



Comparison of the outcomes of spinal and general anesthesia for cesarean section in pregnant women with COVID-19

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Abstract

We aimed to examine the efficacy and safety of spinal or general anesthesia for cesarean section (C/S) delivery in parturient with coronavirus illness (COVID-19). We carried out a retrospective cohort in our tertiary care centre's anesthesiology and reanimation department. We gathered the data from the medical files of 108 pregnant women (average age: 33.44±12.65 years) with COVID-19 who underwent cesarean section (C/S) with either general (Group I, n=30) or spinal anesthesia (Group II, n=78). We compared preoperative, intraoperative, postoperative respiratory, cardiac, hematological, and biochemical indicators between spinal and general anesthesia groups. Patients in Group I were significantly older (p<0.001), had longer APTT (p=0.015), PT (p=0.005), INR (p=0.003), higher levels of AST (p=0.012), CK (p=0.001), CRP (p<0.001), as well as longer duration of ICU stay (p<0.001), and hospitalization (p<0.001). Group II had higher preoperative levels of troponin T (p=0.001). In Group I, the levels of procalcitonin (p=0.002), lactate (p<0.001), AST (p<0.010), ALT (p=0.001), CRP (p<0.001), and total bilirubin (p<0.001) were significantly higher than Group II. Group II displayed increased levels of white blood cell count (p=0.023), CK (p=0.047), and LDH (p=0.001). Our data demonstrated that the selection of the mode of anesthesia must provide safe, patient-centered care and safeguard every member of the obstetric team from COVID-19 infection. During planning for cesarean section (C/S), certain care and special precautions should be employed, and the type of anesthesia must be selected on an individualized basis.

Keywords: cesarean section, COVID-19, pregnancy, general anesthesia, spinal anesthesia

1. Introduction

The Coronavirus Disease 2019 (COVID-19) pandemic has triggered numerous changes in anesthesiology practice. Many anesthesiologists in even modestly damaged places have seen the principles of their work shift focus, from cancelling elective surgical procedures to the rapid construction and staffing of makeshift intensive care units. The basic needs of obstetric anesthesiologists working in the labor and delivery units have not changed, unlike many anesthesiologists working in general service operating rooms. Pregnant women are still going into labor, giving birth, and requesting or requiring services that can only be provided by an anesthesiologist. However, no matter how ordinary the anesthesiologist's actions appear to be, anesthetic care in the Labor and Delivery Unit during the COVID-19 pandemic has become anything from routine (1, 2). According to the existing data on COVID-19 and pregnancy, neither pregnancy nor delivery enhances the risk of contracting the virus, and there is no evidence of a link with a worse clinical picture when compared to nonpregnant females of the same age group (3, 4). Pregnant women who contract COVID-

19-associated pneumonia, on the other hand, have a higher risk of obstetric problems (such as preterm labor, premature rupture of membranes, preeclampsia, and cesarean section (C/S) (4, 5). Furthermore, the increase in body temperature related to COVID-19 (i. e., hyperthermia) has been linked to congenital abnormalities if it occurs during the first trimester (6). Although SARS-CoV-2 has not been discovered in umbilical cord blood and there is no indication of vertical transmission, three cases have been described in which neonates acquired pneumonia despite intensive infection control efforts (7). Furthermore, there is no established strategy for delivering anesthetic care to pregnant women having a cesarean section (C/S) (6).

The direct and indirect risks of caring for infected maternity patients necessitate a shift in how teams collaborate, anesthesia is administered, information is disseminated, and decisions are made in the labor ward, even though pregnant women do not appear to be more vulnerable to COVID-19 than the general

population (1). Unlike previous viral pandemics, COVID-19 incidence, prognosis and maternal and neonatal outcomes do not appear to be worse in pregnant women compared to that in the general population. The controversial area of management concerning maternity widespread viral disease is being investigated, with the rapid dissemination of research and shared-learning encounters proving beneficial in meeting the evolving healthcare needs of pregnant women. For emergency cesarean sections, neuraxial anesthesia, such as spinal anesthesia, is preferred to avoid the risks of aerosolization associated with tracheal intubation and extubation. The risk of infection to medical workers and the impact of tracheal intubation in a patient with acute respiratory failure are the main concerns with general anesthesia for a cesarean section (C/S) delivery. The most experienced anesthetist should attempt intubation with a video laryngoscope to increase the possibility of first-pass success while avoiding aerosolization (8).

In patients infected with COVID-19, the rate of cesarean section (C/S) varies. According to a study of 108 pregnancies, 91 percent were delivered through cesarean section (9). Furthermore, most women who have a cesarean birth have thrombocytopenia and high C-reactive protein, which might make COVID-19 and neurologic problems worse. Patients with COVID-19 have been reported to die after delivery from respiratory problems (10). In evaluations of several studies, neonatal and intrauterine death have been observed (5, 7). From nine births, six infants had shortness of breath, two infants had the onset of thrombocytopenia associated with dysfunction and one premature newborn developed shortness of breath, refractory shock, multiple organ failure and disseminated intravascular coagulation and died (5). Thirty-three neonates born to mothers with COVID-19 including three neonates with COVID-19. The most common symptom was shortness of breath. Of the three neonates with symptomatic COVID-19, the most seriously ill have been symptomatic from prematurity, asphyxia, and sepsis (7). As new information and evidence become available, our understanding of the epidemiology, etiology, disease progression, and clinical course of COVID-19 evolves. The lack of knowledge about COVID-19's effects on pregnant women, as well as clinical experience with COVID-19 in pregnant women, could provide an anesthetic issue during labor and delivery. Professional associations have provided interim guidelines on the evaluation and care of pregnant women with COVID-19 (10).

We aimed to present additional information for anesthesia considerations with pregnant women with confirmed COVID-19 that underwent cesarean section (C/S) with either spinal or general anesthesia and to compare the preoperative, intraoperative, and postoperative variables in these two groups.

2. Materials and methods

2.1. Study design

This retrospective, single-center, cohort study was performed

using data extracted from the medical files of 108 pregnant women with COVID-19 who underwent cesarean section (C/S) in a tertiary care centre's obstetrics and gynecology department. The average age of our population was 33.44 ± 12.65 (range: 18 to 48). The diagnosis of COVID-19 was confirmed with nasopharyngeal swabs using a kit (*BioGerm, Shanghai, China*) following the World Health Organization guidelines for reverse transcriptase (RT) polymerase chain reaction (PCR). Group I (n=30) consisted of patients who received general anesthesia, whereas Group II (n=78) comprised pregnant women who underwent spinal anesthesia before cesarean section (C/S). The approval of the local institutional review board had been obtained before the study, and adherence to the principles announced in the Helsinki Declaration was provided. The information gathered for every patient consisted of baseline descriptives, pre- and postoperative cardiorespiratory indicators, and inflammatory markers, which were noted and compared between the two groups. All mothers had singleton pregnancies. Patients who tested negative for COVID-19 but were clinically suspected (due to a clinical condition or tomography findings) were also included in the study. The PCR test was done on all elective and emergency pregnant women scheduled for cesarean section, per the hospital's routine procedure. All parturients who arrived at the hospital were asked if they had been exposed to COVID-19 or had been diagnosed with it within the previous 14 days.

2.2. Anesthesia procedure

Spinal anesthesia was preferred unless there was a contraindication or emergency that necessitated the performance of general anesthesia. A lower segment cesarean section (CS) was routinely performed in all patients in this series. All clinical data were collected separately by two independent investigators after written informed consent was obtained. Two anesthesia team members, including an experienced anesthesiologist and an assistant anesthesia technician, administered the anesthesia. The patients were moved to COVID-wards or COVID-intensive care units (ICUs) when the surgery was completed. In different zones of the operating room, appropriate personal protection equipment (PPE) was used. During the surgery, N95 masks, goggles, protective suits, disposable medical caps, and medical rubber gloves were worn, as well as biosafety level-3 (BSL-3) protective medical equipment. The anesthesiologist employed a motorized air-purifying respirator to care for patients who had general anesthesia and endotracheal intubation. Medical professionals entered and exited the operating theater following the principles of a clean area, a contaminated pollution area, and two buffer zones. The parturients wore normal surgical masks throughout the process to prevent virus dissemination.

After the patient entered the operating room, routine monitoring (continuous non-invasive blood pressure, electrocardiograph, and pulse oximetry) was performed.

2.3. Conduct of spinal anesthesia

A 25G spinal needle was used to inject 10 mg of hyperbaric bupivacaine and 20 mcg of fentanyl into the L3-4 or L4-5 intervertebral spaces, resulting in subarachnoid blocks. During cesarean section (C/S) delivery, a sensory and motor block plane was maintained from T6–T8 segments to S4–5 segments.

2.4. Conduct of general anesthesia

Preoxygenation was achieved quickly with four maximal capacity breaths with 100% oxygen in instances requiring general anesthesia for cesarean section (C/S). Intravenous doses of propofol (1.5-2.5 mg/kg) and rocuronium (0.6 mg/kg) were administered to establish appropriate intubating conditions. Sevoflurane and fentanyl (1.5 mcg/kg) was used to maintain anesthesia following delivery.

2.5. Maternal and neonatal outcomes

All parturients who arrived at the hospital were asked if they had been exposed to COVID-19 or had been diagnosed with it within the previous 14 days. The mode of anesthesia for cesarean section (C/S), arterial blood gases, operation time, anticipated blood loss, serum biochemical analysis, complete blood count, and maternal complications and outcomes were all documented. The neonates' oral cavity, nose, and face were quickly cleaned and disinfected with a sterile towel after birth. The infants were then moved to a cordoned-off section in the operating room, where they were placed in a radiant warmer bed. The Apgar score was evaluated at one, five, and ten minutes following delivery. Newborns were taken to the neonatal intensive care unit (NICU) by expert nurses when the umbilical cord was ligated, and no further contact with infected mothers was permitted. In the NICU, the newborn's blood gas was measured. For newborns, a reverse transcriptase-polymerase chain reaction (RT-PCR) virus test (nasal swab) was performed twice: once the day after delivery and again the day before discharge. Other clinical outcomes included neonatal death, severe asphyxia, NICU duration of stay, and other factors. Medical personnel were required to undergo RT-PCR nasal swabs and CT scans every two weeks after the C/S delivery.

2.6. Statistical analysis

Statistical Package for Social Sciences program version 21.0 (SPSS Inc., Chicago, IL, USA) was used for analysis. Descriptive data were expressed as mean \pm standard deviation or median (minimum-maximum) for quantitative variables and as numbers and percentages for categorical variables. Normality was tested using the Kolmogorov-Smirnov test. The significance of the difference between the two means was evaluated with the Independent Samples T-test. A p-value less than 0.05 was considered significant.

2.7. Outcome parameters

Baseline descriptives, preoperative and postoperative serum levels of D-dimer, procalcitonin, ferritin, lactate, pH, partial pressures of oxygen and carbon dioxide, activated partial

thromboplastin time (APTT), prothrombin time (PT), international normalized ratio (INR), white blood cell (WBC), neutrophil, lymphocyte, eosinophil counts, hemoglobin, hematocrit, alanine transaminase (ALT), aspartate transaminase (AST), creatinine kinase (CK), troponin-T, C-reactive protein (CRP), bilirubin, results for polymerase chain reaction (PCR) test for COVID-19, duration of stay in the intensive care unit (ICU), length of hospitalization, blood pressure, and pulse rates were recorded and compared between groups.

Patients were allocated to 2 groups per the type of anesthesia administered (spinal or general anesthesia). The differences between preoperative and postoperative laboratory results, as well as complications, duration of stay in ICU, and mortality rates were compared between these two groups.

3. Results

The data were extracted from the medical files of 108 parturients with COVID-19 that underwent cesarean section (C/S) with either spinal or general anesthesia. The average in our population was 33.44 ± 12.65 (range: 18 to 48). Patient demographics and laboratory findings of our series are demonstrated in Table 1. All patients were in stable condition during pregnancy. Preoperative PCR positivity was detected in 64 of 108 patients (59.2%). A total of 30 patients received general anesthesia (27.78%), while 78 patients (72.22%) underwent spinal anesthesia. The rate of maternal mortality was 1.86 % (2/108), and both patients were intubated on the day of admission to the ICU due to extreme dyspnea. Patients died after 17 and 20 days in the ICU due to clinical deterioration. The number of patients that underwent intubation in the spinal and general anesthesia groups was 1 and 2 in ICU due to extreme dyspnea, respectively. In the spinal anesthesia group, three patients were hospitalized in ICU, while four patients in the general anesthesia group were in ICU. The mortality and intubation rates were similar between the two groups ($p=0.079$ and $p=0.144$), whereas patients receiving general anesthesia were more likely for ICU stay ($p=0.019$).

There were no cases of intrapartum death, neonatal mortality, or significant neonatal asphyxia. None of the newborns had any congenital abnormalities, and all babies tested negative for COVID-19 with nasopharyngeal swabs.

Table 2 presents a comparative overview of pre- and perioperative variables in 2 groups under investigation. Patients in Group I were significantly older ($p<0.001$), had longer APTT ($p=0.015$), PT ($p=0.005$), INR ($p=0.003$), higher levels of AST ($p=0.012$), CK ($p=0.001$), CRP ($p<0.001$), as well as longer duration of ICU stay ($p<0.001$), and hospitalization ($p<0.001$). On the other hand, Group II had higher preoperative levels of troponin T ($p=0.001$) compared to Group I.

Table 1. An overview of pre- and postoperative variables in our population (n=108)

Variable	Preoperative		Postoperative	
	Mean ± S. D.	Range	Mean ± S. D.	Range
D-dimer	4.96 ± 6.12	0.19-35.20	2.69 ± 3.82	0.04-35.20
Procalcitonin	4.49 ± 10.99	0.02-106.30	4.90 ± 19.10	0.02-191.90
Ferritin	136.34 ± 229.49	3.50-1952.00	617.47 ± 2614.50	0.07-26947.00
Lactate	2.57 ± 7.68	0.82-81.30	2.30 ± 1.88	0.77-12.06
SpO ₂	72.00 ± 20.18	24.60-98.80	99.05 ± 1.57	90.00-100.00
pCO ₂	38.29 ± 6.06	26.70-57.40	40.42 ± 5.38	20.90-53.70
pO ₂	59.51 ± 35.38	16.20-230.90	54.45 ± 21.71	21.80-142.00
APTT	27.00 ± 4.60	18.30-46.30	29.51 ± 11.46	18.10-127.70
PT	12.05 ± 2.29	9.70-29.90	13.50 ± 4.71	9.70-51.30
PT (%)	98.06 ± 15.97	33.00-141.70	84.19 ± 25.42	16.40-133.60
INR	1.01 ± 0.17	0.83-2.34	1.11 ± 0.43	0.84-4.92
WBC	10.45 ± 5.35	1.68-42.00	10.10 ± 4.92	0.55-48.06
Hb	11.57 ± 1.76	6.70-15.10	10.59 ± 1.64	6.80-14.00
Hct	34.22 ± 5.37	9.20-44.80	31.87 ± 4.60	21.50-43.20
Neu	8.83 ± 8.15	0.42-74.80	7.65 ± 4.73	0.32-44.78
Neu (%)	74.16 ± 14.65	0.01-97.10	73.92 ± 10.11	48.50-95.40
Lymph	1.59 ± 0.69	(0.10-3.80)	1.64 ± 0.66	0.20-3.90
Lymph (%)	17.13 ± 8.07	1.90-46.60	18.23 ± 8.26	4.10-37.90
Eos	0.06 ± 0.08	0.00-0.48	0.11 ± 0.13	0.00-0.71
Eos (%)	0.62 ± 0.81	0.00-5.70	1.16 ± 1.56	0.00-8.40
AST	27.37 ± 19.02	9.00-151.00	34.80 ± 34.23	9.00-197.00
ALT	20.15 ± 24.81	3.00-174.00	29.03 ± 32.32	3.00-197.00
CK	129.28 ± 146.63	0.01-839.00	140.63 ± 177.55	12.00-1364.00
Troponin T	2.96 ± 12.20	0.00-73.52	0.017 ± 0.078	0.00-0.82
LDH	272.64 ± 121.93	13.00-843.00	234.70 ± 96.87	11.00-826.00
CRP	50.52 ± 69.08	0.19-328.08	43.75 ± 56.60	0.00-271.27
Pulse rate	96.62 ± 19.52	50.00-200.00	90.80 ± 14.40	60.00-140.00
Total bilirubin	1.44 ± 0.62	0.00-6.35	0.72 ± 1.18	0.01-9.85

(**Abbreviations:** S.D: standard deviation; CO₂: carbon dioxide; O₂: oxygen; APTT: activated partial thromboplastin time; PT: prothrombin time; INR: international normalized ratio; WBC: white blood cell count; Hb: hemoglobin; Hct: hematocrit; Neu: neutrophil count; Lymph: lymphocyte count; Eos: eosinophil count; AST: aspartate transaminase; ALT: alanine transaminase; CK: creatine kinase; LDH: lactate dehydrogenase; CRP: C-reactive protein)

Table 2. Comparison of preoperative and perioperative variables in groups receiving general (Group 1=30) and spinal anesthesia (Group 2=78)

Variable	Group	Mean ± Standard deviation	p-values	
Age	I	40.73 ± 17.33	<0.001*	
	II	30.63 ± 8.67		
Preoperative	D-dimer	I	7.27 ± 7.60	0.073
		II	4.07 ± 5.26	
	Procalcitonin	I	9.10 ± 18.98	0.014
		II	2.72 ± 4.55	
	Ferritin	I	246.05 ± 162.89	0.781
		II	94.15 ± 238.12	
	Lactate	I	2.19 ± 1.07	0.415
		II	2.71 ± 9.03	
	Sat. O ₂	I	72.33 ± 23.03	0.112
		II	71.87 ± 19.14	
	pH	I	7.40 ± 0.04	0.548
		II	7.40 ± 0.04	
	pCO ₂	I	40.66 ± 6.78	0.220
		II	37.38 ± 5.54	
	pO ₂	I	61.91 ± 34.24	0.526
		II	58.59 ± 35.98	
	APTT	I	27.12 ± 6.16	0.015
		II	26.94 ± 3.84	
PT	I	13.58 ± 3.49	0.005	
	II	11.46 ± 1.2		

Table 2. Comparison of preoperative and perioperative variables in groups receiving general (Group 1=30) and spinal anesthesia (Group 2=78) (continue)

Variable	Group	Mean ± Standard deviation	p-values	
Preoperative	PT (%)	I	89.72 ± 19.62	0.057
		II	101.27 ± 13.11	
	INR	I	1.12 ± 0.26	0.003
		II	0.96 ± 0.08	
	WBC	I	12.08 ± 5.67	0.066
		II	9.82 ± 5.13	
	Hb	I	12.49 ± 1.94	0.115
		II	11.21 ± 1.55	
	Hct	I	36.73 ± 5.58	0.911
		II	33.26 ± 4.99	
	Neu	I	9.80 ± 5.22	0.513
		II	8.46 ± 9.03	
	Neu (%)	I	76.84 ± 15.07	0.252
		II	73.13 ± 14.44	
	Lymph	I	1.47 ± 0.84	0.090
		II	1.62 ± 0.62	
	Lymph (%)	I	14.09 ± 9.14	0.290
		II	18.31 ± 7.35	
	Eos	I	0.08 ± 0.09	0.199
		II	0.05 ± 0.08	
	Eos (%)	I	0.76 ± 0.81	0.282
		II	0.57 ± 0.81	
	AST	I	33.97 ± 26.50	0.012
		II	24.83 ± 14.66	
	ALT	I	24.27 ± 14.67	0.851
		II	18.58 ± 27.67	
	CK	I	199.60 ± 195.15	0.001
		II	102.23 ± 113.43	
Troponin T	I	0.02 ± 0.04	0.010	
	II	4.09 ± 14.22		
LDH	I	318.07 ± 136.08	0.115	
	II	255.16 ± 112.13		
CRP	I	89.72 ± 98.08	<0.001*	
	II	35.43 ± 46.68		
Total bilirubin	I	1.10 ± 1.71	0.319	
	II	1.57 ± 7.19		
SpO ₂	I	98.60 ± 2.19	0.500	
	II	98.86 ± 15.50		
Pulse rate	I	89.30 ± 15.50	0.361	
	II	99.45 ± 20.25		
Perioperative	ICU stay	I	3.83 ± 7.39	<0.001*
		II	0.56 ± 3.07	
	Length of hospitalization	I	12.68 ± 14.31	<0.001*
		II	6.46 ± 5.68	

(Abbreviations: S.D: standard deviation; CO₂: carbon dioxide; Sat: saturation; O₂: oxygen; APTT: activated partial thromboplastin time; PT: prothrombin time; INR: international normalized ratio; WBC: white blood cell count; Hb: hemoglobin; Hct: hematocrit; Neu: neutrophil count; Lymph: lymphocyte count; Eos: eosinophil count; AST: aspartate transaminase; ALT: alanine transaminase; CK: creatine kinase; LDH: lactate dehydrogenase; CRP: C-reactive protein; ICU: intensive care unit)

Postoperative measurements of parameters in two groups are displayed in Table 3. In Group I, the levels of procalcitonin (p=0.002), lactate (p<0.001), PT (%) (P <0.001), pCO₂ (p=0.020), AST (p<0.010), ALT (p=0.001), CRP (p<0.001), and total bilirubin (p<0.001) were significantly higher than Group II. Group II displayed increased levels of white blood cell count (p=0.023), CK (p=0.047), and LDH (p=0.001)

compared to Group I.

4. Discussion

The purpose of the present study was to compare the perinatal and clinical outcomes in pregnant with COVID-19 scheduled for cesarean section (CS) using spinal and general anesthesia. Our results indicated that pregnant with COVID-19 receiving general anesthesia were more likely for an ICU stay. Patients

in Group I (general anesthesia) had longer APTT ($p=0.015$), PT ($p=0.005$), INR ($p=0.003$). On the other hand, the rate of mortality and intubation were similar between pregnant women receiving spinal and general anesthesia. However, verifying our results in larger prospective, controlled, multi-centric trials may yield more reliable outcomes. COVID-19 is becoming more common among pregnant women every day, as it is in every corner of the world. 67.2% of the 61 COVID-19 positive obstetric patients were reported as asymptomatic, while 45% of the symptomatic pregnant women had pneumonia (11). The need for ICU was discovered in 33.33 percent of pregnant women with pneumonia, and the death rate was 11.11%. COVID-19 is not considered a contraindication to regional anesthesia in and of itself (12). While no hypotension was detected in the general anesthetic group, the epidural group had an 86% hypotension rate (13).

Chen et al. found that all patients with general anesthesia were emergency patients, while those undergoing epidural anesthesia were non-emergency patients (13). In a recent study, regional anesthesia was used 78.5% of the time and spinal anesthesia was used 76.2% of the time in emergency C/S patients (14). During the COVID-19 outbreak, Karasu et al. reported a rate of spinal anesthesia of 95.1%, according to this study (11). According to a literature review, most obstetric patients were asymptomatic or experienced COVID-19-like symptoms (fatigue, muscle soreness, shortness of breath, congestion, etc.) at the time of admission, which can easily be confused with usual pregnant symptoms (15-17). An analysis of 38 pregnant women with COVID-19 reported that none of the patients had severe pneumonia and mortality (5). Karasu et al. reported 14.8% of the 61 pregnant women with COVID-19 had pneumonia, and 4.9% required critical care. The first ICU patient was monitored with an oxygen mask, the second with intubation, and the third with intubation after three days of high-flow nasal oxygen. The overall death rate was 1.63%, but it was 5% in patients who presented with symptoms and 11.11% in individuals who had pneumonia. For the length of hospital stay, Karasu et al. discovered a strong negative link with hemoglobin levels, hematocrit levels, fibrinogen levels, and gestational week, as well as a significant positive correlation with age. They suggested that the absence of infection in anesthetists conducting C/S procedures implies that the risk of transmission can be reduced with proper PPE and regional anesthesia (11). When infected with respiratory viruses, physiological alterations in the immunological and cardiopulmonary systems in pregnant women may exacerbate the severity of the disease (18). The cardiovascular collapse has been observed in non-obstetric patients with severe COVID-19 after induction of anesthesia, and vasopressors should be readily available to treat hypotension. Because COVID-19 lower respiratory tract infection impairs respiratory function and pregnancy-related lung capacity decreases lung capacity, early desaturation should be expected after induction (5). Changes in the cardiovascular and respiratory systems,

including increased heart rate, stroke volume, oxygen consumption, and decreased lung capacity, increase the risk for pregnant women to develop severe respiratory disease. Preoxygenation is required, but high-flow nasal or face mask oxygen is not suggested due to the increased danger of aerosolization. Tracheal extubation is also a high-risk procedure for aerosol generation. Thus, coughing by the patient must be avoided, and if feasible, the number of staff in the room must be kept as low as possible during extubation (8). A recent analysis has evaluated pharmacological methods to minimize emergence coughing after general anesthesia with tracheal intubation. Dexmedetomidine, remifentanyl, fentanyl, intra-cuff or intravenous lidocaine, and lidocaine by the tracheal or topical application were all shown to be more effective than placebo or no medicine in suppressing moderate to severe emerging cough (19). However, whether these results would be useful in a group at high risk of emergence coughing is unclear. The use of sedative, respiratory, and hemodynamic medicines like remifentanyl and dexmedetomidine must be carefully weighed against the mother's sedative, respiratory, and hemodynamic effects (8). The newborn outcomes and mothers' recovery from COVID-19 were both unaffected by general anesthesia. The parturient's state, the parturient's wishes, and the obstetrician's recommendations must all be taken into account while deciding on the delivery method. The virus's ability to transmit to the fetus during vaginal birth is unknown. If there is intrauterine fetal distress due to hypoxia or other factors, an emergency cesarean section should be performed as soon as possible (13).

COVID-19 does not contraindicate neuraxial analgesia. When possible, an experienced anesthesia practitioner wearing the necessary PPE should perform neuraxial procedures and intubations (20). Regardless of the patient's COVID-19 status, neuraxial anesthesia appears to be the safer alternative for C/S delivery. In pregnant women with COVID-19 infection, spinal anesthesia does not appear to be related to hemodynamic instability or respiratory decompensation. Although it should be avoided wherever feasible, general anesthesia may be necessary if the mother's respiratory function has deteriorated, or for or during an emergency cesarean delivery. During airway management, particularly tracheal intubation and extubation, this period provides the largest risk of exposure due to direct contact with respiratory droplets (21). Healthcare contamination is also a concern with regional anesthesia for cesarean delivery in COVID-19 patients, especially if the procedure is an emergency. According to a recent study, using the maximum level of protective equipment when working with minimally symptomatic surgical patients under spinal anesthesia appears to lower the chance of transmission to anesthetists (22).

Because of the COVID-19 pandemic, obstetric anesthesiologists are rethinking how basic anesthetic care is delivered in the Labor and Delivery Unit. Modifications suggested include a stronger emphasis on avoiding general

anesthesia, encouraging infected patients to choose early neuraxial analgesia, and avoiding urgent cesarean delivery whenever possible. Adopting these practices can have a substantial impact on minimizing viral illness transmission and maintaining patient and caregiver safety in the labor room if done as a team (1). Although further evidence and instances are needed as information on the anesthetic care of patients with COVID-19, spinal anesthesia with proper protocols during an emergency Caesarean delivery in a patient with confirmed COVID-19 appears safe. Furthermore, newborns can be delivered without infection (23). Furthermore, spinal anesthesia has advantages over general anesthesia for CS because it has lower rates of respiratory depression and is not considered an aerosolizing procedure, so it should theoretically reduce the need for personal protective equipment (6).

One of our major limitations could be our inability to use PCR tests on all patients. The length of hospital stay may have been altered by changes in national treatment policy at the start and end of the pandemic. On the other hand, our research focused on anesthetic experiences in COVID-19 obstetric patients and included a sufficient number of patients. In this aspect, we suggest that our research is useful.

Experienced teams should manage COVID-19-infected women in a multidisciplinary facility, and all healthcare professionals involved in cesarean sections should wear PPE equipment. Our results yielded that both spinal and general anesthesia are safe and effective for pregnant women and newborns. Special precautions should be considered when providing care for pregnant women undergoing cesarean sections (C/S). In a verified COVID-19 pregnant woman, spinal anesthesia is still the first choice of anesthetic for cesarean sections (C/S). On the other hand, general anesthesia can be used as a backup plan in patients with contraindications to spinal anesthesia or in case of spinal anesthesia failure or emergency situations.

Ethical Statement

Ethical approval was granted by the Clinical Research Ethics Committee of University of Health Sciences, Kanuni Sultan Süleyman Training and Research Hospital (20.02.2022, No: KAEK/2022.02.20).

Conflict of interest

Authors declare that there is no conflict of interest for this article.

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Authors' contributions

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