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Our anesthesia experiences in COVID-19 positive patients delivering by cesarean section: A retrospective single-center cohort study

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Abstract

Aim: Pregnancy increases susceptibility to respiratory complications of viral diseases. This study aims to evaluate our anesthesia practices in pregnant women with COVID-19 undergoing cesarean section.

Methods: A total of 61 patients who underwent cesarean section and had positive Polymerase chain reaction (PCR) testing for COVID-19 with nasopharyngeal swabs were included in the study. Patient demographics and information about anesthesia were analyzed retrospectively from the patient medical files.

Results: A total of 61 parturients undergoing cesarean section that had positive SARS-CoV-2 PCR tests were assessed. General anesthesia was applied to only three patients (4.9%), while spinal anesthesia was administered to the remaining 58 patients (95.1%). The incidence of hypotension was 25.9% in the spinal anesthesia group. Forty-one (67.2%) parturients were asymptomatic. While the rate of pneumonia in symptomatic patients was 45% (9/20), the pneumonia incidence among all SARS-CoV-2 PCR (+) parturients was 14% (9/61). Three (4.9%) COVID-19 patients required intensive care in the perioperative period. The overall mortality rate was 1.6% (1/61) among parturients with COVID-19 undergoing cesarean section, while it was 11.1% (1/9) in patients with pneumonia.

Conclusion: It was observed that COVID-19 is associated with mortality in pregnant women undergoing cesarean section. Spinal anesthesia was safely and effectively administered in COVID-19 parturients, especially in patients with pneumonia.

Key words: anesthesia, cesarean section, COVID-19, pneumonia.

Introduction

Coronaviruses (CoV) are a large family of viruses that can cause consequences ranging from mild self-limiting infections—which are common in society, such as the common cold—to more serious infections, such as Middle East respiratory syndrome (MERS) and severe acute respiratory syndrome (SARS). At the end of 2019, a new CoV named SARS-CoV-2 causing COVID-19 was detected in China. The World Health Organization (WHO) declared this easily spreading disease as a global epidemic on March 11, 2020, due to the emergence of COVID-19 cases in 113 countries other than China, where the first epidemic occurred.[1] During the writing process of this paper, there were more than 84 233 579 confirmed cases, and approximately 1 843 293 deaths were reported to WHO.[2]

Physiological changes in the immune and cardiopulmonary systems in pregnant women may increase the severity of illness when infected with respiratory

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viruses.[3] In 2009, pregnant women constituted approximately 1.0% of patients infected with H1N1-subtype influenza-A and accounted for 5.0% of all H1N1-related deaths.[3] While the SARS mortality rate was 10.5% in the general population, it was reported to be 25.0% for pregnant women.[4] Both SARS-CoV and MERS-CoV infections were known to be responsible for serious complications during pregnancy, including endotracheal intubation, intensive care unit (ICU) admission, renal failure, and death.[4,5] To date, there is no information to suggest that pregnant women are more susceptible to COVID-19.[6] Additionally, there is no clear evidence that SARS causes an intrauterine infection leading to congenital disease. Still, it is difficult to conclude on this issue due to the limited number of cases.[7–9]

This study aimed to evaluate the demographic data of COVID-19 patients undergoing cesarean section, our anesthesia practices, complications, and conditions of neonates, and to summarize up-to-date information on COVID-19 in obstetric anesthesia.

Methods

After the approval of the protocol by the institutional ethics committee and registration on www.clinicaltrials.gov (NCT04691934), the study was carried out with the principles of the Helsinki Declaration.

Parturients who underwent cesarean section and had positive polymerase chain reaction (PCR) test for COVID-19 with nasopharyngeal swabs were included in this retrospective, observational, single-center cohort study. Patients who were clinically suspected (such as a clinical situation or travel history) but tested negative for COVID-19 were excluded from the study. According to the hospital's protocol, PCR test was not performed on all elective and emergency pregnant women to be taken for cesarean section. Only patients who were symptomatic or clinically suspected were applied a COVID-19 test. All patients' demographic and medical data were analyzed from the patient files.

Statistical analyses were performed with SPSS 21 Windows (Statistical Package for Social Sciences, Armonk, NY, USA) package software. Continuous data were expressed in mean ± standard deviation, while categorical data were expressed in numbers (percent). Spearman's correlation test was used for correlation analysis. The value of $p < 0.05$ was considered statistically significant.

Results

A total of 97 parturients clinically suspected for COVID-19 were evaluated, and 36 patients were excluded after testing negative for COVID-19. The remaining 61 patients with positive SARS-CoV-2 PCR tests were included in the study and further statistical analysis. Patients' demographics are shown in Table 1, and laboratory findings are presented in -Table 2. The hematocrit levels of 29 patients (47.5%) were below 33%. The platelet counts of two patients were below 100 000/mm^3. General anesthesia was applied to the patient with a platelet count of 79 000/mm^{3,} and spinal anesthesia was performed on the patient with a platelet count of 90 000/mm^3. The lymphocyte count of one patient was below 1000/mm^3.

All patients were operated in surgery rooms reserved for COVID-19 patients. The whole team was equipped with Level-3 personal protective equipment (PPE) (liquid-proof apron, N-95 mask, goggles, visor, and overshoes). Anesthesia was administered by two healthcare professionals from the anesthesia team, including an experienced anesthesiologist and an

TABLE 1 Demographic data of the patients

	$n = 61$
Age, year, mean ± SD	29.83 ± 6.23
Gestational age, week, mean ± SD	37.33 ± 2.45
Parity, *n* (%)	
Nulliparity	8 (13.1)
Multiparity	53 (86.9)
Coexisting disorders, *n* (%)	
Pneumonia	9 (14.8)
Placental abnormalities[a]	4 (6.6)
Preeclampsia	1 (1.6)
Hypertension	2 (3.3)
Type I diabetes mellitus	1 (1.6)
Gestational diabetes mellitus	1 (1.6)
Thyroid cancer	1 (1.6)
Acute cholecystitis	1 (1.6)
Acute pyelonephritis	1 (1.6)
Urinary tract infection	1 (1.6)
ASA, *n* (%)	
II	52 (85.2)
III	9 (14.8)
Emergency operation, *n* (%)	54 (88.5)
Elective operation, *n* (%)	7 (11.5)

Abbreviation: ASA, American Society of Anesthesiologists. and
[a]Placental abruption and placenta previa.

assistant anesthesia nurse. A third anesthesia assistant was kept readily outside the operating room in case of any need. After the end of the surgery, the patients were transferred to the COVID-wards or COVID-ICUs.

The spinal anesthesia rate for COVID-19 pregnant women was 95.1% ($n = 58$). The subarachnoid blocks were performed by injecting 10 mg of heavy bupivacaine and 20 mcg of fentanyl with a 25G spinal needle through the $L_{3\text{-}4}$ or $L_{4\text{-}5}$ intervertebral spaces. The need for ephedrine emerged in 15 patients (25.9%). No vomiting or failed block occurred in any of the patients. A 42-year-old patient in the 34th gestational week with pneumonia was transferred to the ICU after cesarean section delivery under spinal anesthesia. Although the patient received high flow nasal oxygen for three days in ICU, she was intubated due to refractory hypoxemia. The patient received mechanical ventilatory support for 68 days and was then discharged from the ICU 108 days after her admission.

General anesthesia was performed in only three (4.9%) patients. A 31-year-old, 33-week pregnant patient with a low platelet count was taken to emergency cesarean section due to placental abruption and non-reassuring fetal status, and general anesthesia was applied. This patient was transferred to the obstetrics ward after the surgery. The second patient was a 33-year-old and 36-week pregnant woman and received general anesthesia due to her serious cardiac condition. She had an aortic coarctation, bicuspid aortic valve, and underwent coronary stent insertion five years ago. The patient was transferred to the obstetrics ward after one day of postoperative follow-up in the ICU. The third patient has been followed up in ICU under mechanical ventilatory support due to severe COVID-19 pneumonia. She was a 35-year-old and 28-week pregnant woman with preeclampsia referred to the ICU due to respiratory distress. On the day of her admission to the ICU, the patient was intubated because of severe dyspnea, and then an emergent cesarean delivery was decided on the same day. The patient died after 10 days of ICU follow-up due to clinical worsening. There was no need for ephedrine in any of the three patients who underwent general anesthesia. In general anesthesia, rapid sequence intubation was performed using propofol and rocuronium as induction agents, and fentanyl and sevoflurane were administered after cord clamping. Except for the patient with severe

TABLE 2 The results of the laboratory analysis

Laboratory findings	$n = 61$
Hemoglobin, g/dL	11.16 ± 1.84
Hematocrit, %	33.34 ± 4.79
White blood cell, mcL	8.16 ± 4.20
Lymphocyte, $\times 10^{-3}$ mL	16.99 ± 11.51
Platelet, mcL	227.78 ± 77.72
Aspartate aminotransferase, U/L	28.05 ± 21.11
Alanine aminotransferase, U/L	17.06 ± 13.88
Blood urea nitrogen, mg/dL	7.12 ± 3.99
Creatine, mg/dL	0.67 ± 0.75
C-reactive protein, mg/dL	2.16 ± 2.44
Fibrinogen, mg/dL	456.40 ± 144.41
D-Dimer, ng/mL	3.00 ± 2.24
Ferritine, ng/mL	53.66 ± 78.02

TABLE 3 Characteristics of the patients transferred to the intensive care unit

	Case-1	Case-2	Case-3
Age, year	42	35	33
Coexisting disorders	None	Pre-eclampsia	Aortic coarctation, bicuspid aortic valve
Parity	Multiparity	Multiparity	Multiparity
Gestational age, week	34	28	36
Anesthesia type	Spinal anesthesia	General anesthesia	General anesthesia
Newborn babies			
Gender	Female	Female	Male
Weight, kg	2650	920	3650
APGAR (1–5 min)	7–9	4–7	9–10
Mechanical ventilation time, day	68	9	0
Length of stay in intensive care, day	108	10	1
Final situation	Discharged	Died	Discharged

Abbreviation: APGAR, Appearance, Pulse, Grimace, Activity, and Respiration.

TABLE 4 Comparison of patients in terms of pneumonia

	Patients with pneumonia ($n = 9$)	Patients without pneumonia ($n = 52$)
Age, year	33.22 ± 4.23	29.25 ± 6.36
Gestational age, week	35.16 ± 4.03	37.71 ± 1.87
Hematocrit, %	34.52 ± 5.96	33.14 ± 4.60
Lymphocyte, $\times 10^{-3}$ mL	26.587 ± 25.493	15.458 ± 6.626
D-dimer, ng/mL	4.22 ± 3.04	2.80 ± 2.05
Ferritine, ng/mL	145.16 ± 156.53	36.85 ± 35.88
Fibrinogen, mg/dL	449.40 ± 218.94	457.74 ± 128.79
C-reactive protein, mg/dL	2.86 ± 2.86	2.03 ± 2.36

TABLE 5 Characteristics of newborn babies

	$n = 62$
Gender, *n* (%)	
Female	30 (48.4)
Male	32 (51.6)
Weight, kg, mean ± SD	3381.29 ± 2286.44
APGAR score, *n* (%)	
1, minute	
≤7	6 (10)
8–10	54 (90)
5, minute	
≤7	2 (3.3)
8–10	58 (96.7)
Need for neonatal intensive care, *n* (%)	10 (16.1)

Abbreviation: APGAR, Appearance, Pulse, Grimace, Activity, and Respiration.

pneumonia, sugammadex was applied to the other two patients, and they were extubated in the operating room without any problem. The characteristics of patients transferred to the ICU are shown in Table 3.

Forty-one patients (67.2%) were asymptomatic, and 20 (32.8%) patients were symptomatic in the preoperative period. Of all the 61 pregnant women, 16 (26.2%) had a history of close contact with COVID-19 positive patients. The overall symptoms were fever (four patients; 6.6%), coughing (eight patients; 13.1%), and dyspnea (six patients; 9.8%). The chest tomography imaging was performed on 17 (27.9%) patients. The rate of pneumonia was 14.8% (9/61) in all patients and 45% (9/20) in symptomatic patients. The data of patients with pneumonia are presented in Table 4. Of the patients with pneumonia, one patient had diabetic ketoacidosis, one patient had preeclampsia, one patient had aortic coarctation, and the other six patients had no concomitant diseases. The requirement for postoperative ICU follow-up was 4.9% (3/61) in all parturients positive for COVID-19, 15.0% (3/20) in symptomatic patients, and 33.3% (3/9) in pregnant women with pneumonia. The mortality rate was 1.6% (1/61) in all patients, 5.0% (1/20) in symptomatic patients, and 11.1% (1/9) in patients with pneumonia.

The mean length of hospital stay was 7.83 ± 14.99 (min–max, 2–118) days. Three patients' length of hospital stay times was significantly longer than the other patients. Two of these patients, who were followed up in the obstetrics ward had severe anemia and transfused blood products. The length of hospital stay times of these two patients were 25 and 26 days. Since one patient has been followed up for 108 days in ICU, this patient's length of hospital stay was the longest (118 days). Correlation analysis for the length of hospital stay revealed a significant negative correlation with hemoglobin levels ($r = -0.259$, $p = 0.044$), hematocrit levels ($r = -0.309$, $p = 0.015$), fibrinogen levels ($r = -0.351$, $p = 0.008$) and the week of gestation ($r = -0.306$, $p = 0.016$), and a significant positive correlation with age ($r = 0.298$, $p = 0.020$). There was no correlation between C-reactive protein, white blood cell, thrombocyte, lymphocyte, d-dimer, and ferritin levels with the length of hospital stay.

The neonates' demographic variables are shown in Table 5. One of the cesarean sections was a twin pregnancy. No congenital anomaly was observed in any of the newborns. All newborns tested negative for COVID-19 with nasopharyngeal swabs. Two intrauterine fetal deaths occurred (3.2%). Data from these two patients were excluded from the assessment of Appearance, Pulse, Grimace, Activity, and Respiration (APGAR) scores. One of these patients was a 45-year-old and 36-week pregnant woman with gestational diabetes mellitus. The other patient was a 32-year-old and 29-week pregnant woman with COVID-19 pneumonia admitted to the hospital with diabetic ketoacidosis due to type-I diabetes mellitus.

No subsequent COVID-19 infection was observed in any member of the anesthesiology or surgical team involved in the operations of these patients.

Discussion

The incidence of COVID-19 is increasing day by day among pregnant women, as in every part of the

world. In this study, 67.2% of 61 COVID-19 positive obstetric patients were asymptomatic, while 45% of the symptomatic pregnant women were presented with pneumonia. The requirement for ICU was detected as 33.33%, and the mortality rate was 11.11% in pregnant women with pneumonia.

The diagnosis of COVID-19 itself is not accepted as a contraindication for regional anesthesia.[10] Chen et al.[11] applied general anesthesia to three of 17 COVID-19 positive patients undergoing cesarean section, and the remaining 14 patients received epidural anesthesia. While no hypotension was observed in the general anesthesia group; the hypotension rate was as high as 86% in the epidural group.[11] In our study, three of 61 patients were given general anesthesia. Intraoperative ephedrine was not required in any of the patients who underwent general anesthesia, among whom one patient was intubated, and the other was monitored with an oxygen mask in the ICU postoperatively. Our rate of spinal anesthesia was 95.1%, and the requirement for ephedrine emerged in 25.9% of the patients. The low rate of hypotension may be due to the differences in the definition of hypotension. We considered a decrease of more than 20% in systolic arterial pressure than the initial value as hypotension. In the study of Chen et al.,[11] all of the patients undergoing general anesthesia were emergency patients while the epidural group consisted of elective patients. In our study, 88.5% of the cases were emergency patients. A previous study conducted in our hospital found the rate of regional anesthesia as 78.5% and spinal anesthesia as 76.2% in emergency cesarean patients.[12] This study revealed that our rate of spinal anesthesia during the COVID-19 outbreak had reached 95.1%.

A review of the literature showed that most obstetric patients were asymptomatic at the time of admission or had COVID-19-like symptoms (fatigue, muscle pain, shortness of breath, congestion, etc.), which can be easily confused with common pregnancy symptoms.[13–15] In this study, 67.2% of our COVID-19 positive patients included were asymptomatic. We could not detect many of the asymptomatic patients since we could not perform PCR tests on all patients undergoing cesarean delivery. Therefore, we think that the number of asymptomatic patients should be higher than 67.2%.

Zhang et al.[16] reported unilateral pneumonia at a rate of 50%, bilateral pneumonia at a rate of 33%, and severe pneumonia in only one patient out of 18 pregnant women in the third trimester, and there was no mortality in their case series. The authors reported better outcomes in COVID-19 infection compared to SARS and MERS in pregnant women and neonates.[16] Alfaraj et al.[5] analyzed two of their pregnant patients with MERS-CoV and 11 pregnant patients who had MERS-CoV in the literature between 2012 and 2016. Seven of these patients required intensive care, while three pregnant women and two of the newborns died.[5] An analysis of 38 pregnant women with COVID-19 reported that none of the patients had severe pneumonia and mortality.[17] Among our patients, 14.8% of 61 pregnant women with COVID-19, had pneumonia and 4.9% required intensive care. One ICU patient was followed by an oxygen mask, the second with intubation, and the third by intubation after high flow nasal oxygen for three days.

Our mortality rate was 1.63% in all patients, while it was 5% in patients presenting with symptoms and 11.11% in patients with pneumonia. If we had performed PCR tests on all patients who had a cesarean delivery, we could have found a lower overall mortality rate with the increase in the number of asymptomatic patients. Juan et al.[8] reported seven maternal deaths in a review of 324 pregnant women with COVID-19 infection and reported the frequency of serious pneumonia in pregnant women as 0%–14%. In the study of Chen et al.,[11] one of the first articles on pregnant women at the beginning of the pandemic, all patients had chest tomography scans, in which all were compatible with pneumonia. Among our patients, the rate of chest tomography was 27.9%, whereas the rate of pneumonia was 14.8% in all patients, and the rate of pneumonia in symptomatic pregnant women was 45%. Our rate of pneumonia was quite low when compared to the study of Chen et al.[11] and similar ratio according to Juan et al.[8]

Chen et al.[11] emphasized that 14 patients had a hospital stay of 6–13 days. In our study, the length of hospital stay was found as 7.67 ± 13.77 days. We found a significant negative correlation with hemoglobin levels, hematocrit levels, fibrinogen levels, and gestational week for the length of hospital stay and a significant positive correlation with age.

Zhong et al.[18] retrospectively analyzed 49 patients with radiologically confirmed COVID-19 who received spinal anesthesia, among whom 45 patients underwent cesarean section and four lower-limb surgery, and the anesthesiologists who performed spinal anesthesia for these patients. PCR confirmed COVID-19 infection in five of 44 (11.4%) anesthetists performed spinal anesthesia using Level-3 PPE. Lucas et al.[19]

reported that most of the transmissions could be prevented by wearing and removing PPE correctly. Also, in our study, all anesthetists used Level-3 PPE, and none of them became infected afterward. The absence of infection in anesthetists performing cesarean section indicates that the risk of transmission can be reduced with appropriate PPE and regional anesthesia. However, even if these anesthesiologists had been infected, it would not have been possible to tell where they got the infection since they work in several units in our hospital.

Schwartz et al.[17] reported that comorbid diseases (preeclampsia, pregnancy-induced hypertension, gestational diabetes, uterine atony, etc.) do not pose a risk for intrauterine transmission SARS-CoV-2 to the fetus. They also found no association between 30 and 40 weeks of gestation and mother-to-child transmission.[17] Juan et al.[8] reported four intrauterine fetal deaths and two neonatal deaths in their systematic review. No COVID-19 infection or congenital anomaly was detected in any of our newborns. Of these newborns, 16.1% needed neonatal intensive care. Our intrauterine fetal mortality rate was 3.22%. Of two intrauterine fetal deaths, both of the mothers had diabetes, and these parturients were constituted the whole number of patients with diabetes included in our study. The effect of diabetes, a hyperinflammatory condition, on patients with COVID-19 has not yet been clearly demonstrated in the literature.[20] Further pregnant cases with diabetes need to be evaluated to understand better the relationship between diabetes and COVID-19 on the fetus.

The inability to apply PCR tests on all patients could be considered among our main limitations. Changes in nationwide treatment policies at the beginning and end of the pandemic may have affected the length of hospital stay. As the pandemic progressed, the number of patients receiving home treatment has increased throughout the country. A literature review about COVID-19 in obstetric anesthesia mostly reveals editorial articles, reviews, or case reports. Our study presented anesthesia experiences only in SARS-CoV-2 positive obstetric patients and it comprised a relatively higher number of patients than other studies published. In this regard, our study bears significant value.

In conclusion, pregnant women infected with COVID-19 should be managed by expert teams in a multidisciplinary hospital, and all healthcare professionals involved in the cesarean section should pay attention to the use of Level-3 PPE equipment. As it is known, regional anesthesia becomes more prominent in pregnant women with COVID-19 due to the increase in the risk of contamination and morbidity in general anesthesia. We believe that the number of asymptomatic patients is higher than 67.2% in obstetric patients, so it is necessary to perform PCR tests in the preoperative period. Our mortality rate is 11.11% in patients with pneumonia. It is seen that symptomatic pregnant women need careful monitoring against the development of pneumonia. We also observed that no transmission occurs from mother to baby via the umbilical cord, even in symptomatic patients with severe pneumonia. We think that spinal anesthesia can be used effectively and safely in COVID-19 positive obstetric patients, especially in patients with pneumonia.

Conflict of Interest

None declared.

Data availability statement

Data available on request due to privacy/ethical restrictions

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