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Original article

Profile and outcomes of COVID-19 positive patients requiring a caesarean section at an academic hospital in Johannesburg: A retrospective cross-sectional study.

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Abstract

Background
The obstetrics population represents a significant proportion of patients who present to our hospital, Chris Hani Baragwanath Academic Hospital (CHBAH). This study aims to determine the profile and outcomes of obstetric patients who are COVID-19 positive, requiring caesarean section.

Methods
A retrospective cross-sectional observational research study design was performed. The study population consisted of COVID-19 PCR-positive parturients undergoing caesarean section (CS) at CHBAH. A convenience contextual sampling method was used. Anaesthetic and maternal clinical records of 326 patients were reviewed during the period 1st March 2020 to 31st March 2021.

Results
One hundred and seventy-four patients with a median (interquartile range) age of 30 (IQR 26-37) years, a BMI of 26.6 (23.9-30.5) kg/m^{2,} and a median gestational age of 38 (37-39.5) weeks, were included in the study. Most of the patients were classified as ASA-PS 2 (81.6%) and underwent emergency procedures (86.8%). Human immunodeficiency virus (HIV) prevalence was 28.7%, with hypertension (5.7%) being the next most common comorbidity. Pregnancy-related complications were predominantly related to pre-eclampsia (24.1%). Preterm delivery occurred in 40.2% of cases. Thrombocytopenia was uncommon (2.8%), with cases attributable to HELLP syndrome or isolated findings. COVID-19 severity was predominantly mild, with no significant association found between HIV status and disease severity. The patient outcome showed 94% ward admission, 5% HCU/ICU admission, minimal need for inotropic support (0.6%), and overall length of stay (LOS) of 10 days. Mortality was low at 0.6%.

Conclusion
COVID-19 in the pregnant population did not result in poorer outcomes, which is in keeping with other studies in this field.

Recommendation
Maintain standard COVID-19 risk stratification irrespective of HIV status. Prioritise early detection and management of hypertensive disorders, strengthen antenatal care to reduce prematurity, and ensure preparedness for emergency caesarean sections with continued access to critical care and multidisciplinary support.

Keywords: *Coronavirus disease-2019 (COVID-19), Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2), Obstetrics, Outcomes*
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Introduction

Coronavirus disease-19 (COVID-19), which is caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), has been part of our clinical practice since its emergence in December 2019 in Wuhan, China. It was declared a pandemic by the World Health Organization (WHO) on the 11th March 2021 (1, 2). Infected individuals may either be asymptomatic, present with generalized symptoms, or have more specific symptoms for pneumonia, respiratory failure, and multiorgan failure (3). The spread of COVID-19 is described as primarily via respiratory droplets and aerosols (3, 4).

Compared to the general population, normal immunological and physiological changes seen in pregnancy predispose parturients to severe infections, poor foetal outcomes, and the likelihood of requiring mechanical ventilation, as previously seen with other pandemics such as influenza A (H1NI) (5, 6). Tang et al (7) highlight these as important physiological changes that pose a challenge to both the anaesthesiologist and parturient, and these include increased oxygen consumption, reduced functional residual capacity, reduced chest compliance, increased risk for aspiration, and altered lymphocyte immunity (7, 8).

Age, virus variant, pre-existing co-morbidities such as diabetes mellitus, hypertension, obesity, HIV, and pregnancy are predisposing factors to severe disease requiring hospital admission and unplanned ICU admission (6, 9, 10). Juan et al (8) explain that in pregnancy, medical conditions such as pre-eclampsia and gestational diabetes mellitus, increased obstetrics complication in COVID-19 infected parturients, the complications that were noted were pre-term labour, pre-eclampsia, increased caesarean section rate, and disease severity, to name a few (6, 8). South Africa is a low to middle-income country (LMIC) with a high HIV burden; despite this, HIV was not associated with increased maternal morbidity and mortality in the COVID-19 parturient cohort, as shown by Budhram et al., compared to diabetes mellitus and hypertension (11).

At its emergence, there were discussions around COVID-19 causing a hypercoagulable state, but literature also brought up thrombocytopenia in pregnant patients being associated with severe COVID-19 disease and ultimately being a consideration for the anaesthetic management perioperatively (12, 13). Customarily, adopted anaesthetic practice is to perform a neuraxial technique on pregnant patients to prevent airway-related complications, but this became a concern in this cohort because of thrombocytopenia, thus favouring general anaesthesia in patients who are already compromised with increased oxygen consumption, reduced functional capacity, and reduced apnoea time (14, 15). Regional anaesthesia in the absence of absolute contraindications is still being advocated as first line as it avoids aerosol generation and reduces COVID-19 spread (16-18).

The obstetrics population represents a significant proportion of patients that present to our hospital, Chris Hani Baragwanath Academic Hospital (CHBAH), with a very high caesarean section (CS) rate of 49%, compared to the world standard (19). This study aims to profile the COVID-19-infected obstetrics patient requiring CS this will include patients' age, body mass index (BMI), American Society of Anaesthesiologists-Physical status (ASA-PS), co-morbid diseases, gestational age, and platelet levels affecting anaesthetic technique choices. Outcomes in this study will refer to COVID-19 effects on the pregnancy progression, post CS destination (ward, HCU/ICU), morbidity and mortality, and length of hospital stay (20-22).

Methods

Study design

A retrospective cross-sectional observational study design was followed. A convenience sampling method was adopted, and the final sample size was determined by the number of cases done in the study period.

Study setting

The study population consisted of COVID-19 PCR-positive pregnant patients undergoing caesarean section at CHBAH, an institution affiliated to the Faculty of Health Sciences at the University of Witwatersrand (Wits) from 1st March 2020 to 31st March 2021. CHBAH is a tertiary-level, 3000-bed public hospital in Soweto, Johannesburg, South Africa. It is the largest hospital in Africa and the seventh largest in the world, providing services to all specialities except Cardiothoracic and Transplant. The obstetrics population represents a significant proportion of patients who present to this hospital, with two dedicated theatres that operate 24 hours every day.

Study population

The inclusion criteria for this study were all patients undergoing caesarean section who were COVID-19 PCR positive during the study period. The exclusion criteria in this study were illegible records and incomplete records (> 50% missing data). In consultation with a statistician, using Raosoft software, a minimum sample size of 385 total patients was needed for the study to be significant with a 4% margin of error and a 95% confidence level. Due to time constraints and changes in testing and management of COVID-19 positive patients, the sample size that could be achieved was 326 (Figure 1), with 174 COVID-19 PCR positive patients.

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Data collection tool

The data collection tool was drafted by the primary investigator and moderated by supervisors. Content and face validity of this data collection tool was done by senior anaesthesiologists (with long-standing Obstetrics practising history) in the department. The input from the Wits Postgraduate and Ethics committees' suggestions was incorporated into the final data collection tool. The data collection tool was developed via the Research Electronic Data Capture (REDCap®) platform, and consisted of the following sections: patient demographics, pregnancy-related category, indication for caesarean section, COVID-19 related, Method of anaesthesia performed, patient outcome post anaesthesia, ward/HC/ICU admission, organ support required, length of hospital stay,y and overall outcome discharge or mortality.

All data collected from the charts was de-identified, thereby ensuring anonymity. Data collected was housed in the Research Electronic Data Capture (REDCap®) database and is password-protected.

Statistical analysis

Data were analysed in consultation with a statistician. STATA18 MP (StataCorp, College Station, TX: StataCorp LP) was used for analysis. Demographic data and clinical profiles were described using descriptive statistics (frequency and percentages for categorical values) and continuous variables by means and standard deviation if normally distributed or medians and interquartile range if the distribution was skewed. The methods of testing for normality in this study have limitations and are affected by sample size. The Shapiro-Wilks test was used to assess the normal distribution of data, and the results indicated that the data were not normally distributed. Therefore, the median and 25^{th}-75^{th} percentiles were used to describe the data. A p-value ≤0.05 was considered statistically significant. To correlate COVID-19 severity and HIV, a Fisher's Exact test was used.

Bias minimisation

Efforts to minimise potential sources of bias included the use of predefined inclusion and exclusion criteria, standardised data collection via a structured REDCap tool, and review of records over a fixed study period. Selection bias was reduced by including all eligible COVID-19 PCR-positive parturients undergoing CS within the study timeframe. Information bias was mitigated through data verification and oversight by senior clinicians, while statistical analysis was conducted in consultation with a biostatistician to ensure appropriate methodology and interpretation.

Ethical consideration

Given the retrospective nature of the study and the use of de-identified routinely collected clinical data, approval to conduct this study with a waiver of informed consent was obtained from the Human Research Ethics Committee of the Witwatersrand (Medical) (M230275) and CHBAH relevant authorities on 14 June 2024. Patient confidentiality was maintained throughout, with no identifiable information collected or reported.

Results

Characteristics of patients

Over the study period, 1st March 2020 to 31st March 2021, a total of 326 caesarean sections were performed, 174 patients were enrolled into the study, as shown in Figure 1, which also shows the division of patients according to the anaesthetic received. The demographic and clinical profile of the patients is summarised in Table 1.

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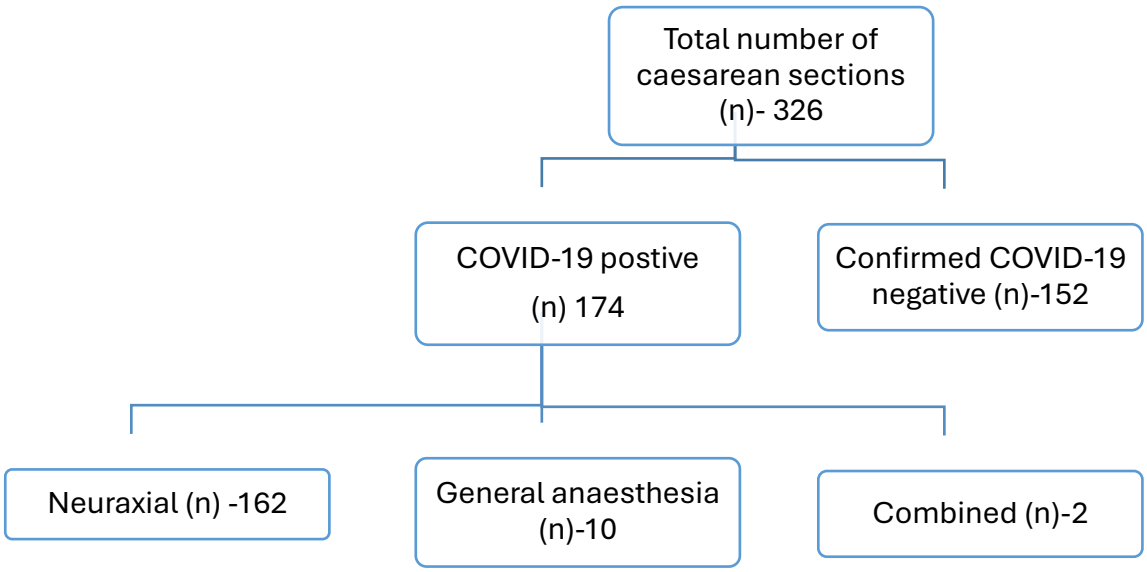

Figure 1: Number of patients enrolled

Table 1: Patient profile

Characteristics	**Median**	**IQR**
Age (years)	30	26-37
BMI	26.6	23.9-30.5
Gestational age (weeks)	38	37-39.5
	Variable	**Frequency (%)**
Chronic co-morbidities		
	HIV	50 (28.7%)
	Hypertension	10 (5.7)
	Diabetes Mellitus	4 (2.3)
	Asthmatic/ COPD	1 (0.6)
	Epilepsy	2 (1.7)
	Thyroid disease	2 (1.1.)
	Other	21 (12.1)
	No co-morbidities	75 (56.9)
Pregnancy related	Pre-eclampsia	42 (41%)
	Gestational diabetes mellitus	5 (2.8%)
	HELLP syndrome	2 (1.1%)
ASA-PS classification	ASA- PS 1	8 (4.6)
	ASA-PS 2	142 (81.6)
	ASA-PS 3	20 (11.5)
	ASA-PS-4	4 (2.3)
Surgical urgency	Emergency	151 (86.8)
	Elective	23 (12.2)
HIV status	Reactive	50 (28.7)
	Non-reactive	115 (66.1)
	Unknown	9 (5.2)

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A total of 50 (28.7%) patients were confirmed HIV reactive, and 70.7% were on treatment. Hypertension 10 (5.7%) was the second predominant chronic co-morbidity in the study population. With regards to pregnancy-related comorbidities, pregnancy-induced hypertension was the most common condition, with 42 (24.1%) of these patients; 2 (1.1%) had haemolysis, elevated liver enzymes, and low platelet count syndrome (HELLP syndrome). There were 5 (2.8%) patients with gestational diabetes mellitus. The majority of the patients were classified as American Society of Anaesthesiology physical status (ASA-PS) class 2, 142 (81.6%).

The median (interquartile range) gestational age of pregnancy was 38 (37-39.5) weeks. There were 104 (59.8%) of patients who were 36 weeks or above of gestational age. A total of 70 (40.2%) were classified as premature delivery of pregnancy, with 2 (1.1%) patients falling in the 24-28 weeks category, as shown in Table 2.

Table 2: Pregnancy gestation age group category (In weeks)

Pregnancy gestation age (In weeks)	Category	Frequency n (%)
	24-28	2 (1.1)
	29-32	10 (5.7)
	33-36	17 (9.8)
	36+	104 (59.8)
Undocumented gestational age		41
Total		174

Thrombocytopenia

The platelet count median (IQR) value was 228 (182-268). Five (2.8%) patients had thrombocytopenia; of these, 2 (1.1%) had HELLP syndrome and the other 3 (1.7%) had isolated thrombocytopenia.

Relation of COVID-19 severity and HIV

Using the qSOFA score to grade the severity of illness due to COVID-19 infection, 11(6.3%) patients were classified as moderate-severe disease. There was no statistically significant relation between the severity of disease, as calculated using the qSOFA score, and HIV infection. This is based on Fisher's exact test 1.41 value with the likelihood ratio of 2.97 showing no significant relationship between severity of disease and HIV, see Table 3.

Table 3: Severity of illness correlated with HIV status

			qSOFA_score			
			Mild	Moderate	Severe	Total
HIV	reactive	Count	34	13	3	50
	non-reactive	Count	75	32	8	115
	unknown	Count	8	1	0	9
Total		Count	117	46	11	174

Patient outcomes

The postoperative destination of the 174 patients is shown in Figure 2. Concerning the patients' outcomes, 4 (2.3%) required intensive care unit (ICU) and were ventilated, with 1 (0.6%) patient requiring inotropic support. Table 4 summarises these outcomes and forms of organ support provided. One (0.6%) mortality was recorded during the study, and 172 (%) were discharged home, with one patient unaccounted for.

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Figure 2: Post-operative destination

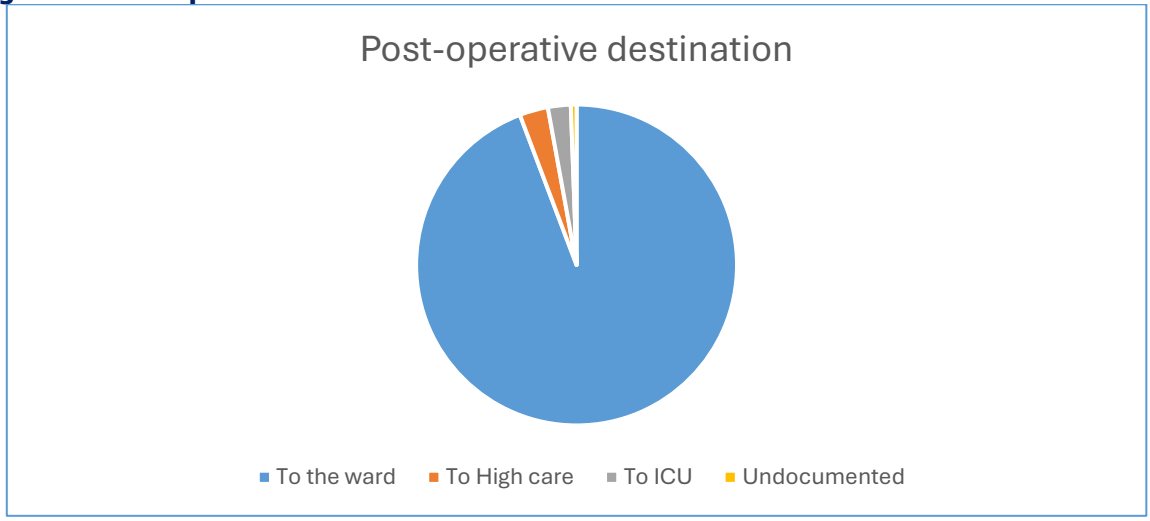

Table 4: Organ support

ORGAN SUPPORT		
Ventilation	Variable	Frequency n (%)
	Invasive	4 (2.3)
	Non-invasive	2 (1.1)
Inotropic support (Adrenaline)		
		1 (0.6)
Other		
	Blood transfusion (Red pack cells)	1 (0.6)
	Face mask oxygen/nasal canulae	6 (3.4)

Discussion

In this study, we reviewed COVID-19-positive pregnant patients undergoing caesarean section, looking specifically at their profiles and outcomes. Of these patients, 174 were confirmed COVID-19 positive and enrolled in the study. Khumalo et al reported 617 CS operated at the same institution in February 2019 (23). The number of patients enrolled was likely influenced by government lockdown periods instituted to limit the spread of disease; fewer patients were recruited into the study. Of note with lockdown periods, we noted fewer cases during the hard lockdown, where interprovincial travelling was prohibited, and a massive surge of confirmed COVID-19 positive patients when less strict measures were employed.

Profile of our patient cohort

The average age of the study population was 30 years, with an average body mass index in the overweight range, as expected for this patient population. Obesity and hypertension are well-described risk factors for severe COVID-19 disease (9, 11, 24). Most patients in this study were classified as ASA-PS 2, as HIV positive status and chronic hypertension were the leading co-morbid diseases identified. Also, results showed that patients who were overweight were more common and fewer cases of class 1 to class 2 obesity.

Thrombocytopaenia

Multiple biochemical markers were discussed as part of COVID-19 severity for in-hospital patients, including platelet count; however, thrombocytopenia can be caused by multiple factors, and in COVID-19 patients includes direct bone marrow infection resulting in abnormal haematopoiesis or an autoimmune response against blood cells (13). The majority of the patients with thrombocytopenia in this study had co-existing pre-eclampsia or pregnancy-induced hypertension disorders, and were mild forms of COVID-19, confounding the relationship between COVID-19 and normally described thrombocytopenia in hypertensive-induced diseases. Other researchers described cases of thrombocytopenia in pregnant COVID-19 patients, and the take-home message was that thrombocytopenia related to physiological pregnancy changes, hypertensive-induced disease, and

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COVID-19 is difficult to differentiate but a diagnosis of exclusion (12, 15).

COVID-19 severity

Review of arterial blood gases and radiology findings to assess pneumonia severity would have been beneficial; however, they were outside the scope of this study.
Gao et al analysed factors that influenced disease severity; these include patients being more likely to require invasive ventilation and longer hospital stays. Ultimately, they identified these factors as major contributing factors: elderly, male patients, pre-existing hypertension, diabetes, obesity, pregnancy, and smoking (25, 26). In our study, HIV, pre-existing hypertension, and overweight were common risk factors noted, and in the severe cases, pre-eclampsia was a common factor. It is, however, unclear whether pre-eclampsia was a complication of COVID-19. In our cohort, 29% of the parturients had HIV, and 70% were on treatment. However, we did not review whether they were virologically suppressed. Comparing the HIV reactive and non-reactive cohorts for COVID-19 severity using the qSOFA score, we noted that higher qSOFA scores belonged to the HIV negative group. This is in keeping with what other studies found, that HIV-positive patients were not at increased risk for higher disease severity, increased LOS, and or increased ICU admission (11, 27).

Pregnancy, gestational age, and pre-term delivery

Concerns surrounding severe COVID-19 pneumonia in pregnancy and its impact on pre-term delivery and the likelihood of requiring a caesarean section were an area of concern in our study. As is known, maternal hypoxia has a great impact on foetal hypoxia (28). Tang et al discussed that pregnant women with severe pneumonia that it was associated with high maternal morbidity and mortality and high foetal adverse outcomes such as intrauterine death, preterm delivery, and requiring caesarean section (7). The majority of our patients during the study period were beyond 36 weeks of gestational age, and COVID-19 severity had no significant impact on preterm delivery. Retrospectively, reviewing neonatal outcomes should have been included. The 6.8% of patients who delivered below 32 weeks of gestational age is concerning, and all these patients had severe pre-eclampsia with no signs of severe COVID-19 illness. In other studies, the preterm delivery rate was highly variable, with an estimated rate of 13% and 43% (5, 29).

Outcomes

Only 4 (2.3%) patients in this study required intensive care unit (ICU) admission for invasive ventilation, this is different to the picture that Ellington et al (9) highlighted, he and his team found that that COVID-19 positive pregnant women compared to their non-pregnant counterparts of similar age (reproductive age 15-44) were likely to require ICU admission and require mechanical ventilation (9). Virk et al (30) described higher mortality in the third trimester for pregnant patients with COVID-19, but also added that higher rates of pre-eclampsia and HELLP syndrome increased morbidity and ultimately increased mortality (30). Contrary to that, Kim et al (29) noted no significant mortality rate in the pregnant patients compared to non-pregnant patients admitted to the ICU (29). This study showed lower numbers for HCU/ICU admission, less than 10% of the obtainable sample size, and a mortality rate at 0.6%. The mortality rate in this study was significantly lower compared to the INTERCOVID study and what Bhoora et al (24) described, but similar to the UK (0.7%) and USA (0.15%) studies of similar cohorts (9, 11, 31). The mortality in this study was young at age 32, in the overweight category (BMI 28kg/m^2), and had severe pre-eclampsia but no features of severe COVID-19 illness.

Interpretation of key findings

The findings of this study demonstrate that COVID-19 infection in parturients undergoing caesarean section was predominantly mild and not associated with substantially worsened maternal outcomes, as evidenced by low ICU admission, minimal organ support requirements, and low mortality. Notably, HIV status was not associated with increased disease severity, suggesting that well-managed HIV infection may not independently confer additional risk in this population. However, the absence of virological data limits definitive conclusions and highlights an area for future research.

Instead, hypertensive disorders of pregnancy, particularly pre-eclampsia, appeared to be the primary drivers of maternal morbidity and preterm delivery, underscoring the continued importance of conventional obstetric risk factors over COVID-19 status alone. The low incidence of thrombocytopenia and its association with pregnancy-related pathology rather than viral illness further supports the safe use of neuraxial anaesthesia in most cases. Collectively, these findings reinforce the need to maintain standard obstetric care and risk stratification frameworks, while avoiding overestimation of COVID-19 severity in stable patients, particularly within well-resourced tertiary care settings. The findings also underscore the resilience

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of maternal care systems in tertiary centres, even during periods of significant healthcare strain.

Generalizability

The generalizability of the findings to other SA hospitals is limited, given the variations in patient demographics, infrastructure, and procedural management of those who were COVID-positive.

Conclusion

Like many studies before it, this study showed infection with COVID-19 in the pregnant population did not necessarily result in poorer outcomes as it would have been expected in this population group, due to their physiological changes of pregnancy and secondary to COVID-19 infection.
This study adds to the existing knowledge regarding COVID-19 in pregnant patients and verifies some high-risk potential complications in a single centre. Lastly, our findings were like other literature on the topic.

Limitations

The contextual, single-centre nature of this study is a potential limitation. Results from other tertiary centres, including maternity centres, would have been helpful; however, with the current data, results may not be generalised across the obstetrics patients within the same country.
The methods of testing for normality in this study have limitations and are affected by sample size. For this reason, there's a substantial departure from normality, which has an absolute skew value of more than 2.1 or an absolute kurtosis value of more than 7.1. Hence, isolated thrombocytopenia could not be discussed as an outcome or its significance in this cohort to be statistically correct.
Obtaining a number for the study was a huge challenge. Lockdown and government-implemented policies on provincial lockdown travel affected the numbers obtained. Record-keeping that includes all data for patients in low-income settings remains a major challenge.

Recommendations

Future recommendations are that all information be digitized for easy access.

Acknowledgement

This research was done in partial fulfilment of a Master of Medicine degree. A special thanks to Dr K Mogotsi, Dr S Dingezweni, and Dr P. N. Mogane from the Department of Anaesthesiology at the CHBAH for their guidance and contributions towards making this study effective.

List of abbreviations

COVID-19 Coronavirus disease-19
SARS-CoV-2 Severe Acute Respiratory Syndrome Coronavirus-2
CS Caesarean Section
IQR Interquartile Range
BMI Body Mass Index
ASA-PS American Society of Anaesthesiologists-Physical status
HIV Human immunodeficiency virus
HELLP Haemolysis, Elevated Liver enzymes, Low Platelet count syndrome
ICU Intensive care unit
LOS Length of Stay
H1N1 Haemagglutinin Type 1 and Neuramidase Type 1 (Influenza A virus)
LMIC Low-Middle-Income Country
qSOFA Quick Sequential Organ Failure Assessment score
CHBAH Chris Hani Baragwanath Academic Hospital
Wits University of the Witwatersrand

Conflict of interest

No conflicts of interest declared.

Funding

There was no funding for this work.

Data availability

The data that support the findings of this study are not publicly available due to ethical and institutional restrictions related to patient confidentiality. De-identified data may be made available from the author on request, and subject to approval by relevant institutional authorities.

Credit authorship contribution statement

M.P Pumlomo: Writing – review & editing, Writing – original draft, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.
K. Mogotsi: Writing – review & editing, Supervision, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.
S. Dingezweni: Writing – review & editing, Supervision, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

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P.N Mogane: Writing – review & editing, Supervision, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

Author biography

Dr Monwabisi Pumlomo was a registrar in Anaesthesiology at CHBAH. He now practises as a specialist anaesthesiologist in the Johannesburg area with a keen interest in teaching and training, particularly in obstetrics, major abdominal surgery, and orthopaedics.

Dr Kena Mogotsi is a specialist anaesthesiologist and intensivist in training. Her interests include obstetrics anaesthesia, critical care, and perioperative risk assessment. She is actively involved in postgraduate teaching and research supervision.

Dr Sithandiwe Dingezweni is a specialist anaesthesiologist and intensivist. He is actively involved in undergraduate and postgraduate teaching, examination, and research supervision. His interests include major surgery, critical care, geriatrics, and perioperative risk assessment.

Dr Palesa Mogane is a specialist anaesthesiologist. She is actively involved in undergraduate and postgraduate teaching, examination, and research supervision. Her interests include major abdominal surgery, critical care, global surgery, paediatrics, and perioperative risk assessment.

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