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CORRESPONDENCE

A retrospective review of pregnant patients critically ill with COVID-19 in a tertiary referral centre

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To the Editor,

COVID-19 appears to be more severe during pregnancy.[1] We conducted a retrospective case review of 21 pregnant persons infected with SARS-CoV-2 admitted to the intensive care unit (ICU) at Mount Sinai Hospital (Toronto, ON, Canada) between March 2020 and June 2021 (Electronic Supplementary Material [ESM] eFig. 1). We recorded demographic and obstetric course, outcome, and data on mechanical ventilation. Positive end-expiratory pressure (PEEP) level, peak pressure, and plateau pressure were recorded using the highest three-hour average in the first 48 hr to avoid outlier measurements. We assessed compliance with the usual guidelines for prone positioning.[2] Lung compliance is challenging to assess retrospectively and was not recorded.

The demographics are summarized in the Table. Eleven patients required invasive mechanical ventilation, and ten were managed with oxygen therapy (including high flow nasal oxygen). Table also documents pharmacotherapy and ventilation parameters. More than half (55%) underwent prone positioning (including after Cesarean delivery) without complications. Of the five ventilated patients not proned, one met proning criteria retrospectively. Obstetrical care involved a daily assessment and communication with the ICU team. Fetal heart rate was assessed daily and a 20-min non-stress test was conducted in patients greater than 26 weeks gestation. Obstetrical ultrasound was performed on admission, once weekly, and if the maternal status deteriorated.

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Table Demographics, management, and delivery of pregnant COVID-19 patients

	Total (N = 21)	Ventilated (N = 11)	Not ventilated (N = 10)
Age 18–35 years	17	8	9
Age > 35 years	4	3	1
Gestation at admission (mean ± SD) weeks	27.9 ± (1.0)	28.3 ± (5.6)	27.6 ± (4.0)
BMI (mean ± SD)	33.7 (± 10.7)	33.4 (± 3.8)	34.7 (± 6.2)
Length of stay (days)			
ICU – days, median (range)	9 (2–47)	13 (4–47)	3.5 (2–14)
Hospital – days, median (range)	17 (5–67)	24 (8–67)	10.5 (5–25)
Pharmacotherapy (n = 21)			
Corticosteroids for COVID-19, *n* (%)	20 (95%)		
Remdesivir, *n* (%)	5 (24%)		
Tocilizumab, *n* (%)	15 (76%)		
Mechanical ventilation (*n = 11)*			
Admission P/F ratio, median (range)		112 (76–291)	
Highest $PaCO_2$, median (range) (mm Hg)		55 (44–87)	
Peak pressure[1], median (range) (cm H_2O)		32 (23–41)	
Driving pressure[1], median (range) (cm H_2O)		17 (10–24)	
PEEP[1], median (range) (cm H_2O)		16 (12–20)	
Tidal volume (ml/kg PBW)[1], median (range)			
1st 24 hr		6.5 (4.4–9.1)	
2nd 24 hr		6.2 (4.2–10.7)	
Neuromuscular blockade		11 (100%)	
Inhaled Nitric oxide (NO)		5 (45%)	
Prone positioning		6 (55%)	
High-frequency oscillation, ECLS, tracheostomy		1 each	
Duration of invasive ventilation, median (range) days		10 (4–47)	
Delivery (n = 6)			
Deliveries during ICU care	6 (29%)	5	1
Primary indication			
Non-reassuring fetal status	4	4	0
Spontaneous labor	1	0	1
Intrauterine fetal demise	1	1	0
Location			
Labor & delivery unit	4	3	1
ICU	2	2	0
Mode of delivery			
Cesarean delivery	5	4	1
Vaginal delivery	1	1	0
Mean gestational age at delivery, weeks (range)			
Delivery during ICU (liveborn)	34.2 (28.8–37.8)		
Delivery after ICU stay	38.1 (32.7–40.9)		
Timing, median (range) days			
Intubation to delivery	1 (0–20)		
Delivery to extubation	5 (1–19)		

[1] Highest 3-hr mean in first 48 hr of ventilation

BMI = body mass index (initial BMI on admission); ECLS = extracorporeal life support; ICU = intensive care unit; P/F = ratio of partial pressure of arterial oxygen to fraction of inspired oxygen; PBW = predicted body weight; PEEP = positive end-expiratory pressure; SD = standard deviation

Our institutional approach was to treat pregnant patients in a similar way to non-pregnant patients, and to follow usual obstetric indications for delivery (ESM eFig. 2). For corticosteroid treatment, methylprednisolone (which does not cross the placenta) was administered at 32 mg/day. If gestation was less than 34 weeks, steroid treatment in the initial 48 hr served the dual purpose of promoting fetal lung maturity and treating COVID-19; for this, dexamethasone 6 mg was administered twice daily.[3] All patients received a single dose of tocilizumab, except one patient who had elevated liver enzymes.

Six patients required delivery during their critical illness (Table). All deliveries were for obstetrical indications, and delivery was not performed to improve maternal respiratory status. Two patients were intubated for respiratory failure in the operating room prior to an emergent Cesarean delivery for abnormal fetal heart rate pattern. Two patients delivered in the ICU because they were too unstable for transfer to the Labor and Delivery Unit. Standard ICU sedation and analgesia (propofol and fentanyl) were continued under the supervision of obstetric anesthesia. Improvement in oxygenation post-delivery cannot be expected in all patients (ESM eFig. 3), and delivery may potentially confer adverse effects (e.g., pulmonary edema, right ventricular overload) related to the increase in central blood volume. Fifteen patients (76%) delivered after the phase of critical illness, 14 after being discharged home. Two patients with diamniotic dichorionic twin gestations experienced intrauterine fetal demise of one twin, diagnosed during critical illness.

No maternal mortality occurred. Morbidity included hypoxic brain injury (one patient) and renal dysfunction requiring prolonged (but temporary) dialysis (one patient). Five out of 11 ventilated patients (45%) developed ventilator-associated pneumonia, with *Staphylococcus aureus* or *Haemophilus influenza*. Nine patients (43%) required vasopressor therapy with norepinephrine. Computed tomography angiography was performed in four patients and ultrasound leg assessment in seven patients, with two diagnosed with pulmonary embolism.

This COVID-19 experience contrasts with our experience during the influenza H1N1 pandemic in 2009, when three of 12 hospitalized patients required ICU care, nine of 12 being discharged home undelivered.[4]

There are limited data to guide the management of respiratory failure in pregnancy. We used standard ICU management protocols and routine obstetric criteria for fetal monitoring and delivery, with excellent interdisciplinary communication between ICU, obstetrics, obstetric anesthesia, and obstetric medicine. We provided noninjurious pressure-limited ventilation, allowing permissive hypercapnia with PEEP based on best oxygenation. Transpulmonary pressure was not measured, although this may be useful in this population. Delivery was not performed as a tool to improve maternal respiratory status despite significant hypoxemia in some patients, based on our previous data,[5] and all births were driven exclusively by obstetrical indications.

Conflict of interest The authors have no conflicts of interest related to this study.

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