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Original Article

Comprehensive Analysis of Anesthesia in Coronavirus Disease-19 Positive Patients in a Dedicated Coronavirus Disease Hospital

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Abstract

Background and Aim: To study the clinical characteristics of coronavirus induced disease 19 (coronavirus disease 19 [COVID-19]) patients undergoing anesthesia.

Methods: It was a retrospective study conducted at a dedicated COVID public hospital. All COVID-19 patients undergoing anesthesia were analyzed for anesthesia techniques, peri-operative course, complications, outcome (Intensive Care Unit [ICU] admission, death), and factors associated with perioperative morbidity and mortality. Software EpiInfo version 7.2 was used for statistical analysis.

Results: Total of 269 COVID-19 patients received anesthesia during the study period with 218 (81%) cesarean section and 51 (19%) other surgical emergencies. The most common anesthesia technique was central neuraxial blockade (CNB) in 235 (87.36%), followed by general anesthesia (GA), regional blocks, and monitored anesthesia care. Intraoperative complications in 14 (5.20%) patients were hypotension, bradycardia, hemorrhage, desaturation, and bronchospasm. ICU care needed in 22 (8.18%) patients and significantly associated with age >50 year ($P < 0.001$, odds ratio [OR] 31.73, 95% confidence interval [CI] 10.87–92.62), co-morbidities ($P < 0.00$, OR 9.36, 95% CI 3.61–24.27), GA ($P < 0.00$, OR 7.85, 95% CI 2.99–20.62), and intra-operative complication ($P < 0.001$, OR 295.20, 95% CI 34.87–498.02) and raised inflammatory markers. The most common post-operative complications were pulmonary (Acute respiratory distress syndrome [ARDS], pneumonia, and respiratory failure) and vascular thrombosis. Mortality was (4) 1.49% and significantly associated with advanced age ($P = 0.002$, OR 41.17, 95% CI 4.07–416.08), co-morbidities ($P < 0.001$, OR 10.70, 95% CI 1.09–104.87), SpO_2 <90% ($P < 0.001$, OR 10.70, 95% CI 1.09–104.87), and complications ($P = 0.003$, OR 23.09, 95% CI 2.97–179.23).

Conclusion: We recommend, regional anesthesia mainly CNB for COVID-19 patients whenever feasible and modified rapid sequence induction for GA. COVID-19 severity with hyper-inflammation and pulmonary involvement should be considered for risk estimation. Vigilance for post-operative pulmonary complications and thrombosis is crucial. Identification of risk factors such as advanced age, comorbidities, severe COVID-19 complications (vascular thrombosis, ARDS, multiorgan failure, etc.) and raised inflammatory markers to decrease perioperative morbidity and mortality is vital.

Key words: Anesthesia in coronavirus disease-19, Coronavirus induced disease 19, Severe acute respiratory syndrome coronavirus 2 pandemic

INTRODUCTION

The corona virus induced disease 19 (coronavirus disease [COVID-19]) pandemic is an international public health emergency, which is caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).[1] More than 35.5 million people are affected across the world and almost 1.04 million deaths are observed, in India more than 6.69 million people are infected and more than 1.04 lakhs deaths till date as per COVID-19 tracker and the toll is still rising. Therefore, many hospitals are designated entirely as COVID only hospitals and many routine health-care procedures are being delayed to prioritize treating COVID-19.[1,2] Our tertiary care teaching public institute in a metro city of India was also converted to a

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dedicated COVID hospital (DCH) and nodal center for obstetric care.

COVID-19 patients undergoing anesthesia pose huge challenges due to variety of reasons such as it's a novel, unknown nature, severity, medications, and complications of COVID-19.[2] SARS-CoV-2 is a respiratory system targeting virus with wide spectrum of manifestation from asymptomatic to severe illness with pneumonia, acute respiratory distress syndrome (ARDS), death and specific treatment protocols for managing COVID-19 are still being evolved.[2] Operation theater (OT) and airway procedures are highly aerosol generating. There is limited information about the clinical characteristics of COVID-19 patients undergoing anesthesia, anesthesia techniques, complications, and overall outcome. Furthermore, the effect of surgery and anesthesia on further course of COVID and vice versa is still under investigation. Due to limited evidence, current guidelines for the anesthetic management of COVID-19 patients are based largely on expert opinion and case series.[3-7] A recent meta-analysis concluded that surgical patients with SARS-CoV-2 are at risk of pulmonary complications and mortality.[8]

Our health system is overwhelmed with logistic challenges and limited resources. Therefore, it is crucial to have evidence-based, standard management protocol for anesthesia in COVID patients. Streamlining optimum use of limited resources and prompt management of complications may help to decrease perioperative morbidity and mortality in COVID. Hence, we conducted comprehensive clinical analysis of COVID-19 patients undergoing anesthesia. Our primary objective was to analyze the anesthesia techniques in COVID-19 patients. We also studied the perioperative course with respect to demographic parameters, co-morbidities, complications, severity of COVID-19, and its complications, the need for intensive care unit (ICU) admission, mechanical ventilation, outcome, and the factors associated with ICU admission and mortality.

METHODS

It was a retrospective study conducted at a tertiary care teaching public institute which was converted into DCH after institute's ethics committee approval (ECARP/2020/81). Study period comprised from April 19, 2020 to August 15, 2020. Waiver of consent was obtained. COVID-19 positive case is defined as positive reverse-transcriptase-polymerase chain reaction (RT-PCR) in a diagnostic specimen. All consecutive COVID-19 positive patients undergoing all types of surgery under anesthesia during the study period were included in the study. All the patients were confirmed RT-PCR positive at different stages of COVID-19. Following data were collected from the medical records: Demographics (age, sex, and weight), medical and surgical history, associated co-morbidities, laboratory and biochemical parameters and available investigations, electrocardiogram, available radiological findings from X-ray chest, and computed tomography scan of thorax. The disease severity of COVID-19 was recorded as mild (mild symptoms without radiological and laboratory changes), moderate (fever, cough with <50% radiological involvement), severe (dyspnea, low SPO_2, and lung infiltrates >50%), and critical (severe COVID associated with complications), which was defined according to the management guidelines for COVID-19 and treatment details were recorded.[9]

American Society of Anaesthesiologist Physical Status (ASA-PS) classification, surgical procedure, details of anesthesia technique and duration of surgery were recorded. Vital parameters: Heart rate (HR), systolic and diastolic blood pressure (BP), and oxygen Saturation (SpO_2) were noted as documented in the immediate pre-operative, intraoperative, and immediate post-operative period from records. Perioperative complications (anesthesia, surgical, and COVID related) and need for ICU admission were recorded. In cases of caesarean section (CS), neonatal outcome was noted. In cases of ICU admission, details of ICU intervention and complications developed were noted. Final outcome of the patient was categorized as discharge or death and the cause of mortality was noted.

The data were collected and compiled in MS Excel. Qualitative data such as gender, and co-morbidities were represented in the form of frequency and percentage. Quantitative data such as age, and SpO_2 were represented using percentage, mean ± standard deviation (SD), median, and interquartile range (IQR). Association between variables was assessed by Chi-square test and by Fisher's exact test (small counts). Analysis was two tailed and an alpha value $P < 0.05$ was used as the cutoff for statistical significance. Bivariate analysis for association among various risk factors (variables) and outcome (ICU admission, mortality) was calculated using Odds ratio (OR) and 95% confidence interval (CI). Appropriate statistical software, including but not restricted to MS Excel, EPI info version 7.2 was used for statistical analysis.

RESULTS

Total of 269 COVID-19 patients received anesthesia for various surgical procedures during the study period at DCH. The surgical procedures comprised of 218(81%) CS

and 51 (19%) other surgical emergencies such as general surgical emergencies (exploratory laparotomy for intestinal obstruction and perforation peritonitis, debridement, amputation), check curettage, ectopic pregnancy, suction evacuation, manual removal of placenta, neurosurgery, ophthalmic, and vascular surgery.

Among 218 females undergoing CS, mean age (±SD) was 28.02 (±4.54) years and among 51 other surgical emergencies, mean age was 45.16 (±17.890) years, of which 32 (62.75%) were females and 19 (37.25%) were males [Tables 1 and 2].

In 218 CS patients, 37 (16.97%) had associated comorbidities such as 27 (12.39%) pregnancy induced hypertension (PIH), six (2.75%) gestational diabetes mellitus (GDM), eight (3.67%) thyroid disorders, and eight (3.67%) other conditions such as bronchial asthma (BA), anemia, and pancytopenia. Among 51 other surgical emergencies, 23 (45.10%) patients had comorbidities such as 19 (37.25%) diabetes mellitus (DM), 13 (25.50%) hypertension (HT) and six (11.76%) BA, ischemic heart disease (IHD), chronic kidney disease (CKD), and 13 (25.50%) had more than one comorbidity.

According to disease severity of COVID-19, 245 (91.08%) patients belonged to mild, 20 (7.43%) moderate, three (1.12%) severe, and one (0.37%) critical category. According to the ASA classification, 251 (93.3%) patients were ASA 1, 2, and 18 (6.69%) were ASA 3, 4.

The indications for 218 CS were previous CS 103 (47.25%), fetal distress 65 (29.82%), PIH and eclampsia 21 (9.63%), and other indications such as breech, multiple pregnancy (one triplet and two twins), non-progress of labor, constituted 41 (18.81%). In two severe COVID patients, persistent low SpO_2 was an additional indication.

Among anesthesia techniques administered, central neuraxial blockade (CNB) was used in maximum patients 235 (87.36%) [Figure 1]. GA was given in 4% patients using modified rapid sequence induction (RSI) technique along with viral filter and closed suction. Intraoperative oxygen was administered through nasal prongs in 128 (47.58%) patients, Hudson mask in 30 (11.15%), non-rebreathing reservoir mask in 15 (5.58%), non-invasive mechanical ventilation (NIV) in three (1.12%) patients, and in ten (3.72%) patients by controlled ventilation through endotracheal tube (ETT).

Intraoperative course was uneventful in 255 (94.8%) patients with stable vital parameters and 14 (5.20%) developed complications [Figure 2]. Intraoperative complications were cardiovascular (hypotension and bradycardia) in nine (3.35%) patients, hemorrhage in three (1.49%), desaturation in two (0.74%), and bronchospasm in one (0.37%) patient.

Neonates born to COVID-19 positive mothers by CS had mean APGAR score of 9.87 ± 0.51, mean birth weight 2.77 ± 0.55 kg, and none of them were RT-PCR positive in the first diagnostic specimen.

Postoperatively, 22 (8.18%) patients needed intensive care. We analyzed the risk factors, associated with requirement of ICU care in post-operative period. The

Table 1: Clinical characteristics and quantitative parameters of patients undergoing LSCS

Quantitative parameters	Mean	SD	Min	25%	Median	75%	Max
Age (years)	28.02	4.54	20.00	24.00	28.00	31.00	40.00
Duration of surgery (min)	82.04	15.74	60.00	70.00	85.00	90.00	200.00
Weight (kg)	64.00	7.28	50.00	58.00	62.00	68.00	90.00
Hemoglobin (g%)	10.80	1.25	8.80	10.00	10.90	11.40	14.90
Total leukocyte count (TLC) ($\times 10^9$/L)	9.85	1.58	3.00	9.80	10.00	11.00	14.50
Platelet count ($\times 10^{11}$/L)	1.71	0.51	0.60	1.2	1.75	2.0	3.4
APGAR score	9.87	0.52	7	10	10	10	10

Table 2: Clinical characteristics and quantitative parameters of patients undergoing emergency surgery

Quantitative parameters	Mean	SD	Min	25%	Median	75%	Max
Age (years)	45.16	17.89	18.00	29.00	42.00	62.00	80.00
Duration of surgery (min)	99.51	92.78	20.00	25.00	45.00	180.00	330.00
Weight (kg)	61.57	12.83	30.00	54.00	58.00	65.00	98.00
Hemoglobin (g%)	10.50	0.99	7.30	10.00	10.20	11.00	13.00
Total leukocyte count (TLC) ($\times 10^9$/L)	10.57	4.84	4.50	7.60	9.00	12.00	25.91
Platelet count ($\times 10^{11}$/L)	2.27	0.81	0.97	1.80	2.20	2.40	5.60
C-reactive protein (mg/L)	22.89	20.51	10.00	10.00	10.00	30.00	90.00
Creatine phosphokinase (U/L)	134.31	119.02	32.00	70.00	70.00	122.00	450.00
Interleukin-6 (pg/ml)	291.39	679.03	3.00	3.00	5.00	250.00	3285.00
Serum Ferritin (ng/ml)	168.04	167.24	40.00	40.00	110.00	240.00	550.00
D-Dimer (mg/L)	2.10	2.96	0.20	0.40	0.40	4.00	10.00

significant factors were age more 50 years, presence of co-morbidities, anesthesia technique (GA), and intraoperative complications [Table 3]. In ICU patients, levels of inflammatory markers were significantly elevated such as Interleukin-6 >35 pg/ml ($P < 0.001$, OR 79.20, 95% CI 8.38–748.75, D-dimer >0.8 mg/l), ($P < 0.001$, OR 64, 95% CI 6.96–588.43, Serum ferritin levels >300 ng/ml), and ($P < 0.001$, OR 13.60 95% CI 2.96–62.42). Complications encountered in the ICU were pulmonary complications such as ARDS, pneumonia, respiratory failure, vascular thrombosis in all 22 (8.18%) patients, followed by acute kidney injury (AKI) in six (2.23%), sepsis three (1.12%), multiorgan dysfunction syndrome (MODS) three (1.12%), and pulmonary fibrosis in two (0.74%). Final outcome of the patient was categorized as discharge or death. 265 (98.51%) patients were discharged and four deaths reported with mortality of 1.49%. The risk factors associated with mortality were advanced age, presence of comorbidities, low preoperative oxygen saturation, and presence of ICU complications [Table 4]. Cause of death was severe ARDS and MODS in severe COVID-19.

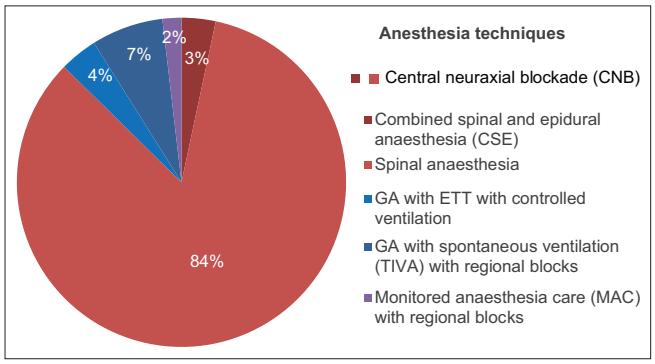

Figure 1: Various anesthesia techniques used in COVID-19 patients. CNB: Central neuraxial blockade, TIVA: Total intravenous anesthesia, MAC: Monitored anesthesia care, GA: General anesthesia

DISCUSSION

Total 269 COVID-19 patients underwent surgical procedure under various types of anesthesia techniques during the study period at DCH. Majority patients belonged to ASA 1, 2 and mild COVID category and had good outcome. ASA 3, 4 and moderate to severe COVID category patients required ICU care and developed post-operative complications; however, six ASA 2 patients developed post-operative COVID related pulmonary complications. Post-operative overt pulmonary manifestations have been reported in COVID due to direct injury to pulmonary epithelium with profound inflammatory response.[8,10] Risk estimation for post-operative outcome may not be accurate using the ASA-PS status alone, COVID disease severity should be considered as an additional index while estimating post-operative outcome.

Various types of anesthesia techniques were administered such as general anesthesia (GA), monitored anesthesia care (MAC), total intravenous anesthesia (TIVA), and regional anesthesia (RA) techniques including central neuraxial blocks (CNB): Spinal, epidural, combined spinal epidural (CSE), and peripheral neural blocks (PNB). Most common technique used was CNB in 235 (87.36%) patients. Anesthesia technique was chosen as per the clinical condition, surgical requirement, COVID-19 severity, lung involvement, hypercoagulopathy, thrombocytopenia, and ongoing COVID medications especially anticoagulants and antivirals. All mild cases received hydroxychloroquine (initial months before obsolete) or favipiravir or doxycycline and ivermectin along with supportive treatment with multivitamins especially Vitamin C and zinc. All moderate to severe COVID-19 patients received LMWH, steroid, and antiviral (favipiravir and remdesivir) medication. CNB was administered as per ASRA guidelines after confirming platelet count, available coagulation parameters (PT, INR, APTT, and D-Dimer) and timing of anticoagulants.[11]

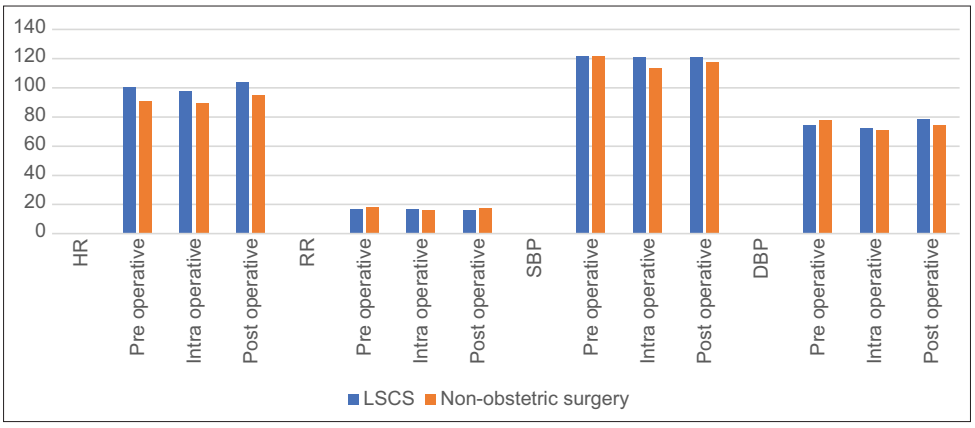

Figure 2: Pre-operative, intraoperative, post-operative trends in vital parameters in COVID-19 patients. Heart rate (HR), respiratory rate (RR), systolic blood pressure (SBP), diastolic blood pressure (DBP)

Table 3: Statistical analysis of different variables with post-operative ICU admission as outcome

Risk factor	ICU admission				Odd's ratio (95% CI) *	*P* value
	Yes (*n*=22)		No (*n*=247)			
	No.	%	No.	%		
Age						
>50 years	12	54.55	9	3.64	31.73 (10.87–92.62)	<0.001
<50 years	10	45.45	238	96.36		
Comorbidity						
Present	15	68.18	46	18.62	9.36 (3.61–24.27)	<0.001
Absent	7	32.82	201	81.38		
Anesthesia technique						
GA	9	40.91	20	8.10	7.85 (2.99–20.62)	<0.001
Non-GA	13	59.09	227	91.90		
Presence of complications						
Present	12	54.55	1	0.40	295.20 (34.87–498.02)	<0.001
Absent	10	45.45	246	99.60		

* CI: Confidence interval

Table 4: Statistical analysis of variables with post-operative mortality as outcome

Risk factor	Mortality				Odd's ratio (95% CI)†	*P* value
	Yes (*n*=4)		No (*n*=265)			
	No.	%	No.	%		
Age						
>50 years	3	75.00	18	6.79	41.17 (4.07–416.08)	0.002
<50 years	1	25.00	247	93.21		
Co-morbidity						
Present	3	75.00	58	21.89	10.70 (1.09–104.87)	<0.001
Absent	1	25.00	207	78.11		
Pre-operative SpO2*						
<90	3	75.00	58	21.89	10.70 (1.09–104.87)	<0.001
>90	1	25.00	207	78.11		
Post-operative Complications						
Present	2	50.00	11	4.15	23.09 (2.97–179.23)	0.003
Absent	2	50.00	254	95.85		

*SpO_2: Oxygen saturation; †CI: Confidence interval

Thrombocytopenia has been documented with severe COVID-19.[12]

Pregnant patients may experience non-specific COVID-19 symptoms (myalgia, diarrhea, headache, vomiting, fever, and shortness of breaths) which may be easily attributed to their pregnancy symptoms. Being a referral and DCH center, most of our obstetric patients had been diagnosed RT-PCR positive in their third-trimester antenatal checkup. All received multivitamins including Vitamin C and zinc from the time of diagnosis; however, LMWH and steroids reserved for moderate to severe patients. Although, HCQ was part of COVID-19 management initially, none of pregnant patient received it. Antiviral (remdesivir) drug was started post-LSCS in severe cases. To prevent unnecessary spread of infection most of LSCS was performed electively in indicated patients. CNB was the choice of anesthesia technique in these patients. Severe PIH and GDM patients were well managed by CSE with mild-to-moderate COVID-19 symptoms. Our one severe PIH patients with severe COVID, who was receiving NIV preoperatively was also managed with regional anesthesia successfully with continuation of intraoperative NIV. The choice of anesthesia was depended on risk benefit ratio in every technique in every patient. We observed mild thrombocytopenia in majority of pregnant patients (lowest 60×10^9), drug-induced thrombocytopenia especially steroids and sepsis ruled out. PIH and eclamptic patient with COVID symptoms, who were receiving magnesium, should be of concern as COVID patients are prone to have AKI. Therefore, close monitoring of renal functions was done in these patients. Carboprost and nonsteroidal anti-inflammatory drugs were avoided as it may precipitate bronchospasm and platelet dysfunction, respectively.

All types of anesthesia have been safely reported in COVID patients.[3,13] Recommended technique in whenever possible

is regional anesthesia.[3,6,14,15] GA is preferably avoided as there is always the possibility of exacerbating pulmonary complications, hampering oxygen diffusion across the pulmonary endothelium and respiratory failure which has been reported in advanced pregnancy in COVID.[3,10,16] CNB and other regional blocks (scalp, axillary, and field block) were our first choice whenever possible. During MAC, sedation was avoided or kept minimal to avoid increased oxygen demand and airway manipulation associated with respiratory depression. Oxygen was provided through nasal prongs under a surgical mask. Use of LMA was avoided. Wax *et al*. recommended use of regional anesthesia wherever possible, even if it is outside the usual standard of care.[17] In our study, 29 patients were given GA due to specific indications such as eclampsia, severe thrombocytopenia, hemodynamic instability, requirement of mechanical ventilation due to COVID, and surgical requirement. Special precautions were taken while providing GA to the patients on NIV. Continuous application of NIV till shifting patient to the operation table was practiced. RSI was done with succinyl choline through intravenous induction agents (Propofol was preferred over thiopentone sodium and etomidate, as patients prone to have hyper-reactive airways with hyperimmune response), and avoiding inhalational anesthetics. Vecuronium was preferred over atracurium and cisatracurium except in deranged renal functions. Intraoperative application of positive end expiratory pressure (PEEP) for maintaining saturation and vigilant hemodynamic monitoring was done.

To prevent risk of cross-contamination and risk of viral spread, positive pressure OT was converted to negative pressure design, by the incorporation of a strong low-level exhaust system. Chow *et al*. suggested conversion of OT from positive to negative pressure environment.[18] We strictly followed infection prevention and control policies with emphasis on meticulous hand hygiene.[5,7,13] During GA with ETT, utmost precaution was taken to limit aerosol spread using modified RSI and intubation techniques with video laryngoscope by the most experienced anesthesiologist. Aerosol box or plastic drapes were used for intubation and extubation along with viral filter and closed suction. Intraoperative monitoring in all stable patients was done from distance and minimal personnel was kept in the OT. However, extra staff was kept standby in high risk cases as managing highly dynamic situations in OT, communication and swift functioning in Personal Protective Equipment (PPE) during sudden emergencies were extremely demanding.

Intraoperative course was uneventful and uncomplicated in most of the patients. Hypotension secondary to spinal anesthesia was well within 20–30% of base line and was managed appropriately with fluid and vasopressors and post-CNB noneurological complications were noted. However, in two patients exaggerated hypotension with arrhythmia (ventricular premature complexes and irregular R-R interval) unrelated to anesthesia and surgical causes was noted. Pirzada *et al*. described varied cardiac manifestations in COVID mainly due to Myocarditis.[19] Intraoperative desaturation (86–92%) and bronchospasm were observed in some severe COVID patients which may be attributed to hyperinflammation. Safety of neuraxial procedures in COVID-19 is documented by authors.[20,21] We observed elevated blood sugar in some moderate to severe COVID patients; however, it was not monitored in all the patients. Hyperglycemia in COVID due to pancreatic isletis or stress hyperglycemia is difficult to optimize.[22,23] Therefore, perioperative blood sugar monitoring is advised at regular intervals in COVID.

Amongst the 22 patients who required ICU, 14 were admitted in ICU preoperatively due to moderate-to-severe COVID. Factors which significantly associated with the requirement of perioperative ICU were: age >50 years, comorbidities, raised levels of inflammatory markers (D-dimer, IL-6, Serum ferritin), GA, and presence of intraoperative complications (hypotension, desaturation). Although, technique of anesthesia for GA was not the reason of ICU admission. Higher ASA class, COVID severity, and duration of surgery >2 h were also important factors in ICU admission clinically; however, they were not statistically significant.

Most common post-operative complication was pulmonary (ARDS, pneumonia, respiratory failure, and Pulmonary fibrosis), vascular thrombosis, followed by AKI, sepsis, MODS. Post-operative pulmonary complications were documented in half of patients with perioperative SARS-CoV-2 infection.[8] In some patients with vascular thrombosis, emergency embolectomy was needed. A hypercoagulable state due to uncontrolled immune-thrombotic response has been reported in severe COVID and is associated with poor outcome.[23-25] Hence, it is crucial that in addition to patient, anesthesia and surgical factors, COVID severity with hyperinflammation and pulmonary involvement should be recognized for anticipated ICU care in the post-operative period.

Mortality in the present study was (4) 1.49%, including only one maternal death out of the 218 CS patients and 265 patients were discharged and no neonatal complications were noted. Cause of death was severe ARDS and MODS in severe COVID-19. Good outcomes in pregnant COVID and no neonatal complications were reported.[26] Parameters significantly associated with mortality were advanced age, presence of comorbidities, low SpO_2, and post-operative complications. Similar factors were associated

with mortality in COVID in many studies across the globe.[23,27,28] A recent meta-analysis found that pulmonary complications and 30-day mortality were highest in those who developed lung involvement.[8] In the present study, pulmonary complications and mortality, however, were less as compared to reported literature.

Limitation of this study was being observational, retrospective, and single center study.

CONCLUSION

Thus, the experience from 269 COVID-19 patients with a large obstetric population, highlights, that regional anesthesia can be safely administered mainly to mild-to-moderate COVID patients as well as in some severe COVID patients with extreme vigilance. GA can also be administered safely, if required, using modified RSI and intubation with intravenous induction and use of intraoperative PEEP, viral filter, and closed suction. COVID severity should be considered as an additional index while estimating post-operative risk. Factors associated with ICU admission and mortality were advanced age, co-morbidities, high inflammatory markers, and SpO2<90%, pulmonary complications such as ARDS, pneumonia, and respiratory failure and should be recognized early for better outcome.

During COVID pandemic, we have changed our institutional practice guidelines with many regional techniques as a standard part of our armamentarium. Hence, we recommend regional anesthesia as technique of choice for COVID patients whenever feasible. Identification of risk factors for anticipated ICU care to decrease perioperative morbidity and mortality is vital.

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