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Anesthesia management for Cesarean delivery in pregnant women with coronavirus disease 2019

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Abstract

Aim: The aim of this study to evaluate our anesthesia experiences and the effect of anesthesia methods performed on maternofetal outcomes in pregnant women diagnosed with COVID-19 who underwent caesarean delivery.

Materials and Methods: In this retrospective and cross-sectional study, 67 pregnant women with COVID-19 infection and had a caesarean delivery in our hospital between 01.04.2020-01.01.2021 were included. Age, body mass index score, gestational week, previous cesarean history, comorbidity, symptoms, laboratory values and radiological images were recorded. Type of anesthesia, emergency or elective cesarean was reported. Hospitalization time, complications, need for high frequency oscillation ventilation, continuous positive airway pressure, mechanical ventilation, intensive care unit need and mortality were evaluated. Gender, height, weight, APGAR scores, premature birth and fetal death were recorded.

Results: The mean age of the patients was 30.9±6.5 years and the body mass index value was 31.7±2.8. The preterm delivery occurred in 25 patients (37.3%). Four (6%) pregnant women had intrauterine ex fetus. Spinal anesthesia was performed to 61 patients (91.0%) and general anesthesia was performed to 6 patients(9.0%). In the pre-cesarean period, 33 patients were asymptomatic (49.3%), 9 patients had fever(13.4%), 32 patients had cough(47.8%), 25 patients had dyspnea(37.3%) and 15 patients had tachypnea(22.4%). Thirty-seven (55.2%) patients had lung involvement on computed tomography. Twenty-one (31.3%) patients needed ICU admission. Mortality occurred in 4(5.98%) pregnant women. Further analysis patients undergoing general anesthesia had a higher need for ICU, HFOV, CPAP and invasive mechanical ventilation and a higher maternal mortality rate.

Conclusions: Spinal anesthesia is safer for pregnant women with COVID-19 than general anesthesia in terms of maternal and neonatal health. Especially in pregnant women with COVID-19 with pulmonary involvement, general anesthesia should be avoided as much as possible, as it may increase the likelihood of requiring invasive mechanical ventilation, exacerbation of respiratory symptoms and cause more respiratory complications.

Introduction

Coronavirus disease 2019 (COVID-19) is a fatal disease characterized by severe pneumonia and acute respiratory distress syndrome (ARDS) caused by Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-COV-2), an RNA virus [1]. In a report published by the World Health Organization (WHO), although COVID-19 is seen mostly at a young age and asymptomatic, it is stated that those with chronic diseases such as cardiovascular disease, diabetes, chronic respiratory disease, hypertension, malignancy and the elderly are in the risk group [2]. Also, it was reported that pregnancy is not an extra risk factor for mortality in COVID-19, unlike SARS-CoV, MERS-CoV and influenza A (H1N1) [3]. In another study, it was even said that the immune system modulation during pregnancy may be protective [4]. In opposing studies, it was stated that maternofetal risks increase in pregnant women with COVID-19 because pregnancy is more risky in terms of infections due to immunosuppression [5,6].

It can be thought that COVID-19 will have a milder course in pregnant women due to the low mortality in young patients and pregnancy occurs mostly at younger ages [7]. However, it is unclear whether pregnancy or childbirth protects against symptoms of pneumonia or exacerbates symptoms [8]. There are no clear data on this subject yet,

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and there are various data in the literature. According to a cohort study (n = 147) in the WHO report, 8% of pregnant women had severe disease requiring oxygen and 1% had critical illness requiring mechanical ventilation [2].

The data in the literature regarding pregnant women with COVID-19 are limited, and there are contradictory information about premature birth, preterm birth, fetal distress, abortus and stillbirth [3, 9, 10]. In the presence of such complications and maternal pneumonia, emergency cesarean delivery (CD] may be required [11]. In pregnant women with COVID-19 with severe disease or critical illness presenting with pneumonia and/or ARDS, serious difficulties can be encountered in the management of obstetric anesthesia. In this study, we aimed to report our anesthesia experiences and the effect of anesthesia methods performed on maternofetal outcomes in pregnant women diagnosed with COVID-19 who underwent CD in our hospital, which provides healthcare services to a region with a high young population and birth rate.

Materials and Methods

In this retrospective and cross-sectional study, pregnant women who had COVID-19 infection and had a CD in our hospital between 01.04.2020-01.01.2021 were included. Local ethics committee approval was obtained. Our hospital is a hospital where pregnant women diagnosed with COVID-19 are followed up and has a service, delivery room, operating room and obstetric intensive care specially designed for these patients. The anesthesia and operation data of the patients were obtained from the electronic records of the hospital. The polymerase chain reaction (PCR) test performed by taking nasopharyngeal and oropharyngeal swaps within the framework of the protocol determined by WHO was positive in all patients. The patients who were <18 years of age, the patients who had negative PCR test and the patients who had lack of data were excluded. Sixty-seven patients were analysed retrospectively.

The patients' age, body mass index (BMI) score, American Society of Anesthesiologists (ASA) score, gestational week, previous CD history and maternal comorbidity information were recorded. The symptoms during admission were investigated. The laboratory values before CD, the applied treatments and the patients who received oxygen support were recorded. The chest X-ray and the computed tomography (CT) images of the patients were examined. CT involvements were classified as mild, moderate and severe as reported by radiology physicians. Those with severe pneumonia and ARDS were determined.

After obtaining consent for anesthesia, the patient was taken to the operating room. Vascular access was provided with 18-G branules from the antecubital region. Saline was started at 10-15ml/kg. Standard monitoring involving non-invasive blood pressure, electrocardiography, and peripheral oxygen saturation (SpO2) was performed and measurements were recorded. Spinal anesthesia was preferred as the first choice to prevent pulmonary complications. Spinal anesthesia was performed with 10-12mg heavy bupivacaine (Marcaine™ 0.5% Ampoule; Astra Zeneca, Istanbul, Turkey) with a 26-G pencil point spinal needle (Egemen, Turkey) at the L3-4 or L4-5 spinal segments according to the protocol and demographic data used in our clinic. General anesthesia was used in emergencies CD, infection at the injection site, severe hypovolemia, coagulopathy or bleeding diathesis, severe preeclampsia, known local anesthetic allergy, severe mitral and/or aortic stenosis or in the case of failed spinal block. For postoperative analgesia, 10mg/kg iv paracetamol (Perfalgam, 10 mg/ml 100 ml, Turkey) and 1-2mg kg iv tramadol (Tramosel, 100mg/2ml amp, Haver, Turkey) were ordered. Complications such as intraoperative analgesic requirement, hypotension and bradycardia were recorded.

Preterm delivery (<37 week), CD indication, type of anesthesia, duration of anesthesia, duration of surgery, emergency or elective cesarean were reported. Gender, height, weight, the 1st minute and 5th minute Activity-Pulse-Grimace-Appearence-Respiration (APGAR) scores, premature birth and presence of stillbirth were recorded. Hospitalization time, maternal complications, need for High Frequency Oscillation Ventilation (HFOV), need for Continuous Positive Airway Pressure (CPAP), need for invasive mechanical ventilation, intensive care unit (ICU) need and presence of mortality were evaluated.

Statistical analyses used the SPSS 22.0 for Windows program. Numerical data are expressed as mean and standard deviation, while categorical data are given as frequency and percentage. The Kolmogorov-Smirnov test was used to assess whether non-categorical data abided by normal distribution or not. Comparison of data abiding by normal distribution used the student t test. Comparison of data not abiding by normal distribution used the Mann-Whitney U test, with results given as mean±SD. Comparison of categorical data in the groups used the chi-square test with results given as % n. All comparisons accepted $p<0.05$ as significant.

Results

Patient selection

During the study period, 18,061 deliveries were performed in our hospital. Of these, 11,810 (65.4%) were normal delivery (ND) and 6251 (34.6%) were CD. During the same period, 1681 pregnant women who were diagnosed with COVID-19 were admitted to our hospital. 328 (19.5%) pregnant women were hospitalized and treated. Of these, 67 (3.9%) women had CD (Figure 1). In the previous year, 22,502 deliveries were performed in our hospital. Of these, 14.569 (64.75%) were ND and 7.933 (35.25%) were CD.

67 pregnant women who underwent CD with positive COVID-19 PCR test results were included in the study. Spinal anesthesia was performed to 61 patients (91.0%) and general anesthesia was performed to 6 patients (9.0%).

Demographic data

The basic characteristics of the patients are shown in Table 1. The mean age of the patients was 30.9 ± 6.5 years and the body mass index (BMI) value was 31.7 ± 2.8. 44 patients (65.7%) had obesity. The mean gestational age of the patients was 36.3 ± 2.6 weeks and preterm delivery occurred in 25 patients (37.3%). Emergency CD was performed in 43 patients and elective CD in 24 patients.

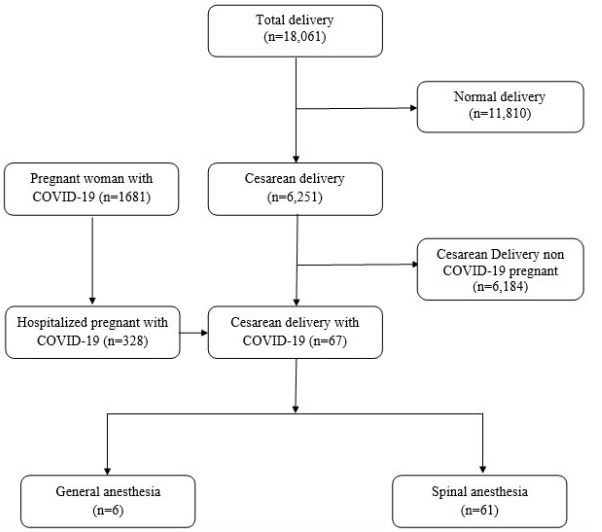

Figure 1. Flow chart

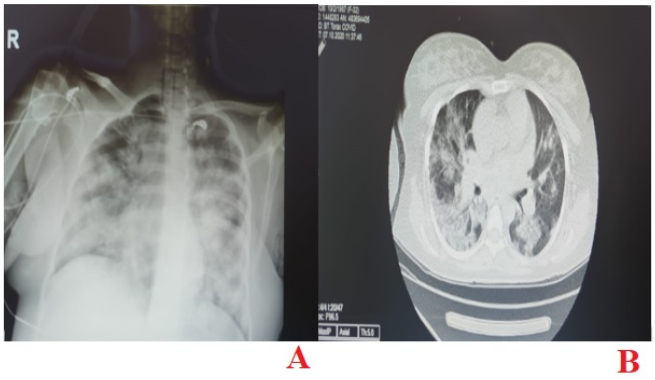

Figure 2. Chest imaging in patients with COVID-19. 34-year-old pregnant woman with severe COVID-19 pneumonia on chest X-ray B: 34-year-old pregnant woman with severe COVID-19 on CT. Abbreviation: COVID-19; Coronavirus disease 2019, CT; computed tomography

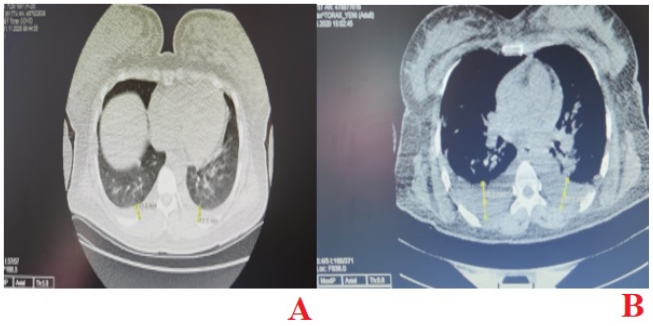

Figure 3. Bilaterally pleural effusion in 39-year-old pregnant woman with COVID-19. COVID-19; Coronavirus disease 2019

Thirty-two patients had repeated CD, while 14 patients had CD due to fetal distress. One patient had twin pregnancy. Among the pregnancy-related complications, ablatio placenta was present in 1 patient, preeclampsia in 2 patients and HELLP in 2 patients.

Clinical and laboratory characteristics

The clinical characteristics of the patients are shown in Table 2. In the pre-cesarean period, 33 patients were asymptomatic (49.3%), 9 patients had fever (13.4%), 32 patients had cough (47.8%), 25 patients had dyspnea (37.3%) and 15 patients had tachypnea (22.4%).

Before CD, 15 (22%) of the pregnant women had elevated leukocyte, 10 (14.9%) had high neutrophil levels, and 18 (26.9%) had lymphopenia. Sixty-six patients had elevated D-dimer (98.5%), 7 patients had elevated ferritin (10.4%), 51 patients had elevated procalcitonin (76.1%) and 50 patients had high C - reactive protein (CRP) levels (74.6%). Thirty-seven (55.2%) patients had lung involvement on CT (Figure 2A and 2B). Of these, 18 had severe, 8 had moderate, and 11 had mild lung involvement. Four patients had pleural effusion (Figure 3).

Maternal and neonatal outcomes (Table 3)

Of the 21 (31.3%) patients who needed an ICU, 14 were taken to the ICU before CD and 7 in the post-cesarean period. Hospital stay was 6.4 ± 5.5 days. Mortality occurred in 4 (5.98%) pregnant women. While the mortality rate was 0.23% (4/1681) in all pregnant women diagnosed with COVID-19, it was 1.21% (4/328) in those who were hospitalized.

While the mean birth weight of the babies born was 2940 ± 628 g, 17 (25.4%) neonates had a low birth weight. The APGAR score of the neonates was 7.1 ± 2.0 at the 1st minute and 8.3 ± 2.0 at the 5th minute. Four (6%) pregnant women had intrauterine ex fetus.

Additional analysis was performed to make a comparison according to the type of anesthesia performed. The symptoms of coughing, dyspnea and tachypnea were higher before CD in those who received general anesthesia. In addition, in patients undergoing general anesthesia, blood lymphocyte, thrombocyte and fibrinogen levels were lower and ferritin levels were higher before CD.

In pregnant women who underwent general anesthesia, the preoperative SpO2 value was lower, and additional oxygen support was required before surgery. In pregnant women who underwent general anesthesia, the need for ICU, HFOV, CPAP and invasive mechanical ventilation was higher, the duration of hospitalization in the ICU was longer, and the maternal mortality rate was higher.

Neonates under general anesthesia had a lower 1st and 5th minute APGAR score, the number of neonates with low birth weight (<2,500 g) and the rate of intrauterine ex fetus was higher.

Discussion

In this study, we found that in pregnant women with COVID-19 who underwent general anesthesia for CD, the need for non-invasive and invasive mechanical ventilation, the need for ICU and maternal mortality rates increased. We also found that the APGAR scores of neonates of women who received general anesthesia were lower.

Although pregnancy is not a factor that increases the severity of the disease, unlike influenza and SARS, the

Table 1. Demographic and obstetric datas of the patients (mean ± SD)

Characteristics	All patients (n=67)	Spinal anesthesia(n=61)	General anesthesia (n=6)	p Value
Maternal age, year	30.9±6.5	30.5±6.5	34.6±4.9	0.103
BMI, kg/m2	31.7±2.8	31.8±2.8	30.6±2.4	0.458
Obesity (BMI≥30), (n, %)	44 (65.7)	41 (67.2)	3 (50)	0.397
Gestational week at birth	36.3±2.6	36.6±2.3	33.5±4.1	0.066
Preterm delivery (<37 weeks), (n, %)	25 (37.3)	21 (34.4)	4 (66.7)	0.119
Mode of cesarean				0.305
Emergency cesarean, (n, %)	43 (64.2)	38 (62.3)	5(83.3)	
Elective cesarean, (n, %)	24 (35.8)	23 (37.7)	1 (16.7)	
Cesarean indication				0.279
Previous cesarean, (n, %)	32 (47.7)	31 (50.8)	1 (16.7)	
Fetal distress, (n, %)	14 (20.9)	12 (19.7)	2 (33.3)	
Others, (n, %)	21 (31.4)	18 (29.5)	3 (50.0)	
Pregnancy complication				0.011*
Preeclampsia, (n, %)	2 (3.3)	2 (3.3)	0 (0)	
HELLP, (n, %)	1 (1.7)	1 (1.7)	1 (0)	
Placental abnormalities, (n, %)	1 (1.7)	0 (0)	1 (1.7)	

BMI; body mass index, HELLP; hemolysis, elevated liver enzymes, low platelet, *statistically significant

Table 2. Clinical characteristics and laboratory values (mean ± SD)

Characteristics	All patients (n=67)	Spinal anesthesia(n=61)	General anesthesia (n=6)	p Value
Asymptomatic, (n, %)	33 (49.3)	33 (49.3)	0 (0)	0.011*
Fever, (n, %)	9 (13.4)	7 (11.3)	2 (33.3)	0.134
Cough, (n, %)	32 (47.8)	26 (42.6)	6 (100)	0.007*
Dyspnea, (n, %)	25 (37.3)	20 (32.8)	5 (83.3)	0.015*
Tachypnea, (n, %)	15 (22.4)	10 (16.4)	5 (83.3)	<.001*
WBC, ×109/L	8.8±3.5	8.8±3.4	8.0±4.5	0.265
Lymphocytes, ×109/L	1.4±0.6	1.4±0.6	0.8±0.3	0.018*
Neutrophils, ×109/L	6.7±3.1	6.8±3.1	6.5±4.3	0.371
Platelet, ×109/L	213±65	221±60	137±76	0.011*
INR	1.05±0.1	1.05±0.1	1.10±0.1	0.906
Fibrinogen, mg/dL	342±116	354±110	227±119	0.011*
D-dimer, ng/ml	1296±1400	1346±1456	781±285	0.599
Ferritin, μg/L	77±99	61±72	237±188	0.020*
Procalcitonin, ng/ml	0.14±0.19	0.14±0.2	0.16±0.1	0.213
CRP, mg/L	34±38	33±38	39±45	0.570
Lung involvement on CT, (n, %)	37 (55.2)	33 (54.1)	4 (66.7)	0.555

WBC; White blood cells, INR; international normalized ratio, CRP; c-reactive protein, *statistically significant

decrease in respiratory capacity due to pregnancy and the increase in oxygen consumption can rapidly cause hypoxia in case of critical illness and negatively affect the course of the disease [1, 12]. In the presence of active disease, surgical stress and anesthesia for cesarean section may further impair respiratory functions by increasing the severity of the disease. Therefore, perioperative management is of great importance in pregnant women with COVID-19, especially when accompanied by ARDS and pneumonia. Since the incidence of perioperative pneumonia is higher in patients undergoing general anesthesia even in the normal population,[13] in COVID-19, which is an infectious disease that affects the respiratory tract, general anesthesia should be avoided and regional anesthesia should be preferred if possible [4, 14]. Because pulmonary functions may deteriorate due to intubation and pulmonary complications that increase maternal morbidity and mortality may develop [15]. Ashokka et al. stated that general anesthesia should be performed in desaturated patients (SpO2<93) and regional anesthesia should be performed in patients with normal oxygen saturation (SpO 2≥O93) [1]. Bhatia et al. reported that the rate of general anesthesia in CD patients decreased during the pandemic period (from 7.7% to 3.7%) [16]. Chen et al. reported that they safely performed regional anesthesia to 14 of 17 pregnant women [5]. In our study, general anesthesia was performed to 6 patients (9%) and spinal anesthesia was performed to 61 patients (91%). All patients undergoing general anesthesia required ICU admission in the postoperative period, and the mortality rate of this group was found to be significantly higher than those who received regional anesthesia. Even though pregnant women are in the young age group, we think that even elective intubation increases the severity of the disease and maternal mortality, as COVID-19 infection may cause pneumonia, ARDS and respiratory failure in pregnant women.

Most COVID-19 patients experience mild symptoms such as fever, cough, sore throat and weakness [17, 18]. Al-

Table 3. Maternal and neonatal outcomes (mean±SD)

	All patients (n=67)	Spinal anesthesia(n=61)	General anesthesia (n=6)	p Value
Maternal SpO2,	93.7±6.0	94.9±2.8	82.1±14.5	0.045*
Preop oxygen support, (n, %)	20 (29.8)	16 (26.2)	4 (66.7)	0.039*
Hypotension during anesthesia, (n, %)	18 (26.9)	17 (27.9)	1 (16.7)	0.555
Sedation during anesthesia, (n, %)	27 (40.3)	25 (41.0)	2 (33.3)	0.715
Received ICU, (n, %)	21 (31.3)	15 (24.6)	6 (66.7)	<.001*
HFOV, (n, %)	10 (14.9)	7 (11.5)	3 (50)	0.012*
CPAP, (n, %)	7 (10.4)	4 (6.6)	3 (50)	0.001*
Mechanic ventilation, (n, %)	6 (8.9)	3 (4.9)	3 (50)	<.001*
Maternal mortality, (n, %)	4 (6.0)	2 (3.3)	2 (33.3)	0.003*
Days in hospital	6.4±5.4	5.3±3.9	17.6±7.5	<.001*
Birth weight, gr	2834±703	2940±628	1758±517	<.001*
Low-birth weight (<2,500 g), (n, %)	17 (25.4)	11 (18.0)	6 (100)	<.001*
APGAR score 1. min	7.1±2.0	7.5±1.4	3.1±3.4	0.002*
APGAR score 5. min	8.3±2.0	8.6±1.3	4.5±3.8	0.001*
Intrauterin ex fetus, n (%)	4 (6.0)	1 (1.6)	3 (50)	<.001*

CT; computed tomography, SpO2; peripheral oxygen saturation, ICU; intensive care unit, HFOV; high frequency oscillatory ventilation, CPAP; continuous positive airway pressure, *statistically significant

though similar symptoms are observed in pregnant women, more serious symptoms such as dyspnea and tachypnea occur in the presence of ARDS and pneumonia due to lung involvement [1]. Farida et al. reported in one metanalysis that 7.5% of pregnant patients were asymptomatic and 92.5% were symptomatic and the most common symptoms were fever and cough. They also reported that 95.6% of pregnant women had mild disease, 3.6% had severe and 0.8% had critical disease [7]. In our study, 49.3% of the patients were asymptomatic. The most common symptoms were cough (47.8%), dyspnea (37.3%) and tachypnea (22.4%), respectively. Contrary to previous studies, our study had less fever than other symptoms (11.9%). Since we only evaluated pregnant patients who underwent cesarean section, the frequency of complaints in our study and the rate of critical disease requiring intensive care follow-up (31.3%) may be different from the rates in Farida et al.'s study, which includes all pregnant patients.

In a review evaluating pregnant women with COVID-19, laboratory findings included elevated D-dimer (22.3%), high CRP (18.7%), lymphopenia (14.0%), increased liver enzymes and thrombocytopenia (1.0%) [7]. Chen et al. evaluated 17 cesarean section patients diagnosed with COVID-19 and found increased CRP at a rate of 41% and lymphopenia at a rate of 29% [5]. Zhong et al. found that the percentage of leukocyte and neutrophils increased and the percentage of lymphocytes decreased after surgery compared to pre-surgery in COVID-19 patients undergoing spinal anesthesia [19]. In our study, 22% of pregnant women had elevated leukocyte, 14.9% increased neutrophil, 26.9% low lymphocyte, 98.5% increased D-dimer, 10.4% increased ferritin, 76.1% increased procalcitonin and 74.6% elevated CRP. Those who received general anesthesia had lower blood lymphocyte, thrombocyte and fibrinogen levels and higher ferritin levels.

In the diagnosis and follow-up of COVID-19 patients, imaging of the lungs is important. In the presence of ARDS and pneumonia, patchy infiltrations, ground glass areas and consolidations can be visualized on CXR and CT [1]. Imaging is important for anesthesia management, especially in patients with shortness of breath and tachypnea. Endotracheal intubation in a patient with lung involvement may increase pulmonary complaints and lead to complications. Li et al. found COVID-19 pneumonia finding on CT in 2.1% of the pregnant women in the prenatal period [20]. In a metanalysis conducted with 385 pregnant women, Farida et al. found radiological findings in 121 women and pleural effusion in 9 women on CT.7 In the studies where Dehan et al. examined 15 pregnant women and Chen et al. examined 17 pregnant women, they reported that all patients had lung involvement on CT [5, 8]. In our study, we found lung involvement in 37 (55.2%) of the patients on CT. Of these, 18 had severe, 8 had moderate, and 11 had mild lung involvement. Four patients had bilateral pleural effusion. The rate of lung involvement on CT in our study is lower than the rates found in Dehan et al. and Chen et al.'s study. However, our findings are higher than those in the studies by Farida et al. and Li et al. The reason for this may be the fact that while all pregnant women were included in their study, only the cesarean section pregnant women were included in our study.

In the presence of COVID-19 in pregnant women, it often has a mild course similar to the general population. However, in some cases, the disease may have a moderate (fever, dyspnea, radiological pneumonia) or severe (respiratory rate> 30/minute, resting SpO2<93%, PaO2/FiO2<300 mmHg and lung imaging >50% within 24-48 hours excessive lesion progression) course. In case of critical disease, oxygen support, HFOV, CPAP and invasive mechanical ventilation support may be required due to respiratory failure [1, 17]. Also, in critical disease, respiratory failure, sepsis, organ failure and death may occur. Huijun et al. reported that all 9 pregnant patients who underwent cesarean section needed additional oxygen support, but none of them had severe pneumonia and required mechanical ventilation [9]. Na li et al. reported

that although most of the 34 pregnant women with confirmed or suspected COVID-19 had pneumonia, none of them needed HFOV or ICU [20]. In our study, additional oxygen support was required in 20 patients and ICU was required in 21 patients. Of these, 10 required HFOV, 7 required CPAP, and 6 required mechanical ventilation, and 4 patients died. In pregnant women undergoing general anesthesia, the need for additional oxygen support, ICU admission, HFOV, CPAP and mechanical ventilation before the operation were higher. Again, those who underwent general anesthesia had a longer hospital stay and higher maternal mortality. The reason for this may be due to the fact that there was more severe or critical illness in patients undergoing general anesthesia before CD in our study. One reason for this situation may be that intubation and inappropriate mechanical ventilation may worsen the disease.

It has been reported that in pregnant women with COVID-19, the rate of premature birth and fetal distress increased, thus the rate of emergency cesarean section increased [10, 18]. In a large series study including 385 pregnant women, Farida et al. found fetal distress in 7.8% of the patients and 1 neonatal death [7]. In some studies conducted with confirmed or suspected COVID-19 pregnant patients, it has been stated that pregnancy complications were observed in more than 70% of the patients, preterm delivery in 20%, low birth weight in 15-20% and fetal distress in 5-10% of the patients. These rates were found to be higher than the control groups [3, 20]. In our study, we detected pregnancy complication in 7.5%, preterm delivery in 37.3% and low birth weight 25.4% of the patients. Fetal distress occurred in 14 patients and neonatal death occurred in 4 patients. APGAR scores were lower and neonatal mortality rate was higher in those who were performed general anesthesia. Since there are a limited number of studies on this subject, there are very different rates in the literature. We think that this issue should be elucidated with larger series studies.

Strength and Limitations

Strength of our study is that it was built in a hospital serving pregnant women in one of the provinces with the highest birth rate in our country and this hospital was designed as a pandemic hospital for pregnant women. Our results can be generalized to all pregnant women, since pregnant women with COVID-19 in our city have a CD only in this hospital and there are relatively sufficient patients. The strength of our data and access to various factors that will affect anesthesia practices is another strength of our study. Our study has some limitations. The first is that the study was conducted retrospectively and cross-sectionally. The second may be that it cannot be compared with a control group of pregnant women who are not diagnosed with COVID-19. Another limitation of our study is that the vertical transition and long-term neonatal results were not evaluated.

Conclusion

As a result, spinal anesthesia is safer for pregnant women with COVID-19 than general anesthesia in terms of maternal and neonatal health. Especially in pregnant women with COVID-19 with pulmonary involvement, general anesthesia should be avoided if possible, as it may increase the likelihood of requiring invasive mechanical ventilation, exacerbating respiratory symptoms and causing more respiratory complications. However, since there are limited and contradictory results in the literature on this subject, further randomized controlled studies are needed in which maternofetal results are evaluated in more detail.

Abbreviations

COVID-19, Coronavirus disease 2019; ARDS, acute respiratory distress syndrome; SARS-COV-2, Severe Acute Respiratory Syndrome Coronavirus 2; WHO, World Health Organization; CD, Cesarean delivery; PCR, polymerase chain reaction; BMI, body mass index score; ASA, American Society of Anesthesiologists; CT, computed tomography; SpO2, peripheral oxygen saturation; APGAR, Activity-Pulse-Grimace-Appearence-Respiration; HFOV, High Frequency Oscillation Ventilation; CPAP, Continuous Positive Airway Pressure; ICU, intensive care unit; CRP; c-reactive protein

Ethical Approval

This study was approved by the Ministry of Health (Turkey) and Local Ethics Committee University of Health Sciences Diyarbakır Gazi Yaşargil Training and Research Hospital. (approval date and number: 12.02.2021-671).

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