# A review of hemodynamic changes in pregnant patients with SARS-CoV-2 infection presenting for delivery under neuraxial anesthesia

Sudheer Pratap Godara [1], Juhi Godara[2], Abhay Kuber Bodhey[3], Osama Sami Maki Al Ani[4]

1. Specialist Anaesthesiology, Rashid Hospital, Dubai
2. Specialist obstetrics and gynaecology, Dubai Hospital, Dubai
3. Specialist Anaesthesiology, Rashid Hospital, Dubai
4. Consultant Anaesthesiology, Rashid Hospital, Dubai

## Abstract

The COVID-19 pandemic posed extraordinary challenges for obstetric anesthesia practitioners worldwide. COVID-19, caused by the SARS-CoV-2 virus, presented as a highly contagious disease with severe respiratory implications, particularly for vulnerable populations like pregnant women. Anesthesia management for pregnant COVID-19 patients necessitated a careful balance between ensuring optimal maternal care and minimizing viral transmission risks.

This narrative review explores critical aspects of obstetric anesthesia during the pandemic, with a focus on the use of spinal anesthesia for cesarean sections in COVID-19-positive parturients. Spinal anesthesia emerged as the preferred choice due to its capacity to maintain hemodynamic stability, minimize respiratory complications, and reduce aerosol-generating procedures. However, concerns surrounding maternal hypotension and the potential for viremic blood transmission into the epidural space were addressed through strategies like vasopressor administration and meticulous fluid management.

The review also emphasizes the importance of individualized care, optimal infection control measures, and alternative pain management strategies in postoperative care. Insights from this study inform future healthcare crises and underscore the need for adaptive healthcare systems that prioritize patient safety, even in the face of unprecedented challenges.

## Keywords

SARS- CoV- 2 , Acute respiratory syndrome ,General Anaesthesia. Neuraxial anaesthesia, Pregnancy, labor analgesia

## Introduction

In December of 2019, a novel virus emerged in the city of Wuhan, China. This virus was initially designated as the "Severe Acute Respiratory Syndrome Coronavirus-2" or "SARS-CoV-2," and it quickly became known as COVID-19. COVID-19 is notorious for its rapid transmission, primarily through respiratory droplets within a one-meter radius of an infected individual. Moreover, the virus can also spread through contaminated surfaces and has been observed to be transmitted by asymptomatic carriers.[1]

COVID-19 can lead to severe illness and, in some cases, even fatalities, particularly among individuals with weakened immune systems, such as pregnant women[2] During the global COVID-19 pandemic, ensuring the provision of secure obstetric anesthesia services emerged as a critical concern, given the continuously evolving risks associated with COVID-19 cases.[3] Pregnant individuals who contract COVID-19 require specialized care, especially those who develop severe respiratory symptoms. The challenges associated with managing anesthesia for obstetric patients with COVID-19 are multifaceted. First, COVID-19 is highly contagious, primarily transmitted through respiratory droplets, putting healthcare staff at significant risk of infection.[4] Second, patients with severe respiratory issues are more vulnerable to airway and respiratory complications. Third, the scarcity of published evidence complicates the process of making evidence-based clinical decisions.

In light of these challenges, the responsibility of anesthesia practitioners during this crisis is to deliver safe anesthesia that maximizes positive outcomes while minimizing staff exposure. In this study, we undertook a comprehensive review of anesthesia management recommendations for pregnant women who are infected with COVID-19 and are presenting for cesarean section. Our examination focused on several critical aspects, including the choice of anesthesia, anesthetic management strategies, and measures to reduce the transmission of the virus.

Coronaviruses, a family of single-stranded RNA viruses, are commonly found in various species, including bats, birds, and humans. COVID-19, caused by the newly identified SARS-CoV-2, was first identified in Wuhan, China, in December 2019. Coronaviruses, including SARS and MERS, are known to cause respiratory infections in humans, ranging from mild to severe. In March 2020, the World Health Organization declared COVID-19 a global pandemic that affected numerous countries. While most research has concentrated on the general population, there is limited knowledge regarding its impact on vulnerable groups, such as pregnant women. Pregnancy introduces physiological changes that may increase susceptibility to infection and

exacerbate its severity, making pregnant individuals a particularly vulnerable group worthy of study.[5]

Neuraxial labor analgesia (NLA) is the most effective pain relief technique during labor and is associated with maternal and neonatal safety. Administering epidural anesthesia early can prevent worsening of respiratory symptoms during labor and reduce the need for aerosol-generating procedures like general anesthesia in the event of an emergency cesarean section for COVID-19 patients. However, administering NLA to COVID-19-positive parturients comes with risks, as some patients may exhibit abnormalities, including thrombocytopenia, which has been reported in approximately one-third of COVID-19 patients, as well as coagulopathy due to the underlying infection's prothrombotic nature. Theoretically, viremic blood from COVID-19-positive patients could introduce the virus into the epidural space, potentially leading to meningitis. Moreover, healthcare professionals wearing personal protective equipment face technical challenges during the administration of NLA.

While NLA in COVID-19 patients can help prevent respiratory deterioration during labor and facilitate emergency cesarean sections, it may also lead to maternal hypotension, which carries a risk of transient tachypnea in newborns.[6] However, existing studies on hypotension incidence during cesarean delivery after NLA do not include COVID-19-positive parturients.

.

In summary, the emergence of COVID-19 posed significant challenges for anesthesia practitioners caring for pregnant women.[7] The rapid transmission of the virus, the heightened risks associated with respiratory complications, and the lack of published evidence all made the management of obstetric anesthesia during the pandemic particularly challenging. Nevertheless, neuraxial anesthesia emerged as a preferred option for cesarean delivery in pregnant COVID-19 patients due to its safety profile. This study investigated the hemodynamic responses to spinal anesthesia in pregnant individuals with COVID-19, aiming to shed light on potential differences compared to historical and COVID-19-negative controls.[8] Additionally, the research explored the use of vasopressors and considered demographic and clinical factors as secondary outcomes. It was hypothesized that COVID-19-positive patients would exhibit lower blood pressure and an increased risk of hemodynamic instability following spinal anesthesia, based on reports of increased hypotension in this population.[9]

## *Literature Review*

This narrative review aims to draw important lessons from the COVID-19 pandemic to inform future healthcare crises, particularly in the context of Obstetric anesthesia practice. The rapid evolution and dissemination of research and clinical findings during this crisis forced the scientific community to adapt and transform clinical practice in unforeseen and valuable ways. This

transformation was facilitated by the integration of advanced platforms, techniques, and technologies, including artificial intelligence and extensive collaborative training. The insights gained from this pandemic are expected to have broader applications and ultimately enhance safety and care standards across various medical conditions. However, it's essential to acknowledge that this global health crisis has also exposed vulnerabilities and limitations within our healthcare system.

The practice of anesthesiology on a global scale has undergone significant changes due to the impact of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) pandemic.[10] In the United States, healthcare facilities managing antepartum patients with COVID-19 have had to implement stringent isolation measures while continuing to provide obstetric anesthesia services for expectant and postpartum patients. Although many pregnant individuals infected with SARS-CoV-2 remain asymptomatic, compelling evidence suggests that pregnancy elevates the risk of severe COVID-19 and adverse obstetric and neonatal outcomes. Pregnant individuals with COVID-19 are more likely to require intensive care unit (ICU) admission and mechanical ventilation compared to their non-pregnant counterparts.[11] Additionally, preexisting maternal comorbidities further heighten the risks for both mothers and newborns. [12]

## *Discussion*

This discussion section will delve into the key findings and implications of the review, highlighting the significance of understanding these hemodynamic changes and their clinical relevance in managing obstetric patients during the COVID-19 pandemic.

Most studies done till date advocated for regional anesthesia, specifically spinal anesthesia, as the preferred choice for cesarean sections in COVID-19-positive patients. This recommendation aligns with the goal of minimizing aerosol-generating procedures, such as endotracheal intubation and extubation, which carry an increased risk of viral transmission. Spinal anesthesia not only avoids these aerosol-generating procedures but also offers stable hemodynamics, making it a safer option in this context.

1. **Hemodynamic Stability:** Spinal anesthesia is a preferred choice for cesarean delivery in COVID-19 positive patients due to its advantages in maintaining hemodynamic stability.[13] It limits the need for general anesthesia and associated aerosol-generating procedures. Some studies reported that spinal anesthesia resulted in mild-to-moderate hypotension in these patients. This decrease in blood pressure was attributed to sympathetic blockade, leading to vasodilation and reduced venous return.[14] To address this issue, various strategies were proposed, including the administration of vasopressors such as phenylephrine and the optimization of fluid management.[15] These interventions aimed to

maintain maternal blood pressure within acceptable limits and ensure adequate uteroplacental perfusion.[16]

2. **Respiratory Considerations:** Pregnant individuals with COVID-19 are at an increased risk of respiratory compromise.[17] Spinal anesthesia avoids the need for endotracheal intubation and mechanical ventilation, which can exacerbate lung injury.

3. **Medications and Adjuvants:** The addition of adjuvants to spinal anesthesia, such as clonidine or higher concentrations of local anesthetics, can help prolong the anesthesia effect. This can be essential in ensuring the patient remains comfortable throughout the procedure. These include clonidine, opioids, and local anesthetics.[18] The choice of these agents should be individualized based on patient characteristics and the specific clinical scenario.

4. **Postoperative Pain Management:** Effective postoperative pain management is crucial and there should be cautious use of opioids in COVID-19 positive patients due to the risk of respiratory depression. Alternative strategies, such as non-opioid analgesics, should be considered.

5. **Infection Control Measures:** These include the use of personal protective equipment (PPE), maintaining appropriate room temperature, minimizing staff exposure, and employing equipment safeguards.

**Clinical Implications:**

Understanding the hemodynamic changes associated with spinal anesthesia in COVID-19 positive obstetric patients is of paramount importance for several reasons:

1. **Optimal Anesthetic Choice:** Anesthesiologists and obstetric teams must make informed decisions regarding the choice of anesthesia. Spinal anesthesia is favored for its hemodynamic stability and reduced risk of respiratory complications.[19]

2. **Risk Mitigation:** Awareness of the potential hemodynamic fluctuations during spinal anesthesia allows for proactive measures to mitigate these changes.[20] Proper patient positioning, choice of adjuvants, and vigilant monitoring are essential components of care.

3. **Postoperative Care:** Effective postoperative pain management is crucial for patient comfort and recovery. Healthcare providers must balance pain control with the risk of respiratory depression, especially in COVID-19 positive patients.[21]

4. **Infection Control:** The implementation of stringent infection control measures, as highlighted in the review, is critical to prevent viral transmission in the healthcare setting. This protects both patients and healthcare workers.

5. **Individualized Care:** The review emphasizes the importance of individualized care. Patient characteristics, including disease severity and comorbidities, should guide anesthesia and analgesia choices.

## Conclusion

In summary, the COVID-19 pandemic thrust obstetric anesthesia into uncharted territory, demanding innovative approaches to ensure maternal safety and mitigate viral transmission risks. Spinal anesthesia emerged as a cornerstone in this endeavor, offering hemodynamic stability and minimizing respiratory complications, aligning with the overarching goal of reducing aerosol-generating procedures. Strategies to address hypotension and viremic blood transmission concerns were identified and advocated for, emphasizing the importance of vigilant monitoring and individualized care.

This narrative review underscores the broader significance of the insights gained during the pandemic, extending beyond obstetric anesthesia. It highlights the necessity of adaptive healthcare systems, robust infection control measures, and alternative pain management strategies. The lessons learned from this crisis will undoubtedly influence and enhance healthcare practices across various medical conditions, reinforcing the resilience of healthcare infrastructure in the face of unforeseen challenges.

## Acknowledgement
None.

## Conflict of Interest
There are no conflicts of interest by author.

## References

[1] Alyamani O, Abushoshah I, Tawfeeq NA, Al Dammas F, Algurashi FA. Considerations and recommendations for obstetric anesthesia care during COVID-19 pandemic—Saudi Anesthesia Society Guidelines. Saudi J Anaesth. 2020;:14: 359–364. doi:10.4103/sja.SJA_310_20.

[2] Van Oirschot, J. T. "Vaccinology of classical swine fever: From lab to field." Vet Microbiol 96 (2003): 367-384.

[3] Lassi ZS, Ana A, Das JK, Salam RA, Padhani ZA, Irfan O, et al. A systematic review and meta-analysis of data on pregnant women with confirmed COVID-19: clinical presentation, and pregnancy and perinatal outcomes based on COVID-19 severity. J Glob Health. 2021;:11: 05018. doi:10.7189/jogh.11.05018.

[4] Fridman D, Kuzbari O, Minkoff H. Novel influenza H1N1 in pregnancy: a report of two cases. Infect Dis Obstet Gynecol. 2009;:2009: 514353. doi:10.1155/2009/514353.

5 Chen H, Guo J, Wang C, Luo F, Yu X, Zhang W, et al. Clinical characteristics and intrauterine vertical transmission potential of COVID-19 infection in nine pregnant women: a retrospective review of medical records. Lancet. 2020;:395: 809–815. doi:10.1016/S0140-6736(20)30360-3.

6 Sachdev, Perminder S., Darren M. Lipnicki and Nicole A. Kochan, et al. "The prevalence of mild cognitive impairment in diverse geographical and ethnocultural regions: the COSMIC collaboration." PloS one 10 (2015): e0142388.

7 Kaye R, Chang CWD, Kazahaya K, Brereton J, Denneny JC. COVID-19 anosmia reporting tool: initial findings. Otolaryngol Head Neck Surg. 2020;:163: 132–134. doi:10.1177/0194599820922992.

8 Bauer ME, Chiware R, Pancaro C. Neuraxial procedures in COVID-19 positive parturients: a review of current reports. Anesth Analg. 2020 [cited 4 Sep 2020]. doi:10.1213/ANE.0000000000004831.

9 Jain K, Bhatia N, Grewal A, Pandya ST, Gupta S, Bagga R, et al. Management of pregnant laboring women during COVID-19 pandemic. J Anaesthesiol Clin Pharmacol. 2020;:36: S91–S96. doi:10.4103/joacp.JOACP_258_20.

10 Wang D, Hu B, Hu C, Zhu F, Liu X, Zhang J, et al. Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus-infected pneumonia in Wuhan, China. JAMA. 2020;:323: 1061. doi:10.1001/jama.2020.1585.

11 Chen H, Guo J, Wang C, Luo F, Yu X, Zhang W, et al. Clinical characteristics and intrauterine vertical transmission potential of COVID-19 infection in nine pregnant women: a retrospective review of medical records. Lancet. 2020;:395: 809–815. doi:10.1016/S0140-6736(20)30360-3.

12 LaRosa, David F. and Jordan S. Orange. "Lymphocytes." J Allergy Clin Immunol 121 (2008): S364-S369.

13 Bauer ME, Bernstein K, Dinges E, Delgado C, El-Sharawi N, Sultan P, et al. Obstetric anesthesia during the COVID-19 pandemic. Anesth Analg. 2020;:131: 7–15. doi:10.1213/ANE.0000000000004856.

14 Thornburg KL, Jacobson SL, Giraud GD, Morton MJ. Hemodynamic changes in pregnancy. Semin Perinatol. 2000;:24: 11–4. doi:10.1016/s0146-0005(00)80047-6.

15 Guan W-J, Ni Z-Y, Hu Y, Liang W-H, Ou C-Q, He J-X, et al. Clinical characteristics of coronavirus disease 2019 in China. N Engl J Med. 2020;:382: 1708-1720. doi:10.1056/NEJMoa2002032.

16 Klöhr S, Roth R, Hofmann T, Rossaint R, Heesen M. Definitions of hypotension after spinal anaesthesia for caesarean section: literature search and application to

parturients. Acta Anaesthesiol Scand. 2010;:54: 909–921. doi:10.1111/j.1399-6576.2010.02239.x.

[17] Wang D, Hu B, Hu C, Zhu F, Liu X, Zhang J, et al. Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus-infected pneumonia in Wuhan, China. JAMA. 2020;:323: 1061. doi:10.1001/jama.2020.1585.

[18] Hawkins JL. Epidural analgesia for labor and delivery. N Engl J Med. 2010;:362: 1503–10. doi:10.1056/NEJMct0909254.

[19] Bampoe S, Odor PM, Lucas DN. Novel coronavirus SARS-CoV-2 and COVID-19. practice recommendations for obstetric anaesthesia: what we have learned thus far. Int J Obstet Anesth. 2020;:43: 1–8. doi:10.1016/j.ijoa.2020.04.006.

[20] Knigin, David, Alexander Avidan and Carolyn F. Weiniger. "The effect of spinal hypotension and anesthesia-to-delivery time interval on neonatal outcomes in planned cesarean delivery." Am J Obstet Gynecol 223 (2020): 747-e1.

[21] Jung H, Kwak K-H. Neuraxial analgesia: a review of its effects on the outcome and duration of labor. Korean J Anesthesiol. 2013;:65: 379–384. doi:10.4097/kjae.2013.65.5.379.