



Management of maternal COVID-19: considerations for anesthesiologists

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Purpose of review

To describe updates to pragmatic recommendations that were published during the first coronavirus disease 2019 (COVID-19) surge, including the current thinking about whether pregnancy worsens the severity of COVID-19.

Recent findings

Although a majority of pregnant women infected with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) remain asymptomatic or paucisymptomatic, pregnancy puts women at higher risk of severe COVID-19 and adverse birth outcomes. Pregnant and recently pregnant women are more likely to be admitted to intensive care units and receive mechanical ventilation than nonpregnant patients with COVID-19, although preexisting maternal comorbidities are significant risk factors.

Early provision of neuraxial labor analgesia with a functional indwelling epidural catheter has been universally promoted, with the goal to reduce avoidable general anesthesia for cesarean delivery and mitigate risks for healthcare workers during airway manipulation. This recommendation, along with updated workflow models of anesthesia coverage, may contribute to a reduction in general anesthesia rates.

Summary

Initial recommendations to provide early neuraxial labor analgesia and avoid general anesthesia for cesarean delivery have not changed over time. Although workflows have significantly changed to allow continued patient and healthcare workers' safety, clinical anesthesia protocols for labor and delivery are essentially the same.

Keywords

anesthesia, cesarean delivery, COVID-19, neuraxial analgesia, pregnancy, SARS-CoV-2

INTRODUCTION

The severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) pandemic has drastically changed the practice of medicine. However, unlike many hospital services, labor and delivery units across the country have maintained prepandemic patient volume, while simultaneously absorbing antepartum patients with coronavirus disease 2019 (COVID-19) and managing safe isolation practices for parturients through their labor and delivery course.

In this review, we present updates in recommendations on (1) maternal COVID-19 and the impact of COVID-19 on pregnancy (2) infection prevention and control on the labor and delivery unit, and (3) anesthetic considerations for labor and delivery. The management of severe critical maternal COVID-19 and admission of obstetric patients to intensive care units will not be discussed here, as this complex topic is beyond the scope of this review and may be addressed in the critical care literature.

MATERNAL CORONAVIRUS DISEASE 2019

The early recommendations to conduct SARS-CoV-2 testing on all parturients have provided data on the proportions of infected but asymptomatic [1^{••}], versus mildly, moderately, or critically ill parturients, allowing for detailed analysis of obstetric and perinatal outcomes. Some of the early questions related to whether pregnancy might be 'masking' COVID-19 symptoms [2,3], while data about how pregnancy might be worsening the course of the disease started to emerge [4].

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KEY POINTS

- Universal SARS-CoV-2 testing identified that a majority of pregnant women with COVID-19 are asymptomatic or paucisymptomatic, although pregnancy does seem to place women at higher risk of severe COVID-19 and adverse birth outcomes.
- Adapting workflow, implementing checklists and drills, and ensuring adequate supplies of personal protective equipment have been key in allowing safe care for pregnant women and all healthcare providers.
- Early neuraxial labor analgesia with a well-working epidural catheter has been universally promoted with the goal to reduce the need for general anesthesia in the event of intrapartum cesarean delivery.
- Neuraxial anesthesia is preferable to general anesthesia for all cesarean deliveries, as avoiding airway manipulation and endotracheal intubation is preferable with a known or unknown SARS-CoV-2 status.
- It is likely that labor epidural rates will not have decreased during the pandemic, and general anesthesia rates for cesarean delivery seem to have gone down, due to clinical recommendations and improved anesthesia staffing models.

Presentation of coronavirus disease 2019 in pregnancy

The majority of women with COVID-19 present without symptoms or with mild symptoms, with rates of asymptomatic or mild COVID-19 ranging from 65% to 78% [1[■],5–7]. In an observational cohort study conducted in 33 United States medical centers, reporting on 1219 pregnant women with COVID-19, 47% of women were asymptomatic, 27% mildly symptomatic, 14% moderate, 8% severe, 4% critical, with four deaths (0.3%) attributed to COVID-19 [8[■]]. From data presented in a living systematic review and meta-analysis including 77 studies (11,432 women) [9], pregnant or recently pregnant women were less likely to present with fevers and myalgia, whereas preexisting diabetes, chronic hypertension, increased maternal age, and high BMI were associated with more severe manifestations of COVID-19 [9].

Impact of pregnancy on severity of coronavirus disease 2019

A key question has been whether pregnant women, when compared to nonpregnant women, have an increased likelihood of experiencing severe COVID-19. A case-control study with 38 pregnant women with severe COVID-19 matched to nonpregnant controls demonstrated that composite morbidity was

worse in the pregnant cohort, despite an increase in preexisting conditions in the nonpregnant cohort [10]. Data presented in the living systematic review and meta-analysis also reported a higher likelihood for pregnant or recently pregnant women to be admitted to the intensive care unit (ICU) and be mechanically ventilated, although preexisting maternal comorbidity was a significant risk factor for ICU admission and mechanical ventilation [9]. In June 2020, the Center for Disease Control and Prevention (CDC) published that pregnant women are 5.4 times more likely to be hospitalized, 1.5 times more likely to be admitted to the ICU, and 1.7 times more likely to receive mechanical ventilation [4]. An update from November 2020, examining over 400,000 symptomatic women, compared pregnant and nonpregnant cohorts of women aged 15–44, and concluded that pregnant women are at three-fold adjusted relative risk of ICU admission (10.5 versus 3.9/1000 cases) and mechanical ventilation (2.9 versus 1.1/1000 cases) [11[■]]. Serious adverse outcomes associated with COVID-19 among women in general were found to be low in this analysis, and the authors attributed increased relative risk in pregnancy to pregnancy-related physiologic changes, including tachycardia, increased oxygen consumption, decreased lung capacity, altered immunity, and hypercoagulability. A significant limitation of this large analysis is the absence of pregnancy status in 65% of reported cases. These observational data suggest that while the absolute likelihood of severe disease in pregnancy remains low, pregnancy itself might be a risk factor for severe COVID-19.

Perinatal complications of coronavirus disease

Pregnant women with laboratory-confirmed severe or critical COVID-19 (but not asymptomatic or mild to moderate disease) have higher adjusted relative risks of postpartum hemorrhage [2.04 (95% confidence interval, CI, 1.19–3.47)], hypertensive disorders of pregnancy [1.64 (95% CI, 1.21–2.23)], cesarean delivery [1.57 (95% CI, 1.30–1.90)], and preterm birth [3.53 (95% CI, 2.42–5.15)] [8[■]]. Placental pathology, including villitis, avascular villi, and fibrin deposition [12] can exist even without vertical transmission of COVID-19 to the neonate, with some cases of placental damage being severe [13]. Though the above referenced study suggests increased cesarean delivery rates only in severe or critical COVID-19, others have reported increased rates in symptomatic (46.7%) and asymptomatic COVID-19 infections (45.5%) compared with noninfected patients (30.9%) [7]. There are also studies demonstrating no association with adverse pregnancy outcomes, though these may be underpowered for this question [14].

Racial discrepancies in coronavirus disease 2019 morbidity and mortality

In general, racial minorities, specifically black patients, experience significantly greater burden of morbidity and mortality from COVID-19 [15,16]. Such disparity in healthcare outcomes is also evidenced by the three-fold higher mortality rates in black pregnant and postpartum women in the United States [17], and the syndemic of healthcare disparities among ethnic/racial minorities and COVID-19 poses a risk of serious maternal morbidity and death [18¹,19–24]. Acknowledging the crucial opportunity to develop resources to support equitable obstetric care during the COVID-19 pandemic, the Society for Maternal-Fetal Medicine (SMFM) outlined challenges to overcome, which include telehealth access and confronting bias, among many others [25¹].

Appropriate level of care for pregnant patients with coronavirus disease 2019

Optimizing care for obstetric patients with COVID-19 is a constant challenge, requiring rapid adaptations to new workflow and practice recommendations, all the while healthcare providers themselves are potentially getting sick and progressively burning-out.

Institutions have substantially modified their obstetric anesthesia services and created tools to allow for new workflows while accounting for potentially inexperienced staff to urgently care for patients in high-risk situations without prior experience [26¹]. At our institution, we operationalized an obstetric intensive care unit on the labor and delivery unit, to allow management of critically ill COVID-19 and noninfected obstetric patients on our unit, because all traditional ICUs were overfilled during the first surge in spring of 2020 [27¹,28]. Collaborative work with the obstetricians/MFM specialists was key to ensuring a multidisciplinary approach that would account for both maternal and perinatal concerns.

In general, based on severity of illness using CDC criteria, patients with moderate, severe, or critical COVID-19 infection should be transferred to a level III or IV obstetric care facility as regional resources allow [29].

INFECTION PREVENTION AND CONTROL ON THE LABOR AND DELIVERY UNIT

Accurately identifying parturients with COVID-19 is necessary to guide resource allocation on labor and delivery units, safeguard COVID-19 nonexposed neonates in the newborn nursery, identify mothers

at risk of perinatal complication, and institute adequate infection prevention and control measures.

Universal screening of parturients

One in ten pregnant women admitted to the hospital for any reason are diagnosed at that time with COVID-19 infection [9], though this number varies based on local prevalence. In institutions where universal screening was instituted early in the pandemic, the vast majority of patients found to be positive for COVID-19 were asymptomatic or paucisymptomatic [5,7]. Guidelines from the Infectious Diseases Society of America recommend universal testing of patients when doing so can guide personal protective equipment (PPE) and resource allocation [30]. The CDC states that screening tests can utilize either rapid antigen or nucleic acid amplification testing (NAAT), however, recommends use of NAAT to confirm both positive and negative antigen test results [31]. The CDC specifically states that asymptomatic parturients undergoing screening tests should be considered negative until proven otherwise [32]. If screening is performed a few days prior to admission for a planned cesarean delivery, then care should be taken to coordinate with other pre-admission testing such as blood type and screening.

Personal protective equipment

Prior recommendations for PPE use on labor and delivery units, and specifically considerations for neuraxial procedures, have balanced the preservation of patient safety with protection of healthcare providers from possible exposure. General considerations include planned allocation of resources and staffing, modification of the clinical environment, and ready availability of equipment, PPE, supplies and drugs, all while avoiding unnecessary waste due to contamination [26¹,33¹,34,35].

For all interactions with patients with suspected or confirmed COVID-19, the CDC recommends a respirator mask (N-95 PAPR or CAPR) with face shield or goggles, although an acceptable alternative is a surgical face mask with the face shield or goggles [36]. The American College of Obstetrics and Gynecology (ACOG) statement endorses use of a respirator but states that it is still gathering evidence about whether stage II of a vaginal delivery is an aerosolizing event [37].

The Obstetric Anaesthetists Association provided recommendations for PPE for obstetric anesthesiologists based on mode of transmission risk: for labor epidural or cesarean delivery spinal anesthesia droplet precautions, and for cesarean delivery general anesthesia airborne protection [38].

Recommendations surrounding PPE and specific considerations during general anesthesia have unambiguously recommended N95/respirator use [39]. Several studies have reported on the risk of acquiring COVID-19 infection for healthcare workers during endotracheal intubation of patients with suspected or known SARS-CoV-2 infection on the order of 10% [40,41].

Our experience in New York City at the peak of the COVID-19 surge in the spring of 2020 was that despite 60% of colleagues reporting a potential work-related exposure, only few reported symptoms, and only 12% of tested providers had detectable SARS-CoV-2 antibodies [42], which we had attributed to the availability of PPE and relative adherence to protection protocols. Similar rates were reported in a study reporting on antibody seroconversion among frontline maternity healthcare workers in the United Kingdom (12.5% anesthesiologists, 13.5% obstetricians, and 15.7% midwives) [43].

Airborne minimizing apparatus

Devices to minimize aerosolization of viral particles during intubation have been suggested. Recent reviews of their use demonstrate no clear benefit [44], especially when the seal is not tight [45], and they do not obviate the need for adequate PPE. We recommend against use of an aerosol retention device in obstetric patients.

Support persons

Unique to obstetric units, the presence of a support person during labor is deemed essential; it was suggested before the pandemic as an approach to reduce the odds for cesarean delivery [46]. Pregnant women with COVID-19 should have access to a support person for labor and delivery care. Transmission of COVID-19 by support persons can be limited by screening for symptoms, limiting movement on the labor floor, and prohibiting visitors who have been diagnosed with COVID-19 within the preceding 14 days [47]. Screening of the support person is not sufficient in itself, because a non-negligible proportion may be asymptomatic (up to 20% in a New York City site) [48]; therefore, allowing the support person to be present during a cesarean delivery should be encouraged only when PPE availability allows for it. Screening both patients and their support persons has been a proposed strategy, because a discordance of close to 10% between parturients and their support person has been reported [48].

Vaccination of pregnant and breastfeeding patients

The approval of multiple SARS-CoV-2 vaccines and beginnings of coordinated vaccination efforts have raised hope for immunity in the near future. The question about whether vaccines can be administered safely to pregnant and breastfeeding women has been raised. Pregnant women were not included in vaccine safety trials; therefore, there is no evidence for or against their safe use in obstetrics. While the CDC and WHO stress this lack of safety data in their statements about vaccination in pregnancy, ACOG points out that it had unsuccessfully advocated for the inclusion of pregnant women in the initial vaccine trials and their lack of inclusion should not serve as a barrier to vaccination.

ACOG and SMFM had released a joint statement on the WHO recommendations stipulating ‘... given clear evidence of the dangers of COVID-19 in pregnancy, an absence of data demonstrating adverse effects associated with the vaccine in pregnancy, and in the interest of patient autonomy, ACOG and SMFM recommend that pregnant individuals be free to make their own informed decisions regarding COVID-19 vaccination ... ACOG and SMFM continue to firmly assert that pregnant individuals should be given the opportunity to make their own decision as to whether to receive the COVID-19 vaccine and that barriers should not be put in place to prevent access and hinder the ability of pregnant people to protect themselves from a virus that could potentially be life-threatening’ [49].

Advisories from the CDC [50], ACOG [51], and recently WHO [52] now all consistently follow this approach, recommending that at-risk pregnant women be offered the COVID-19 vaccine. Pregnancy testing is neither required prior to vaccination, nor is documentation of discussion about vaccination with a healthcare provider [53]. The National Institute of Health (NIH) called for action for greater inclusion of pregnant and breastfeeding people in COVID-19 vaccine research [54], and ‘thoughtfully including pregnant and lactating individuals in clinical research will lead to clinical care recommendations based on solid evidence’ [55]. The most recent updates on vaccination outcomes among pregnant women (over 30 000 women recorded in the CDC V-Safe report) have been reassuring [56].

Currently, the CDC stipulates that the change in status conferred to a fully vaccinated individual is limited to being absolved of the need to quarantine after exposure to COVID-19 for three months after vaccination [57]. Vaccination confers no change in

the need to wear PPE, practice physical distancing, or adhere to travel restrictions.

ANESTHESIA CONSIDERATIONS FOR LABOR AND DELIVERY

Notably, obstetric anesthesia practice has not significantly changed since the early pragmatic clinical recommendations published in spring of 2020 [33²²,58²²,59,60²²], mostly because no breakthrough data in the last ten months has suggested that management of labor analgesia should be any different. The Society for Obstetric Anesthesia and Perinatology produced a COVID-19 Toolkit with Interim Considerations for Obstetric Anesthesia Care Related to COVID-19 (first drafted in March, with minor updates in May 2020) and several other educational resources which included simulation and drills materials [34].

Overall, two areas of concern about the safety of neuraxial anesthesia in women with COVID-19 were raised after early publication from China: hypotension during cesarean delivery [61,62] and thrombocytopenia [63]. The early report from China alerted about possible hemodynamic instability following neuraxial anesthesia for cesarean delivery [61,62]; however, findings were not replicated and concerns mostly dissipated [64].

Significant thrombocytopenia precluding a neuraxial procedure ($< 70\,000 \times 10^6/L$) does not seem to be associated with COVID-19 [63]. However, one case with a nadir count of $40\,000 \times 10^6/L$ was described in a French series of three thrombocytopenic parturients with mild COVID-19 [65].

Overall, data related to COVID-19 coagulopathy showed thrombocytopenia occurring on the one hand and a procoagulant state associated with thromboembolic events on the other [66]. Recommendations for monitoring coagulation status in parturients with COVID-19, taking hypercoagulability of pregnancy into account, have been proposed [67²²].

Pregnant women admitted with COVID-19 have an indication for thromboprophylaxis if on bedrest, critically ill, or mechanically ventilated unless active bleeding, severe thrombocytopenia, or another contraindication precludes administration [68].

Neuraxial labor analgesia

Initial recommendations for provision of neuraxial labor analgesia were based on early lessons from United States institutions sharing their first experiences as of mid-March 2020 [2,33²²,34,69]. In general, providing early neuraxial labor analgesia and ensuring a well-functioning epidural catheter have been the mainstay of all recommendations from

societies around the world throughout the pandemic [34,68,70].

Routine practice recommendations include:

- (1) Placing neuraxial labor analgesia early, as it allows procedures to occur in a more controlled manner, for teams to become more familiar with appropriate PPE donning and doffing of PPE, and for all logistics related to protecting anesthesia equipment (epidural carts, supplies, pumps, medication) to occur.
- (2) Not delaying epidural placement until COVID-19 screening test results are obtained. If a woman in labor requests her epidural, then adequate PPE should be utilized per institutional guidelines and the epidural should be placed without delay.
- (3) Reducing unnecessary patient encounters without compromising patient safety or comfort. Strategies include combining informed consent with the procedure itself and suggesting an experienced provider performs the procedure.
- (4) Minimizing physician administered top-ups by maximizing efficacy of neuraxial analgesia using combined spinal epidurals (CSE), programmed intermittent epidural bolus pumps, and considering addition of adjuvants (e.g. clonidine) [33²²].
- (5) Ensuring a well-functioning epidural catheter to allow use of epidural anesthesia if an intrapartum cesarean delivery became indicated to minimize the need for general anesthesia in all women, whether confirmed to have COVID-19 or with unknown SARS-CoV-2 status.
- (6) Performing an epidural blood patch (EBP) to manage severe cases of postdural puncture headache (PDPH) which should be discussed case by case, because not treating severe PDPH is not recommended due to the risk of severe complications [71], and alternative treatments, such as sphenopalatine ganglion blocks are not recommended in COVID-19 patients due to risk of aerosolization [34,35]. Safe use of an EBP in a COVID-19 patient after cesarean delivery has been reported [72], although caution has been suggested [73,74] due to the hypercoagulable state and possible risk of central nervous system inoculation associated with autologous blood injection in the epidural, and possibly subarachnoid, space.

Anesthesia for cesarean delivery

Provision of neuraxial anesthesia, via an indwelling epidural catheter for an intrapartum cesarean delivery or with a spinal/CSE, is unambiguously the

preferred method to avoid the aerosolization of viral particles during endotracheal intubation/extubation and other airway manipulation.

As mentioned earlier, strategies to reduce the rate of general anesthesia for emergent cesarean delivery have included (1) heightened communication between obstetrical, nursing, and anesthesia teams and (2) early neuraxial labor analgesia with a well-functioning epidural catheter. All labor and delivery units should employ a precesarean delivery huddle to improve team communication prior to moving a patient to the operating room for a cesarean delivery or any operative procedure.

Preceding the COVID-19 pandemic, a large epidemiological report had demonstrated adverse events and complications associated with avoidable general anesthesia for cesarean delivery, with a higher rate of avoidable general anesthetics among minority women, particularly black women [75], and the use of general anesthesia for cesarean delivery was reported to be significantly higher among black women in two other studies [76,77]. Further, maternal mortalities attributable to general anesthesia for cesarean delivery in low- and middle-income countries were reported [78]. Therefore, regardless of SARS-CoV-2 status, strategies to avoid nonindicated general anesthetics should be prioritized.

In the United Kingdom, the COVID-19 pandemic has been perceived as an opportunity to reduce the general anesthesia rates for cesarean delivery [79]. In a cross-sectional study from April to July 2020 from six maternity wards in the north-west of England with over 17 000 deliveries, the anesthesia model of coverage changed (the on-site out-of-hours anesthesia consultant support system) resulting in more experienced and skilled anesthesiologists allowing for better supervision, higher neuraxial anesthesia rates and lower conversion rates to general anesthesia; the general anesthesia rate was more than halved (from 7.7% to 3.7%) [80]. The authors list the many possible reasons that contribute to neuraxial anesthesia being the preferable anesthetic mode which are well known to anesthesiologists: (1) superior perioperative pain relief which allows partners to be present during the cesarean delivery, (2) earlier skin to skin contact with the neonate, (3) mitigation of difficult intubation risks, aspiration and awareness, (4) decreased blood loss, (5) decreased transfusion, (6) decreased thromboembolism risk, (7) reduced hospital stay, and (8) decrease respiratory tract and surgical site infections. Because none of these are specific to COVID-19, clearly, the risk of contamination for anesthesia staff and other healthcare workers in the operating room played a significant role in this reduction, and the availability of a more senior

anesthesiologist contributed to achieving this reduction. The premise that obstetric anesthesiologists and fellowship training in obstetric anesthesia will significantly reduce the odds for general anesthesia during unplanned cesarean delivery has already been demonstrated [81,82].

CONCLUSION

Regarding the logistics of obstetric anesthesia care, initial recommendations to adapt the workflow on labor and delivery units with the double goal to (1) maintain safe care for all parturients whether infected or not and (2) minimize contamination risks, have been crucial. Overall, despite being front-line healthcare providers, obstetric anesthesiologists' work-related exposure seems to have been well contained, mostly thanks to the availability of adequate PPE, adaptations to the workflow, checklists and simulation drills, and in some instances increased anesthesia staffing and more senior anesthesiologists being present.

For the asymptomatic and noncritically ill COVID-19 parturients during labor and delivery, two principles have guided our management: (1) provision of early neuraxial labor analgesia ensuring that the epidural catheter is well functioning throughout labor has been advocated as a safe way to reduce the likelihood of urgent general anesthesia being used for unplanned cesarean deliveries and (2) favoring neuraxial over general anesthesia for cesarean delivery whenever possible, for its well-known benefits but also to reduce healthcare exposure during airway manipulation; evidence that general anesthesia rates for cesarean delivery can be improved has emerged during the pandemic.

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Conflicts of interest

There are no conflicts of interest.

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- of special interest
- of outstanding interest

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