

CASE REPORT



A successful case of extracorporeal membrane oxygenation for COVID-19: walking home without oxygen supplementation

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ABSTRACT

Introduction: Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) emerged from Wuhan, China in December 2019 and is the strain of coronavirus that causes coronavirus disease 2019 (COVID-19). Approximately one-third of the patients with COVID-19 require intensive care unit (ICU) admission, and almost 30% of the patients develop acute respiratory distress syndrome (ARDS). Extracorporeal membrane oxygenation (ECMO) is used as salvage therapy for severe ARDS. The role of ECMO in the treatment of COVID-19 remains unclear, although there is emerging evidence that this approach may be an effective salvage therapy for severe ARDS.

Case Presentation: We present a case of a previously healthy 39-year-old Hispanic male who presented to the hospital with flu-like symptoms, including headache, fatigue, and myalgia for 8 days in late April 2020. He denied dyspnea on exertion. The patient's symptoms progressed, resulting in pneumonia and acute respiratory distress syndrome (ARDS). The patient was managed with prone positioning, convalescent plasma and veno-venous extracorporeal membrane oxygenation (VV-ECMO) for 35 days. The patient successfully recovered and was able to ambulate independently and was discharged home from an acute care hospital without oxygen supplementation on hospital day 63.

Conclusion: We present one of the first few documented cases of ECMO for severe ARDS due to COVID-19. After a prolonged hospital course requiring VV-ECMO, the patient was discharged home from an acute care hospital without oxygen requirement and ambulated independently, likely as a result of daily aggressive mobility-focused rehabilitation.

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1. Introduction

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) emerged from Wuhan, China in December 2019 and is the strain of coronavirus that causes coronavirus disease 2019 (COVID-19). As of April 2020, the COVID-19 global pandemic resulted in an estimated case-fatality rate of about 6.8% [1]. According to the COVID-19 Global Cases by the Johns Hopkins Center for Systems Science and Engineering (CSSE), there have been over 39 million reported cases worldwide with 1 million deaths as of mid-October 2020 [2]. The majority of COVID-19 infections are asymptomatic or have mild symptoms. However, approximately one-third of the patients with COVID-19 require intensive care unit (ICU) admission, and almost 30% of patients develop ARDS [1,3].

Extracorporeal membrane oxygenation (ECMO) provides respiratory and cardiac support and is used as a rescue therapy in respiratory failure and heart failure. In 2009, ECMO was shown to be an effective

salvage therapy for Influenza A H1N1 pneumonia with respiratory failure [4]. However, there have been limited studies showing the use of ECMO in COVID-19 pneumonia. In January 2020, the World Health Organization (WHO) released an interim guidance regarding the use of ECMO in COVID-19 patients [5]. Although there are insufficient data regarding the use of ECMO in COVID-19, the National Institutes of Health (NIH) included this modality in their treatment guidelines [6].

In addition, there have been limited reports of home discharge as an outcome in patients receiving ECMO due to COVID-19 [7,8]. We report one of the first cases of a previously healthy 39-year-old Hispanic male with COVID-19 pneumonia who developed severe ARDS requiring veno-venous extracorporeal membrane oxygenation (VV-ECMO). The patient was successfully decannulated and was able to ambulate independently and be discharged home without oxygen supplementation.

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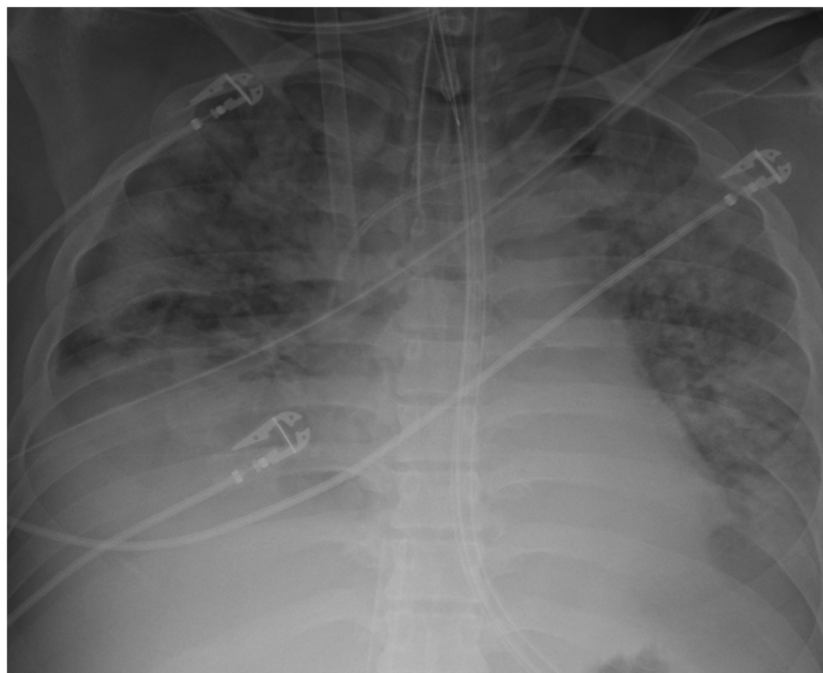


Figure 1. Chest x-ray on hospital day 7 demonstrating diffuse multifocal lung infiltrates.

2. Case presentation

A previously healthy 39-year-old Hispanic male presented with flu-like symptoms, including headache, fatigue, and myalgia for 8 days. He had no significant prior past medical history, never smoker, and took no medications. Progressive flu-like symptoms and new development of cough and chills prompted the patient to present to the hospital in late April 2020. He denied dyspnea on exertion, nausea, vomiting, diarrhea, or exposure to sick contacts. He lived at home with his girlfriend, who had no symptoms. He denied any alcohol, tobacco, or illicit drug use.

The patient presented to a level III trauma center. On presentation, physical examination was notable for a fever of 102.6°F, heart rate 133 beats/min, blood pressure 118/76 mmHg, respiratory rate 20 breaths/min and oxygen saturation 94% on room air. The patient was not in distress, but was warm to touch. Diminished vesicular breath sounds were present in all lung fields. Approximately 3 hours later, oxygen saturation decreased to 89% on room air, requiring oxygen supplementation via nasal cannula. Initial laboratory findings showed white blood cell count 7.8 K/uL, venous blood gas pH 7.37 and PaCO₂ 44 mmHg, ferritin 635 ng/ml, lactate dehydrogenase (LDH) 395 U/L. Chest x-ray showed multifocal infiltrates and the patient tested positive for SARS-CoV-2 RNA by real-time polymerase chain reaction testing. Blood and sputum cultures were negative. Echocardiogram revealed a left ventricular ejection fraction of 65%. The patient was admitted for acute hypoxic respiratory failure and sepsis secondary

to COVID-19 pneumonia and was started on intravenous fluids, azithromycin and ceftriaxone.

Two days later, the patient developed respiratory distress, initially requiring high flow nasal cannula oxygen and subsequently intubation due to increased work of breathing. He was placed on lung protective ventilation, for which he received neuromuscular blockade and sedation. The patient was diagnosed with severe ARDS and was ventilated in the prone position on two separate occasions with progressive worsening PaO₂/FiO₂ ratios (initially 131 and finally 83). In addition to convalescent plasma, the patient received 40 mg methylprednisolone IV twice daily and 40 mg subcutaneous enoxaparin twice daily.

On hospital day 6, the patient developed worsening ARDS, remaining hypoxic despite 100% FiO₂. Laboratory results showed increased inflammatory markers, including interleukin-6 (IL-6) 10 pg/ml, ferritin 1432 ng/ml, d-dimer 3670 ng/ml, LDH 1100 units/L, C-reactive protein (CRP) 35.1 mg/dl. Due to refractory hypoxia despite maximal therapy, the patient was transferred to a quaternary care referral center and was started on VV-ECMO on hospital day 7. Chest x-ray showed persistent bilateral multifocal infiltrates and chest computerized tomography (CT) scan showed diffuse lung opacities (Figures 1 and 2). His hospital course was complicated by delirium, *Enterococcus faecalis* bacteremia, and a non-occlusive deep vein thrombosis in the inferior vena cava (IVC) thrombus near the previous VV-ECMO site. He underwent a tracheostomy on hospital day 36. The patient slowly improved and was decannulated on hospital day 42, after 35 days on VV-ECMO. The following day, the patient was placed on

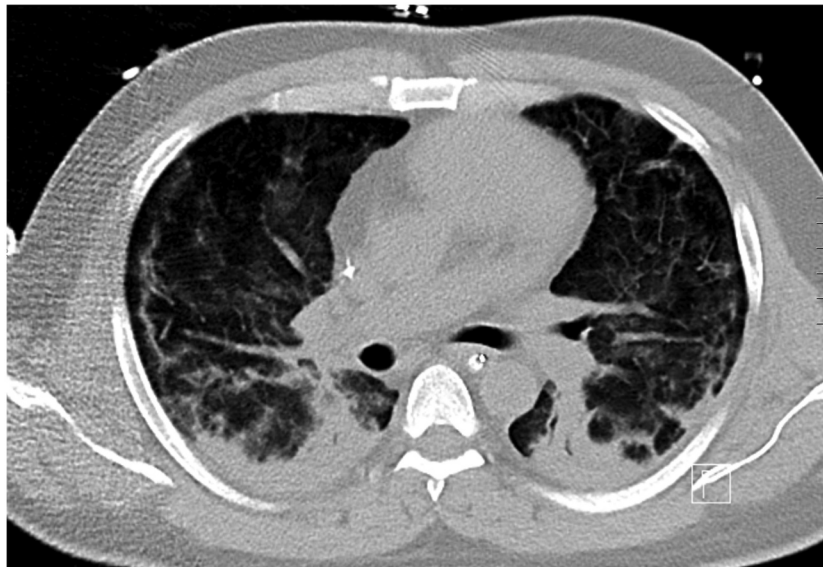


Figure 2. CT chest on hospital day 25 showing bilateral diffuse opacities.

mechanical ventilation via pressure support ventilation 8/8 cm H₂O and tolerated tracheostomy collar the next day.

The patient tested negative for SARS-CoV2 on hospital days 30, 39 and 58. His overall clinical presentation significantly improved; he passed a speech-language assessment and was able to tolerate oral diet without signs of aspiration. CT chest on hospital day 58 showed significant improvement of the bilateral opacities compared to hospital day 25 (Figure 3). The patient received aggressive daily rehabilitation treatment with physical therapy (PT) and occupational therapy (OT). By the time of discharge, PT and OT deemed that he was able to ambulate independently and perform all activities of daily living (ADLs) independently. Tracheostomy was decannulated on hospital day 62. The patient was discharged home

without oxygen supplementation on hospital day 63 (Figure 4).

Follow-up CT chest imaging showed complete resolution of the bilateral multifocal opacities 20 days after discharge (Figure 5). Additionally, the patient's SARS-CoV-2 test remained negative 17 days and 43 days post-discharge. The patient continues to do well and has returned to his baseline with respect to the activities of daily living as of 4 months post-discharge free of respiratory symptoms or complications.

3. Discussion

We present one of the first few documented successful cases of ECMO for severe ARDS due to COVID-19. He recovered successfully and was able to

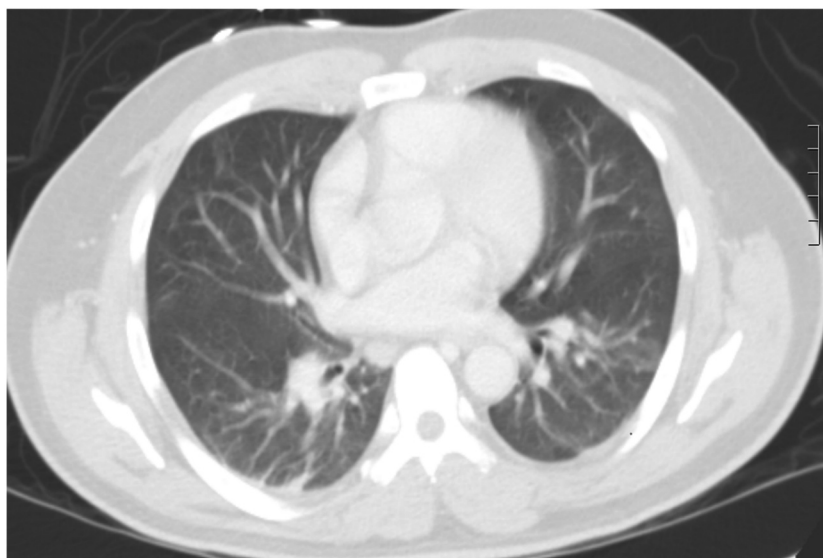


Figure 3. CT chest on hospital day 58 (five days prior to discharge) demonstrating improvement of the bilateral opacities compared to Figure 2.



Figure 4. The patient ambulated independently and was discharged home without oxygen supplementation on hospital day 63. We have obtained consent from the patient to use this photograph.

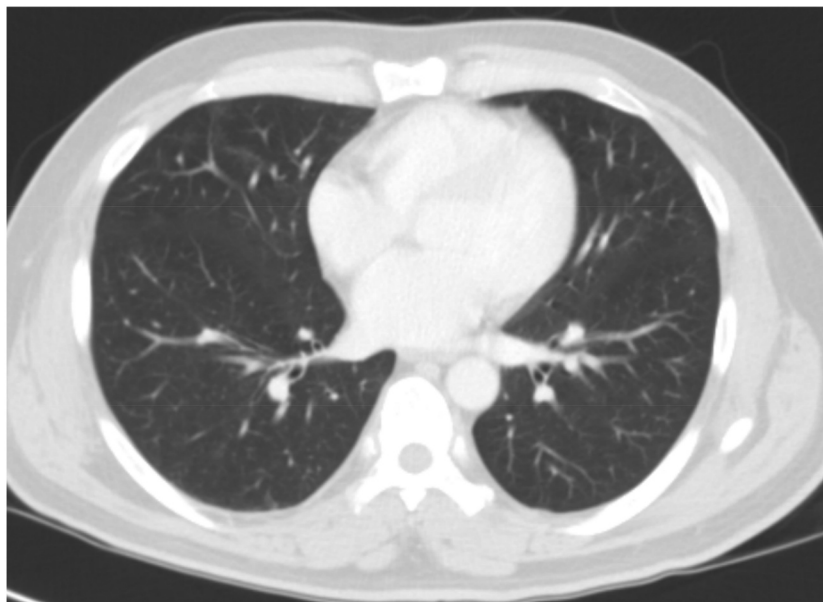


Figure 5. Follow-up CT chest 20-days post-discharge showing complete resolution of the multifocal opacities when compared to the patient's hospitalization.

ambulate independently upon discharge, likely as a result of daily aggressive mobility-focused rehabilitation. Our prior study has shown that mobility-based rehabilitation is associated with higher rates of survivors of critical illness being discharged home [9]. He was discharged home fully independent, without oxygen supplementation, on hospital day 63.

The role of ECMO in COVID-19 pneumonia with severe ARDS remains controversial [10]. To date, there have been limited cases of ECMO in COVID-19 patients, resulting in disposition to home [7,8,11–8,11–13]. In those reports, the degree of independence at the time of discharge was not clear. In the

initial reports, severe COVID-19 pneumonia associated with ARDS managed with ECMO appeared to have very poor outcomes, with high mortality rates of up to 84–100% [8,14,15]. Yang et al. reported a case series of 52 critically ill patients who had SARS-CoV-2 pneumonia. Thirty-one of those patients died at 28-days; of six of those patients received ECMO, five died [15]. More recent studies demonstrated a more beneficial role of ECMO in COVID-19 pneumonia infection with severe ARDS [16]. Barbaro et al. performed a large multivariable Cox model analyzing 1035 patients with COVID-19 who received ECMO across 36 countries, and have

found that the 90-day estimated mortality after ECMO, with the final disposition being either death or discharge, was less than 40% [17].

There are limited reports of patients receiving VV-ECMO for COVID-19 infection who survive and are discharged home. To further contextualize and compare outcomes of other cases of COVID-19 pneumonia treated with ECMO, we performed a literature search for other cases of COVID-19 managed in a similar fashion. Hartman et al. reported a case of a 44-year-old male who was discharged home on hospital day 24 without supplemental oxygen, but required a walker at discharge [12]. Larson et al. presented a case of a 27-year-old pregnant female who was discharged home on hospital day 14 without supplemental oxygen and was able to ambulate independently [13]. Of these cases, it is unclear if these patients were able to ambulate independently on the day of discharge. Rajdev et al. report a case of a 32-year-old male who was sent home on hospital day 47, but required home physical rehabilitation [11]. In our case, our patient had a very prolonged hospital course of 63 days. The multidisciplinary team and the aggressive rehabilitation treatment that the patient received greatly played a role on his positive hospital outcomes.

4. Conclusion

We present one of the first few documented cases of a previously healthy patient who experienced a prolonged and complicated hospital course due to severe ARDS secondary to COVID-19 pneumonia treated with VV-ECMO and was successfully extubated and discharged home without oxygen requirements and ambulated independently. No COVID-19 sequelae nor respiratory symptoms were noted at 4-months follow-up after discharge.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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