



Anesthetic management of obstetric patients with COVID-19: A scoping review

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ABSTRACT

Background: The SARS-CoV-2 virus is a novel beta corona virus that causes a severe acute respiratory syndrome. COVID-19 may cause severe illness and even death especially in patients with weakened immune system such as pregnant women. The obstetric patient suffering from COVID-19 requires special anesthetic care and presents several challenges for the anesthesia provider.

Methods: This scoping review was reported following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) extension for scoping review guidelines. A search of PubMed, Scopus, and Web of Science Databases was conducted. Additional information was retrieved by reviewing the reference lists from identified articles. The titles and abstracts of potentially relevant studies were screened before the retrieval of the full texts which were then examined to determine which studies met the eligibility criteria

Results: Three hundred and seventy-nine potentially eligible studies were identified. 360 records were excluded as they were either duplicates or did not meet the eligibility criteria leaving 19 articles discussing anesthetic management in obstetric patients with COVID-19.

Conclusion: The results of this scoping review suggest that general anesthesia, as an aerosol-generating procedure, should be avoided when possible in favor for regional anesthetic techniques when managing obstetric patients with COVID-19. To prevent the spread of infection, health care providers involved in labor or cesarean section delivery should utilize personal protective equipment and strictly adhere to infection control measures. Further studies with larger patient samples are required to shed light on the recommendations for anesthetic management for obstetric patients infected with COVID-19.

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1. Introduction

In December 2019, the first case of a new virus was reported in Wuhan, China. The “International Committee on Taxonomy of Viruses” named it the “Severe Acute Respiratory Syndrome Coronavirus-2”, or “SARS-CoV-2”, or as many people know it: COVID-19. COVID-19 is a fast-spreading virus. Transmission is via respiratory droplets within one meter of the site of generation [1]. Additionally, the transmission of the virus can happen from contaminated surfaces and the virus has been reported to spread from asymptomatic individuals. COVID-19 may cause severe illness and even death especially in a patient with a weakened immune system such as a pregnant woman. During the global COVID-19 outbreak, ensuring secure obstetric anesthesia services was considered critical with the constantly evolving risk requirements for COVID-19 cases [2]. The obstetric patient who suffers from COVID-19 requires special care especially those who develop severe respiratory disease. The challenges of anesthesia management for the obstetric patient with COVID-19 have several reasons: First, COVID-19 is a fast-spreading virus, and it is transmitted via

respiratory droplets which puts the staff at a high risk for contagion. Second, patients with severe respiratory diseases will be at higher risk for airway and respiratory complications. Third, the difficulty of making evidence-based clinical decisions in view of the lack of published evidence [1]. Accordingly, the responsibility of the anesthesia practitioner in this time of crisis is to provide safe anesthesia with the best possible outcome and establish an effective system of communication and workflow and dedicated management areas while minimizing staff exposure. In this study, we reviewed the recommendations for anesthesia management for pregnant women infected with COVID-19 presenting for labor delivery or cesarean section. Our major considerations included the choice of anesthesia, anesthetic management, and strategies to decrease the spread of infection.

2. Aim

The aim of this study was to provide an overview of evidence-based recommendations or expert opinions for anesthesia practitioners caring for obstetric

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patients during the COVID-19 pandemic with a focus on the choice of anesthesia, anesthetic management, and strategies to decrease the spread of infection.

3. Methodology

This scoping review was carried out according to the Current Recommendations of Cochrane Collaboration and reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) extension for scoping review guidelines [3].

4. Search strategy and study selection

Five researchers independently searched "PubMed", "Scopus", and "Web of Science" databases using the following strategy ["anesthesia" OR "anesthetic management"] AND ["obstetric" OR "pregnant" OR "pregnancy"] AND ["COVID-19" OR "SARS-COV-2" OR "coronavirus 2"], for all three databases. The search

was performed between December 1st and 28 December 2021. Publications in the English language and dating between 2019 and 2021 were included. Retrieval of additional information was achieved by reviewing the lists of references lists from the relevant articles. The number of included articles was 19 out of 379 retrieved articles. The titles and the abstracts of relevant articles were reviewed before retrieving the full texts. All five researchers examined the full articles to decide on the studies that met the specified inclusion criteria. Disagreements about the studies selected were resolved by discussion and consensus. After reviewing the reference lists of the retrieved articles an additional search was conducted through Google Scholar based on several criteria such as English language, full-text articles as well as articles related to anesthetic management for obstetric patients with COVID-19 but yielded no additional articles. Figure 1 shows the flow chart for study selection.

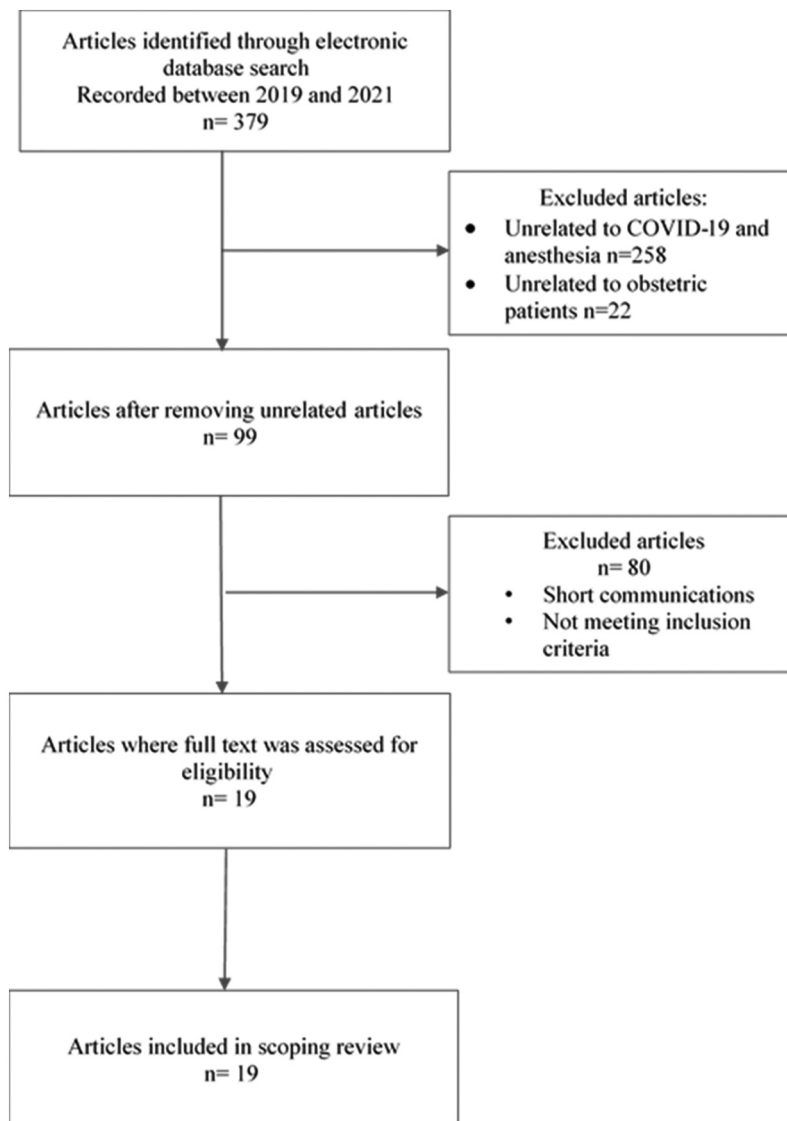


Figure 1. Flow chart for study selection.

4.1. Inclusion and exclusion

Inclusion criteria:

- Study design: “randomized controlled trials”, “systematic reviews”, “meta-analysis” “review article”, “clinical research report”, “case report”, “clinical report”, “case series”
- Population: Pregnant females suffering from COVID-19 undergoing cesarean section or normal delivery.
- Intervention: General or regional anesthesia or analgesia
- Outcomes:
 - Primary outcome: anesthetic management (choice of anesthesia, airway management, medications, etc ...)
 - Secondary outcome: prevention of infection spread

Exclusion criteria:

- Articles that were not published in English
- Unavailability of the full text
- Procedures other than cesarean section or labor.
- Irrelevance to anesthetic management

4.2. Extraction of data and analysis

A data extraction form was developed by the researchers and utilized to evaluate all included articles. The five researchers extracted the following data from eligible studies: Authors, year of publication, region, number of patients in the study (if applicable), characteristics of patients, intervention, and outcomes. Disagreements about the data extracted were resolved by discussion with the supervisor and consensus.

5. Search results

In total, 379 potentially eligible studies were identified through the initial literature search. Three hundred and sixty records were excluded as they were either duplicates or did not meet the inclusion criteria leaving us with 19 articles. Our secondary search of the reference lists of the 19 articles yielded no further records, thus a total of 19 articles ultimately met the inclusion criteria. Ten of the reviewed studies were review articles, narrative reviews, or state of the art reviews. 8 were case reports or clinical reports and one was a case series of 17 patients. The characteristics of the studies included in the review are displayed in [Table 1](#). A summary of the findings of the studies included in the scoping review is presented in [Table 2](#).

6. Discussion

This scoping review surveyed the literature on the anesthetic management of obstetric patients infected with COVID-19. Most of the studies included in the review advocated regional anesthesia as a safer option than general anesthesia to decrease the spread of infection and decrease the need for aerosol-generating procedures such as intubation and extubation. Additionally, complete airborne precautions were recommended in situations where general anesthesia was likely, such as emergency cesarean sections or difficult regional anesthesia (e.g., obesity, scoliosis, or a poorly working labor epidural).

Scoping reviews help to map the available literature. By reviewing the current literature, we found that there was a limited number of studies discussing the anesthetic management of obstetric patients infected with COVID-19, this is explained by the recency of the COVID-19 outbreak. Most of the reviewed studies were

Table 1. Characteristics of the studies included in the review.

First Author	Year	Region	Age	Primary Outcomes				Secondary Outcomes	
				Choice of Anesthesia	Anesthetic Management	Perioperative Medications	Postoperative Analgesia	PPE	Infection Control
S. Bampoe	2020	London	Adult	+	+	+	+	+	+
Kajal Jain	2020	India	Adult	+	+	∅	∅	+	+
Limin Song	2020	Wuhan	Adult	+	+	+	∅	+	+
Laurence E. Ring	2020	New York	Adult	+	+	+	+	+	+
Jennifer L. Harenberg	2019	Wuhan	Adult	+	+	+	+	+	+
Rong Chen	2020	Wuhan	Adult	+	+	+	∅	+	+
Venkata Ganesh	2020	India	Adult	+	+	∅	+	+	+
M. Alharbi	2021	Saudi Arabia	Adult	+	+	∅	∅	+	+
D. Bani Hani	2020	Jordan	Adult	+	+	+	+	+	+
Christopher Ryalino	2020	Indonesia	Adult	+	+	+	∅	+	+
J.S.E Lee	2020	Singapore	Adult	+	+	∅	∅	+	+
Omar Alyamani	2020	Saudi Arabia	Adult	+	+	+	∅	+	+
Rebecca Martinez	2020	New York	Adult	+	+	∅	∅	+	+
Yin Du	2020	Japan	Adult	+	+	∅	∅	+	+
Melissa E. Bauer	2020	New York	Adult	+	+	+	+	+	+
L. D'Souza	2021	Canada	Adult	+	+	+	+	+	+
Estella Morau	2020	France	Adult	+	+	+	∅	+	+
Alejandro Rodriguez	2020	Spain	Adult	+	+	+	∅	∅	∅
Anjolie Chhabra	2020	India	Adult	+	+	+	∅	+	+

+, mentioned in the study; ∅, not mentioned in the study

Table 2. Summary of study findings.

Authors	Study type	Primary Outcome	Secondary Outcome
Trikha, Ganesh and Bhatia, (2020)	Review article	Neuraxial block techniques should be considered as the first line against general anesthesia due to avoid aerosol-generating procedures (AGP).	Only necessary drugs and equipment should be inside the OR. Staff should wear fluid-resistant surgical masks, eye protection, gloves, fluid-resistant disposable gowns, and PPE.
Bani Hani et al., (2020)	Case report	Regional anesthesia is advised during the cesarean section for patients with COVID-19 as these techniques will reduce hemodynamic instability. Sedation should be avoided as respiratory depression could occur	The anesthesia team proceeds with the procedure by wearing PPE.
Al Harbi et al., (2021)	Case report	Early insertion of epidural is recommended to avoid the use of general anesthesia.	During regional anesthesia, all healthcare providers in OR must wear a surgical mask, gloves, eye protection, and gown. The number of health care providers present must be minimized.
Ryalino et al., (2020)	Review article	Spinal anesthesia is safer than general anesthesia to reduce the spread of infection.	Hand hygiene, personal isolation, and protection devices are necessary to reduce viral spread. Limitations to the entrance/exit movements of health care providers to control infection.
Harenberg et al., (2020)	Case report	The epidural block should be performed to relieve labor pain in patients with COVID-19. Preoperative antiemetics can be administered to patients who will undergo cesarean delivery to avoid vomiting. Potential for immunosuppression with corticosteroid use, dexamethasone should not be included in this patient	A patient with COVID-19 is placed in a negative pressure bed. PPE is required for all staff members who may be in direct contact with the patient.
Chen et al., (2020)	Case series (17 patients)	Combined spinal and epidural (CSE) or epidural is preferred to avoid GA. General anesthesia should be considered in case of maternal or fetal emergency, in patients with contraindications to epidural or CSE procedures, or in case of failure of spinal anesthesia.	For cesarean deliveries of a parturient with COVID-19, negative pressure operating rooms should be used. Appropriate PPE was used in various zones of the operating room.
Bampoe et al., (2020)	Review article	Neuraxial analgesia is recommended for labor to avoid risks associated with general anesthesia. No evidence of harm associated with the use of NSAIDs. Remifentanyl should be avoided in patients with low SpO ₂ .	The PPE is classified according to the risk of converting to general anesthesia. Equip the operating room with disposable equipment and essential anesthesia devices. Avoid auscultation in pre-operative assessment to reduce the spread of infection.
Ring et al., (2020)	Review article	Early placement of neuraxial labor analgesia is recommended. Using patient-controlled analgesia (PCA) with COVID-19 patient causes respiratory depression for the parturient and fetus. Nitrous oxide and single-shot spinal anesthesia techniques are not recommended. No evidence of harm of use NSAIDs.	Before entering the OR, the staff needs enough time to wear PPE. Cover the anesthesia machine and workstation to minimize infection spread. Use high-efficiency particulate air filters in the ventilator.
Limin et al., (2020)	Case report	Preparing vasoactive drugs for patients with possible hemodynamic changes.	The operating room should be under negative pressure. All staff should wear PPE and perform hand hygiene before and after the removal of PPE.
Jain et al., (2021)	Review article	Using NSAIDs for pain management is not recommended because it may aggravate COVID-19. No specific recommendation for choice between spinal, epidural, and CSE. Single-shot spinal anesthesia may be used to prolong the duration of postoperative analgesia. Performing rapid-sequence induction with a maximum dose of muscle relaxant. Avoid manual mask ventilation.	The OR should be in an isolated area with negative pressure. Air conditioning should be changed 25–30 times per hour. The temperature should be between 22°C–24°C. PPE should be available.
Morau et al., (2020)	Review article	An early epidural is performed for patients with mild to severe symptoms to decrease the incidence of respiratory depression. Neuraxial anesthesia is safer to decrease the chance of staff exposure to infection. Using NSAIDs and steroids could worsen COVID-19 symptoms. Rapid-sequence induction and intubation by video laryngoscopy to avoid aerosol generation.	Placing a hydrophobic filter between facemask and bag or between facemask and breathing circuit. Healthcare providers should wear FFP2 masks and PPE. Small tidal volumes are applied if manual ventilation is required.
Chhabra et al., (2020)	Case report	Use the subarachnoid block to reduce the chance of aerosolization. Ephedrine is used to treat hypotension. If general anesthesia is required, a video laryngoscope with disposable blades for intubation is preferred.	Level 3 PPE should be worn by the entire team The patient's face should be covered with an N-95 mask. Negative pressure should be available in the OR.

(Continued)

Table 2. (Continued).

Authors	Study type	Primary Outcome	Secondary Outcome
D'Souza et al., (2021)	State of art review article	Use of dexamethasone is advised in pregnant patients with COVID-19 requiring mechanical ventilation. Use of MgSO ₄ in preeclampsia, for fetal neuroprotection, and patients with respiratory distress. Low-dose aspirin may be used to prevent placental complications and low molecular weight heparin for thromboprophylaxis NSAIDs and N ₂ O can be used for labor analgesia. Opioids should be used in the absence of respiratory depression. Neuraxial analgesia and early epidural are favorable for Cesarean section.	Droplet precautions should be used by all staff and the patient should wear a surgical mask. Using a microbiological filter to prevent contamination of the gas inhalation system.
Rodriguez et al., (2020)	Case report	Hypertension is treated by labetalol, amlodipine, and captopril. Covid-19 can increase the risk of neurological complications and brain endothelial damage during pregnancy.	After the procedure, the infected patient is transferred to a hospital specialist for covid-19.
Lee et al., (2020)	Case report	Neuraxial anesthesia is preferred to improve the chances of success. Combined spinal-epidural is preferred if the surgery will be long to minimize the risk of conversion to general anesthesia. Rapid-sequence induction and intubation by video-laryngoscope are performed to maximize the chances of successful intubation, and face mask-ventilation is avoided.	Wearing an N95 mask, double gloves is advised. COVID-19 positive parturient patient should be placed under negative pressure (-2.5 Pa)
Alyamani et al., (2020)	Review article	During mechanical ventilation, using tidal volumes of 4–8 cc/kg is advised. Respiratory rate should be increased to maintain minute ventilation. Rapid sequence induction should be performed to minimize the risk of aspiration Ensure sufficient depth of anesthesia to avoid coughing during induction Using IV lidocaine before extubation to suppress airway reflexes	Keeping the airway carts outside the operative room, using disposable plastic covers for the anesthesia machine. Until pre-oxygenation, attach a HEPA or HMEF filter to the Y piece on the patient's side. Clamp the endotracheal tube if the disconnection is needed. The use of antiemetics may help minimize infection from vomiting.
Du et al., (2020)	Clinical report	Spinal anesthesia is superior in reducing maternal and neonatal complications. Tracheal intubation is one of the procedures with the greatest risk of infection by the virus	Spraying the operating room with 500 mg/L chlorine dioxide solution to kill the virus.
Martinez et al., (2020)	Review article	Fast neuraxial anesthesia administration can be a method of avoiding general anesthesia and the complications it entails. Provide non-invasive ventilation modes such as continuous positive airway pressure and high-flow nasal cannula.	The operating room should be on negative pressure airflow to minimize aerosolization.
Bauer et al., (2020)	Narrative review	The results showed that excessive hypotension occurred in 12 out of 14 cases with epidural anesthesia with COVID-19 – positive patients undergoing cesarean delivery. The authors recommended avoiding general anesthesia to prevent infection and avoiding the use of IV PCA opioids for the risk of respiratory depression and avoiding the use of ACE inhibitors.	High-flow nasal oxygen or noninvasive ventilation can be considered, but they are usually discouraged due to the risk of increased aerosolization.

OR = operating room, CSE = combined spinal epidural, GA = general anesthesia, PCA = patient control analgesia, NSAIDs = non-steroidal anti-inflammatory drugs, ACE = angiotensin-converting enzyme, AGP = aerosol generating procedures, PPE = personal protective equipment, HEPA = high-efficiency particulate absorbing, HMEF = heat and moisture exchanger, IV = intravenous.

review articles, clinical reports, case series, and case reports. On the other hand, there were obvious gaps in the number of randomized controlled trials, retrospective studies, and systematic reviews and meta-analyses.

6.1. Labor analgesia

For patients scheduled for labor epidural analgesia, most of the reviewed studies (11 out of 19 studies) advocated the early placement of an epidural catheter by an experienced anesthesiologist and its regular review to minimize the possibility of emergency conversion to general anesthesia if cesarean section became required. Trikha et al., (2020) and Ring et al., (2020) recommended assuring that the epidural catheter was well functioning at all times

and that, if any doubt existed as to the functioning of the catheter, it should be replaced immediately to avoid general anesthesia in case an emergency cesarean section was needed [4,5]. Furthermore, Lee et al., (2020) suggested that early placement of an epidural catheter provided the additional benefit of reducing the need to use N₂O and O₂ inhalation, thus further decreasing the spread of viral infection [2].

However, A meta-analysis of 1779 patients with COVID-19 performed by Lippi et al., (2020) observed that platelet counts were lower in patients with severe disease [6]. Moreover, 3 studies including a total of 249 patients suggested that a platelet count of less than 100,000 x 10⁶/L was reported in 6.6% of patients with COVID-19 [7]. Accordingly, checking the platelet count before the placement of the epidural catheter and before

its removal was strongly recommended in several of the reviewed studies for patients with severe COVID-19. On the other hand, asymptomatic patients and patients with mild symptoms did not require such laboratory testing before epidural placement [1,8,9].

Additionally, Ring et al., (2020) emphasized that patients with moderate to severe COVID-19 symptoms receiving labor epidural analgesia required close monitoring with a pulse oximeter and that insertion of an arterial line was recommended in some cases to analyze arterial blood gases frequently. The authors further pointed out that temperature monitoring was important as the development of fever in these patients was an indicator of worsening outcomes for the mother and the baby [5].

6.2. Cesarean section delivery

For patients infected with COVID-19 undergoing cesarean section delivery, our results showed that most studies advocated the use of regional anesthesia as a safer alternative to general anesthesia to decrease the spread of infection and the need for aerosol-producing procedures such as mechanical ventilation and airway manipulation. Additionally, the use of regional anesthesia was also preferred by several authors as it reduced hemodynamic instability such as cardiopulmonary compromise caused by the stress of labor and respiratory depression. These studies suggested prolongation of the effect of spinal anesthesia by adding adjuvants (e.g., clonidine), increasing the concentration of local anesthetics, and/or increasing the volume or rate of the infusion [5,10].

On the other hand, a study carried out in Wuhan, China, describing outcomes in seventeen COVID-19 positive women undergoing cesarean section delivery, concluded that “excessive hypotension” was reported in 12 out of 14 cases who received epidural anesthesia compared to 3 women receiving general anesthesia; however, the authors did not report on the blood pressure trends or the use vasopressors [11]. Contrastingly, a larger case series of 45 patients receiving spinal anesthesia for cesarean delivery was well tolerated and blood pressure was stable [12].

Although most articles recommended the use of neuraxial blockade techniques as a first-line choice for patients with COVID-19 (18 articles out of 19 articles), certain cases may present where regional anesthesia is difficult such as in case of scoliosis or obesity or in case of a poorly functioning labor epidural or in emergency cesarean section. In these, cases rapid-sequence induction and intubation by an experienced anesthesiologist using a video-laryngoscope is recommended after pre-oxygenation with 100% oxygen. Adequate depth of anesthesia should be ensured, and the maximum dose of a neuromuscular blocking agent should be administered to avoid coughing during intubation. Additionally, manual mask ventilation should be avoided, and the distribution of contaminated aerosol should be limited by extubating

under an acrylic transparent box or clear plastic drapes after clamping the ETT. [1,5,13] Lee et al., (2020) and Trikha et al., (2020) further recommended that, when applying manual positive pressure mask ventilation, smaller tidal volumes should be used [2,4].

In a case series of 17 patients, Chen et al. (2020) recommended the use of 8% sevoflurane in 100% oxygen with continuous cricoid pressure and preoxygenation with positive pressure ventilation, accompanied by intravenous injection of 2% lidocaine, remifentanyl, and succinylcholine to ensure optimum intubating conditions and that sufentanil and propofol could be used to preserve anesthesia after the delivery [11]. On the other hand, Rodriguez et al., (2020) recommended anesthesia induction with propofol 200 mg and rocuronium 100 mg and administering fentanyl 300 mcg after the delivery of the fetus and maintaining anesthesia with sevoflurane [14].

In contrast to most authors who advocated regional anesthesia for cesarean section in patients diagnosed with COVID-19, Ryalino et al., (2020), and Morau et al., (2020) suggested that general anesthesia may become important if the obstetric patient’s respiratory function deteriorated or during an emergency cesarean delivery due to poor maternal status [15,16]. Similarly, Limin et al., (2020) highlighted that general anesthesia provided the advantage of ensuring a secure airway but it also requires mechanical ventilation, which can exacerbate lung injury [17].

Furthermore, Bauer et al., (2020) indicated that, as acute respiratory distress syndrome was one of the more severe complications affecting COVID-19 patients, lung-protective strategies for ARDS should be implemented including low tidal volumes (6 mL/kg based on expected body weight), plateau pressure of 30 cmH₂O, and a combination of the reduced fraction of inspired oxygen (FiO₂) and increased positive end-expiratory pressure (PEEP). Additionally, as pregnant patients have a physiological decrease in partial pressure of carbon dioxide, the authors recommended maintaining a PaCO₂ of 28–32 mm Hg [8].

6.3. Perioperative anesthesia management

Postpartum pain management is one of the important aspects of anesthetic management for obstetric patients. Out of the 19 reviewed articles, 6 reports suggested avoiding the use of NSAIDs for pain relief following cesarean section as it may aggravate the course of COVID-19 infection. On the other hand, 3 of the 19 articles indicated no evidence supporting the avoidance of NSAIDs in post-cesarean pain. Bauer et al., (2020) suggested that using ketorolac or ibuprofen as analgesics was safe for women with mild or no symptoms of COVID-19 [8]. Contrastingly, Ganesh et al., (2020) advocated avoiding the use of these drugs as they may worsen COVID-19 infection [4]. Additionally, 6 out of the 19 reviewed articles suggested that intravenous and epidural opioids should be used

with caution for fear of respiratory depression and that they should be avoided in patients with O₂ saturation lower than 95% to avoid the risk of respiratory depression and nausea and vomiting.

The use of Nitrous oxide for labor analgesia in COVID-19 was discussed by several of the reviewed articles. Four out of 19 articles suggested that nitrous oxide could be used for labor analgesia with the use of a single-patient microbiological filter and while using PPE. On the other hand, Bampoe et al., (2020) considered that the use of N₂O analgesia was unnecessary for confirmed or suspected COVID-19 patients as its method of administration added to the risk of infection of the staff caring for the patient [1].

Several drugs are often indicated to manage conditions and complications that may arise in the peripartum period. The safety of these drugs in obstetric patients infected with COVID-19 was discussed by several of the reviewed articles. D'Souza et al., (2021) suggested that magnesium sulfate may be used for seizure prophylaxis, fetal neuroprotection, or for women with respiratory distress [9]. Similarly, Bauer et al., (2020) considered MgSO₄ to be beneficial in preventing respiratory depression and for its nervous system impacts [8]. Ring et al., (2020) and D'Souza et al., (2021) recommended phenylephrine for intraoperative hypotension in pregnant women with COVID-19 [5,9] while Alyamani et al., (2020) recommended not using Hydroxyethyl starches in resuscitation for these patients [18]. Furthermore, 4 out of 19 articles supported avoiding the use of dexamethasone because of the risk of immunosuppression, while D'Souza et al., (2021) recommended dexamethasone for the treatment of pregnant patients with COVID-19 under mechanical ventilation or needing supplemental oxygen [9]. Additionally, Harenberg et al., (2020) advised using prophylactic antiemetics to avoid the risk of aerosolization caused by vomiting [19] and D'Souza et al., (2021) suggested that the use of low-dose aspirin to inhibit placental complications was safe [9].

6.4. Infection control measures (PPE and operating room preparation)

In addition to the challenges of administering anesthesia to a patient infected with a respiratory virus, care must be taken to minimize the spread of infection to the members of the healthcare team and other patients. Personal protective equipment (PPE) is specialized clothing and equipment worn for protection and for preventing the spread of infection. Gloves, gowns, aprons, goggles, and face masks are among the items that may be used as PPE. Other than PPE, several measures can be used in the OR environment to minimize the spread of the virus. This includes having a separate operating room with a negative pressure of 2.5 Pa before surgery on COVID-19 patients whether assumed or documented, as well as

using the same room and anesthesia machine for all cases of COVID-19 during the time and using single-use devices such as disposable laryngoscope blades [8].

Out of the 19 records included in our study, 18 studies described the use of infection control methods and PPE for parturients infected with COVID-19 undergoing cesarean section or vaginal delivery. Jain et al., (2020) recommended that the operating room temperature should be maintained between 22 and 24 degrees Celsius and that a minimum number of workers should be present when removing the endotracheal tube to prevent contact with aerosols [13]. Moreover, the authors advocated limiting the dissemination of contaminated aerosol by extubating under an acrylic translucent box or clear plastic drapes and that following extubation the patient should be instructed to wear an N-95 mask with oxygen administered via a nasal cannula from below. Bauer et al., (2020) proposed that, since neuraxial labor analgesia placement is not an aerosol-generating technique, the likelihood of COVID-19 transmission to the anesthesiologist during its administration was minimal [8]. The authors added that all medical personnel in the operating room should wear contact (impervious gown and gloves) and droplet protection (surgical mask and eye protection).

Additionally, Harenberg et al., (2020) recommended that the anesthesia machine should be fitted with a heat and moisture exchanger between the circuit and the patient's airway to prevent the virus from entering the internal parts of the machine and to subsequently prevent pathogen transmission to other patients [19]. Furthermore, Al Harbi et al., (2021) highlighted the importance of hand hygiene before and after coming into touch with the anesthesia system and equipment as well as shielding the anesthesia system and other work surfaces with disposable plastic covers. The authors also advocated the use of disposable or single-patient tracking devices wherever possible (e.g., pulse oximeter, BP cuff, etc.) [20]. Similarly, Chhabra et al., (2020) stated that anesthesia providers should wear three layers of gloves which include sterile gloves on top of the two pairs provided by PPE [21]. Again, Martinez et al., (2020) and Du et al., (2020) recommended the use of full airborne precautions when providing general anesthesia for cesarean section in patients infected with COVID-19. This includes filtering face-piece type 3, eye cover, apron, fluid-resistant disposable gown, and gloves. When cesarean section was performed under neuraxial anesthesia, the authors recommended droplet precautions while assessing the risk of conversion to general anesthesia. [22,23]

7. Limitations

When evaluating the findings of this scoping review there are some limitations to consider. The corona virus disease is a relatively new disease, hence the difficulty in finding information and the scarcity of

randomized controlled trials. This resulted in difficulty in identifying high levels of evidence and reliance on case reports and expert opinions as sources of recommendations. By reviewing the current literature, evidence regarding the avoidance of certain drugs such as NSAIDs, dexamethasone, and opioids for COVID-19 patients is still limited and requires further investigation.

8. Conclusion

COVID-19 remains a new territory for anesthesia practitioners which necessitates further studies on larger patient populations to obtain strong evidence-based recommendations. This scoping review suggests that general anesthesia, as an aerosol-generating procedure, should be avoided when possible in favor for regional anesthetic techniques when managing obstetric patients with COVID-19. To prevent the spread of infection, all health care providers involved in labor or cesarean section delivery should utilize personal protective equipment and strictly adhere to infection control measures. Obstetric patients go through distinct physiological changes, and evidence of the effect of COVID-19 on pregnant patients is growing but still insufficient. To shed light on concerns and guidelines in obstetric anesthesia management during the COVID-19 pandemic, we recommended further studies on larger patient samples.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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