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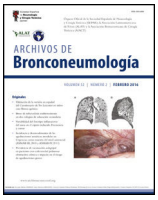

Editorial

Extracorporeal Membrane Oxygenation as a Bridge to Lung Transplantation☆

Membrana de oxigenación extracorpórea en el puente al trasplante de pulmón

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The use of extracorporeal membrane oxygenation (ECMO) has grown exponentially in the last 20 years, mainly due to technological advances in systems,[1] and the favorable results of the technique in adult respiratory distress syndrome during the influenza A (H1N1) epidemic, when several groups achieved survival greater than 70%,[2,3] especially in patients transferred to ECMO reference centers.[3]

ECMO is a rescue therapy that replaces cardiac and respiratory function (venoarterial ECMO) or respiratory function (venovenous ECMO) in patients with severe heart and/or respiratory disease, when the risk of mortality is high in spite of optimal standard treatments.[4] This technique is useful in 3 situations in lung transplantation (LT): as a bridge to LT with or without mechanical ventilation (MV), intraoperative cardiac and/or respiratory support during cardiopulmonary bypass replacement, and primary and postoperative graft dysfunction. ECMO as a bridge to LT is the most common indication due to the scarcity of lung donors and high waiting list mortality rates in countries such as the United States.[5] According to the international Extracorporeal Life Support Organization registry, 1066 ECMO systems were used in LT patients between 1990 and 2016, with 65% survival at hospital discharge.[6]

Until 2010, the use of MV and ECMO in the pre-transplantation period was a contraindication for LT.[1] Nowadays, when MV is insufficient, ECMO can be used as a bridge to LT in highly selected patients in experienced centers, in cases in whom the indication for LT has already been established, and in very exceptional cases in whom LT can be considered.[7] In the latter situation, ECMO can allow time for a decision to be made or for completion of procedures for inclusion in the LT waiting list. It has not yet been established if the best alternative for these patients is the exclusive use of MV or combined MV and ECMO,[8] but we do know that the use of pre-transplantation MV is associated with higher mortality in the post-transplantation period,[9] due to immobilization resulting from sedation and complications associated with MV, pneumonia in particular. More recently, evidence has shown that the use of pre-transplantation MV is associated with a 2-fold increase in the risk of death in the first 6 months post-transplantation, compared with patients who did not receive MV.[10] In a study of 60 patients, Fuehner et al.[11] found that survival at 6 months was higher in the group who received ECMO without MV, compared to the group who received MV (80% vs 50%, $P = .02$). Avoiding MV and using ECMO in awake patients leads to better rehabilitation and obviates MV-related complications.

ECMO offers clear benefits to patients with terminal respiratory failure and/or severe pulmonary hypertension with right ventricular failure who cannot maintain the optimal physical situation necessary to tolerate a LT.[7] It also indirectly increases the patient's likelihood of LT by increasing their lung allocation score (LAS), because although ECMO is not specifically scored, elevated FiO_2 and the need for MV are.[12] A meta-analysis of 14 retrospective studies and 441 patients in total showed that ECMO as a bridging strategy was successful in 50% and 83% of cases, with a 1-year survival of 50%–90%,[8] mortality being attributed to multiorgan failure, septic shock, heart failure, and hemorrhagic complications derived from anticoagulation from the ECMO system. Consequently, we must always weigh up the possible complications associated with these devices (which become more frequent over time) against their benefits,[7] taking into account that the longer duration and improved biocompatibility of the membranes, the possibility of reducing or withdrawing anticoagulation from the systems, and the availability of multiple configurations and systems have been key factors in the growing use of ECMO and improved survival in LT.[1]

The factors influencing prognosis in patients receiving ECMO as a bridge to LT are not fully established, but as they become clear they will help improve patient selection and outcomes. The success of ECMO depends on knowing which patients should receive it and when, even though this selection is not without controversy. We must select young patients with no organ compromise other than heart and lung failure, who have good prospects for rehabilitation.[7]

Unfortunately, the only studies available to date are a few case series with a wide range of indications for LT, types of ECMO support used, clinical situations, LAS scores, and bridge duration, and

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no maximum waiting time or age limits for starting ECMO.[7,8] In a recently published survey conducted in the United States, 55% of centers reported no limits with regard to maximum pre-LT ECMO support, and 30% imposed a maximum of 10 days.[13] However, the duration of pre-LT ECMO does appear to affect patient prognosis, and risk of mortality increases when it is administered for more than 14 days.[8] In the same survey, an age greater than 65 years was considered a contraindication in 45% of centers, while 36% had no specific age cut-off.[13]

There is no doubt that level of clinician expertise and underlying diseases directly affect the prognosis of pre-LT ECMO support, both in terms of the effectiveness of the strategy and 1-year survival. Centers with a high volume of LT that use ECMO have higher 1- and 2-year survival rates than low-volume centers.[14]

If we analyze the most frequent indications of lung transplantation, we see that in a recent study, 1-year survival in cystic fibrosis was greater than in interstitial disease (70.3% vs 46.7%), with a median overall survival of 80.3% at 1 year and 84% at 2 years. In that study, only 15% of patients were receiving MV at the start of ECMO.[15]

One-year survival, then, is similar in patients receiving ECMO with respect to those who have not received it in centers with a high volume of LT and use of ECMO, where the absence of MV and sedation, the use of respiratory physiotherapy, and active mobilization play a key role in the correct selection of candidates. It is clear that MV can only be avoided in highly selected cases, such as cystic fibrosis patients, and patients with terminal interstitial disease and hypoxemic respiratory failure are not candidates for this technique. In the meantime, ECMO is a valid alternative bridging strategy to LT with or without MV in highly selected patients whenever it is used in reference centers with experience in the use of this technique.

Technological advances are helping to simplify extracorporeal respiratory support systems for the elimination of CO_2 through a single venous access and lower blood flows than required in an ECMO system.[1] These CO_2-eliminating systems can be used in hypercapnic patients without MV or in combination with non-invasive VM on the bridge to LT, allowing patients to remain mobile and receive physiotherapy.

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