

Prevalence and factors associated with cesarean section in HIV-positive patients in a university teaching hospital – A case-control study

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ABSTRACT

INTRODUCTION: Cesarean section (CS), although a relatively safe procedure, is associated with more risks than vaginal delivery, regardless of HIV status. Complications following CS are greater in HIV-positive women than in HIV-negative women. This study's objective was to determine the prevalence and factors associated with CS in HIV-positive patients in our environment.

METHODS: A case-control study of factors associated with and outcomes of CS over 13 years was conducted in HIV-positive and HIV-negative women at UMTH. Multinomial regression analysis was used to determine factors independently associated with CS in HIV-positive women. Stratified analysis was used to determine factors associated with the development of complications following CS in HIV-positive women. A p-value <0.05 was considered statistically significant.

RESULTS: The prevalence of CS in HIV-positive women was 3.02%, with PMTCT 51.5% (53/103) as the major indication. Compared to the control, the HIV-positive women were more likely to have pre-operative anemia (P= 0.001) and their CS to be undertaken electively (P<0.001), under general anesthesia (P<0.001), to last more than 60 minutes (P=0.002) and develop a postoperative complication (77.8% vs. 22.2%). Pre-operative anemia and preterm delivery were found to be associated with the development of a complication.

CONCLUSION: The prevalence of cesarean section in HIV-positive patients is low in our environment. CS is also more likely to be performed electively for over 60 minutes under general anesthesia on a nulliparous woman with no formal education and pre-operative anemia.

Keywords: Caesarean section, HIV, Pregnancy, Prevalence, Hospitals, Teaching

INTRODUCTION

About 37.7 million people are living with HIV as of 2020, the majority of which (about 53%) are women and girls [1]. Some of these women are of reproductive age and may become pregnant.

HIV-positive pregnant women can transmit the disease to their babies during pregnancy, labor, and breastfeeding [2]. It has been reported that 30% of women are not tested for HIV during pregnancy, and another 15-20% receive no or minimal perinatal care, allowing for potential

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newborn transmission [3]. Cesarean section (CS), defined as the birth of a fetus via laparotomy and hysterotomy [4], can be used to prevent maternal-to-child transmission (PMTCT) of HIV. In addition, HIV-positive pregnant women can have CS because of other obstetrics indications. To prevent PMCTC, CS is indicated in HIV-positive women who are not on antiretroviral therapy (ART), have hepatitis C co-infection, or when the viral load is > 1000 copies/ml [5]. Cesarean section, although a relatively safe procedure, is associated with more risks than vaginal delivery regardless of HIV status, and complications following cesarean section are greater in HIV-positive women than HIV-negative women. Some of these complications included endometritis, UTI, pneumonia, wound infection, anemia, and blood transfusion [5]. The increased operative morbidity following cesarean section in HIV-positive women compared with the HIV-negative is majorly due to immunosuppression caused by HIV infection [5,6].

Knowledge of the factors associated with CS in HIV-positive women will help formulate strategies that may help properly plan and manage the procedure to improve its outcomes.

This study aims to determine the prevalence and factors associated with CS in HIV-positive patients. This may help in the proper planning and execution of the procedure for possible improvement of the outcome of the procedure in HIV-positive women.

METHODS

This was a retrospective case-control study of the outcome of cesarean section in HIV-positive women at the University of Maiduguri Teaching Hospital Maiduguri, North-East Nigeria, between 1st January 2008 and 31st December 2020.

The Ethical Committee of the University of Maiduguri Teaching Hospital gave ethical clearance for this study (UMTH/REC/569).

The hospital numbers of all HIV-positive patients that had cesarean delivery during the study period were identified and retrieved from the obstetrics theatre records, labor ward records, antenatal ward and antenatal clinic records, and special care baby unit (SCBU) admissions and discharge records. The hospital numbers were used to retrieve the patients' case notes from the central record department.

The cases were all HIV-positive patients who underwent cesarean section during the study

period. For each HIV-positive woman who had a cesarean section during the study period (case), the next woman who was HIV-negative and had a cesarean section was selected as a control.

A survey form design for the study was used to collect data from the patients' case files. The inclusion criteria were being HIV positive and requiring a cesarean section because of any indication. The data obtained included sociodemographic characteristics such as age, parity, education, occupation, co-morbid condition, type of pregnancy (singleton or multiple), gestational age at delivery, pre-operative packed cell volume, type of CS, type of anesthesia, duration of surgery, and the cadre of the surgeon. The indication for surgery for each case and control was also noted. Data on the outcome of surgery in terms of postoperative packed cells volume estimated blood loss, blood transfusion, ICU admission, APGAR score, birth weight, and SCBU admission was also obtained.

Data analysis was done using the statistical package for social sciences (SPSS) version 25 (IBM SPSS Statistics for Windows, Armonk, NY: IBM Corp) and presented as tables. The relationship between categorical variables was determined using chi-square or Fisher exact test as appropriate. Multinomial regression analysis was used to determine the sociodemographic and clinical characteristics that were independently associated with cesarean delivery. Factors included in the regression model were those found to have a statistically significant ($P < 0.05$) or tending toward statistical significance ($P \leq 0.1$) in the bivariate analysis conducted. Furthermore, to determine the factors associated with the development of complications following CS in HIV-positive patients compared to CS in HIV-negative patients, a stratified analysis was performed where the study population (cases/control) was cross-tabulated with the perioperative factors using the development of complication as layering variables. A P-value of < 0.05 was considered statistically significant.

RESULTS

During the study period, there were 3409 deliveries in HIV-positive women, of which 103 were cesarean deliveries (3.02%). A total of 206 patient records were used for this study, of which 103 were cases, and 103 were controls. Table

1 shows a comparison of the sociodemographic characteristics of the cases and controls of the study population. Compared to HIV-negative women (control), HIV-positive women (cases) were more likely to be nulliparous ($P=0.006$) and have no formal education ($P<0.0010$).

PMTCT was the commonest indication for CS among HIV-positive women (51.5%), followed by prolonged pregnancy (16.7%), CPD (6.8%), and fetal distress (4.9%). On the other hand, fetal distress (16.5%) was the most common indication of CS among HIV-negative women.

The clinical characteristics and outcomes of the cesarean delivery among the cases and the control group were as depicted in Table 2. Compared to the control, the cases were more likely to have pre-operative anemia ($P=0.001$). Their CS is to be done as elective ($P<0.001$), under general anesthesia ($P<0.001$), with the operation to last more than 60 minutes ($P=0.002$), and for them to stay in the hospital for more than 7 days ($P<0.001$).

The cases were also found to be more likely to develop a postoperative complication (77.8% vs. 22.2%) and deliver male babies (55.9% vs. 44.1%) but less likely to have five minutes Apgar score <7 (31.6% vs. 68.4%) compared to the control. Although these differences were not statistically significant, they tend toward statistical significance ($P<0.1$).

The multinomial logistic regression analysis showing the significant clinical characteristics and outcomes of the cesarean delivery in the HIV-positive women (cases) in our study population are shown in Table 3. After controlling for confounding factors, CS for HIV-positive women was found to be independently associated with staying in the hospital for >7 days OR (95%CI) = 76.5 (6.3 – 926.7), pre-operative anemia OR (95%CI) = 4.1 (1.3 – 12.9), nulliparity OR (95%CI) = 5.6 (1.8 – 17.6) and having no formal education OR (95%CI) = 3.8 (1.5 – 9.3).

There were four maternal deaths in the cases and none in the control group.

The results of the stratified analysis to determine the factors associated with the development of complications following CS in HIV-positive patients compared to CS in HIV-negative patients are shown in Table 4. Pre-operative anemia OR (95%CI) = 6.731 (1.229– 36.862), P -value= 0.014 and preterm delivery OR (95%CI) = 7.280 (1.121 - 47.268), P -value= 0.018 were found to be associated with the development of complications, while grand multiparity OR (95%CI) = 0.068 (0-013 – 0.360), P -value <0.001 was found to be protective.

DISCUSSION

Our study showed a prevalence of cesarean section in HIV-positive patients of 3.02%, with PMTCT as the

Table 1: Comparison of the sociodemographic characteristics of the HIV-positive and the HIV-negative patients

Characteristics	Cases	Control	$\chi^2 / Fisher exact^a$	P-value
Age group				
<20 years	1 (25.0%)	3 (75.0%)	1.033 ^a	0.597
20 – 35 years	83 (50.3%)	82 (49.7%)		
> 35 years	19 (51.4%)	18 (49.75)		
Parity group				
0	27 (69.2)	12 (30.8%)	10.368	0.006
1 – 4	64 (49.2%)	66 (50.8)		
≥ 5	12 (32.4%)	25 (67.6%)		
Education				
Yes	25 (30.9%)	56 (69.1%)	19.552	<0.001
No	78 (62.4%)	47 (37.6%)		
Occupation				
Yes	44 (71.0)	18 (29.0%)	15.598	<0.001
No	59 (41.0%)	85 (59.0%)		

Table 2: The clinical characteristics and outcomes of the cesarean delivery among the cases and the control groups

Characteristics	Cases	Controls	χ^2 /Fisher Exact test ^a	P-value
Type of pregnancy				
Singleton	98 (50.8%)	95 (49.2%)	0.739	0.390
Twins	5 (38.5%)	8 (61.5%)		
Co-morbid conditions				
Yes	2 (50.0%)	2 (50.0%)	0.000 ^a	1.000
No	101 (50.0%)	101 (50.0%)		
GA at delivery				
<37wks	7 (33.3%)	14 (66.7%)	2.598	0.107
≥37wks	96 (51.9%)	89 (48.1%)		
Pre-operative PCV				
<30%	31 (72.1%)	12 (27.9%)	10.610	0.001
≥30%	72 (44.2%)	91 (55.8%)		
Type of CS				
Emergency	35 (31.8%)	75 (68.2%)	31.212	<0.001
Elective	68 (70.8%)	28 (29.2%)		
Type of anesthesia				
Spinal	63 (38.4%)	101 (61.6%)	43.186 ^a	<0.001
General	40 (95.2%)	2 (4.8%)		
Duration of operation				
≤60min	82 (45.8%)	97 (54.2%)	9.590	0.002
>60min	21 (77.8%)	6 (22.2%)		
Cadre of surgeon				
Resident	98 (49.7%)	99 (50.3%)	0.116 ^a	0.733
Consultant	4 (55.6%)	4 (55.6%)		
Postoperative PCV				
<30%	62 (52.1%)	57 (47.9)	0.497	0.481
≥30%	41 (47.1%)	46 (52.9%)		
Estimated blood loss				
<1000mls	8 (66.7%)	4 (33.3%)	1.416 ^a	0.234
≥1000mls	95 (49.0%)	99 (51.0%)		
Blood transfusion				
Yes	22 (59.5%)	15 (40.5%)	1.614	0.204
No	81 (47.9%)	88 (52.1%)		
ICU Admission				
Yes	1 (100.0%)	0 (0.0%)	1.005 ^a	0.316
No	102 (49.8%)	103 (50.2%)		
Duration of hospital stay				
≤7days	75 (42.6%)	101 (57.4%)	26.374 ^a	<0.001
>7days	28 (93.3%)	2 (6.7%)		
Complications				
Yes	7 (77.8%)	2 (22.2%)	2.905 ^a	0.088
No	96 (48.7%)	101 (51.3%)		
Baby's sex				
Male	57 (55.9%)	45 (44.1%)	2.796	0.094
Female	46 (44.2%)	58 (55.8%)		
Birth weight				
<2.5kg	16 (51.6%)	15 (48.4%)	0.038	0.845
≥2.5kg	87 (49.7%)	88 (50.3%)	.	
Apgar 5				
<7	6 (31.6%)	13 (68.4%)	2.841	0.092
≥7	97 (51.9%)	90 (48.1%)		
SCBU admission				
Yes	7 (33.3%)	14 (66.7%)	2.598	0.107
No	96 (51.9%)	89 (48.1%)		

commonest indication. Compared with cesarean section in HIV-negative patients, the cesarean

sections in HIV-positive women were more likely to be done as an elective procedure, under general

Table 3: Multinomial Logistic Regression Analysis showing the significant clinical characteristics and outcomes of the cesarean delivery in the HIV-positive women (cases) in our study population

Factor	Coefficient	Adjusted OR	95%CI	P-value
GA at delivery				
<37	-0.785	0.456	0.041 – 5.014	0.521
>=37	Ref			
Apgar 5				
<7	-3.100	0.045	0.003 – 0.585	0.018
>=7	Ref			
Duration of Hosp. Stay				
>7	4.338	76.516	6.318 – 926.736	0.001
<=7	Rep			
Complications				
Yes	0.919	2.507	0.166 – 37.780	0.507
No	Rep			
Duration of Operation				
>60min	2.173	8.781	2.115 – 36.464	0.003
<=60min	Rep			
Pre-Operative PCV				
<30	1.419	4.132	1.316 – 12.979	0.015
>=30	Rep			
Occupation				
No	-0.642	0.526	0.194 – 1.430	0.208
Yes	Rep			
Education				
No	1.350	3.857	1.586 – 9.378	0.003
Yes	Rep			
SCBU Admission				
Yes	-0.187	0.830	0.082 – 8.411	0.875
No	Rep			
Type of CS				
Emergency	-1.770	0.170	0.067 – 0.430	<0.001
Elective	Rep			
Type of Anaesthesia				
Spinal	-3.930	0.020	0.002 – 0.193	0.001
GA	Rep			
Parity Group				
0	1.730	5.638	1.805 – 17.614	0.003
>=5	-0.378	0.685	0.194 – 2.425	0.558
1-4	Rep			

Table 4: Stratified analysis of factors associated with the development of complications following CS in HIV-positive patients compared to CS in HIV-negative patients

Factors	Odds ratio (95%CI)	P-value
Parity ≥5	0.068 (0-013 – 0.360)	<0.001
ICU Admission	1.011 (0.990-1.031)	0.786
Sex of baby	1.082 (0.230- 5.097)	0.921
Having formal education	0.396 (0.082- 1.907)	0.235
Being employed	0.994 (0.211- 4.686)	0.994
Pre-opt PCV<30%	6.731 (1.229 - 36.862)	0.014
Duration of opt >60min	1.621 (0.292- 9.007)	0.578
Estimated Blood loss >1000mls	0.472 (0.050- 4.488)	0.504
Preterm delivery	7.280 (1.121 - 47.268)	0.018
Co-morbid disorders	1.021 (0.992- 1.052)	0.700
Cadre of surgeon	0.261 (0.025- 2.713)	0.229

anesthesia in a nulliparous woman, with no formal education and pre-operative anemia. The CS was also more likely to be associated with birth asphyxia (5 minutes Apgar score <7), duration of operation of ≥ 60 minutes, and duration of hospital stay greater than 7 days, whilst pre-operative anemia and preterm delivery were associated with the development of complication and grand multiparity was protective.

The rate of cesarean section in our study of 3.2% was lower than that reported by other studies [7,8] and also lower than the 5 – 15% rate recommended by the World Health Organization (WHO) and the Pan American Health Organization [9]. This low rate was despite PMCTC being an additional indication in our study population. The reported cesarean section rates in Sub-Saharan Africa are generally low, and a population-based cross-sectional study by Emmanuel O Adewuyi et al. [10] reported a rate of 2.1%. This lower rate may represent an unmet need. Some factors adduced to be responsible include poverty, ignorance, lack of health insurance coverage, lack of husband/partner's formal education, and cultural beliefs [10].

Most of the CS in our study was most likely done as an elective procedure because, in 53% of the cases, the procedure was done for PMTCT, which is normally done as an elective. Also, HIV infection may be a reason for having a low threshold for restoring to delivery by CS, then allowing labor in the face of any additional obstetrics/medical problems in a pregnant woman. Furthermore, this study found that compared with

caesarean section in HIV-negative patients, the cesarean section in HIV-positive women was more likely to be undertaken in a nulliparous woman, with no formal education and pre-operative anemia, under general anesthesia. This finding has practical implications as it can assist during counseling and preparation for CS in HIV patients. However, the association of nulliparity with CS is a concern because this may limit the reproductive carrier of the woman in an environment where large family size is usually required for economic and social reasons. Anemia resulting from the HIV disease or its treatment is a known complication of HIV infection, and anemia was found to increase the risk of CS [11]. Although with general anesthesia, patent airways are maintained, ventilation is controlled, and there is less cardiovascular depression [12], regional anesthesia is the anesthesia of choice for CS because it is safer and more effective [13].

Birth asphyxia results from interactions of antepartum and intrapartum risks [14], and cesarean section is a known risk factor for birth asphyxia due to the fetal chest being compressed as the newborn passes through the birth canal during vaginal delivery is absent. In this study, CS in HIV patients was associated with the delivery of a baby with a low 5 minutes APGAR score compared with CS done in HIV-negative patients, possibly because of differences in antepartum risks. For example, our results reveal that HIV patients were more likely to have pre-operative anemia. Furthermore, the HIV disease and its treatment might be a risk for birth asphyxia, although Li Huixia et al. [15]

found no association between HIV infection and birth asphyxia.

The operation was also found to be more likely to last for 60 minutes or more in the cases (HIV positive) compared to the controls (HIV negative). Prolonged operation time is associated with postoperative morbidity [16]. This was probably why the cases were found to be more likely to stay for 7 days or more in the hospital after the operation, compared with the control.

To determine the factors that were independently associated with the development of complications following CS in HIV-positive patients compared to CS in HIV-negative patients, a stratified analysis was performed where the study population was cross-tabulated with the perioperative factors using the development of complications as layering variables and pre-operative anemia and preterm delivery were found to be associated with the development of a complication. In their study, Jessica Viola et al [17] also show that anemia is associated with the development of complications following surgery. Generally, anemia leads to tissue hypoxia, and patients with pre-operative anemia have a greater likelihood of complications from surgery, including a higher risk of infection, organ dysfunction, longer hospital stays, and a higher death rate than those without have anemia. The association of preterm delivery with CS complications may be because of the cause of the preterm delivery. In addition to this, preterm CS may be associated with more procedural technicalities and difficulties than term CS.

The strength of this study was the appropriate selection of the control and the use of multivariate regression for the analysis of associations to control for possible confounding factors. While its limitation is the study design being a case-control, it is prone to misclassification and recall bias, incidence cannot be calculated, and causation cannot be assessed.

Conclusion

There was a low prevalence of cesarean section in HIV-positive patients in our environment, and cesarean section in HIV-positive women was associated with birth asphyxia and prolonged hospital stay. The CS was also more likely to last for more than 60 minutes, to be done as an elective procedure, under general anesthesia on a nulliparous woman, with no formal education and pre-operative anemia.

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