

ECMO in COVID-19

Daniel Brodie

ATS Critical Care Training Forum

December 8th, 2020

Disclosures

ALung Technologies

Baxter

Abiomed

Hemovent

Xenios

Chair, International ECMO Network (ECMONet)

President-elect, Extracorporeal Life Support Organization (ELSO)

Extracorporeal membrane oxygenation support in COVID-19: an international cohort study of the Extracorporeal Life Support Organization registry

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Extracorporeal Life Support Organization Registry addendum COVID-19

1035 COVID-19 ECMO patients
213 centers
36 countries

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1093 ECMO patients ≥ 16 y

January 16th through May 1st, 2020

57 without COVID addendum, 1 2nd run ECMO (1st prior to COVID)

1035 ECMO-supported

Lab-confirmed SARS-CoV-2

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ELSO Registry 125,000 ECMO patients

Database definitions

Detailed instructions for ELSO Site Managers

Site managers complete data entry exam

Point-of-entry data assessment with error & validity checks

Full record validation triggered on submission

COVID addendum

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Epidemiology, hospital course, outcomes

Multivariable Cox model

Patient & hospital factors associated with in-hospital mortality

90 days of follow up from ECMO initiation

No post-discharge follow-up available in the registry

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Primary outcome = in-hospital death assessed 90 days after ECMO initiation

Time-to-event analysis

Not all patients have a final disposition at time of database lock
Calculating in-hospital mortality without accounting for differential follow-up results in length-time bias

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Discharged alive to home or acute rehab

VS

Discharged to another location
(LTAC or unknown)

VS

Discharge to another hospital

Treated as distinct competing events for the primary outcome of in-hospital mortality

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Records in which the last update indicated the patient had not:
Died
Been discharged
Or completed 90 days of follow-up after ECMO initiation
Censored at the time of their last update

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Secondary outcomes

Disposition at time of analysis

ECMO duration

Hospital LOS

Tracheostomy use

Complications

AKI

Renal replacement therapy (regardless of AKI)

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	Full cohort (n=1035)	ARDS cohort* (n=779)
Age (years)	49 (41–57)	50 (42–57)
BMI (kg/m ²)†	31 (27–37)	32 (28–37)
Sex‡		
Male	764 (74%)	572 (74%)
Female	269 (26%)	206 (26%)
Race and ethnicity		
Black	150 (14%)	119 (15%)
White (non-Hispanic)	346 (33%)	250 (32%)
Asian	152 (15%)	86 (11%)
Middle Eastern or North African	35 (3%)	26 (3%)
Other	27 (3%)	21 (3%)
Unknown	54 (5%)	38 (5%)
Multiple	53 (5%)	51 (7%)
Hispanic	218 (21%)	188 (24%)
Pre-ECMO comorbidities		
No comorbidity	311 (30%)	243 (31%)
Cancer	11 (1%)	10 (1%)
Immunocompromised	24 (2%)	21 (3%)
Diabetes	245 (24%)	187 (24%)
Pre-existing cardiac disease	24 (2%)	13 (2%)
Pre-existing respiratory disease	29 (3%)	21 (3%)
Pre-existing renal insufficiency	21 (2%)	14 (2%)
Asthma	110 (11%)	91 (12%)
Pregnancy	22 (2%)	13 (2%)
Obesity (BMI >30 kg/m ²)	487 (47%)	362 (47%)
Acute illness		
ARDS	819 (79%)	775 (100%)
Acute heart failure	50 (5%)	25 (3%)
Myocarditis	22 (2%)	7 (1%)
Acute kidney injury	301 (29%)	247 (32%)
Pre-ECMO cardiac arrest§	48 (5%)	26 (3%)

Table 1: Patient characteristics before initiation of ECMO

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	N	Median (IQR) or n (%)	N	Median (IQR) or n (%)
Non-invasive ventilation				
Non-invasive ventilation before intubation	1032	606 (59%)	776	434 (56%)
Pre-ECMO intubation (days)	914	4.0 (1.8–6.4)	688	4.3 (2.0–6.5)
Conventional ventilation†	951	942 (99%)	729	721 (99%)
PEEP (cm H ₂ O)	868	14 (12–16)	661	15 (12–18)
PIP (cm H ₂ O)	699	33 (30–38)	532	34 (30–38)
FiO ₂	888	1.0 (0.90–1.0)	672	1.0 (0.90–1.0)
PaO ₂ :FiO ₂ (mm Hg)	868	72 (59–94)	657	72 (60–93)
PaCO ₂ (mm Hg)	896	60 (50–74)	678	60 (50–74)
Pre-ECMO support				
Prone positioning	1019	612 (60%)	766	464 (61%)
Neuromuscular blockade	1015	729 (72%)	762	567 (74%)
Inhaled pulmonary vasodilators	1019	293 (29%)	766	242 (32%)
Any vasoactive support	1015	606 (60%)	758	447 (59%)
Norepinephrine	1015	561 (55%)	762	416 (55%)
COVID-19 therapies and immunomodulators				
Any therapy	1035	786 (76%)	779	633 (81%)
Glucocorticoids	1035	420 (41%)	779	331 (42%)
Support type				
Respiratory	1035	995 (96%)	779	777 (99.7%)
Cardiac	1035	29 (3%)	779	0
ECPR	1035	11 (1%)	779	2 (0.3%)

Table 2: Supportive care and therapies delivered before ECMO

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Patient status at study completion		
Discharged alive to home or acute rehabilitation centre	311 (30%)	262 (34%)
Discharged alive to long-term acute care centre or unspecified location	101 (10%)	79 (10%)
Discharged to another hospital	176 (17%)	97 (12%)
Remain in the hospital (discharged from ICU)	11 (1%)	10 (1%)
Remain in the ICU	56 (5%)	40 (5%)
In-hospital death	380 (37%)	291 (37%)
Tracheostomy†	444 (44%)	353 (47%)
Select complications‡		
Seizure	6 (0.6%)	5 (0.7%)
CNS infarct	7 (0.7%)	5 (0.7%)
CNS haemorrhage	56 (6%)	44 (6%)
Haemolysis	48 (5%)	37 (5%)
Membrane lung failure	82 (8%)	63 (9%)
Pump failure	8 (0.8%)	6 (0.8%)
Circuit change	148 (15%)	99 (13%)

Table 3: Outcomes

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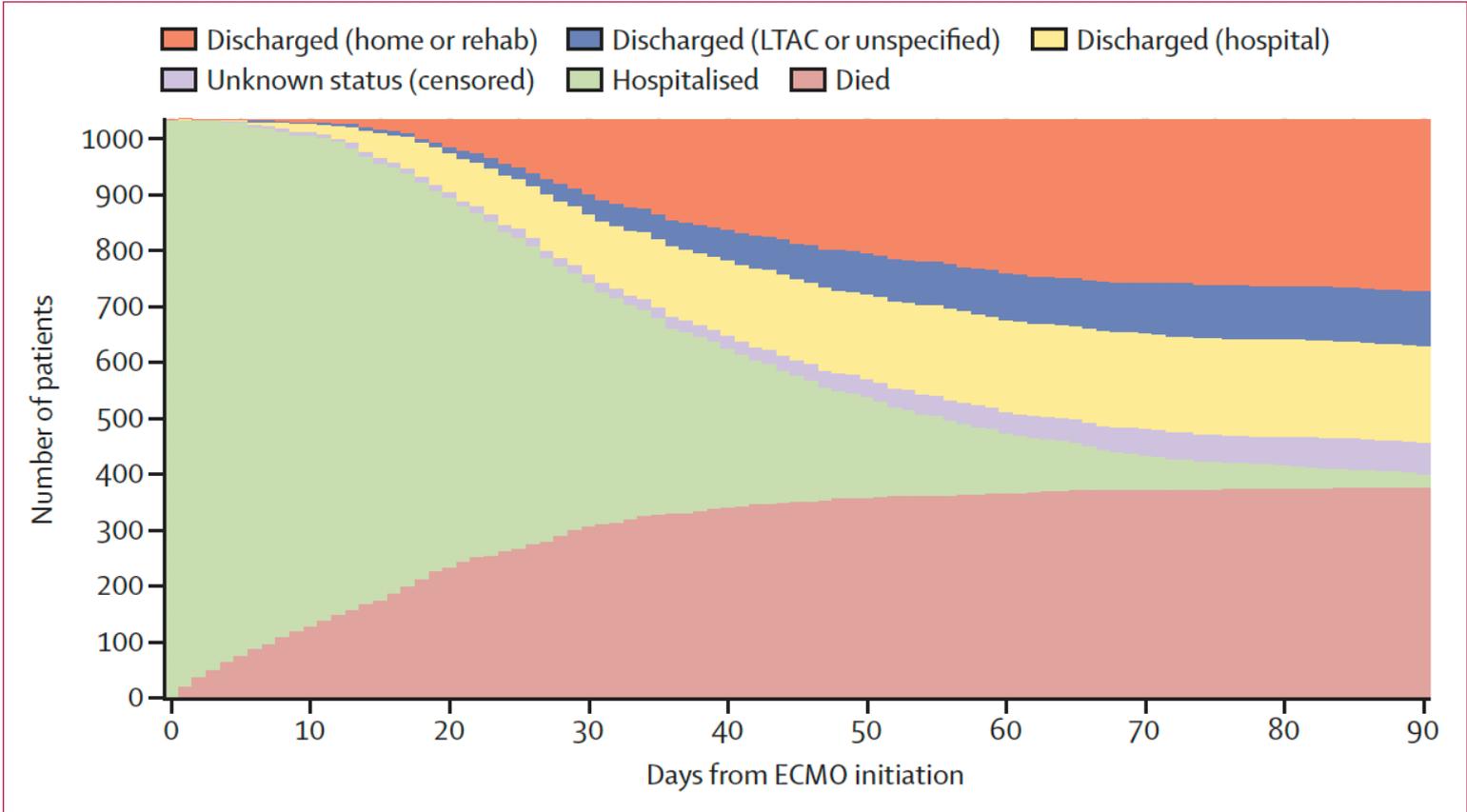


Figure 1: Stacked bar plots of disposition over time for patients with COVID-19 who received ECMO

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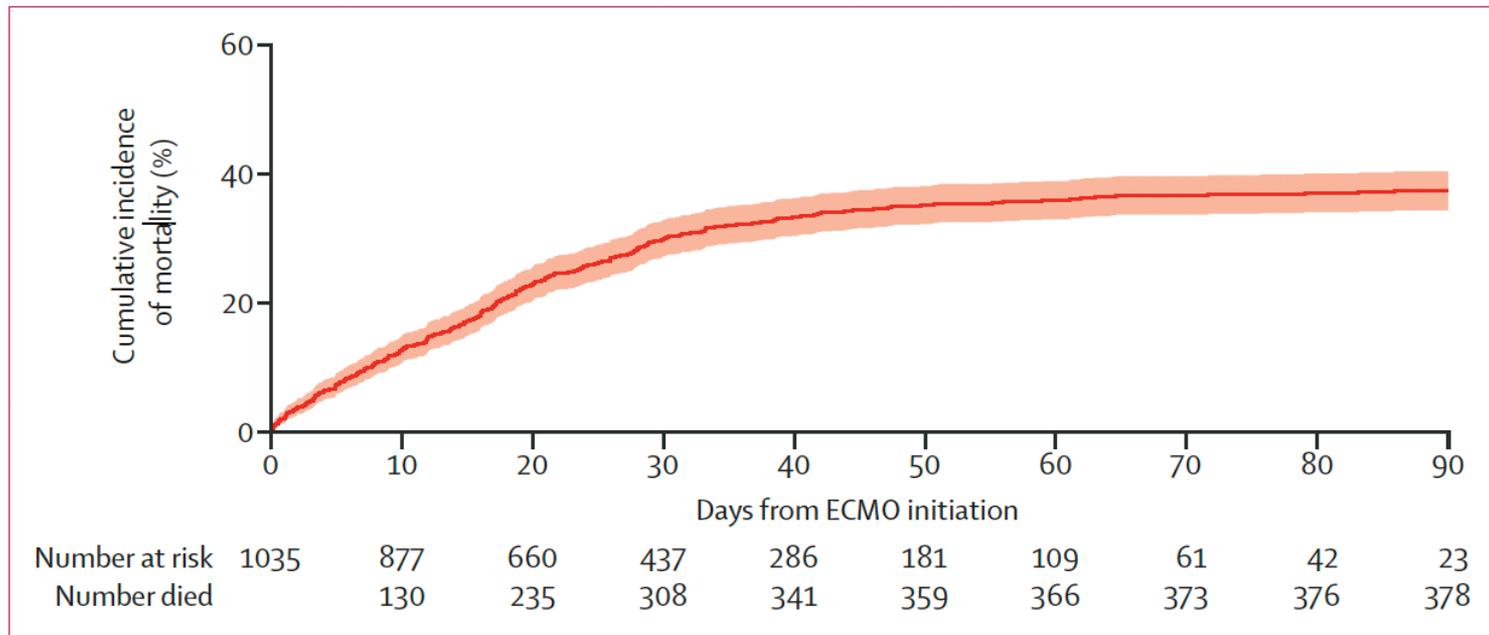


Figure 2: Cumulative incidence of mortality from time of ECMO initiation

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Estimated cumulative incidence of in-hospital mortality 90d after initiation of ECMO

37.4%

Among those with a final disposition of death or hospital discharge

39%

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Similar to EOLIA patients

Pre-ECMO prone 60% (EOLIA 59%)

Median P:F 72 (mean P:F EOLIA 73)

No patients discharged to hospice

KM median duration of hospitalization 26.9 days

Median LOS for survivors 31.1 days, non-survivors 16.0 days

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Membrane lung failure	82 (8%)	63 (9%)
Pump failure	8 (0.8%)	6 (0.8%)
Circuit change	148 (15%)	99 (13%)

Table 3: Outcomes

Table S12: Complications noted during extracorporeal membrane oxygenation

	<u>Complications per ECMO run</u>		<u>Complications per 1000 ECMO hours</u>	
	2020 COVID-19 n=983	2019 Adult n=12176	2020 COVID-19 n=983	2019 Adult n=12176
Any complication except renal replacement therapy	538 (55%)	5938 (48.8%)	2.85	5.148
Any mechanical complication	277 (28.2%)	1645 (13.5%)	0.69	0.999
Seizure	6 (0.6%)	129 (1.1%)	0.01	0.06
CNS infarct	7 (0.7%)	309 (2.5%)	0.02	0.129
CNS hemorrhage	56 (6%)	336 (2.8)	0.14	0.146
Pneumothorax	77 (8%)	313 (2.6%)	0.19	0.147
Hemolysis	48 (5%)	459 (3.8%)	0.12	0.209
Cannula site bleeding	67 (7%)	1025 (8.4%)	0.17	0.455
Membrane lung failure	82 (8%)	396 (3.3%)	0.20	0.211
Pump failure	8 (0.8%)	83 (0.7%)	0.02	0.035
Circuit change	148 (15%)	694 (5.7%)	0.37	0.367
Circuit clot	44 (5%)	359 (2.9%)	0.11	0.186

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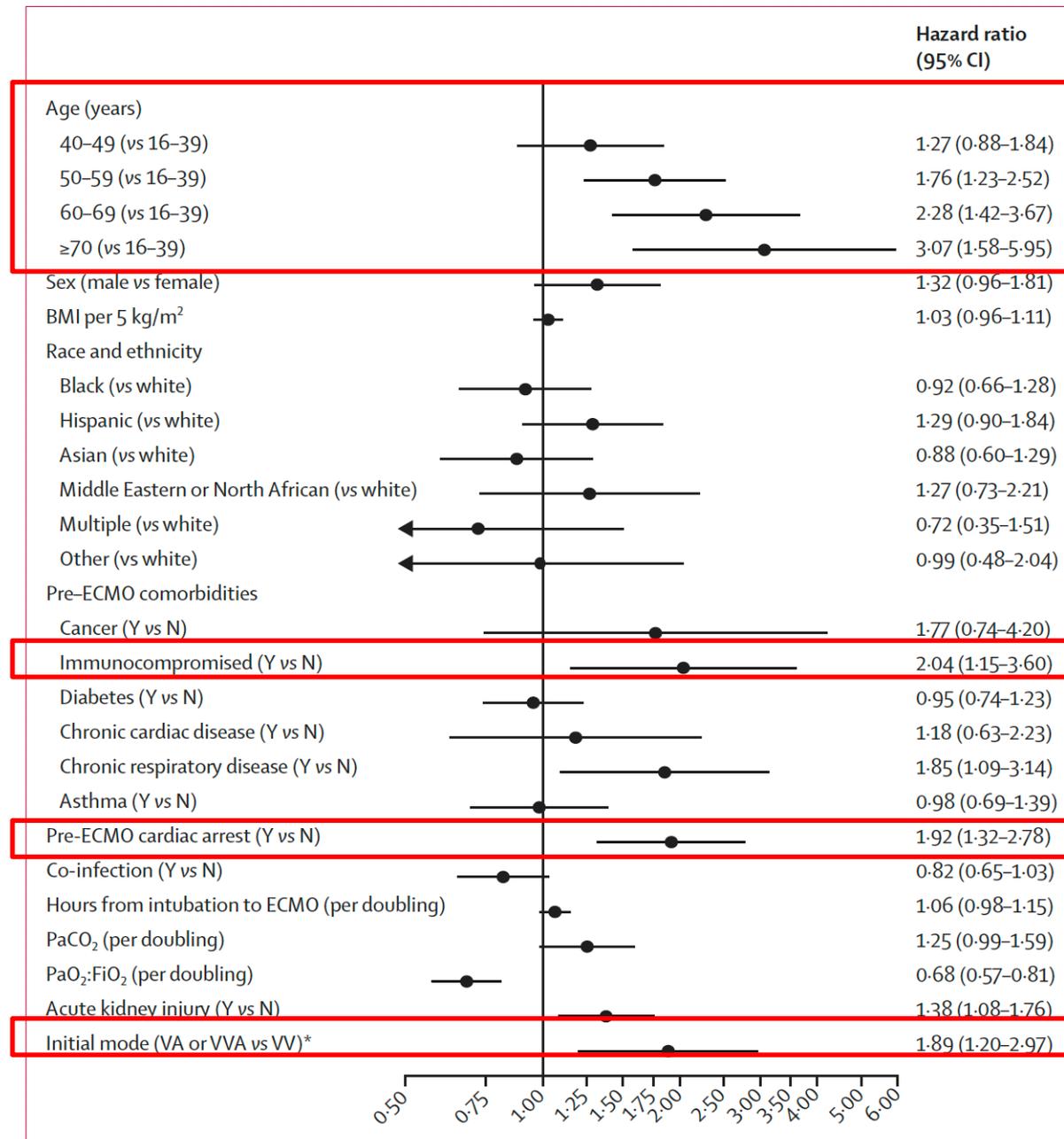


Figure 3: Cox model for factors associated with in-hospital mortality in patients with COVID-19 supported with ECMO

Patients with COVID-19 may benefit from ECMO

Data Source:

ELSO Registry
January-May 2020

1035

Patients



Mortality
90 days after ECMO

37%

(similar to prior studies of
ECMO support in ARDS)

Patient Cohort:



Laboratory
Confirmed
SARS-CoV-2

213

Hospitals



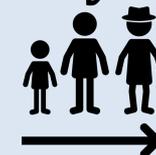
36

Countries

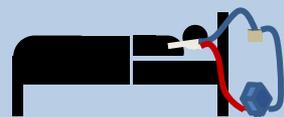


Higher mortality risk

Increasing
Age



Circulatory
Support



Initiated ECMO
Age 16+ years

Letters

RESEARCH LETTER

Extracorporeal Membrane Oxygenation for Patients With COVID-19 in Severe Respiratory Failure

JAMA Surgery Published online August 11, 2020

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Devang J. Joshi, MD
Deborah R. Tabachnick, MD
Chadrick A. Cross, MD
Pat S. Pappas, MD
Antone J. Tatoes, MD

Rush University & Advocate Christ
40 COVID-19 ARDS
EOLIA criteria

Letters

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- Pat S. Pappas, MD
- Antone J. Tatroles, MD

Table. Patient Characteristics (N = 40)

Characteristic	No. (%)
Prehospitalization	
Age, mean (SE), y	48.4 (1.5)
Median (range), y	51 (22-64)
Sex	
Male	30 (75)
Female	10 (25)
Race/ethnicity	
White	8 (20)
African American	16 (40)
Hispanic	14 (35)
Other	2 (5)
BMI, mean (SE) [range]	34.2 (1.1) [20.4-52.4]
Medical history	
Obesity ^a	28 (70)
Hypertension	23 (58)
Hyperlipidemia	7 (18)
Diabetes	10 (25)
Asthma	6 (15)
Chronic obstructive pulmonary disease	1 (3)
Smoking	7 (18)
Alcohol use	11 (28)
Coronary artery disease	1 (3)
Deep vein thrombosis/pulmonary embolism	6 (15)
Chronic kidney disease	4 (10)
Stroke	0

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Table. Patient Characteristics (N = 40)

Pre-extracorporeal membrane oxygenation	
Ventilator settings	
FiO ₂ , mean (SE)	0.98 (0.01)
PEEP, mean (SE) [median], cm H ₂ O	17.0 (0.5) [16]
Respiratory rate, mean (SE), breaths/min	25.8 (1.1)
Tidal volume, mean (SE), mL	429.4 (12.1)
Peak pressure, mean (SE) [median], cm H ₂ O	40.0 (2.0) [38]
Plateau pressure, mean (SE) [median], cm H ₂ O	32.7 (0.8) [32]
Arterial blood gas, mean (SE)	
pH, mean (SE)	7.24 (0.02)
PaCO ₂ , mean (SE) [median], mm Hg	71.6 (2.5) [68]
PaO ₂ , mean (SE) [median], mm Hg	66.9 (2.8) [66]
O ₂ saturation, mean (SE), %	88.7 (1.5)
PaO ₂ /FiO ₂ , mean (SE) [median]	68.9 (3.1) [66]
Bicarbonate, mean (SE), mEq/L	27.7 (0.9)
Pronation	29 (73)
Chemical paralysis	31 (78)
Vasopressors	24 (60)
Left ventricular ejection fraction, mean (SE), %	59.3 (2.3)
Inflammatory markers, mean (SE)	
D-dimer, µg/mL	13.9 (2.0)
Ferritin, ng/mL	1844.3 (254.1)

ECMO initiation to extubation
Mean 13.0 days

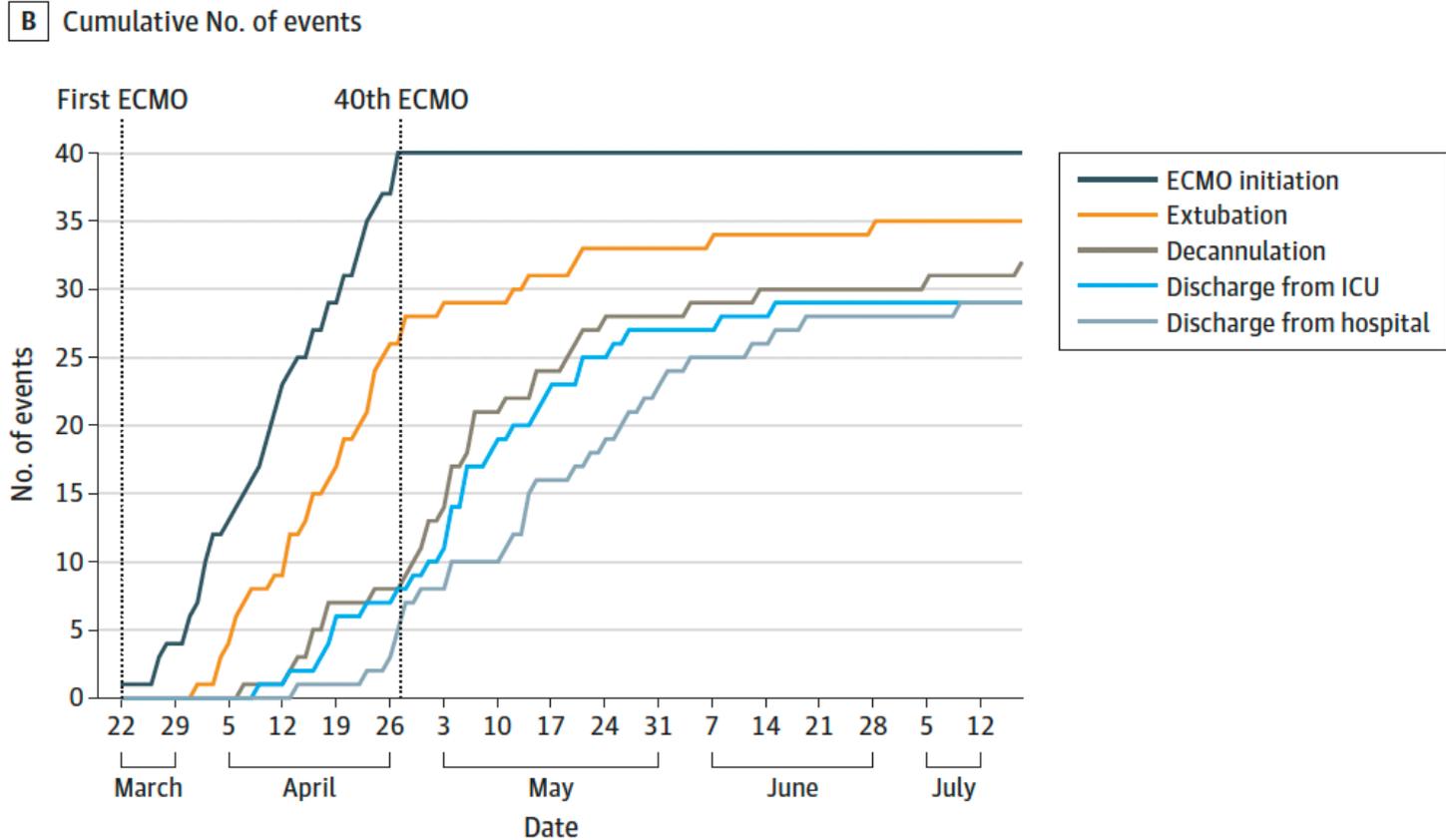
Letters

RESEARCH LETTER

Extracorporeal Membrane Oxygenation for Patients With COVID-19 in Severe Respiratory Failure

JAMA Surgery Published online August 11, 2020

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COVID ECMO

Upcoming data





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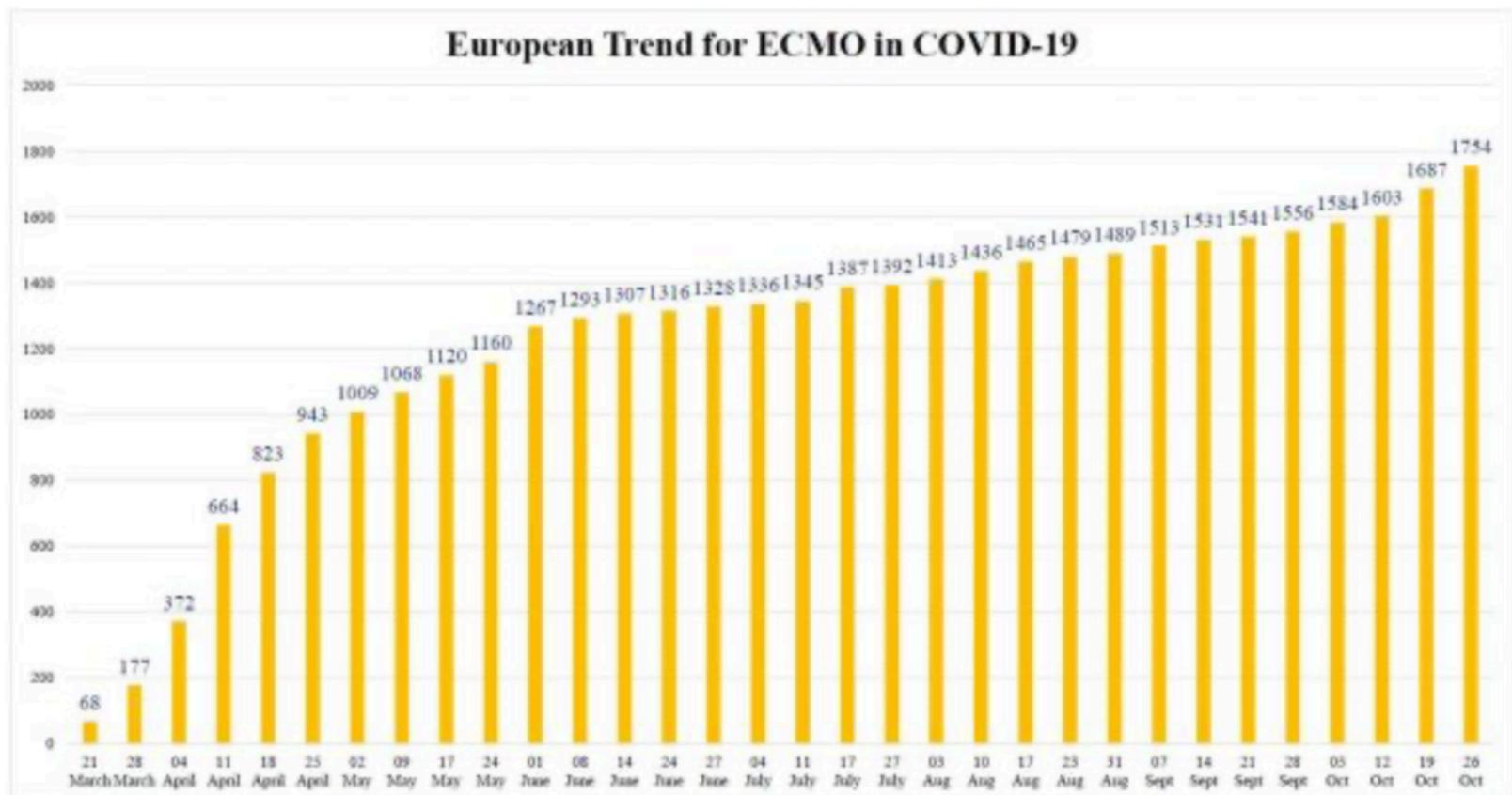
The background of the banner is a teal-colored field filled with several stylized, spherical coronavirus particles. Each particle is covered in numerous small, protruding spikes, giving them a characteristic "crown" appearance. The particles vary in size and are scattered across the frame, with some appearing more prominent than others.

CORONAVIRUS COVID-19 SURVEY ON ECMO USE

EUROELSO SURVEY ON ECMO USE IN ADULT COVID-19 PATIENTS IN EUROPE

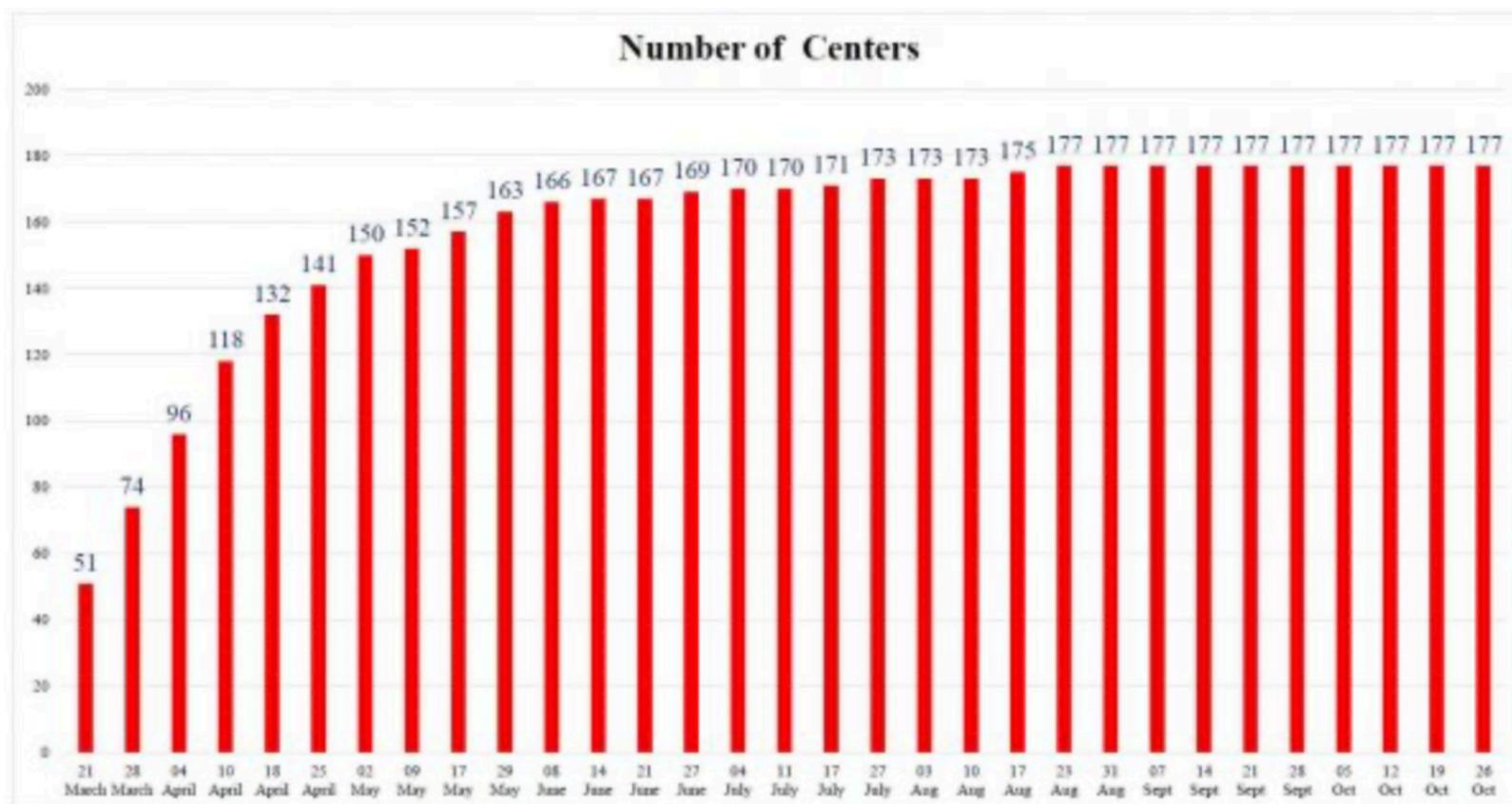


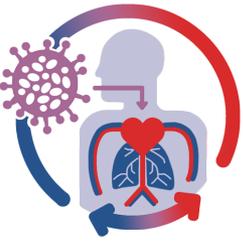
European Trend for ECMO in COVID-19 (Status: 26 October 2020)





Trend Number of Centers (Status: 26 October 2020)





**COVID-19 Critical
Care Consortium**
Incorporating **ECMOCARD**

The COVID-19 Critical Care Consortium (COVID Critical) a global alliance, collecting data on COVID-19 patients in ICU.

Since its inception on 21 January 2020, COVID Critical has grown to:

- 53 Countries
- 6 Continents
- 376 Collaborative Centres
- 203 Recruiting Centres
- 2500 Enrolled Patients

More information and contact

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COVID-19
Critical Care Consortium
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