Editorial

Health benefit and economic impact of utilising ECMO in COVID-19 patients: patient or cost first

Sundas Butt[1], Meera Shankar[2], Bothayna Amien[3], Oleg Fedevici[3], Amer Harky[3]^

[1]Department of Trauma and Orthopaedic Surgery, Queen's Medical Centre, Nottingham, UK; [2]School of Medicine, Faculty of Health and Life Science, University of Liverpool, Liverpool, UK; [3]Department of Cardiothoracic Surgery, Liverpool Heart and Chest Hospital, Liverpool, UK

Correspondence to: Amer Harky, MRCS, MSc. Department of Cardiothoracic Surgery, Liverpool Heart and Chest Hospital, Liverpool L14 3PE, UK. Email: amer.harky@lhch.nhs.uk.

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Late 2019 saw the rapid rise of the deadly severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) (1). First reported in Wuhan, Hubei, a province in China, the World Health Organisation (WHO) soon declared it a pandemic by March 2020 (2). This novel coronavirus is thought to exhibit fatal complications through its unique disease pathogenesis. Initial entry into type 2 pneumocytes in the lungs via ACE2 receptors has been shown to trigger an inflammatory cytokine response, which can subsequently lead to acute respiratory distress syndrome (ARDS) (3). This is where extracorporeal membrane oxygenation (ECMO) comes into play; displaying its benefits as a rescue therapy in the intensive care unit when mechanical ventilation has failed in this regard (4). The utilisation of ECMO was soon encouraged by the WHO and Extracorporeal Life Support Organisation (ELSO) and advocated through interim guidelines as part of the supportive management of patients (5). This supportive therapy was initially recommended when maximal conventional therapies with coronavirus disease 2019 (COVID-19)-related ARDS failed, functioning as a rescue cardiopulmonary bypass to reduce the effects of the virus on the cardiorespiratory system (6). Despite several, recent studies highlighting improved patient outcomes when ECMO is utilised (1), there is also concern over the economic burden of using ECMO during this pandemic (4). Current data concerning this topic is limited within reported literature and it requires further evaluation to ensure that the current guidelines on the use of ECMO for COVID-19 related ARDS is justified and safe.

In this issue of the *Annals of Translational Medicine*, Oh *et al.* (4) shared the results from a population-based, nationwide, retrospective cohort study. This study comprised a total of 6,044 patients, with a range of indications requiring ECMO support, such as cardiac (59.0%), respiratory (10.9%) and other causes (30.1%). The "other" category was defined as conditions, such as cancer or sepsis, which would eventually require secondary ECMO therapy. The authors found that the median total healthcare cost of patients on ECMO support was United States Dollars (USD) 46,308.0 [interquartile range (IQR): 25,727.0–86,924.8]. This was demonstrated by the median ECMO support and hospital stay duration of ECMO survivors between 3 (IQR: 1–7) and 25 (IQR: 15–31) days. With a total healthcare cost increase of USD 1000, these patients were also found to have an increased three-year all-cause mortality when compared to patients who did not accrue such costs. Interestingly, they did not find the mortality rates to be significantly different between the cardiac and respiratory indication cohorts (P=0.926). However, a 1.94-fold higher mortality rate was

^ ORCID: 0000-0001-5507-5841.

demonstrated in the "other" indication group in comparison to their cardiac-related counterparts. In addition, lower healthcare costs were accrued in the respiratory indication group compared to the cardiac group. The authors attributed this to specialist service and expansive treatment use per day, accruing higher healthcare costs. The primary outcome of the study was the total healthcare cost for ECMO survivors to highlight the economic burden, whereas secondary outcomes were long-term survival rates. The commonest factors associated with an increased economic burden were found to be older age and a higher Charlson Comorbidity Index (CCI) score, reflecting the increased healthcare demands on multimorbid patients.

While this paper has made a good attempt to assess the long-term outcomes and implications of ECMO use, it is not without its limitations. Oh *et al.* considered demographics such as age, gender and area of residence and the CCI, a widely-accepted tool to predict long-term outcomes (7), however, they failed to include certain factors, namely, body mass index, alcohol consumption, smoking status, or ethnicity. This information could be valuable, as previous studies have found that outcomes are heavily dependent on patient selection and these comorbidities significantly differed between non-survivors and those successfully discharged (8).

Another limitation of this study is it did not include data on the timing of ECMO initiation or severity of disease, therefore making it difficult to assess if the administration of ECMO was ill-timed or not and the impact on outcomes and economic burden. The authors acknowledged the study's inability to distinguish between venoarterial (VA) and venovenous (VV) ECMO, instead classifying patients based on diagnosis at time of ECMO initiation. There is some ambiguity on whether the correlation between diagnosis and type of ECMO holds true in all patients, as previous studies have reported this is not always the case (9). Furthermore, the method of classification used only considered the most prominent disease needing treatment during hospitalisation, however, it does not account for other chronic complex coexisting diseases which may have led to changes in ECMO status and could have implications not only for inaccurate classification but also long-term outcomes.

Finally, this study aimed to investigate the overall cost of ECMO survivors' post-admission but did not compare this to the cost of other management measures. The cost-effectiveness and feasibility of ECMO can only be determined if compared against other widely used treatment options. As the authors noted, the economic burden calculated in this study may not be universally representative since 97% of Koreans are covered by the Korean National Health Insurance, while the remaining 3% who cannot afford insurance are covered under the Medical Aid Program (10). Thus, it is reasonable to assume the economic burden of ECMO may be significantly higher in other countries.

The COVID-19 pandemic incited the need for effective treatment with limited resources more so than before. The results presented by Oh *et al.* on the economic burden of ECMO therapy and its impact on long-term outcomes only reiterate the need for cost-effective guidelines to better promote survival rates. At the very start of the COVID-19 pandemic in Wuhan, China, Wang *et al.* reported out of the 138 hospitalised patients admitted with COVID-19, 4 (2.9%) of them needed ECMO support (11). Since then, there has been considerable debate on the use of ECMO for patients with coronavirus disease. Oh and colleagues found in their study that the length of ECMO support was proportional to the duration of hospital stay and total healthcare cost. These findings were comparable to a study analysing COVID-19 patients requiring ECMO therapy at over 650 hospitals in the United States (12). This study was also one of the first to report positive outcomes of ECMO therapy in COVID-19 patients but recommended its use as a rescue therapy after failed conventional management keeping in mind the economic implications.

A systematic review investigating 3,428 COVID-19 patients advised a case-by-case analysis for use of ECMO therapy to maximise the benefit from this 'scarce resource' (13). The authors also called for further research on the effect of comorbidities on COVID-19 outcomes to guide practical and economical recommendations in the future. This aligns with the findings of Oh *et al.*, which can guide COVID-19-specific guidelines for ECMO therapy.

Overall, it can be concluded Oh *et al.* have provided valuable insights into the total healthcare costs for one year following the use of ECMO to treat COVID-19 patients with ARDS. The study also demonstrates the association with a higher three-year all-cause mortality, which appears to suggest a significant clinical consequence to this supportive therapy. The study marks a vital first step for future investigations surrounding the economic impact of ECMO in COVID-19. Thus, providing scope for larger multicentre studies to inform current recommendations and aid in the formulation of tangible solutions to improve patient outcomes. Finally, clinicians should carefully consider patients when it comes to ECMO, those patients

should be carefully selected and discussed through a multi-disciplinary meeting to ensure a good outcome is likely to happen when using this advanced procedure (14). Therefore, there is a need for risk stratification and patient selection pathway to be decided upon in the upcoming studies and guidelines.

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References

1. Savarimuthu S, BinSaeid J, Harky A. The role of ECMO in COVID-19: Can it provide rescue therapy in those who are critically ill? J Card Surg 2020;35:1298-301.
2. World Health Organization, 2020. WHO Director-General's opening remarks at the media briefing on COVID-19-11 March 2020.
3. Giwa AL, Desai A, Duca A. Novel 2019 coronavirus SARS-CoV-2 (COVID-19): An updated overview for emergency clinicians. Emerg Med Pract 2020;22:1-28.
4. Oh TK, Song IA. The economic burden and long-term mortality in survivors of extracorporeal membrane oxygenation in South Korea. Ann Transl Med 2022;10:1266.
5. ELSO. Elso.org. 2022. Extracorporeal Membrane Oxygenation in COVID-19 | ECMO. [online] Available online: https://www.elso.org/ecmo-education/2022elsomeeting.aspx. [Accessed 29 November 2022].
6. Davies A, Jones D, et al. Extracorporeal Membrane Oxygenation for 2009 Influenza A(H1N1) Acute Respiratory Distress Syndrome. JAMA 2009;302:1888-95.
7. Carroll BJ, Shah RV, Murthy V, et al. Clinical Features and outcomes in adults with cardiogenic shock supported by extracorporeal membrane oxygenation. Am J Cardiol 2015;116:1624-30.
8. Charlson ME, Pompei P, Ales KL, et al. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. J Chronic Dis 1987;40:373-83.
9. Schmidt M, Hajage D, Lebreton G, et al. Extracorporeal membrane oxygenation for severe acute respiratory distress syndrome associated with COVID-19: a retrospective cohort study. Lancet Respir Med 2020;8:1121-31.
10. 2022 National Health Insurance & Long-Term Care Insurance System in Republic of Korea. Available online: https://www.nhis.or.kr/english/wbheaa03500m01.do?mode=download&articleNo=10814171&attachNo=323871
11. Wang D, Hu B, Hu C, et al. Clinical Characteristics of 138 Hospitalized Patients With 2019 Novel Coronavirus-Infected Pneumonia in Wuhan, China. JAMA 2020;323:1061-9.
12. Nguyen NT, Sullivan B, Sagebin F, et al. Analysis of COVID-19 Patients With Acute Respiratory Distress Syndrome Managed With Extracorporeal Membrane Oxygenation at US Academic Centers. Ann Surg 2021;274:40-4.
13. Haiduc AA, Alom S, Melamed N, et al. Role of extracorporeal membrane oxygenation in COVID-19: A systematic review. J Card Surg 2020;35:2679-87.
14. Alom S, Haiduc AA, Melamed N, et al. Use of ECMO in Patients With Coronavirus Disease 2019: Does the Evidence Suffice? J Cardiothorac Vasc Anesth 2021;35:1256-62.

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