Six-Month Pulmonary Function After Venovenous Extracorporeal Membrane Oxygenation for Coronavirus Disease 2019 Patients

OBJECTIVES: Venovenous extracorporeal membrane oxygenation has been largely used in patients with refractory acute respiratory distress syndrome due to coronavirus disease 2019. Few data on long-term pulmonary function among venovenous extracorporeal membrane oxygenation survivors are available.

DESIGN: Retrospective, observational cohort.

SETTING: Two mixed medical-surgical tertiary (30 beds) and secondary (22 beds) ICUs.

PATIENTS: All critically ill adult coronavirus disease 2019 survivors treated with venovenous extracorporeal membrane oxygenation between March 10, and April 30, 2020.

MEASUREMENTS AND MAIN RESULTS: The last available lung function and 6-minute walking tests, performed after a median of 178 days (ranges, 72–232 d) from ICU admission, were analyzed. Among the 32 coronavirus disease 2019 patients treated by venovenous extracorporeal membrane oxygenation during the study period, 11 (34%; median age 56 yr; median duration of mechanical ventilation and extracorporeal membrane oxygenation therapy of 26 and 15 d, respectively) were successfully weaned and discharged home. Spirometry was performed in nine patients; the volumetric lung function was preserved, that is, median forced vital capacity was 83% of predicted value (51–99% of predicted value), and median forced expiratory volume in 1 second was 82% of predicted value (60–99% of predicted value). Also, the median residual volume and the lung capacity were 100% of predicted value (50–140% of predicted value) and 90% of predicted value (50–100% of predicted value); only the diffusion capacity of the lung for carbon monoxide and 6-minute walking test were decreased (58% of predicted value [37–95% of predicted value] and 468 meters [365–625 meters], corresponding to [63–90% of predicted value], respectively).

CONCLUSIONS: Among survivors from severe coronavirus disease 2019 pneumonia treated with venovenous extracorporeal membrane oxygenation, preserved long-term volumetric lung function with decreased diffusion capacity of lung carbon monoxide was observed.

KEY WORDS: acute respiratory distress syndrome; coronavirus disease 2019; extracorporeal membrane oxygenation; pulmonary function test
A total of 92 COVID-19 patients were admitted over the study period; of those, 32 (35%) required venovenous ECMO, and 11 of 32 (34%) survived at hospital discharge (median age 56 yr; 8/11 men; median body mass index 30.5 kg/m²). None of them had preexisting pulmonary or cardiac disease. All patients were treated with oral hydroxychloroquine (400 mg/d for 5 d), and only two patients received IV methylprednisolone (1 mg/kg for 7 d) after the second week since admission. The decision to initiate venovenous ECMO was based on the criteria from a recent randomized study (i.e., PaO₂/FIO₂ ratio < 80 for more than 6 hr or < 50 for 3 hr or pH < 7.25 and Paco₂ > 60 mm Hg for more than 6 hr); the median pre-ECMO PaO₂/FIO₂ ratio was 60 (44–90), and all patients had previously received muscle relaxants and several sessions of prone positioning. Duration of mechanical ventilation and ECMO therapy was 26 days (ranges, 17–50 d) and 15 days (8–36 d), respectively.

Among the 11 hospital survivors, all were still alive without oxygen requirement on January 31, 2021. Pulmonary function tests were obtained in nine patients after a median of 178 days (72–232 d) and 147 days (55–211 d) from ICU admission and ECMO weaning, respectively (Table 1, Supplemental Digital Content, http://links.lww.com/CCX/A720). The results of these tests showed a preserved median forced vital capacity (FVC, 83% of predicted value [51–99% of predicted value]) and forced expiratory volume in 1 second (82% of predicted value [60–99% of predicted value]). Pulmonary volumes were also within normal ranges, as the median residual volume and the median total lung capacity were 100% of predicted value (50–140% of predicted value) and 90% of predicted value (50–100% of predicted value), respectively. Only the diffusion capacity of the lung for carbon monoxide (DLCO) was decreased (median 58% of predicted value [37–95% of predicted value]). The 6-minute walking test (6MWT) was performed in six patients and resulted in a median of 468 meters (365–625 meters), corresponding to 68% of predicted value (57–90% of predicted value); the median pulsed oxygen saturation in ambient air before exercise was 97% (96–98%), which slightly decreased at the end of 6MWT to 92% (91–96%).

Together with recent studies showing persistence of radiological involvement (2) and abnormality of pulmonary function tests (3) in COVID-19 patients at hospital discharge, our data suggested that, in the most severe pulmonary involvement of COVID-19 requiring ECMO support, long-term diffusion disorders (i.e., 7/9 patients have DLCO < 80% of predicted) may persist without other remarkable abnormalities of their pulmonary function tests. These values are similar to those reported by Grasselli et al (4) in 18 patients treated with venovenous ECMO for other causes than COVID-19. The modest but still relevant limitation on the 6MWT may also suggest, with all the limitations of a test available only in six patients and the lack of pre-COVID assessment, that the diffusion pulmonary impairment could potentially compromise high-level physical efforts. The main limitations of this study are the lack of standardization for “long-term” assessment (i.e., which varied between 2.5 and 7.5 mo after the onset of COVID-19), of radiological (i.e., chest CT scan) evaluation, and of further appraisal (i.e., at 1 yr). In this small retrospective study, patients with a successful recovery from COVID-19 after ECMO support presented modest alterations of long-term respiratory diffusion and physical capacities.

1. Department of Intensive Care, Erasme Hospital, Université Libre de Bruxelles (ULB), Brussels, Belgium.
2. Department of Pneumology, Erasme Hospital, Université Libre de Bruxelles (ULB), Brussels, Belgium.
3. Department of Critical Care, Centres Hospitaliers Jolimont, La Louvière, Belgium.

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For information regarding this article, E-mail: amedee.ego@erasme.ulb.ac.be

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