



## CASE REPORT

# Low fetal age is not a contraindication for extracorporeal membranous oxygenation in COVID-19-related ARDS

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## Abstract

**Introduction:** The coronavirus disease 2019 (COVID-19) causes a small proportion of patients to be admitted to intensive care units, where they sometimes require extracorporeal membrane oxygenation (ECMO). The literature on pregnant women with COVID-19 who require ECMO is sparse.

**Case report:** We describe here the earliest-fetal-age pregnant patient with COVID-19 who underwent ECMO yet reported, who kept her child while under close follow-up with magnetic resonance imagery and ultrasound.

**Conclusion:** The management of acute respiratory distress syndrome (ARDS) in pregnant women, including ARDS secondary to COVID-19 and those cases which are not eligible for fetal delivery, may benefit from the assistance of ECMO even in the early pregnancy.

**KEYWORD**  
perfusion

## 1 | INTRODUCTION

COVID-19 necessitates intensive care in a small proportion of patients. Infected individuals may require the use of treatments up to and including extracorporeal membrane oxygenation (ECMO), which carries estimated mortality of 15%–50%.<sup>1</sup>

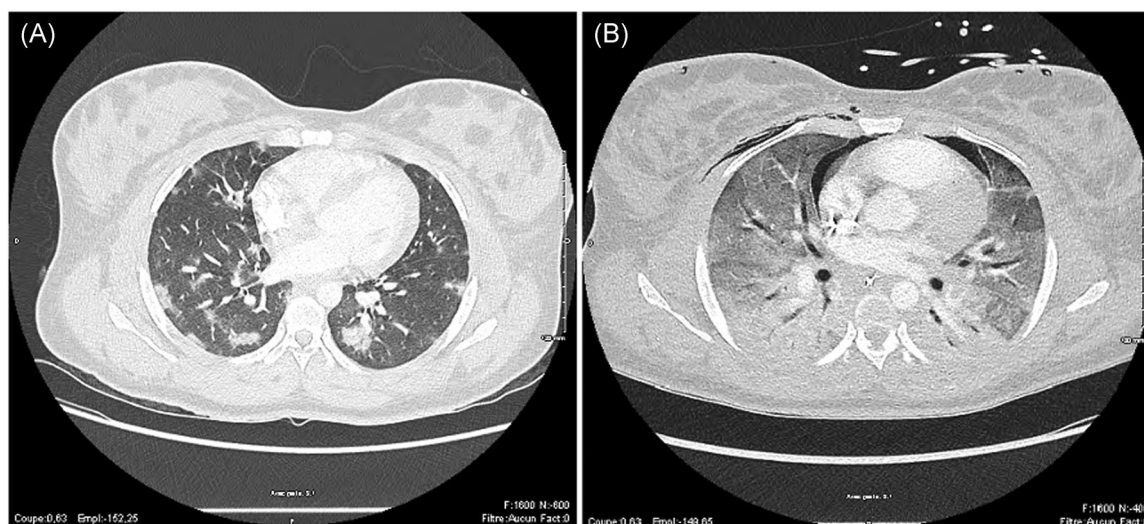
Pregnancy complicates COVID-19 management, especially since the severity of the pulmonary involvement may require ECMO. The most common indication for ECMO in pregnant women is acute respiratory distress syndrome (ARDS) (49.4%), with preterm delivery as the main complication in 48% of cases.<sup>2</sup> Regardless of the use of ECMO, the literature reports a slight increase in the rate of preterm delivery in patients with COVID-19, corresponding to 23% of pregnant patients.<sup>3</sup> Fewer than 10 cases of pregnant women with COVID-19 requiring ECMO have been reported in the literature.<sup>1,4,5</sup> In most of these cases, the pregnancy was advanced enough that a cesarean section extraction of a viable fetus could be performed.<sup>1,4,5</sup> One report describes a single patient who kept her child until term despite ECMO,<sup>6</sup> but infection with SARS-CoV-2 had occurred at

26 weeks of pregnancy. Here we describe here the earliest fetal-age case so far reported, at 18 weeks' gestation. IRB was not applicable and patient gave a complete informed statement and permission to publish her case report.

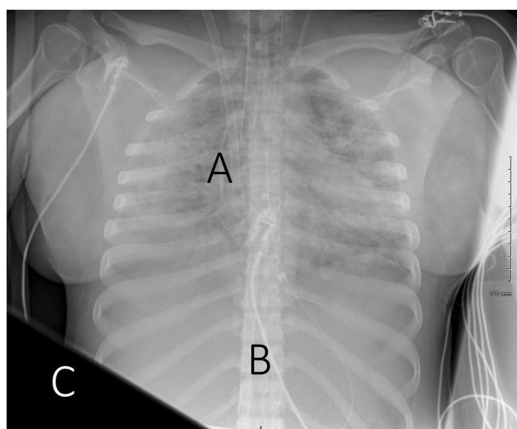
## 2 | CASE REPORT

An 18-year-old woman, gravida-II para-0, was admitted with COVID-19 at 18 weeks of pregnancy. Her previous pregnancy had been electively aborted, and her current pregnancy was already complicated by premature rupture of membranes diagnosed through a PROM-Test.

In her current history, she was first admitted to a nearby hospital with respiratory and digestive symptoms and found positive for SARS-CoV-2. Medication including oxygen therapy, dexamethasone, and enoxaparin was initiated. An initial computed tomography (CT) scan with low-dose parameters demonstrated severe lung lesions involving 30% of the parenchyma (Figure 1A). Four days later, the respiratory condition



**FIGURE 1** Computed tomography scan showing lung lesions. (A) Initial image. (B) Image on day of extracorporeal membrane oxygenation insertion

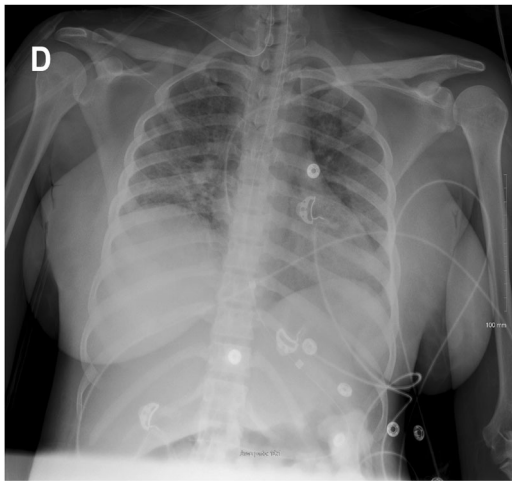


**FIGURE 2** An initial chest X-ray showing massive lung damage corresponding to COVID-19 infection. (A) Jugular cannula. (B) Venous cannula. (C) Protective lead for the fetus

of the patient had worsened, justifying the initiation of mechanical ventilation. Despite this therapy, the patient remained unstable. Because of her clinical state and impending respiratory failure, our mobile ECMO team initiated venovenous ECMO, with access through the right femoral vein for drainage and the right internal jugular vein for blood inflow. The position of the cannulas was checked using transthoracic echocardiography during implantation. At ECMO insertion, arterial blood gas revealed a  $p\text{CO}_2$  of 53 mmHg and  $p\text{O}_2$  of 60 mmHg, while  $\text{FiO}_2$  was at 100% with  $\text{PaO}_2/\text{FiO}_2$  at 70 mmHg, despite the ventilator parameter settings of  $\text{FiO}_2$  100%, positive end-expiratory pressure (PEEP) 12  $\text{cmH}_2\text{O}$ , and tidal volume 393 ml. The ECMO was started at the full theoretical flow rate. The patient was then transferred to our hospital for multidisciplinary follow-up involving thoracic and cardiovascular surgeons and intensivists, obstetricians, anesthetists, and perfusionists.

On admission to our hospital, 6 days after the onset of symptoms, the chest X-ray showed massive pulmonary damage (Figure 2) and a low-dose CT scan (100 kV, 210 mA, with DLP at 174 mG) revealed a worsening of the lung lesions, with left pulmonary embolism (Figure 1B). Prophylactic corticosteroid therapy with methylprednisolone was initiated, and anticoagulation therapy was started with an unfractionated heparin infusion at 5000 IU (76 IU/kg), followed by a continuous dose of  $15 \text{ IU kg}^{-1} \text{ h}^{-1}$ . The anticoagulation activity was assessed using the anti-factor Xa value, which ranged between 0.2 and 0.3 IU/ml. Nitric oxide was also used and the patient was prone positioned using Tolcher et al.<sup>7</sup> step by step algorithm, without fetal monitoring.

The course of the following hospital stay was favorable, and ultrasound follow-up showed a live fetus developing normally. Accordingly, the patient's weaning from ECMO was started and achieved 15 days after insertion. Since then, the patient's hemodynamics and respiration have remained stable, and her vital parameters have remained normal with improved blood analysis. The mechanical ventilator was set to spontaneous mode after weaning from ECMO, with  $\text{FiO}_2$  at 35% and PEEP at 10  $\text{cmH}_2\text{O}$ , leading to a  $\text{PaO}_2/\text{FiO}_2$  of 180. A chest X-ray was almost normal (Figure 3). She was then extubated, based on the Richmond Agitation Sedation Scale, which was evaluated at 0. Five days after ECMO weaning, a tracheotomy was performed, given the difficulties of weaning from mechanical ventilation. Patient ventilation was thus continued via the tracheostomy cannula. She was then discharged home with a referral for kinesiotherapy for motricity and respiratory restoration. Otherwise, the pregnancy course was uneventful: ultrasound follow-up performed 3 months after the diagnosis demonstrated a pregnancy of 30 weeks and 3 days with a live female fetus, and the fetal parameters corresponded to those expected for the period of gestation, with a fetus weight of 1340 g. In addition, magnetic resonance imagery for antenatal assessment performed at 30 weeks of pregnancy confirmed that the fetus was doing well neurologically, consistent with the gestation period (Figure 4).



**FIGURE 3** A follow-up chest X-ray showing improvement of the lesions after extracorporeal membrane oxygenation and medical therapy



**FIGURE 4** Magnetic resonance imagery at 30 weeks of pregnancy for fetal neurological evaluation

### 3 | DISCUSSION

Although data are limited to date, ARDS in COVID-19 appears to have a more severe course in pregnancy.<sup>8</sup> Early delivery, frequently reported in the literature<sup>3</sup> was not possible here because of the fetal age. However, although delivery is not recommended for the improvement of respiratory symptoms, the balance of risk versus that of prolonged ECMO should be discussed. An important aspect of ARDS treatment is the

protective ventilation allowed by ECMO oxygenation. Neonatal survival after ECMO, whatever the indication, is described in the literature as being around 65%.<sup>9</sup> In a 2020 meta-analysis, Sebastian et al. highlight the importance of considering ECMO as a marker of pathology severity and consider that even with higher fetal mortality it remains a validated therapy during pregnancy, allowing maternal survival in 90% of cases.<sup>10</sup> Hemorrhage under ECMO is the main complication of this technique. It is secondary to the high doses of heparin but has not been widely evaluated. Fetal effects are limited, however, as unfractionated heparin does not cross the placental barrier.

### 4 | CONCLUSION

The management of ARDS in pregnant women, including ARDS secondary to COVID-19 which are not eligible for fetal delivery, may benefit from the assistance of ECMO. Early pregnancy must not a contraindication for ECMO.

### CONFLICT OF INTERESTS

The authors declare that there are no conflict of interests.

### AUTHOR CONTRIBUTIONS

*Concept/design:* Lionel Camilleri and Nicolas d'Ostrevy. *Data analysis:* Issaka Zalle, Yann Barthelemy, and Nicolas d'Ostrevy. *Drafting article:* Issaka Zalle, Yann Barthelemy, and Antonio Piperata. *Critical revision of article:* Geraud Galvaing, Lionel Camilleri, and Nicolas d'Ostrevy. *Approval of article:* Issaka Zalle, Yann Barthelemy, Antonio Piperata, Geraud Galvaing, Lionel Camilleri, and Nicolas d'Ostrevy.

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### REFERENCES

1. Douglass KM, Strobel KM, Richley M, et al. Maternal-neonatal dyad outcomes of maternal COVID-19 requiring extracorporeal membrane support: a case series. *Am J Perinatol.* 2021;38:82-87.
2. Naoum EE, Chalupka A, Haft J, et al. Extracorporeal life support in pregnancy: a systematic review. *J Am Heart Assoc.* 2020;9:e016072.
3. Di Toro F, Gjoka M, Di Lorenzo G, et al. Impact of COVID-19 on maternal and neonatal outcomes: a systematic review and meta-analysis. *Clin Microbiol Infect.* 2021;27:36-46.
4. Takayama W, Endo A, Yoshii J, et al. Severe COVID-19 pneumonia in a 30-year-old woman in the 36th week of pregnancy treated with postpartum extracorporeal membrane oxygenation. *Am J Case Rep.* 2020;21:e927521.
5. Hou L, Li M, Guo K, et al. First successful treatment of a COVID-19 pregnant woman with severe ARDS by combining early mechanical ventilation and ECMO. *Heart Lung J Crit Care.* 2021;50:33-36.
6. Tambawala ZY, Hakim ZT, Hamza LK, Al Rayes M. Successful management of severe acute respiratory distress syndrome due to COVID-19 with extracorporeal membrane oxygenation during mid-trimester of pregnancy. *BMJ Case Rep.* 2021;14:e240823.
7. Tolcher MC, McKinney JR, Eppes CS, et al. Prone positioning for pregnant women with hypoxemia due to coronavirus disease 2019 (COVID-19). *Obstet Gynecol.* 2020;136:259-261.

8. Favre G, Pomar L, Musso D, Baud D. 2019-nCoV epidemic: what about pregnancies? *Lancet*. 2020;395:e40.
9. Moore SA, Dietl CA, Coleman DM. Extracorporeal life support during pregnancy. *J Thorac Cardiovasc Surg*. 2016;151:1154-1160.
10. Sebastian NA, Spence AR, Bouhadoun S, Abenhaim HA. Extracorporeal membrane oxygenation in pregnant and postpartum patients: a systematic review. *J Matern Fetal Neonatal Med*. 2020.

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