

RESEARCH LETTER

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Survival after extracorporeal membrane oxygenation in severe COVID-19 ARDS: results from an international multicenter registry

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Survival of coronavirus disease 2019 (COVID-19) patients with severe respiratory failure treated with venovenous extracorporeal membrane oxygenation (V-V ECMO) ranges around 60%, according to recent studies [1, 2]. Initial recommendations for the use of V-V ECMO in COVID-19-related acute respiratory distress syndrome (ARDS) were largely based on studies from the pre-COVID-19 era [3, 4]. V-V ECMO was initiated in younger patients (i.e., <71 years) and in those with rather short duration of mechanical ventilation (MV) prior to ECMO (i.e., <7 or <11 days, respectively) [1, 5]. While it is reasonable to focus on selected ECMO cohorts in controlled trials, survival of COVID-19 patients treated with ECMO beyond these limitations remains unclear, so far. Here, we report survival data of COVID-19 ARDS patients treated with V-V ECMO from a large, international multicenter registry.

Data were collected retrospectively from medical records at 3 ECMO centers in the USA, 9 in Germany, and 1 in Switzerland, Belgium, and Italy. At the participating centers, all patients with reverse transcriptase polymerase chain reaction (rtPCR) positive testing for SARS-CoV-2, who received V-V ECMO from March 12 to June 5, 2020 (i.e., during the first wave of the pandemic), were included.

A total of 127 patients were analyzed: 53/127 (41.7%) of them survived at day 90 after ECMO implantation (Table 1). Higher survival was observed in patients younger than 71 years when compared to others (Fig. 1: 110/127, 45.5% vs. 17/127, 17.6%, $p=0.004$). However, patients being on MV before ECMO for less than 7 days had slightly higher survival rate than those with longer MV course though not reaching statistical significance (77/127, 46.8% vs. 50/127, 34.0%; $p=0.167$). Similar results were observed when the duration of MV was dichotomized in <11 and ≥ 11 days (101/127, 45.5% vs. 26/127, 26.9%; $p=0.044$).

Our findings derive from an international multicenter registry of COVID-19-related ARDS patients treated with V-V ECMO. 90-day survival in our cohort was 41.7%, which was lower than previously described for COVID-19 patients treated with V-V ECMO in large registries and survival reported for non-COVID-19 ARDS patients [1, 2, 5]. The lower survival rate might be attributable to a more liberal use of V-V ECMO in this real-world cohort outside a prospective trial or to a different policy than in other ECMO centers. Even though survival of patients treated with ECMO even after longer periods of time of MV was lower than survival of patients with early initiation of ECMO, the latter still showed considerable survival rates. Our results therefore challenge strict contraindications for initiation of ECMO in COVID-19 patients solely based on duration of MV. Moreover, even though 90-day-survival of patients aged ≥ 71 years was significantly lower than for patients <71 years, not all treatments in this elderly population ended fatal.

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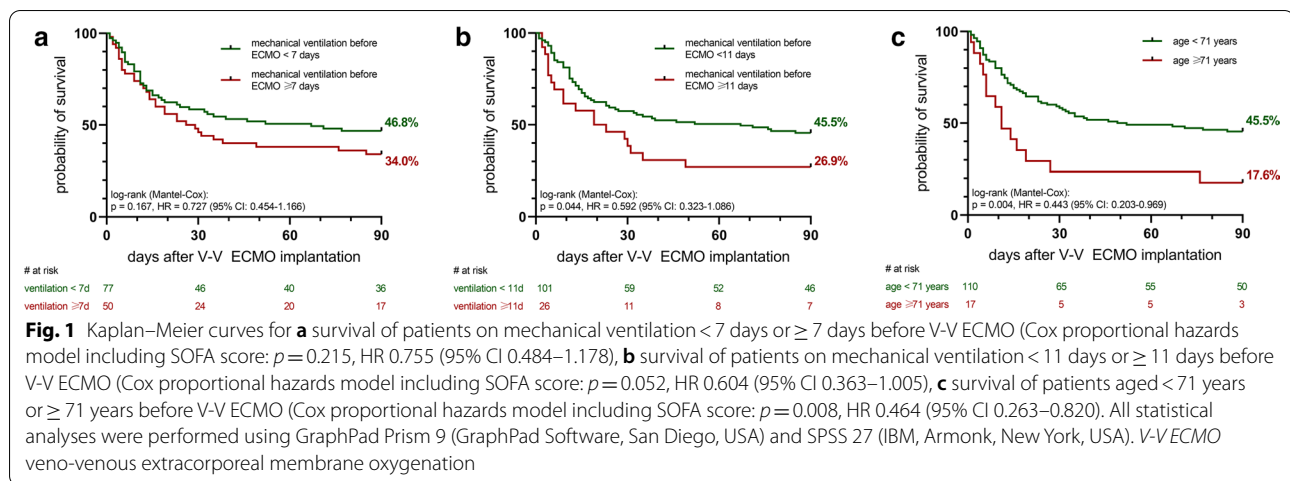
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Table 1 Patient baseline characteristics before initiation of extracorporeal membrane oxygenation (ECMO) and 90-day survival

	Total	Mechanical ventilation prior to ECMO < 7 days (n = 77)	Mechanical ventilation prior to ECMO ≥ 7 days (n = 50)	Mechanical ventilation prior to ECMO < 11 days (n = 101)	Mechanical ventilation prior to ECMO ≥ 11 days (n = 26)	Age < 71 years (n = 110)	Age ≥ 71 years (n = 17)
Number of patients, No. (% of total)	127 (100)	77 (61)	50 (39)	101 (80)	26 (20)	110 (87)	17 (13)
Female gender, No. (%)	27 (21)	20 (26)	7 (14)	22 (22)	5 (19)	24 (22)	3 (18)
90-day survival, No. (%)	53 (41.7)	36 (46.8)	17 (34.0)	46 (45.5)	7 (26.9)	50 (45.5)	3 (17.6)
Age [years], median (IQR)	59.0 (53.0–66.0)	57.0 (48.5–64.5)	61.0 (56.0–69.0)	58.0 (51.0–66.0)	61.0 (55.8–69.3)	58.0 (51.0–64.0)	73.0 (72.5–75.5)
Duration of invasive mechanical ventilation before ECMO [days], median (IQR)	5 (2–9)	2 (1–4)	11 (8–15)	3 (1–6)	15 (12–20.5)	5 (1–9)	6 (3.5–9.5)
SOFA, median (IQR)	9.0 (7.0–10.0)	8.0 (6.5–10.0)	9.0 (8.0–10.25)	9.0 (7.0–10.0)	9.0 (8.0–10.3)	9.0 (7.0–10.0)	10.0 (8.5–10.0)

All statistical analyses were performed using GraphPad Prism 9 (GraphPad Software, San Diego, USA)
 IQR interquartile range, SOFA Sequential Organ Failure Assessment



Therefore, age limits should be viewed with caution and decisions for or against the use of ECMO for patients above 70 years of age should be performed on an individual case-by-case level.

The main strength of our study is the high number of patients and multicenter analysis. However, our results are limited due to the retrospective design, small case volume at each center, the lack of a control group, and potential differences in ECMO practices and criteria for ECMO at the different centers.

In conclusion, our data may support the use of V-V ECMO in severe COVID-19 ARDS, also after prolonged periods of mechanical ventilation in selected patients. Upper age limits should be viewed with caution and not taken as the sole reason to withhold ECMO treatment.

Acknowledgements

The authors thank Franziska Frech, Moritz Kuhl, Sissi Mueller, Timm Zahn, and Arina-Cornelia Chifulescu for their support in the collection and evaluation of patient data.

Collaborating authors (COVEC-study group): Jeff DellaVolpe, Methodist Hospital, San Antonio, Texas, USA; Dominik Scharpf, SLK-Hospital Heilbronn, Germany; Matthias Ulmer, RKH Hospital Ludwigsburg, Germany; Maximilian Halbe, Heart Center, University Hospital Zurich, Switzerland; Alexander Vogt, Department of Medicine III, University Clinic Halle (Saale), Germany; Raj Ramanan, University of Pittsburgh Medical Center (UPMC), Pennsylvania, USA; David Boldt, UCLA Healthcare System, Los Angeles, USA; Stephanie-Susanne Stecher, Medical Department II, LMU Hospital Munich, Germany; Andrea Montisci, Istituto Clinico Sant'Ambrogio, University of Milan, Italy; Tobias Spangenberg, Department of Cardiology, Angiology and Intensive Care, Marien Hospital Hamburg, Germany; Olivier Marggraf, Asklepios Clinic North, Hamburg, Germany; Chandra Kunavarapu, Methodist Hospital, San Antonio, Texas, USA; Lorenzo Peluso, Department of Intensive Care, Erasme Hospital, Université Libre de Bruxelles, Brussels, Belgium; Sebastian Muenz, SLK-Hospital Heilbronn, Germany; Monica Buerle, RKH Hospital Ludwigsburg, Germany; Naveen G. Nagaraj, Heart Center, University Hospital Zurich, Switzerland; Sebastian Nuding, Department of Medicine III, University Clinic Halle (Saale), Germany; Catalin Toma, University of Pittsburgh Medical Center (UPMC), Pennsylvania, USA; Vadim Gudzenko, UCLA Healthcare System, Los Angeles, USA; Hans Joachim Stemmler, Medical Department III, LMU Hospital Munich, Germany; Federico Pappalardo, Department of Anesthesia and Intensive Care, IRCCS ISMETT, UPMC Italy, Palermo, Italy; Georg Trummer, Department of Cardiovascular Surgery, Heart Center, University of Freiburg, Germany; Christoph Benk, Department of Cardiovascular Surgery, Heart Center, University of Freiburg, Germany; Guido Michels, Department of Acute and Emergency

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Authors' contributions

All authors' contributions to this work comply with ICMJE authorship recommendations. AS and DLS designed the study. Data collection was conducted by AS, JDV, CK, FST, LP, DS, SM, MU, MB, PML, MH, NN, SZ, AV, SN, RR, CT, DBo, VG, SSS, HJS, AM, FP, TS, OM, and DLS. Data was evaluated by AS, KK, TW and DLS. AS, TW, and DLS wrote the first draft of the manuscript. GM, DD, CvzM, GT, CBe, CBo and DBr assisted in data evaluation and reviewed the manuscript. All authors read and approved the final manuscript.

Funding

This work was financed by internal funds from the participating institutions.

Availability of data and materials

All data will be available from the corresponding author on reasonable request.

Ethics approval and consent to participate

The study was approved by the leading institutional ethics committee of the University of Freiburg (EK 329/20). Due to the retrospective and observational nature of the study and anonymous data evaluation, the need for informed consent was waived.

Consent for publication

Not applicable.

Competing interests

All authors have completed the ICMJE form (available upon request from the corresponding author). FS Taccone reports personal fees from Eurosets outside the submitted work. C Benk and G Trummer are shareholders of Resuscitec GmbH and received personal fees from Resuscitec GmbH outside the submitted work. C Benk and G Trummer hold patents US 10695407 and EU 3016675 issued to Resuscitec GmbH. D Brodie reports grants from ALung Technologies, personal fees from Baxter, personal fees from Xenios, personal fees from Abiomed, and unpaid consultancy for Hemovent outside the submitted work. G Michels reports personal fees from ZOLL, Sedana Medical, Orion Pharma, and Getinge outside the submitted work; the competing interests are not related to the present work. All other authors declare no competing interests.

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Received: 3 December 2020 Accepted: 2 February 2021

Published online: 01 March 2021

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