortality [2]. Contributing to this high mortality is the lack of effective and safe means to support these patients waiting for transplantation, once they develop acute respiratory failure with hypoxemia and refractory hypercapnia [3].

Mechanical ventilation (MRA) per se can aggravate respiratory failure and hemodynamic insatiability, increasing the risk of injury and ventilator-associated pneumonia. Patients in MRA are exposed to lung infections, sepsis and muscle atrophy making it difficult to wean (weaning) post-transplant and prolonging the stay in intensive care unit. Therefore, pretransplant ARM has been reported as a cause of significantly higher mortality in post-transplant [4].

Extracorporeal membrane oxygenation (ECMO) is a temporary and artificial extracorporeal life support (SVEC) modality of the respiratory and/or cardiovascular system used in the treatment of cardiopulmonary failure refractory to conventional treatments. The patient's blood is drained from the body from a cannula placed in a central vein (usually femoral vein or right internal jugular vein in the case of double lumen cannulas), passed through a membrane oxygenator (commonly called an artificial lung) and reinfused through a cannula placed in a vein (veno-venous ECMO or VV-ECMO) or an artery (veno-arterial ECMO or VA-ECMO). A centrifugal pump that generates negative pressure is responsible for creating the pressure gradient needed to establish blood flow. More than 30 years ago, ECMO was used for the first time in patients on the lung transplant list dying of acute respiratory failure refractory to MRA [5]. The results were not good and the ECMO fell into disuse [2]. Recently, thanks to improvements in technology, safety profiles and the management of extracorporeal life support strategies, ECMO has been reintroduced in some centers as an option for patients with severe respiratory failure on the lung transplant list [5].

ECMO is today an alternative to MRA in awake patients with spontaneous breathing [6]. In these conditions, the ECMO allows patients to preserve muscle tone, with a greater possibility of early mobilization and intensive rehabilitation, thus improving their condition in the face of tras-planet and the a posteriori evolution of the same [7]. Having patients awake avoids the hemodynamic consequences of general anesthesia and positive pressure ventilation, a situation that benefits them even more especially those with pulmonary hypertension. This new treatment approach for these patients involve a multidisciplinary group that includes physical and respiratory therapists, doctors and nurses.

The appropriate selection of the patient to be admitted to ECMO is essential to obtain good results [8]. Clearly the clinical conditions of patients sustained in ECMO are usually more critical than those on the elective list and this leads to worse outcomes [9]. Among the factors that can affect the post-transplant evolution in patients with ECMO, the most frequent is the time in which they remain in this situation [10]. Although patients can tolerate ECMO for long periods, beyond 14 days there is a significant increase in morbidity and mortality [11]. Therefore, these patients must be reassessed all the time and very carefully to detect if any criteria for exclusion from the waiting list appear, the most frequent being sepsis, hemorrhages, neurological damage, renal failure and deep malnutrition. In some cases, patients are sustained with ECMO and MRA, adding the potential complications of both methods and making their follow-up even more complex [4].

In this interesting article by Dr. Bertolotti., *et al*. the authors describe their experience in a retrospective cohort. In their five-year analysis they demonstrated the benefits of using extracorporeal life support in 23 critical patients on the list or candidates for lung transplantation. Of these 23 patients, 15 were accepted for transplantation and of these, half died on the waiting list. The time in which these patients remained in SVEC was between one to three weeks and those who arrived at the transplant had 85% survival at 30 days, although most of them had prolonged hospitalization since they were "severely ill and weakened". The authors comment that one of the challenges has been the 8 patients who, having been placed in SVEC, had to be removed due to futility of the same. I agree from my personal experience on the difficulty of the situation for the treating group and for the family. In medicine it is easier to place a treatment than to remove it. The authors also give a very good description of the lesson learned: from 2010 to 2012 only 20% arrived at the transplant under SVEC while from 2013 to 15% 60% arrived. While the number of patients is small, this marks the favorable impact on the learning curve.

Without any doubt, a pre-transplant SVEC plan should be carried out in programs with a high volume of annual transplants, as in this case. The Extracorporeal Life Support Organization recommends that ECMO should be used in centers that implement it in a minimum of six cases per year [12]. However, there are some considerations that must be taken into account: the median time on the waiting list in emergency in our country is long: 4.8 months [13] and the costs of these interventions are very high, hence the selection of patients who enter ECMO as a bridge to transplantation must be very careful. As the authors mention, only a little more than 1% of patients in the world arrive at transplantation under these conditions.

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