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CASE REPORT

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A case of a pregnant patient with COVID-19 infection treated with emergency c-section and extracorporeal membrane oxygenation

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Abstract

Coronavirus disease 2019 (COVID-19) causes the development of severe acute respiratory distress syndrome. Pregnant women may be at increased risk for the development of severe disease. We present the case of a pregnant patient who developed respiratory failure due to COVID-19 and rapidly decompensated requiring intubation. Despite mechanical ventilation, the patient's respiratory status continued to worsen. At bedside, cardiothoracic surgeons, obstetricians, intensivists, and neonatologists discussed balancing the risk of COVID-19 and respiratory failure to the patient, premature delivery to the neonate, potential coagulopathy associated with COVID-19, and the need for anticoagulation with mechanical circulatory support. Ultimately, the decision was to proceed with emergency cesarean section delivery in the intensive care unit followed by peri-partum veno-venous extracorporeal membrane oxygenation initiation. The patient and neonate were both discharged home in stable condition.

KEYWORDS

clinical review, COVID-19 infection, extracorporeal membrane oxygenation, pregnancy

1 | BACKGROUND

Coronavirus disease 2019 (COVID-19), caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), was designated a global pandemic in March 2020.[1] As of January 2021, 61,911 cases of COVID-19 in pregnant women have been reported in the United States, including 10,604 hospitalized cases.[2] While pregnancy does not appear to increase susceptibility to COVID-19 infection, physiologic changes in pregnancy may increase the risk for severe infection.[3,4] Reports have emerged of pregnant patients with severe COVID-19 infections requiring intensive care unit (ICU) admission, endotracheal intubation, and subsequent initiation of extracorporeal membrane oxygenation (ECMO).[5–8] We present a case of a G4P1021 who developed respiratory failure due to SARS-CoV-2 infection who was successfully treated with peri-partum veno-venous (VV) ECMO following emergency cesarean section delivery in the ICU. Written consent was obtained from the patient and this case report was not subject to formal IRB review.

2 | CASE PRESENTATION

A 30-year-old G4P1021 without significant past medical history and one previous uncomplicated vaginal delivery tested positive for COVID-19 and was admitted to an outside hospital 6 days after her initial onset of symptoms with worsening shortness of breath, chest pain, cough, vomiting, and weakness. The patient was 28 weeks and 4 days pregnant when admitted. Before her presentation, the

pregnancy had been uncomplicated. On admission, computed tomography (CT) angiogram of the chest showed multifocal pneumonia consistent with COVID-19 without pulmonary embolism. She was treated with dexamethasone, remdesivir, convalescent plasma, and therapeutic enoxaparin (1 mg/kg). On hospital day 5, the patient decompensated with rapidly increasing oxygen requirements resulting in emergent endotracheal intubation. Following intubation, she was transferred to our institution, a quaternary care center which has cared for more than 3000 COVID-19 patients.

On arrival, the patient was intubated and sedated. Initial laboratory studies were notable for leukocytosis (15.6 1000/UL), normocytic anemia (hemoglobin 10.9 g/dl), mildly elevated procalcitonin (0.57 ng/ml), elevated D-dimer (3.84 μg/ml FEU), and positive fibrin monomers. Despite ventilator settings of 100% fraction of inspired oxygen (FiO2) and positive end expiratory pressure (PEEP) of 15, the patient's initial P/F ratio was 94, consistent with severe acute respiratory distress syndrome (ARDS). Inhaled nitric oxide was initiated at 20 parts per million. The patient's respiratory status continued to quickly worsen with a repeated blood gas revealing a P/F ratio of 71 and persistent desaturations below 92%. A cisatracurium infusion was initiated to improve ventilation. Norepinephrine infusion was started to maintain the mean arterial pressure greater than 65 mmHg. Transthoracic echocardiogram was notable for a mildly dilated right ventricle (RVD 4.6 cm) with mildly depressed systolic function (TAPSE 2.4 cm) and hyperdynamic left ventricular systolic function.

At this time, the patient was 29 weeks and 2 days pregnant. Fetal heart monitoring revealed a category 1 tracing with heart rate in the 150s. Magnesium was not initiated for fetal neuroprotection given concerns of additional respiratory depression in the setting of severe maternal respiratory failure.

As the patient was progressively worsening, an interdisciplinary meeting between maternal-fetal medicine, cardiothoracic surgery, and ICU teams was held. The patient's refractory hypoxic respiratory failure would require emergent VV ECMO. Given the relatively advanced gestational age of the fetus and that the fetus was now steroid complete, the decision was made to proceed with bedside emergency cesarean section for potential maternal benefits before initiation of VV ECMO. Additionally, it was felt to be safer to pursue emergent delivery before initiation of systemic anticoagulation for ECMO.

Before cesarean section, right internal jugular vein and right femoral vein access was obtained under ultrasound guidance to allow for rapid initiation of VV ECMO should the patient decompensate further during delivery. An emergent cesarean section was performed bedside with delivery of a viable neonate who was immediately intubated and transferred to the neonatal ICU team. Following successful delivery, a 28-French venous catheter was inserted in the right femoral vein and a 22-French catheter was placed in the right internal jugular vein and the patient was connected to the VV ECMO circuit. The right side is our preference for VV ECMO access, and the patient had no contraindication to proceeding according to our standard practice. Immediately following delivery, the patient was noted to have vaginal bleeding and initiation of a heparin drip was deferred until twelve hours after delivery.

The patient's ventilator was adjusted for lung-protective volumes and the patient was maintained on VV ECMO with flows of 4–5 L/min. There were no immediate bleeding or thrombotic complications. While on VV ECMO, lung-protective ventilation was continued targeting ARDSnet tidal volumes and low plateau pressures. FiO2 was minimized and PEEP was maintained at 10 to promote alveolar recruitment. Daily sweep-off trials were performed to assess readiness for ECMO decannulation. FdO2 was weaned to 21% and inhaled epoprostenol was initiated to aide in VV ECMO weaning.[9] The patient was weaned off VV ECMO and successfully decannulated after 5 days (hospital day 10). Following decannulation, the patient was placed in prone position. CT scan was performed for post-ECMO surveillance and incidentally showed an incisional ventral hernia with fascial dehiscence. The patient was taken to the operating room on hospital day 11 and underwent exploratory laparotomy and successful fascial repair. She was extubated on hospital day 15 and transferred out of the ICU the following day. The patient was slowly weaned off supplemental oxygen and was discharged from the hospital on day 21. The neonate was cared for in the neonatal ICU, was extubated 3 days after delivery, and ultimately discharged home.

3 | DISCUSSION

Here we present a case of a critically ill pregnant patient with severe COVID-19 who was placed on VV ECMO immediately following emergency cesarean section. The patient delivered a viable neonate, was successfully weaned off ECMO, and was discharged from the hospital. This case adds to previously published reports of ECMO use in critically ill pregnant patients with COVID-19[5–7] and provides evidence for the use of ECMO in severe COVID-19, specifically in pregnant patients. The Society for Maternal Fetal Medicine (SMFM) clearly states that ECMO should not be withheld for pregnant patients who would otherwise be candidates for ECMO with COVID-19.[10]

Changes in lung volumes, chest wall compliance, decreased functional residual capacity, and a baseline compensated respiratory alkalosis put the pregnancy patient at high risk of rapid deterioration in the setting of a respiratory insult necessitating early evaluation for ECMO. Before the COVID-19 pandemic, there were multiple recent studies of ECMO use in pregnancy. Zhang et al.[11] published a meta-analysis of ECMO use in pregnancy, reporting maternal survival of 77.2% and fetal survival of 69.1%. Naoum et al.[12] reported similar maternal and fetal survival rates and reported acute respiratory distress syndrome as the most common indication for initiation of ECMO, representing 49.4% of reported cases. Pregnant patients are generally younger and healthier at baseline than other critically ill patients which likely contributes to these high reported survival rates.[11–13]

Consideration of ECMO for pregnant patients requires balancing of risks and benefits for both the mother and the fetus, although SMFM guidelines state that ECMO is not in and of itself an indication for delivery.[10,11] In this case, the advanced gestational age (GA) of the fetus was balanced with the mother's critical, rapidly worsening clinical status. Survival rates for neonates born after 29 weeks of GA have been reported as high as 98%.[14] Further, the mother had already received multiple days of intravenous steroids as part of her COVID-19 treatment, completing a full course for fetal lung maturation. Given the high likelihood of fetal survival in this case, cesarean section was pursued to optimize maternal chances for survival. VV ECMO cannulation was prepared before delivery given the high risk for further maternal decompensation related to peripartum fluid shifts.

In this case, anticoagulation management also contributed to the decision to proceed with delivery before VV ECMO. Generally, pregnant patients who are fully heparinized while on ECMO may require tranexamic acid (TXA) during delivery to reverse hemorrhage. However, as COVID-19 is associated with a hypercoagulable state and the development of both venous and arterial thrombi[15] and the use of TXA could be potential harmful to the mother in this setting. In this case we discussed initiation of VV ECMO without heparin infusion as an alternative to delivery before VV ECMO, but ultimately decided on proceeding with delivery first. While anticoagulation was deferred for 12 h following cesarean section due to vaginal bleeding, the patient was subsequently managed with continuous infusion heparin. For COVID-19 patients on VV ECMO, we typically administer 3000–5000 units of heparin before cannulation followed by heparin continuous infusion guided by ACT with a goal of 160–180. In this case we omitted the heparin bolus due to bleeding concerns.

Newborns born to mothers with COVID-19 are rarely observed to have COVID-19.[16] However, there is evidence that maternal IgG antibodies to SARS-CoV-2 cross the placenta and may provide neonates protection against COVID-19.[17] In our case, the neonate was immediately intubated as a paralytic infusion had been initiated before delivery to assist the mother with mechanical ventilation. The neonate was transferred to the neonatal ICU for further care and subsequently extubated after a short course of mechanical ventilation.

When indicated for pregnant patients with severe COVID-19 infection, VV ECMO should be considered for both maternal and neonatal benefit and pregnancy should not be seen as a contraindication to the appropriate use of ECMO.

AUTHOR CONTRIBUTIONS

Joshua A. Rushakoff: *concept/design, drafting article, data analysis/interpretation, approval of article. Alexander Polyak: concept/design, drafting article, data analysis/interpretation, approval of article.* Jayne Caron: *critical revision of article.* Kristin Parrinella: *critical revision of article.* Reza Salabat: *critical revision of article, approval of article.* Melissa Wong: *critical revision of article, approval of article.* Dominic Emerson: *critical revision of article, approval of article.*

CONFLICT OF INTERESTS

The authors declare that there are no conflict of interests.

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