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Pregnancy and delivery considerations during COVID-19

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■ ABSTRACT

Pregnant women are also affected by COVID-19, with infection rates similar to nonpregnant women. Labor and delivery by a women with COVID-19 presents unique challenges for ensuring the safety of the mother, fetus, and newborn as well as the safety of clinicians and other healthcare personnel. In this article, we present perinatal obstetric anesthetic management strategies derived from the best available evidence to provide guidance in caring for the obstetric patient with COVID-19.

■ INTRODUCTION

Clinical symptoms of COVID-19 range from asymptomatic to mild upper respiratory infection to pneumonia and respiratory distress syndrome. The disease is extremely contagious and spreads mostly by aerosol droplet transmission. Pregnant women have about the same risk of being infected as nonpregnant women, but they do appear to have a greater risk for severe disease, although the overall risk is low.¹ In addition, there may be an increased risk for adverse pregnancy outcomes, such as preterm birth, associated with COVID-19 during pregnancy.²⁻⁶

Perinatal infection could cause adverse maternal and neonatal outcomes owing to the associated systemic physiological and immunological changes associated with pregnancy. Earlier pandemics with coronaviruses caused severe adverse effects during pregnancy resulting in worsened perinatal outcomes.⁷

Management of pregnant women with COVID-19 presents unique challenges for ensuring the safety of the mother, fetus, and newborn as well as the safety of clinicians and other healthcare personnel. The obstetric environment with its high density of prac-

tioners and close contact with the patient increases the risk of nosocomial transmission of SARS-CoV-2, making it important to have strategies and protocols in place to achieve safe patient care and adequate infection control.

This article discusses guidelines and best practices on obstetric care during the pandemic.

■ PREGNANCY AND COVID-19

Clinical manifestations

Pregnancy-related changes in respiratory, cardiovascular, and immune systems increase susceptibility to hypoxia and COVID-19–related complications. Varying proportions of pregnant patients infected with COVID-19 were symptomatic in contrast to only 20% in the general population. In a systematic review by Elshafeey and colleagues³ of 385 pregnant patients with COVID-19, 368 (96%) had mild symptoms and 14 had severe symptoms. Two-thirds had fever and cough. Dyspnea, sore throat, malaise, and diarrhea were reported in 7%, and 5% reported nasal congestion, rash, sputum production, headache, and loss of appetite. Symptoms appeared in 5% of patients in the postpartum period. Gestational rhinitis due to estrogen-mediated hyperemia of the nasopharynx occurs in 20% of pregnant patients.⁸ In the Elshafeey cohort, approximately 5% of the pregnant women required intensive care unit admission and 1.6% required mechanical ventilation.³ Of those, 1 patient died and 1 required extracorporeal membrane oxygenation (ECMO) treatment.

The nonspecific symptoms of pregnancy may delay the diagnosis of COVID-19 in pregnant patients, which could lead to asymptomatic spread among the community and hospital staff. Pregnancy can cause significant respiratory changes, such as decreased functional residual capacity, and higher oxygen consumption increases susceptibility to hypoxia, symp-

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toms worsened by COVID-19. Thus, physiological dyspnea due to pregnancy should be differentiated from COVID-19–related dyspnea.

Immune system changes

Research indicates that patients with COVID-19 who develop the cytokine storm syndrome develop severe or critical illness. Pregnancy causes relative immunosuppression. During pregnancy, it is surmised that human chorionic gonadotropin and progesterone inhibit the Th1 proinflammatory pathway via decreasing release of cytokines. This, in turn, prevents development of the cytokine storm syndrome and the subsequent morbidity and mortality in those with COVID-19.⁹ First and third trimesters are considered “pro-inflammatory states” that have the potential to result in significantly greater symptom manifestations in pregnant patients compared with the second trimester.

■ WHAT’S KNOWN ABOUT PERINATAL OUTCOMES?

The mortality rate from COVID-19 during pregnancy is extremely low (> 1%) in contrast to previous coronavirus pandemics, such as the severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS), which had fatality rates of 10.5% and 34.4%, respectively.⁵ Overall, the study found that pregnant women hospitalized with COVID-19 had higher rates of preterm birth, preeclampsia, cesarean delivery, and perinatal death than the general population; however, the case numbers were small. Though the course of pregnancies did not seem to be much affected by COVID-19, 77.7% of women underwent cesarean delivery.

In the Elshafeey study,³ only 4 neonates among 385 tested positive for COVID-19 based on reverse transcription polymerase chain reaction (RT-PCR) testing. They all had mild disease and were successfully discharged without any further complications. However, in the COVID-19 cohort, neonatal mortality occurred in 3 cases; 2 were stillbirths related to critical illness in the mothers (1 maternal mortality and 1 woman on ECMO). Breast milk was found to be negative for COVID-19 in all 29 women tested.³

There are insufficient data to support or refute intrauterine transmission of SARS-CoV-2. Schwartz et al¹⁰ reported no evidence of vertical transmission; however, in the meta-analyses by Goh et al,¹¹ 9 of the 330 newborns tested positive (95% CI 3.40–73.11). Similarly Kotlyar et al¹² reported an average incidence of 3.2% vertical transmission accounting for

27 neonates affected among 936 neonates (95% CI 2.2–4.3) for vertical transmission. Vertical transmission of SARS-CoV-2 thus is possible and seems to occur in a minority of cases of maternal infection in the third trimester. More data are needed to determine transmission in an early trimester.

■ WHAT’S THE IMPACT ON CLINICAL PRACTICE?

Healthcare facilities need to have management strategies and response plans in place to care for pregnant patients with or potentially infected with COVID-19. They should provide guidance for the multidisciplinary team, which includes anesthesiologists, obstetricians, labor and delivery nurses, neonatologists, critical care practitioners, infectious disease and infection control experts, employee health services, environmental health services, and telemedicine services.¹³ The Centers for Disease Control and Prevention has guidelines to follow regarding use of personal protective equipment (PPE) when visiting a potential COVID-19 patient for pre-evaluation, performing procedures, and for other needed examinations.¹⁴

Hospitals also need policies for allowing a deliver partner to be present. It is important to thoroughly screen that person for COVID-19, and they should wear a face mask while in the facility.

Prenatal evaluation

Preferably, the prenatal examination should be conducted through telehealth. This meeting provides practitioners with an opportunity to explain the course of labor and delivery and specific COVID-19 preparation. It is advised to show a short video description of labor and delivery suite to familiarize the woman with the facility.

Peripartum management

All patients presenting to the delivery suite should be tested for COVID-19, preferably with a rapid test. Patients who are COVID-19–negative should be managed routinely; however, practitioners need to wear a facemask and practice social distancing and hand hygiene at all times to account for the small incidence of false-negative test results.

Ideally, COVID-19–positive and symptomatic COVID-19–negative pregnant patients should be cared for in an airborne infection isolation room or negative-pressure rooms.¹³ During transfer to the delivery suite, COVID-19–infected patients should wear a mask, preferably N95 rated. Transport staff should wear full PPE.

The logistics of increased staffing requirements

should be anticipated and be made available. A backup team of anesthesiologists and support personnel may be required during delivery, especially if a cesarean section is needed.

Similarly, a designated operating room should be available that has separate surgical trays and anesthesia carts containing all essential equipment and drugs. This can help minimize exposure of other personnel and reduce contamination of other equipment and supplies.

Facilities should be equipped with remote monitoring options including those for vital signs and physical examination. Providers should be able to interact with patients through video and audio chat to help reduce the number of room visits. This would both decrease the chances of infection spread and save PPE. Informed consent is ideally documented on a paper form to avoid contamination of a computer and signature pad.

Labor and delivery suite and operating rooms should have a designated buffer zone. The medical personnel should wear their PPE in this area and remove it after they leave a room housing a COVID-19 patient. Entry to patient rooms should be restricted to the minimum required providers. Visitors, in general, should not be allowed in the delivery suite except for the birthing partner.

■ ADMINISTERING REGIONAL ANESTHESIA

The basic principles of anesthetic management in a pregnant woman are as follows:

- Perinatal care and safe delivery and COVID-19 status for the mother
- Reduce anxiety of the mother
- Protection of healthcare workers
- Protection of other patients, and
- Preventing infection in the newborn.

Neuraxial analgesia

Patients with COVID-19 should strongly be encouraged to have neuraxial regional labor analgesia. In addition to providing traditional analgesic benefits, it avoids airway manipulation, which would be required for administration of general anesthesia. In case of a cesarean section, providing general anesthesia poses a significant risk to both the patient and newborn and to the caregivers in the operating room requiring enhanced PPE use.^{8,15,16}

There are no contraindications for neuraxial analgesia based on COVID-19 status unless the patient has sepsis-related coagulopathy. Also, there have been no reported complications associated with viral

seeding of the central nervous system during neuraxial procedures.

Guan et al¹⁷ reported a 36.2% incidence of thrombocytopenia during pregnancy in patients with COVID-19, and the more severe the disease the lower the platelet count. The risk-benefit ratio of epidural analgesia should be weighed in the setting of thrombocytopenia. It is essential to monitor the rate of platelet count decrease, which should be considered in addition to the threshold of a specific number. If there is no other evidence of coagulopathy, epidurals can be safely used in a patient with a platelet count of 70,000/mm³ (reference range, 150,000–450,000/mm³) or lower if the count is stable.¹⁸

Epidural or spinal placement is not an aerosolizing procedure, but the patient and delivery companion should always wear facemasks. Using an electronic tablet or iPad video for preanesthetic evaluation and monitoring is recommended. Bring only the essential epidural kit and drugs to the delivery room instead of the whole epidural cart. The most experienced anesthesiologist present should perform the procedure to maximize the likelihood of successful placement and avoid dural puncture.

Other analgesia options

Although nitrous oxide can be used, the scavenging and prevention of aerosolization is more difficult to control and, thus, is not recommended. Intravenous remifentanyl is an option, but it provides inferior analgesia to neuraxial techniques. Also, the respiratory depression caused by remifentanyl could potentially worsen the respiratory issues of COVID-19.

■ HEMODYNAMIC MONITORING

In addition to routine hemodynamic monitoring, patients need constant monitoring of their respiratory status including respiratory rate and pulse oximetry. Deterioration of respiration should be detected and appropriately addressed.

Team meetings should happen frequently to discuss options for intervention and early delivery. Individualized plans for the use of steroids and magnesium should be developed. Continued close surveillance of fetal status is crucial to avoid the need for emergency cesarean section.

■ MANAGING POSTDURAL PUNCTURE HEADACHE

If a patient with COVID-19 develops postdural puncture headache, an epidural blood patch might be avoided or at least delayed until a later point when the patient is unlikely to be viremic. Though no studies

or case reports have been reported about performance of epidural blood patch in these patients, it can be a safe option if the headache is affecting the patient's wellbeing.¹⁹ Patients need periodic monitoring of their platelet count, which can deteriorate owing to COVID-19 infection. A sphenopalatine ganglion block can be used to relieve a postdural puncture headache, but this requires a nasal approach, which has the potential for aerosolization and should be avoided.

■ CESAREAN DELIVERY AND COVID-19

As noted, the rates of cesarean delivery are higher in patients with COVID-19 than in the general population. However, having COVID-19 by itself is not an indication for cesarean section; obstetric and neonatal factors should play the predominant role in determining the need for surgical delivery. Nevertheless, circumstances requiring urgent or emergent cesarean sections should be specified, and there should be a low threshold to this delivery option. Early decisions by the multidisciplinary team are essential.

Continuing normal labor if the non-reassuring maternal and fetal status exists is not acceptable given that transport and preparation for an emergency cesarean section takes substantial time. Routine oxygen supplementation is not required unless dictated by maternal oxygen saturation. A patient with a compromised respiratory system due to COVID-19 may require head elevation, and care should be taken to avoid high spinal level of the block as it would exacerbate "air hunger" and dyspnea.

Regional anesthesia is the choice for cesarean section as it avoids aerosolizing procedures and potential difficult endotracheal intubation. However, 5% of patients receiving regional anesthesia require conversion to general anesthesia,²⁰ and the risk increases with the urgent nature of cesarean section. A study from China reported excessive hypotension with epidural anesthesia for cesarean section in 12 of 14 patients with COVID-19,¹⁵ though subsequent studies have disputed the results. However, precautions should be taken in patients with established sepsis. Other studies from China have reported increased proportion of women with COVID-19 having delivery by cesarean section.^{21,22} The need for emergency cesarean sections could be substantially reduced by planned cesarean section.

■ WHAT ABOUT GENERAL ANESTHESIA?

General anesthesia may be required for fetal and maternal emergency conditions as well as for the presence of contraindications to regional analgesia such as coagulopathy. In addition to pregnancy-induced difficult airways, patients may have a swollen upper respiratory tract caused by COVID-19. Preoxygenation may require more time due to impaired gas exchange.

Use of video-assisted laryngoscopy will facilitate intubation and help keep the intubating clinician's face away from the patient. Though there are methods of covering the patient's face to avoid aerosolizing the operating room, the clinician's convenience and comfort should play a major role in use of adjunct coverings. Patients should be completely paralyzed for intubation to avoid coughing and the attendant aerosol generation.

Postpartum bleeding should preferably be treated with oxytocin and ergot alkaloids. Prostaglandin preparations have been reported to cause prolonged bronchospasm in patients with COVID-19-infected airways²³ and should be avoided.

Acetaminophen and judiciously administered opioids are the preferred means of postoperative analgesia. Nonsteroidal anti-inflammatory drugs may be used, although some controversy exists about potential adverse effects on respiratory status in COVID-19-positive patients.

■ STRATEGIES FOR POSTPARTUM MANAGEMENT

Patients should recover either in the operating room or in an isolated delivery room rather than in the postanesthesia care unit. Many patients have worsening of symptoms after delivery and should be carefully monitored. If a patient has increasing oxygen requirements or is in respiratory distress, transfer to the intensive care unit should be considered. Although mothers with COVID-19 may shed the virus, the mother and newborn should ideally be together owing to the proven beneficial effects of bonding, such as increased success with breastfeeding and promotion of family-centered care. Barriers may be used to prevent spreading the infection. COVID-19 could exacerbate maternal postpartum depression, which needs to be addressed. If tubal sterilization is planned, it should be postponed for at least for 4 to 6 weeks after the patient completely recovers from COVID-19. Postoperative visits can be done electronically.

CONCLUSION

Testing and multidisciplinary communication are crucial factors for managing obstetric patients during the COVID-19 pandemic. Universal testing of both women and partners would be ideal. Respiratory deterioration, escalation of care, and advanced critical care support may be required during the peripartum period. Strategies should be formulated to avoid general anesthesia, if possible. Early neuraxial analgesia and timely decision making by a multidisciplinary team are keys to the best delivery outcomes. Close communication among providers combined with judicious use of universal precautions are vital for managing the patients and preventing hospital personnel from acquiring COVID-19 in delivery suites.

DISCLOSURES

The authors report no relevant financial relationships which, in the context of their contributions, could be perceived as a potential conflict of interest.

REFERENCES

1. Zambrano LD, Ellington S, Strid P, et al; CDC COVID-19 Response Pregnancy and Infant Linked Outcomes Team. Update: Characteristics of symptomatic women of reproductive age with laboratory-confirmed SARS-CoV-2 infection by pregnancy status - United States, January 22-October 3, 2020. *MMWR Morb Mortal Wkly Rep* 2020; 69(44):1641-1647. doi:10.15585/mmwr.mm6944e3
2. Yu N, Li W, Kang Q, et al. Clinical features and obstetric and neonatal outcomes of pregnant patients with COVID-19 in Wuhan, China: a retrospective, single-centre, descriptive study. *Lancet Infect Dis* 2020; 20(5):559-564. doi:10.1016/S1473-3099(20)30176-6
3. Elshafeey F, Magdi R, Hindi N, et al. A systematic scoping review of COVID-19 during pregnancy and childbirth. *Int J Gynaecol Obstet* 2020; 150(1):47-52. doi:10.1002/ijgo.13182
4. Wang Z, Wang Z, Xiong G. Clinical characteristics and laboratory results of pregnant women with COVID-19 in Wuhan, China. *Int J Gynaecol Obstet* 2020; 150(3):312-317. doi:10.1002/ijgo.13265
5. Di Mascio D, Khalil A, Saccone G, et al. Outcome of coronavirus spectrum infections (SARS, MERS, COVID-19) during pregnancy: a systematic review and meta-analysis. *Am J Obstet Gynecol MFM* 2020; 2(2):100107. doi:10.1016/j.ajogmf.2020.100107
6. Ryan GA, Purandare NC, McAuliffe FM, Hod M, Purandare CN. Clinical update on COVID-19 in pregnancy: a review article. *J Obstet Gynaecol Res* 2020; 46(8):1235-1245. doi:10.1111/jog.14321
7. Favre G, Pomar L, Musso D, Baud D. 2019-nCoV epidemic: what about pregnancies? *Lancet* 2020; 395(10224):e40. doi:10.1016/S0140-6736(20)30311-1
8. Bauer ME, Bernstein K, Dinges E, et al. Obstetric anesthesia during the COVID-19 pandemic. *Anesth Analg* 2020; 131(1):7-15. doi:10.1213/ANE.0000000000004856
9. Sarapultsev A, Sarapultsev P. Immunological environment shifts during pregnancy may affect the risk of developing severe complications in COVID-19 patients. *Am J Reprod Immunol* 2020; 84(3):e13285. doi:10.1111/aji.13285
10. Schwartz DA. An analysis of 38 pregnant women with COVID-19, their newborn infants, and maternal-fetal transmission of sars-cov-2: maternal coronavirus infections and pregnancy outcomes. *Arch Pathol Lab Med* 2020; 144(7):799-805. doi:10.5858/arpa.2020-0901-SA
11. Goh XL, Low YF, Ng CH, Amin Z, Ng YPM. Incidence of SARS-CoV-2 vertical transmission: a meta-analysis. *Arch Dis Child Fetal Neonatal Ed* 2021; 106(1):112-113. doi:10.1136/archdischild-2020-319791
12. Kotlyar AM, Grechukhina O, Chen A, et al. Vertical transmission of coronavirus disease 2019: a systematic review and meta-analysis. *Am J Obstet Gynecol* 2021; 224(1):35-53.e3. doi:10.1016/j.ajog.2020.07.049
13. ObG Project. COVID-19: The SMFM/SOAP guidelines for labor and delivery. <https://www.obgproject.com/2020/03/29/covid-19-the-smfm-soap-guidelines-for-labor-and-delivery/>. Accessed March 22, 2021.
14. Centers for Disease Control and Prevention. Using personal protective equipment (PPE). <https://www.cdc.gov/coronavirus/2019-ncov/hcp/using-ppe.html>. Accessed March 22, 2021.
15. Chen R, Zhang Y, Huang L, Cheng B-H, Xia Z-Y, Meng Q-T. Safety and efficacy of different anesthetic regimens for parturients with COVID-19 undergoing Cesarean delivery: a case series of 17 patients. *Can J Anaesth* 2020; 67(6):655-663. doi:10.1007/s12630-020-01630-7
16. Guasch E, Brogly N, Gilsanz F. COVID in obstetrics: labor analgesia and cesarean section. *Curr Opin Anaesthesiol* 2021; 34(1):62-68. doi:10.1097/ACO.0000000000000949
17. Guan W-J, Ni Z-Y, Hu Y, et al. Clinical characteristics of coronavirus disease 2019 in China. *N Engl J Med* 2020; 382(18):1708-1720. doi:10.1056/NEJMoa2002032
18. Lee LO, Bateman BT, Kheterpal S, et al. Risk of epidural hematoma after neuraxial techniques in thrombocytopenic parturients: a report from the Multicenter Perioperative Outcomes Group. *Anesthesiology* 2017; 126(6):1053-1063. doi:10.1097/ALN.0000000000001630
19. Guglielminotti J, Landau R, Li G. Major neurologic complications associated with postdural puncture headache in obstetrics: a retrospective cohort study. *Anesth Analg* 2019; 129(5):1328-1336. doi:10.1213/ANE.0000000000004336
20. Bauer ME, Kountanis JA, Tsen LC, Greenfield ML, Mhyre JM. Risk factors for failed conversion of labor epidural analgesia to cesarean delivery anesthesia: a systematic review and meta-analysis of observational trials. *Int J Obstet Anesth* 2012; 21(4):294-309. doi:10.1016/j.ijoa.2012.05.007
21. Della Gatta AN, Rizzo R, Pilu G, Simonazzi G. Coronavirus disease 2019 during pregnancy: a systematic review of reported cases. *Am J Obstet Gynecol* 2020; 223(1):36-41. doi:10.1016/j.ajog.2020.04.013
22. Mullins E, Evans D, Viner RM, O'Brien P, Morris E. Coronavirus in pregnancy and delivery: rapid review. *Ultrasound Obstet Gynecol* 2020; 55(5):586-592. doi:10.1002/uog.22014
23. Breslin N, Baptiste C, Miller R, et al. Coronavirus disease 2019 in pregnancy: early lessons. *Am J Obstet Gynecol MFM* 2020; 2(2):100111. doi:10.1016/j.ajogmf.2020.100111

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