The Impact of the COVID-19 Pandemic on Anesthesia Management and Clinical Outcomes in Cesarean Section Surgery

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Abstract

Aim: It is known that postoperative morbidity and mortality increased during the COVID-19 pandemic, even if there is no known COVID-19 infection in surgical patients. In this study, it was aimed to evaluate the effects of the pandemic period on anesthesia management and maternal and neonatal outcomes by considering pregnant women who had cesarean section (C/S) surgery between September 2019 and September 2020 in two different groups as pre-pandemic and pandemic.

Methods: In this study, pregnant women who underwent C/S surgery within the scope of one-year experience in a tertiary hospital were analyzed retrospectively in two different periods, before and during the COVID-19 pandemic. The primary outcome measure of the study was the rate of administration of regional anesthesia in C/S surgeries during the pandemic period.

Results: According to the results of this study, in which 1241 C/S cases were analyzed, maternal age, gestational age, gravida, pregnancy-related morbidities, neonatal data including APGAR score and indications for C/S surgery did not change during the early COVID-19 pandemic period. However, the rate of pre-existing maternal diseases including anemia, the rate of hospitalization in neonatal intensive care units and the length of hospital stay decreased in the pandemic period compared to pre-pandemic. it was also found that regional anesthesia practices and postoperative maternal complication rates increased during the pandemic.

Conclusions: In this study, it was observed that various changes occurred in the field of clinical practices of obstetric anesthesia and in patient outcomes with the initiation of the COVID-19 pandemic.

Keywords: *Cesarean section, COVID-19, obstetric anesthesia, pandemic.*

1. Introduction

The Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection, which continues today, albeit to a limited extent, is a global health problem that has caused approximately 770 million infections and 7 million deaths worldwide[1]. With the emergence of SARS-CoV-2 infection, coronavirus disease 2019 (COVID-19) rapidly spreads among pregnant women, as in all individuals.

Furthermore, with the declaration of the pandemic, lifestyle changes and infection measures in all areas of life took place as well as in the health system and in all interventional procedures, especially surgery and anesthesia practices. Similarly, in cesarean section (C/S) surgeries, with the belief that the risk of transmission due to aerosolization will be lower during airway management, the behavior of preferring neuraxial anesthesia to general anesthesia has developed and has come to the fore in obstetric anesthesia management during the COVID-19 pandemic[2,3]. However, general anesthesia for urgent C/S was preferred predominantly in pregnant women with pulmonary COVID-19 infection, and insufficient oxygen saturation (≤93%)[4]. In addition, it is known that postoperative morbidity and mortality increase during the pandemic, even if there is no known COVID-19 in surgical patients[5,6]. Therefore, with this study, it was aimed to evaluate the effects of the early pandemic period on anesthesia practice and maternal and neonatal outcomes, by considering the pregnant women who underwent cesarean section between September 2019 and September 2020 in two separate groups, as pre-pandemic and

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pandemic periods. The primary outcome measure was the incidence of regional anesthesia practice during COVID-19 pandemic, and secondary outcomes included the distribution of C/S indications, fetal, neonatal and maternal complications including intensive care unit (ICU) admission, bleeding, and mortality, and length of hospital stay.

2. Materials and methods

This study was approved by the Institutional Investigation and Ethics Committee on September 10, 2021, with approval number: 114/12 and conducted at Cukurova University in Turkey.

2.1. Patients

For this retrospective cohort study, 1241 pregnant women who underwent C/S surgery by the Department of Obstetrics at Cukurova University Hospital between September 2019 and September 2020 were recruited. The sample size of the study consisted of all pregnant women who had C/S surgery within one-year experience of our tertiary care hospital. Power analysis was not used in the study. Only two patients were excluded from the study because their perioperative records were not available.

2.2. Data collection

Electronic medical records, anesthesia records, preoperative evaluation records, nursing records, laboratory findings, and postoperative evaluation records and clinical outcomes were reviewed for all women and neonates. All data were collected, recorded and checked by two different independent research assistants.

2.3. Outcomes

From the preoperative records, the demographic characteristics of the women (age, weight, gestational age, gravida), American Society of Anesthesiologists (ASA) physical status classification, preexisting diseases, pregnancy associated comorbidities, history of COVID-19, indication of C/S, and preoperative laboratory tests were recorded. From the records during the operation, type of anesthesia, requirement of vasopressor, APGAR score, weight, height, sex, head circumference, and presenting part of neonate, and postoperative analgesia method were noted. From the postoperative period records, maternal and neonatal complications, postoperative laboratory tests and length of hospital stay were documented. Maternal complications were defined as excessive bleeding requiring blood transfusion, cardiovascular or respiratory complications, seizure, systemic inflammatory response syndrome (SIRS), wound infection, ICU admission, and mortality. Neonatal complications were ICU admission, SIRS, and mortality.

All data were compared with each other in two different periods, before and during the COVID-19 pandemic.

2.4. Statistical Analysis

Categorical measurements were expressed as numbers and percentages, and numerical measurements as mean and standard deviation (median and minimum-maximum where appropriate). The Chi-square test was used to compare categorical measures between groups. Whether the numerical measurements provided the assumption of normal distribution was tested with the Kolmogrov Smirnov test. In the comparison of numerical measurements between the groups, T-test was used in independent groups if the statistical hypotheses were met, and Mann Whitney U test was used if the statistical hypotheses were not met. Logistic Regression was used to identify risk factors for the variables of groups (pre-COVID vs. post-COVID). Variables that were significant at the $p<0.25$ level in univariate analysis were included in the logistic regression analysis. IBM SPSS Statistics Version 20.0 package program was used for statistical analysis of the data. Statistical significance level was accepted as 0.05 in all tests.

3. Results

In this study, a total of 1241 C/S cases within the one-year experience of a single tertiary hospital were analyzed in two different periods, just before the COVID-19 pandemic (n=621) and during the early COVID-19 pandemic (n=620) period. When the two groups were compared in terms of maternal age, gestational age, gravida and pregnancy-related comorbidities, the two groups were comparable, but preexisting diseases as well as preoperative anemia were significantly higher in the pre-pandemic group (Table 1). Neonatal data including sex, weight, head circumference, presenting part of fetus, and APGAR scores were comparable between groups (Table 2).

Operative characteristics and anesthetic data were presented in Table 3. During the pandemic period, the rate of regional anesthesia practice was significantly higher compared to general anesthesia (Table 3) (Figure 1). Moreover, in the pandemic, the rate of NSAID use in postpartum pain management decreased significantly and the rate of paracetamol use increased compared to the pre-pandemic (Table 3). While the incidence of maternal complications was found to be significantly higher in the pandemic, the rate of fetal complications mainly as ICU admission was significantly lower than in the pre-pandemic. In addition, the length of hospital stay was significantly reduced during the pandemic (Table 4). In the multivariate analysis model adjusted according to maternal age, gestational age, infant APGAR score, birth weight, urgency of surgery, preoperative hemoglobin level, preoperative white blood cell count, anesthesia type, intraoperative vasopressor requirement, postoperative complications, and length of hospital stay, it was shown that preoperative anemia and overall postoperative complications including both maternal and neonatal adverse events were significantly lower in pandemic. Similarly, in univariate analysis, preoperative anemia and the rate of general anesthesia practice (Figure 1) were significantly higher in pre-pandemic (Table 5).

4. Discussion

Although many changes in anesthesia practice, such as postponing elective cases, reconsidering urgency, have emerged with the COVID-19 pandemic, pregnancy-related procedures such as C/S surgery have not been interrupted[7]. Therefore, the best opportunity to observe the effects of the pandemic was obtained in these cases. During the COVID-19 pandemic, there were periodic differences in the SARS-COV-2 infection and the course of the disease, treatment and preventive modalities, and all clinical practices. In this context, in this retrospective study, in which 1241 C/S cases were analyzed, the effects of the COVID-19 pandemic on pregnancy, labor, patient outcomes and clinical practice in the initial period of the pandemic were evaluated. The current study reveals that, maternal age, gestational age, gravida, pregnancy-related morbidities, neonatal data including APGAR score, anthropometric measurements excluding height, and presenting part of neonate, and indications of C/S surgery were unchanged during the early COVID-19 pandemic. However, in the pandemic, pre-existing comorbidity, and anemia rate, NSAID use, neonatal ICU admission and length of stay in hospital decreased, on the other hand, regional anesthesia rate and maternal complications such as bleeding and infection increased. Although intrauterine bacterial infections are known as the main cause of spontaneous preterm birth, there is evidence that viral pathogens such as influenza, SARS and MERS also cause this adverse condition[8,9]. In this context, although there is a lot of evidence reporting the risk of preterm birth after COVID-19, this has not been clarified in all aspects[10,11].

Table 1

Maternal Characteristics, Concomitant Diseases and Preoperative Hemoglobin Values of Pre-pandemic and Pandemic Groups

Parameter	Pre-pandemic (n=621)	Pandemic (n=620)	p value
Maternal age (year) [a]	30.9±5.9	30.7±6.2	0.780
Gestational age (week) [a]	37.3±3.0	37.3±3.0	0.659
• <28 week[b]	12 (1.9)	11 (1.8)	
• 28-32 week[b]	36 (5.8)	34 (5.5)	0.991
• 33-37 week[b]	176 (28.3)	177 (28.5)	
• >37 week[b]	397 (63.9)	398 (64.2)	
Pre-existing disease[b]	244(39.3)	186(30)	0.001*
• Diabetes mellitus	26(4.2)	19(3,1)	
• Hypertension	31(5.0)	26(4.2)	
• Obesity	9(1.4)	6(1.0)	
• Asthma	18(2.9)	20(3.2)	
Gravida[b]			
• Primigravida	108(17.4)	121(19.5)	0.342
• Multigravida	513(82.6)	499(80.5)	
Pregnancy-related comorbiditiesb,[c]	282(45.4)	286(46.1)	0.068
Preoperative hemoglobin (g/dL)[a]			
• <11 g/dL	175 (28.2)	123 (19.8)	0.001*
• >11 g/dL	446 (71.8)	497 (80.2)	

[a] Values are given as mean±standard deviation. [b] Values are given as n (%).clncluding gestational diabetes mellitus and hypertension, preeclampsia, eclampsia, HELLP syndrome, oligohydramnios, anhydramnios, premature rupture of membranes or prolonged rupture of membranes, urinary tract infection etc. *These values indicate statistical significance (p<0.05).

Table 2

Comparison of Neonatal Data Between Study Groups

Parameter	Pre-pandemic (n=621)	Pandemic (n=620)	p value
Sex (Male/Female)a	314(50.6)/307(49.4)	322(51.9)/298(48.1)	0.629
APGAR score at 1 min[a]			
• 8-10	396(63.7)	355(57.3)	0.191
• 4-7	188(30.3)	229(36.9)	0.153
• <4	37(6.0)	36(5.8)	0.474
APGAR score at 5 min[a]			
• 8-10	536(86.3)	542(87.4)	0.604
• 4-7	72(11.6)	66(10.6)	0.738
• <4	13(2.1)	12(1.9)	0.932
Birth weight (g)b	2965.4±813.0	3008.9±771.4	0.300
• <2500 g	154(24.8)	130(21.0)	
• 2500-4200 g	448(72.1)	474(76.5)	0.221
• >4200 g	19(3.1)	16(2.5)	
Height (cm)[b]	46.7±4.7	47.2±4.5	0.009*
Head circumference (cm)[b]	33.5±2.8	33.7±3.0	0.406
Presenting parta			
• Head	505(81.3)	532(85.8)	
• Buttocks	79(12.7)	62(10.0)	0.193
• Transverse	28(4.5)	19(3.1)	
• Other (feet, face or oblique)	9(1.4)	7(1.1)	

[a] Values are given as n (%). [b] Values are given as mean±standard deviation. *This values indicates statistical significance (p<0.05).

Table 3

Comparison of Operative Characteristics and Anesthetic Data Between Study Groups

Parameter	Pre-pandemic (n=621)	Pandemic (n=620)	p value
Indication of C/S surgery			
• Fetal reasons	71(11.4)	51(8.2)	0.462
• Maternal reasons	246(39.6)	250(40.3)	
• Failed labor	40(6.4)	47(7.6)	
• Placental abnormality	22(3.5)	18(2.9)	
• Fetal and maternal reasons	60(9.7)	63(10.2)	
• Maternal and labor reasons	81(13.0)	76(12.3)	
• Fetal and labor reasons	60(9.7)	57(9.2)	
• Maternal and placental reasons	25(4.0)	38(6.1)	
• Patient request	16(2.6)	20(3.2)	
Type of surgery			
• Emergency surgery	284(45.7)	256(41.3)	0.114
• Elective surgery	337(54.3)	364(58.7)	
ASA status			
• II	615(99.0)	609(98.2)	0.221
• III	6(1.0)	11(1.8)	
Type of anesthesia			
• Regional	354(57.0)	402(64.8)	0.005*
• General	267(43.0)	218(35.2)	
Intraoperative vasopressor requirement			
• Yes	77(12.4)	64(10.3)	0.249
• No	544(87.6)	556(89.7)	
Postpartum pain management			
• Paracetamol	74(11.9)	112(18.1)	0.040*
• NSAID	241(38.8)	222(35.8)	
• Paracetamol+NSAID	238(38.3)	211(34.0)	
• Opioid	31(5.0)	36(5.8)	
• Opioid+Paracetamol	30(4.8)	34(5.5)	
• Epidural analgesia	7(1.1)	5(0.8)	

Abbreviations: C/S, cesarean section; ASA, American Society of Anesthesiologists; NSAID, Non-steroidal anti-inflammatory drug. Values are given as n (%). *This value indicates statistical significance ($p<0.05$).

In a large recent cohort, It has been reported that severe COVID-19 in late pregnancy triggers spontaneous preterm delivery, but mild and moderate, as well as early-term disease have a minimal effect on this risk[12]. Furthermore, in a systematic review and meta-analysis, it was concluded that preterm birth was not overall affected during the pandemic[13]. Consistent with this, in the present study, the gestational age distribution of pregnant women in the early COVID-19 pandemic was similar to that before the pandemic. Similarly, no increase in pregnancy-related comorbidities was observed during the pandemic. In contrast, in the large cohort study of Handley et al.[12], an increase in the rate of gestational diabetes and hypertension was reported during the outbreak period. This is a large database study analyzing 994,268 obstetric cases and covering the first one-year course of the COVID-19 pandemic, therefore it is inevitable being beyond our current study.

The association of preoperative anemia with adverse perioperative outcomes is well known[14]. Similarly, it has been shown that anemic pregnant women with COVID-19 have a higher risk of intensive care unit admission[15]. Interestingly, in the present study, the rate of cases with anemia before the pandemic was 28.2%, while it was 19.8% during the pandemic period. There could be numerous possible reasons for this situation. One of these may be due to the increasing intensity of pregnancy follow-up programs, and the improvement in preventive activities in primary health care. Another reason may be that the pregnant women's nutrition and healthy life habits improved and extra care has emerged, especially with the outbreak.

Researches evaluating C/S indications in the COVID-19 pandemic have reported that the incidence of fetal distress increased among all indications, and as well as elective surgery rates decreased[12,16,17]. Nonetheless, in our study, there was no difference between the COVID-19 pandemic and the C/S indications and elective surgery rates.

Table 4

Distribution of Postoperative Maternal and Neonatal Complications and Length of Hospital Stay in Study Groups

Parameter	Pre-pandemic (n=621)	Pandemic (n=620)	p value
Maternal complications[a]	36(5.8)	71(11.5)	0.001*
• Respiratory	2(0.3)	3(0.5)	
• Bleeding[b]	12(1.9)	25(4.0)	
• Systemic complications[c]	12 (1.9)	21 (3.4)	
• Wound infection	4 (0.6)	9 (1.4)	
• ICU admission	1(0.16)	2(0.32)	
• Thrombosis	0(0.0)	1(0.2)	
• COVID-19 PCR (+)	0(0.0)	8(1.3)	
• Other[d]	5(0.8)	2(0.3)	
Fetal complications[a]	66(10.6)	31(5.0)	0.001*
• Neonatal ICU admission	55(8.8)	20(3.2)	
• Neonatal mortality	11(1.8)	11(1.8)	
• Length of hospital stay[e]	2.1±0.9	1.8±1.5	0.001*

Abbreviations: ICU, intensive care unit; PCR, polymerase chain reaction.[a] Values are given as n (%).[b] Required blood transfusion or total abdominal hysterectomy.[c] Hemodynamic abnormality, arrythmia, impaired blood glucose, seizure, or fever. [d] Allergic reaction, ileus, and psychologic symptoms.[e] Value is given as mean±standard deviation. *These values indicate statistical significance (p<0.05).

Table 5

Univariate and Multivariate Analysis of the Potential Risk Factors in Pre-pandemic and Pandemic Groups

Parameter	Pre-pandemic n(%)	Pandemic n(%)	Univariate OR(95% CI)	p value	Multivariate aOR[a](95% CI)	p value
Preterm labor (<37 week)	224(36.1)	222(35.8)	1.01(0.80-1.27)	0.923	0.49(0.22-1.08)	0.077
Preoperative anemia (Hb<11 g/dL)	175(28.2)	123(19.8)	1.58(1.21-2.06)	0.001*	1.75(1.02-2.99)	0.039*
Maternal and neonatal complications	112(18.0)	104(16.7)	0.84(0.61-1.169	0.300	0.56(0.33-0.94)	0.029*
APGAR at 5 min <8	85(13.7)	78(12.6)	0.95(0.90-1.02)	0.186	-	-
Low birth weight (<2500 g)	154(24.8)	130(21.0)	0.80(0.36-1.76)	0.580	-	-
Emergency surgery	284(45.7)	256(41.3)	0.83(0.67-1.04)	0.115	-	-
Preoperative leukocytosis (WBC>11 103/mL)	389(62.6)	397(64.0)	1.00(0.78-1.28)	0.960	-	-
Type of anesthesia						
• RA	354(57.0)	402(64.8)	0.71(0.57-0.90)	0.005*	-	-
• GA	267(43.0)	218(35.2)				
Vasopressor requirement	77(12.4)	64(10.3)	0.81(0.57-1.15)	0.250	-	-
Length of hospital stay (mean±SD)	2.1±0.9	1.8±1.5	0.89(0.80-0.99)	0.390	-	-

Abbreviations: OR, odds ratio; aOR, adjusted OR; CI, confidence interval; Hb, hemoglobin; WBC, weight blood cell; RA, regional anesthesia; GA, general anesthesia. [a]aOR was adjusted according to maternal age, gestational age, infant APGAR score, birth weight, urgency of surgery, preoperative hemoglobin level, preoperative white blood cell count, anesthesia type, intraoperative vasopressor requirement, postoperative complications, and length of hospital stay. *These values indicate statistical significance (p<0.05).

It is obvious that great changes are observed in anesthesia practices during the COVID-19 pandemic period. Particularly in this period, there was a decrease in elective cases and a divergency from general anesthesia to limit airway interventions.[7,18] For that reason, regional anesthesia practices have arisen significantly in all procedures, as well as in C/S surgery[16,19]. In our study, it was shown that general anesthesia rates in C/S surgery decreased from 43% to 35% in the early pandemic period, consistent with the evidences.

In the early stages of the COVID-19 pandemic, many opinions have been suggested that the use of non-steroidal anti-inflammatory drugs may exacerbate COVID-19 and have serious side effects, and subsequently the World Health Organization (WHO) has published a statement on this issue. Therefore, clinicians have been relatively away from NSAIDs during the pandemic period.

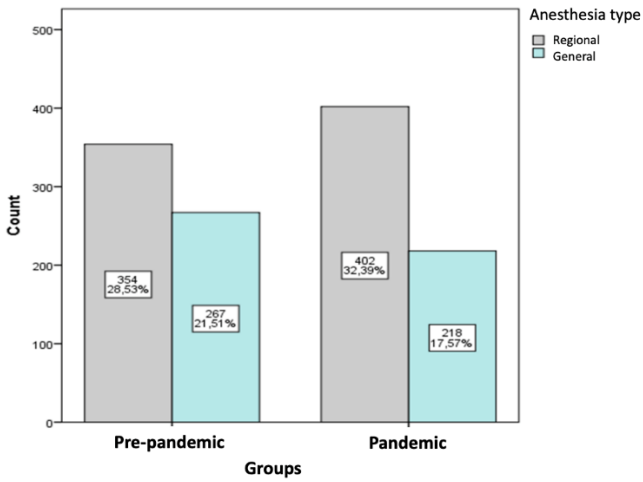

Figure 1

Comparison of the anesthesia types between the two study periods

Despite the lack of conclusive evidence and conflicting results, a decrease in NSAID use tendency has been observed. In the current study, a significant decrease in the rate of NSAID use in postpartum pain management was demonstrated statistically.

In a systematic review addressing the impact of the COVID-19 pandemic on maternal and perinatal outcomes at a global level, it was reported that maternal mortality, stillbirth, and ruptured ectopic pregnancies increased in the pandemic compared to pre-pandemic period. In contrast, preterm birth, maternal gestational morbidity, and neonatal outcomes including APGAR less than 7 at 5 minute, neonatal ICU admission, low birth weight, and mortality were unaffected[13]. It is understood from this that the COVID-19 pandemic does not seem to have directly affected the obstetric outcomes except maternal mortality and stillbirth. Mortality and stillbirth outcomes are probably due to pregnant women in the population with severe COVID-19 and reduced access to care. In our study, no difference was found between the two periods in terms of neonatal APGAR scores, birth weights, head circumferences, presenting part of neonate, and mortality. On the other hand, a significant decrease was observed in the neonatal ICU admission rate during the pandemic period. We interpreted this finding as neonatal ICU follow-up indications were revised and narrowed during the pandemic period.

In our study, a significant increase was found in postnatal maternal complications in C/S cases during the pandemic period. Eight patients had COVID-19 and one patient had thrombotic complications. However, in a way we could not explain, there was an increase in bleeding-related complications and systemic complications such as hemodynamic abnormality, arrhythmia, impaired blood glucose, seizure or fever in postnatal women during the pandemic.

While concerns about postpartum early discharge as a family-friendly and cost-effective approach have been on the agenda in recent years, this trend has accelerated during the COVID-19 pandemic period[12,19,20]. In the large database study mentioned above[12], it was observed that the length of hospital stay was significantly shortened in obstetric patients during the COVID-19 pandemic, and it did not cause any difference in re-admission to the hospital within postpartum 6 weeks. In the present study, we also found that the length of hospital stay was significantly shorter during the pandemic period.

The strength of the study is that it covers all C/S cases in our tertiary care hospital during the one-year period that includes just before and during the COVID-19 pandemic, thereby facilitating the comparability of the data and evaluation of the impacts of outcomes. The main limitation is the retrospective and single center design of the study by that limiting the generalization of the results. Another is that the pregnancy processes of the patients included in the study are not completely within these periods due to the long gestational duration.

5. Conclusions

In this study, which covers the immediate pre- and early period of the COVID-19 pandemic, the changes caused by the outbreak on health care delivery and patient outcomes were evaluated. Our findings suggest that C/S indications, gestational age, gestational comorbidities, and neonatal outcomes, including APGAR score, anthropometric measurements, and mortality, did not change during versus before the COVID-19 pandemic. Nevertheless, during the pandemic period, the rate of anemic pregnant women reduced, the use of regional anesthesia increased, the rate of postpartum NSAID use decreased, the neonatal ICU admission rate and length of hospital stay were shortened. We think that there is a need for large and homogeneous cohort studies at a global level that examine the longer-term effects of the COVID-19 pandemic on maternal and perinatal outcomes.

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Statement of ethics

The study was registered at the Cukurova University Institutional Investigation and Ethics Committee on 10 September 2021 with the approval number: 114/12 and conducted at Cukurova University in Turkey following the most recent version of the Declaration of Helsinki.

Conflict of interest statement

The authors declare no conflict of interest.

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Author contributions

All authors contributed to the study conception and design.

All authors read and approved the final manuscript.

Informed Consent

Informed consent was obtained from all subjects or their relatives.

Availability of Data and Materials

The datasets analyzed in this study are available upon request to the corresponding author.

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