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Research Brief

Respiratory extracorporeal membrane oxygenation and central-line–associated bloodstream infection: Experience at a tertiary-care center during the coronavirus disease 2019 (COVID-19) pandemic

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Extracorporeal membrane oxygenation (ECMO) is used for respiratory failure or respiratory ECMO. It is usually indicated for patients with reversible, acute respiratory failure who fail to improve with conventional ventilatory support or for those on prolonged mechanical ventilation.[1,2]

One of the most critical ECMO complications is ECMO central-line–associated bloodstream infection (ECMO-CLABSI), which has an incidence density of 3.1–8.0 per 1,000 ECMO days according to previous studies.[3,4] Because ECMO use has increased during the coronavirus disease 2019 (COVID-19) pandemic, we investigated the incidence and changes in the trend of ECMO-CLABSI during the current pandemic.

Methods

This retrospective study was conducted from December 2013 to the end of February 2021 in 28-bed intensive care units at Tokyo Metropolitan Tama Medical Center, a 790-bed, public, tertiary-care center in Tokyo, Japan. The study center began respiratory ECMO placement in December 2013. The center has been registered with the extracorporeal life support organization (ELSO) since 2015,[5] and 10–20 respiratory ECMO placements are performed there annually.

Patients who received respiratory ECMO during the study period were enrolled for analysis. Their demographic data, indication for ECMO placement, ECMO device days (called ECMO days), duration of ICU hospitalization, in-hospital mortality at the index hospitalization, the number of ECMO-CLABSI events, and causative pathogens were extracted from the electronic medical records. ECMO-CLABSI patients were required to have a laboratory-confirmed bloodstream infection that was not secondary to an infection at another body site. The definitions of CLABSI, ECMO days, and the ECMO device utilization ratio (DUR) from the National Healthcare Safety Network (NHSN) were used for ECMO-CLABSI.[6] The incidence density of ECMO-CLABSI and the ECMO-DUR were calculated. The Institutional Review Board of the Tokyo Metropolitan Tama Medical Center approved this study.

Results

In total, 97 patients received respiratory ECMO placement, and the cumulative ECMO-days were 1,138. The in-hospital mortality rate was 38.1% (37 of 97), the median respiratory ECMO-days per patient was 8.0 days (range, 1–55), and the overall ECMO-DUR was 0.023. All the patients with ECMO were concurrently fitted with a central venous catheter and arterial catheter during ECMO use.

In total, ECMO-CLABSI developed in 12 patients, and the cumulative incidence density of ECMO-CLABSI during the entire study period was 10.54 per 1,000 ECMO days. Figure 1 shows the trends in the ECMO-CLABSI incidence and the ECMO-DUR. After February 2020, when the study center began admitting patients with COVID-19, both the ECMO-DUR and ECMO-CLABSI incidence density increased noticeably in comparison with the preceding period The ECMO-DUR was 0.018–0.061, with a rate ratio of 3.29 (95% confidence interval [CI], 2.89–3.72). The ECMO-CLABSI incidence density was 10.11–11.53 per 1.000 ECMO days, with an incidence ratio of 1.14 (95% CI, 0.16–3.42). The most common causative pathogens in ECMO-CLABSI were *Candida* spp (3 of 12) followed by *Staphylococcus* spp (2 of 12). In-hospital mortality was higher in patients with ECMO-CLABSI than in those without ECMO-CLBSI: 75.0% (9 of 12) versus 32.9% (28 of 85).

When the outcomes of the patients with COVID-19 on ECMO were compared with those without COVID-19 (Supplementary Table 1 online), the former tended to be more obese (body mass index >25 km/m^2). Although the difference was statistically non-significant, more ECMO-CLABSI cases were observed among patients with COVID-19. The incidence density was 16.19 per 1,000 ECMO days among patients with COVID-19 versus 8.98 per 1,000 ECMO days among those without COVID-19, for an incidence ratio of 1.80 (95% CI, 0.26–5.41).

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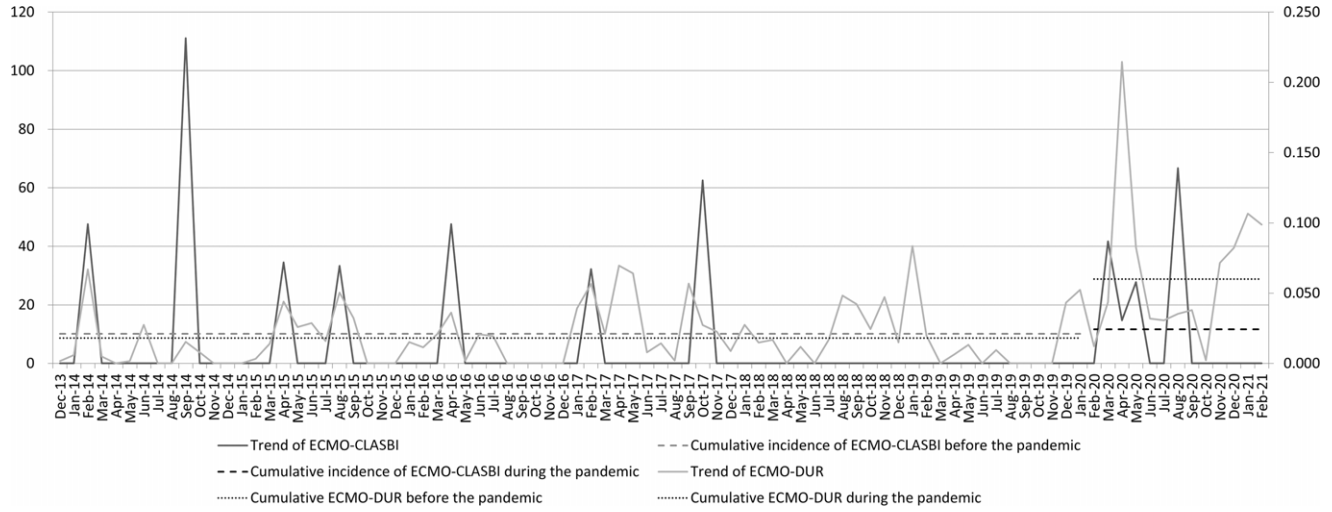

Fig. 1. Trends in extracorporeal membrane oxygenation (ECMO) central-line–associated bloodstream infection and the ECMO device utilization ratio.

Discussion

In this study, we examined trends in respiratory ECMO use over 7 years at a tertiary-care center in Japan. The overall incidence density of ECMO-CLABSI was 10.54 per 1,000 ECMO days, which is in line with other observational studies.[3,4] Respiratory ECMO use has increased since the COVID-19 pandemic began, and increasing incidence density of ECMO-CLABSI has also been observed.

The clear increase in the incidence density of ECMO-CLABSI following the COVID-19 outbreak in the present study reflects the findings of a previous study in which an increase in the incidence of healthcare-associated infections, including CLABSI, occurred during the COVID-19 pandemic.[7,8] Supplementary Table 1 (online) shows that the proportion of patients with BMI >25 kg/m^2 was higher among those with COVID-19 while on ECMO. Although central venous catheterization in the femoral vein should be avoided in obese patients,[9] respiratory ECMO catheterization is frequently performed using the femoral vein. Dressing failure, local contamination, and local bacterial overgrowth create suboptimal conditions for the catheterization site. Moreover, prolonged catheterization, which can also contribute to ECMO-CLABSI development, has been observed in patients with COVID-19. Given the increased use of ECMO during the COVID-19 pandemic, an evidence-based approach is urgently needed to prevent ECMO-CLABSI.

This study has several limitations. Because it was conducted at a single tertiary-care center, its findings may not apply to other institutions. Because all patients with ECMO were fitted with a central venous catheter and an arterial catheter, distinguishing ECMO-CLABSI from other catheter-related BSI was challenging. Moreover, ECMO-CLABSI may not have caused the death of the patients with ECMO. Because relatively few patients were enrolled, further studies enrolling a larger cohort are needed to verify these findings. Although there is a consensus on indications for ECMO placement, some variation in the ECMO procedure in the present study may have affected the results.

In the present study, we determined the incidence of ECMO-CLABSI at a tertiary-care center in Japan. Since the COVID-19 pandemic began, demand for ECMO use has been increasing, and patients with COVID-19 requiring ECMO placement may be at risk of developing ECMO-CLABSI. Further studies enrolling a larger patient population with ECMO placement in the context of COVID-19 care are needed to clarify the ECMO-CLABSI risk in patients with COVID-19.

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