




# Outcomes of Minority COVID-19 patients managed with ECMO: A single-center experience

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## Abstract

**Background:** The coronavirus disease 2019 (COVID-19) pandemic has significantly burdened the global healthcare system since December 2019. Minority populations are found to have a higher incidence of hospitalization and higher mortality when compared to Caucasians. Extracorporeal membrane oxygenation (ECMO) is reserved for COVID-19 patients who develop respiratory failure refractory to conventional management. To our knowledge, no data has been reported on outcome differences between Minority COVID-19 patients and Caucasian COVID-19 patients managed with ECMO. We aimed to investigate the outcome differences between these two groups.

**Methods:** Our retrospective cohort study had 23 adults (aged 18 and older) diagnosed with COVID-19 by polymerase chain reaction. All patients developed acute respiratory distress syndrome (ARDS), refractory to conventional treatment, and were managed on ECMO support. The primary outcome of interest was mortality; the secondary outcome was the rate of ECMO-related complications.

**Results:** The overall mortality rate of our study was higher (70%) than other reports of the COVID-19 population on ECMO. Caucasians in our study had more severe respiratory acidosis with carbon dioxide retention and appeared to have a higher mortality rate of 85.7% compared to Minorities (62.5%). No differences in complication rates between these two groups were identified.

**Conclusions:** Our cohort revealed a high overall mortality rate of COVID-19 patients on ECMO support. The Caucasian group was observed to have higher mortality than the Minority group. The high overall mortality was likely attributed to the Caucasian group, which had more severe respiratory acidosis before ECMO initiation, a known predictor of poor prognosis in ARDS patients. Our cohort's ethnic composition may also partially explain the high mortality rate since COVID-19 Minorities are reported to have worse outcomes than Caucasians. Larger and randomized studies are needed to investigate further the mortality and complication differences between Minority and Caucasian patients diagnosed with COVID-19 and managed by ECMO.

## KEYWORDS

cardiovascular research, COVID-19, ECMO, minority

## 1 | INTRODUCTION

The coronavirus disease 2019 (COVID-19) pandemic has significantly burdened the global healthcare system since December 2019. The existence of health disparities in COVID-19 incidence, complication rates, hospitalization, and mortality have been reported. Both medical and socioeconomic factors may contribute to this disproportionate mortality burden. Several factors, including race, region, and socioeconomic status, have been suggested to influence outcomes.<sup>1</sup> Minority ethnicity was an independent risk factor for contracting COVID-19.<sup>2</sup> Black and Hispanic populations especially appeared to be at higher risk for hospitalization than Caucasians.<sup>3</sup> There have been mixed study results regarding the difference in mortality rates between Minorities and Caucasians. Higher mortality rates have been observed in Minorities.<sup>4</sup> After adjusting for age, gender, medical insurance, and underlying comorbidities, Yehia et al.<sup>5</sup> found no significant difference in COVID-19 mortality between Caucasian and Minority populations. Conversely, a recent large-scale study of 1326 COVID-19 patients from the United Kingdom found that ethnicity-related outcome differences could not be fully explained by socioeconomic status or baseline chronic conditions.<sup>2</sup>

Acute respiratory distress syndrome (ARDS) secondary to COVID-19 is a major life-threatening complication typically managed with mechanical ventilation. Extracorporeal membrane oxygenation (ECMO) is reserved for COVID-19 patients who develop respiratory failure refractory to conventional management.<sup>6</sup> To our knowledge, no data has been reported on outcome differences between Minority COVID-19 patients and Caucasian COVID-19 patients managed with ECMO. We report our findings of overall mortality and mortality and complication differences between Caucasian and Minority COVID-19 patients on ECMO support at our community hospital. This study cohort was majorly composed of Minorities.

## 2 | METHODS

Our retrospective observational study included 23 adults (aged 18 and older) diagnosed with COVID-19 by polymerase chain reaction. All patients developed ARDS, refractory to conventional treatment, and were managed on ECMO support at a tertiary cardiovascular care center from August 2020 to December 2020. Patients were stratified into Caucasian and Minority groups. The Minority group was composed of Blacks and Hispanics. Patients' demographics, hemodynamics, lab values, treatments, outcomes, and complications were recorded. The primary outcome of interest was mortality; the secondary outcome was the rate of ECMO-related complications. The study was approved by a local institution with IRB exemption.

## 2.1 | Statistical analysis

Baseline patient demographics (age, gender, body mass index, comorbidities, and medications), complications (pneumothorax, hemorrhage, deep vein thrombosis, pulmonary embolism [PE], thrombocytopenia, and hospital-acquired infections), and outcomes were compared between Caucasians and Minorities using SPSS, Version 27 (IBM). Continuous variables were analyzed using an analysis of variance. Categorical variables were analyzed using Fisher's exact test. Significance was determined using  $\alpha = .05$ . All statistical tests were two-tailed.

## 3 | RESULTS

Of the 23 patients, 7 were Caucasians, and 16 were Minorities. The average age of the Minority group was 46 years old. The average age of the Caucasian group was 40 years old. Minorities and Caucasians had similar clinical characteristics and comorbidities on admission (Table 1). All patients who presented were diagnosed with COVID-19 with acute respiratory failure, and ECMO was initiated after admission.

Both groups were treated with systemic steroids, remdesivir, convalescent plasma, and empiric antibiotics during the hospitalization. Azithromycin was the most commonly used antibiotic. All patients received thromboembolic prophylaxis and were managed on ventilators. Pneumothorax, hemorrhage, and hematological complications such as deep venous thrombosis and PE were observed in both groups. There were no statistically significant differences in complications between the two groups (Table 2). Minorities were diagnosed with hospital-acquired infections during the ECMO course; however, no statistical differences were detected between these two groups.

At the end of the hospital course, 6 Minorities were discharged to home or long-term care facilities, and 10 Minorities were deceased. One Caucasian was discharged alive, and six Caucasians were deceased. At our center, the overall mortality rate of the combined two groups was high at 70%. Minority patients had a significantly lower in-hospital mortality rate than Caucasians (62.5% vs. 85.7%,  $p < .001$ ). Additionally, Caucasian patients were observed to have a longer hospitalization course than their Minority counterparts (34 vs. 32 days,  $p = .014$ ) (Table 3). Caucasians also presented with more severe respiratory acidosis on admission ( $p = .007$ ) (Table 4).

## 4 | DISCUSSION

We reported our findings from a retrospective study of 23 COVID-19 patients who were managed on ECMO. Our overall mortality rate was high. Minority patients had a significantly lower mortality rate when compared to Caucasian patients. Caucasian patients were found to have worse respiratory acidosis before initiating ECMO.

**TABLE 1** Characteristics of patients with COVID-19

Characteristic	Minority N = 16	Caucasian N = 7	p
Age (years), median	46.63	40.71	.12
Gender			.858
• Male	12 (75%)	5 (71.4%)	
• Female	4 (25%)	2 (28.6%)	
BMI (kg/m <sup>2</sup> )	31.53	30.74	.593
Comorbidities			
• Hypertension	7 (43.75)	3 (42.9%)	.968
• Diabetes	8 (50%)	3 (42.9%)	.752
• Hyperlipidemia	3 (18.75%)	1 (14.3%)	.795
• Chronic lung disease	0	0	
Active smoker	0	0	
Medications			
• Angiotensin-converting enzyme inhibitor or angiotensin receptor blocker	3 (18.75%)	1 (14.3%)	.795
• Statins	2 (12.5%)	1 (14.3%)	.907
• Beta-blockers	4 (25%)	0	.146

Abbreviations: BMI, body mass index; COVID-19, coronavirus disease 2019.

#### 4.1 | Mortality of the COVID-19 patients managed on ECMO

The estimated survival of ECMO-managed COVID-19 patients has been reported to be similar to survival seen in ECMO-treated ARDS patients secondary to non-COVID-19 etiologies. A 36% mortality rate was reported in Schmidt et al.'s<sup>6</sup> cohort of 83 ECMO-managed COVID-19 patients. Similarly, an international large-scale cohort study of 1035 COVID-19 patients suggested that the 90-day mortality in COVID-19 patients receiving ECMO was 39%.<sup>7</sup> According to the EuroECMO-COVID survey of 30 countries conducted in February 2021, the mortality of COVID-19 patients from all combined races on ECMO was approximately 55%.<sup>8</sup> Our cohort's mortality rate (70% overall/62.5% for Minorities) is higher than the literature.

ECMO should be considered rescue therapy for COVID-19 patients who develop refractory respiratory or cardiac failure,<sup>6</sup> even though ECMO is an independent risk factor for death in COVID-19 patients.<sup>7</sup> Currently, the Society of Critical Care Medicine recommends using ECMO for COVID-19 patients with refractory to conventional management who have a high risk of mortality.<sup>9</sup> The decision of when to initiate ECMO should be made on a case-by-case basis while considering comorbidities, age, and overall prognosis. While studies have reported that ECMO may be beneficial in treating COVID-19 patients who failed conventional management,<sup>10</sup> there is

**TABLE 2** Complications of ECMO-managed Minority and Caucasian patients

Complications	Minority N = 16	Caucasian N = 7	p
Pneumothorax	9 (56.25%)	4 (57.14%)	.276
Hemorrhage requiring transfusion	13 (81.25%)	5 (71.43%)	.301
• Gastrointestinal bleeding	7 (43.75%)	1 (14.29%)	
• Cannulation site	2 (12.5%)	2 (28.6%)	
• Tracheostomy site	7 (43.75%)	4 (57.14%)	
DVT	5 (31.25%)	1 (14.29%)	.243
PE	2 (12.5%)	0	.206
Thrombocytopenia	11 (68.75%)	2 (28.6%)	.298
Hospital-acquired infections			.105
• Ventilation associated pneumonia	6 (37.5%)	0	
• Bacteremia	4 (25%)	0	

Abbreviations: DVT, deep venous thrombosis; ECMO, extracorporeal membrane oxygenation; PE, pulmonary embolism.

scant research on whether there is a difference in outcomes based on race.

#### 4.2 | COVID-19 disease burden in Minority populations

Current research suggests that Minority populations represent a disproportionately high COVID-19 incidence burden and higher mortality rates.<sup>11</sup> Our cohort's ethnic composition may partially explain the observed high mortality rate.

Both medical and socioeconomic determinants of health contribute to COVID-19 morbidity and mortality in Minority populations. Black, Asian, and other Minority ethnic populations are at greater risk of developing severe COVID-19 than their Caucasian counterparts.<sup>2</sup> A higher incidence of pre-existing chronic diseases in Minority populations complicates management and may negatively impact outcomes. Furthermore, a higher prevalence of public transportation utilization,<sup>12</sup> multigenerational households, and close living quarters<sup>11</sup> in Minority populations may facilitate the spread of the virus in these communities. Additionally, air pollution and particulate matter (PM) concentrations tend to be higher in Minority communities.<sup>13</sup> In early 2020, Setti et al.<sup>14</sup> reported that COVID viral RNA was present on outdoor PM. High concentrations of PM may contribute to the outbreaks seen in Minority communities. A lack of access to insurance and unsteady household income may also contribute to increased morbidity and mortality in these populations.<sup>15</sup>

Outcome	Minority N = 16	Caucasian N = 7	p	Combination
Alive and discharged	6 (37.5%)	1 (14.3%)	<.001	7 (30.4%)
Deceased	10 (62.5%)	6 (85.7%)	<.001	16 (70.0%)
Length of hospitalization (days)	32.3	33.57	.014	32.69

**TABLE 3** Mortality and hospital length of Minority and Caucasian patients

**TABLE 4** Laboratory value before initiation of ECMO

Lab value before ECMO initiation	Minority	Caucasian	p
Air blood gas			
• PH	7.37	7.28	.018
• PaO <sub>2</sub>	75.84	84.06	.194
• PaCO <sub>2</sub>	43.36	59.96	.007
White blood cells (×10 <sup>9</sup> )	14.74	15.48	.965
Hemoglobin (g/dl)	9.39	9.58	.325
Platelets (×1000 cells/μl)	236.6	195	.036
Serum creatinine (mg/dl)	1.18	0.72	.840
Alanine transaminase (U/L)	67.2	21.8	.161
Aspartate aminotransferase (U/L)	124.4	55.17	.748
Total bilirubin (mg/dl)	1.09	0.93	.474
D-dimer (ng/ml)	2034.4	2046.7	.987
Ferritin (ng/ml)	1287.7	736	.627
C-reactive protein (mg/dl)	13.6	20.5	.221
Lactate dehydrogenase (U/L)	613.2	543.3	.818

Abbreviation: ECMO, extracorporeal membrane oxygenation.

### 4.3 | Racial differences in ECMO outcomes

Literature evaluating race-based ECMO management and outcomes for COVID-19 is scant. In the Extracorporeal Life Support Organization (ELSO)'s large scale study<sup>16</sup> of non-COVID patients, the Caucasian race was associated with decreased mortality on ECMO support. Conversely, Minorities were reported to have an approximately fivefold increased mortality risk while on ECMO.<sup>17</sup> Interestingly, Caucasians in our study appeared to have higher mortality of 85.7% compared to Minorities.

To our knowledge, our study is the first of its kind to report on the mortality differences between Minority and Caucasian COVID-19 populations on ECMO support. Of note, there were significant differences in respiratory status before ECMO initiation between these two groups. Caucasian patients had more severe respiratory acidosis with carbon dioxide (CO<sub>2</sub>) retention (Table 4). Acidosis with CO<sub>2</sub> retention has been reported to be a predictor of poor prognosis.<sup>18</sup> The severity of respiratory acidosis is associated with mortality in ARDS patients.<sup>19</sup> Using the ELSO registry of 4361 hospitalized patients, Posluszny et al.<sup>16</sup> reported that pre-ECMO PaCO<sub>2</sub> is positively correlated to mortality. In Yang et al.<sup>18</sup> studies, 12 patients died among 21 COVID-19 patients on ECMO. Nonsurvivors

were found to have more severe CO<sub>2</sub> retention. Thus, CO<sub>2</sub> retention may influence the outcome of COVID-19 patients on ECMO to support more significantly than ethnicity and socioeconomic status.

There are a few limitations of our study. Our smaller sample size may not represent the general population. Due to its retrospective nature, confounders and selection bias may exist.

## 5 | CONCLUSION

We investigated the overall mortality rate and significant complications and mortalities of Minority COVID-19 patients versus Caucasian COVID-19 patients managed with ECMO. Our overall mortality rate was higher than other reports of the COVID-19 population on ECMO. This mortality may be attributed to the Caucasian group, which had more severe respiratory acidosis before ECMO initiation, a known predictor of poor prognosis in ARDS patients. Meanwhile, our cohort's ethnic composition may partially explain the observed high mortality rate, since Minorities are reported to have worse outcomes of COVID-19 than Caucasians. In our study, the Minority COVID-19 group showed mortality benefits compared to the Caucasian group on ECMO support. Larger and randomized studies are needed to investigate further the mortality and complication differences between Minority and Caucasian patients diagnosed with COVID-19 and managed by ECMO.

### ETHICS STATEMENT

The studies involving human participants were reviewed and approved by the local Institutional Review Board. The patients/participants/family members provided their written informed consent to participate in this study.

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#### SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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