

What is wrong with extracorporeal membrane oxygenation in COVID-19: The patient or the indication?

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It is undoubtedly true that identification of novel coronavirus-2019 (COVID-19) infection, announcement of pandemic, and its social and economic effects, and reflections to the healthcare system are expected to be the subject to many researches for next years. It is a rightful interest with the actual numbers of over seven million diagnosed cases and over 400,000 deaths.^[1] Debatable subjects among the healthcare professionals include diagnosis and treatment methods, epidemiological observations, and future predictions. There are many case reports and different therapy strategies of COVID-19 in recent papers about the pandemic. The relationship between COVID-19 and cardiovascular surgery is the management of surgical strategies during pandemic and extracorporeal membrane oxygenation (ECMO) use which is, itself, a subject of debate in terms of efficacy and outcomes. The special interest of healthcare professionals other than cardiovascular surgeons is, somehow, noteworthy. The number of ECMO used for COVID-19 all over the world is only 1,371 according to the Extracorporeal Life Support Organization (ELSO), which is one of the most important organizations recording ECMO data.^[2] This number is quite insignificant, compared to over seven million patients. However, ECMO deserves this attention, as it can be the last option for COVID-19 patients who do not have a chance of cure with any other therapy modality.

Before discussing this subject in detail, one should know what ECMO is and is not. In particular, venoarterial ECMO (VA-ECMO) is used as the left ventricular support system for postcardiotomy cardiogenic shock, although it does not provide a left ventricular support at all. This is most probably due to easy insertion and old habits. The VA-ECMO does not help ventricular improvement, as it does not decompress left ventricle at all. On the contrary, it

worsens the situation due to the increase of afterload because of the arterial cannula in such patients.^[3] For sure, VA-ECMO should be used for only very serious oxygenation problems or to maintain tissue perfusion in patients with cardiogenic shock. On the other hand, there is no debate on the conditions in which venovenous ECMO (VV-ECMO) is used. It is indicated in severe hypoxic cases of severe pulmonary infections such as COVID-19.^[4,5] The VA-ECMO can be used in a small number of COVID-19 patients with respiratory problems and severe circulatory disturbances.

Which COVID-19 patients should receive ECMO support? As mentioned previously, it can be used as the last option for severe hypoxia in acute respiratory distress. However, due to the limited number of data, it still remains unclear whether conventional respiratory support machines or ECMO would be more appropriate for these patients. Some reports revealed that patients who did not receive ECMO support had higher survival rates than patients receiving ECMO support.^[6] As a result of this controversy, clinicians attempted to support the indication, severe respiratory distress, as mentioned above, with clinical and respiratory parameters. For instance, the ELSO has provided selection criteria needed for ECMO referral. If despite optimal ventilation strategies, neuromuscular blockade, appropriate positive end expiratory pressure, prone positioning, and the use

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of pulmonary vasodilators, patients who meet the following criteria can be referred for ECMO referral: partial pressure of oxygen (PaO_2)/fraction of inspired oxygen (FiO_2) less than 60 mmHg for longer than 6 h, $\text{PaO}_2/\text{FiO}_2$ less than 50 mmHg for less than 3 h or pH less than 7.20 + PaCO_2 greater than 80 mmHg for less than 6 h, and having no contraindications.^[2] In addition, some risk scoring systems can be used for the definition of indications.^[7] For instance, patients having severe respiratory distress with a Murrey score of 3 to 4, it is reasonable to use ECMO.^[7] Beside all these experiences, even if limited, and parameters, choosing the right patient is of utmost importance, as the results are still obscure and sources should be used very carefully. In this regard, it seems to be reasonable to use ECMO for young patients without comorbidity, and healthcare professionals who provide the greatest support in the breakthrough of pandemic.

Unfortunately, very few data are available on ECMO use for COVID-19, which are rarely used, but widely known. Recent reports demonstrated that ECMO use was not as helpful, as it was thought regardless of COVID-19 pandemic.^[8-11] Based on this information, the results of COVID-19 patients with ECMO support are not very good, as well. Studies about ECMO use in small numbers of COVID-19 patients, survival was reported as ranging between 0 and 16%.^[12-15] It should be kept in mind that patients who received ECMO support were in seriously poor hemodynamic conditions than the other group. Additionally, case reports of successful ECMO use led to confusion. However, it is ironic that the reason why these papers were accepted by the editors was the small number of successful ECMO use.

While debates about ECMO use for COVID-19 continue, there are also social, economic, and ethical problems particularly on this subject. The most important problem is the obligation of effective use of resources in a pandemic which puts so much burden on the healthcare system. There is an unmet need for a large organization, when it is decided to use ECMO, to protect healthcare professionals in the first place. The ECMO is more expensive than other conventional systems such as ventilators, which poses another problem. Less developed and developing countries should be more careful while using ECMO in terms of cost-saving. Another point is the necessity of a professional team to cope with the setup and complications of ECMO. This team is expected to handle these problems and get out of the

system in pandemic circumstances, which is likely to reduce the number of healthcare professionals in the field. There are two other specific problems about the ECMO use. The first one is the coagulation problems commonly seen in COVID-19 patients. Many reports showed that COVID-19 patients had a tendency to thrombosis.^[16-18] This makes management of anticoagulation process more difficult than it already is. The second problem is cardiomyopathy which was accounted for one-third of critical COVID-19 patients.^[14,19] This is explained as myocardial damage and microvascular thrombosis caused by the cytokine storm.^[5] Myocardial problems with a wide spectrum including simple electrocardiographic changes to severe cardiac insufficiency can occur in COVID-19 patients. These problems obviously make ECMO use more complicated than it is during pandemic. If such kind of myocardial damage is skipped while the VV-ECMO is inserted to a COVID-19 patient with severe respiratory distress, the results would be catastrophic. As aforementioned, choosing the VA-ECMO in such circumstances would not yield better results, particularly if there is left ventricular insufficiency due to myocardial damage.

In conclusion, the ECMO use for COVID-19 patients should be assessed in the light of these data. Regarding confusing problems and uncertain results, the most important point in this process is to choose the right patient who will benefit most. If this cannot be achieved, both waste of resources and disappointment of healthcare workers are inevitable.

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