

## BLOOD TRANSFUSION REQUIREMENT DURING CAESAREAN DELIVERY: RISK FACTORS

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### ABSTRACT

**Background:** Group specific blood is often cross-matched ready for all patients scheduled for caesarean section in anticipation of haemorrhage during the surgery. This study was conducted to determine the risk factors for blood transfusion during anaesthesia for caesarean section.

**Methods:** This was a prospective cross-sectional study. A total of 706 pregnant patients scheduled for emergency or elective Caesarean section at the University College Hospital, Ibadan, Nigeria between March and August 2011 were recruited. Participants were followed-up from the date of delivery till the end point of the study which could fall into either of the following conditions: satisfactory post-operative clinical status up to 48 hours post-delivery or death. Transfusion rate was determined and Chi-square test was used to determine if there exist an association between blood transfusion status and preoperative haematocrit level, years of experience of obstetrician, indication for Caesarean Section (CS), CS type (primary or repeat) and HIV status.

**Results:** Transfusion rate was 9.1 %; variables found to be significantly associated with blood transfusion were; preoperative haematocrit less than 26%, increasing parity, years of experience of resident obstetrician, indication for CS (bleeding or not bleeding) and estimated blood loss. Being HIV positive does not increase the need for blood transfusion.

**Conclusion:** Preoperative anaemia, increasing parity and severe blood loss at surgery significantly contribute to the requirement for blood transfusion in patients undergoing caesarean section.

**Keywords:** Blood transfusion, Caesarean delivery, Risk factors, Anaemia

### INTRODUCTION

Operative delivery poses the risk of excessive blood loss and possible need for blood transfusion in the pregnant patient. Factors predisposing to increased risk for blood transfusion identified from previous studies include preoperative anaemia, previous Caesarean section and antepartum haemorrhage among others.<sup>1-3</sup> However, other factors that may significantly affect blood loss during Caesarean section (CS) such as the level of expertise of the surgeon and the presence of co-morbidities which predispose to anaemia in pregnancy<sup>4</sup> (such as Human Immunodeficiency Virus (HIV) infection) have not been previously studied in our institution. Anaemia in pregnancy is not uncommon in our setting, with prevalence of 25-30% being reported in Ibadan.<sup>5,6</sup> Various studies<sup>2,3,7,8</sup> have shown that severe antepartum haemorrhage from causes such as placenta abnormalities can lead to anaemia and are significantly associated with blood loss with the attendant risk of blood transfusion during operative delivery.

The large scale deployment of antiretroviral agents has led to improved survival of People Living with HIV and AIDs (PLWA). With increasing well-being, many PLWAs are getting pregnant and may require operative delivery on account of Preventing Mother-to-Child Transmission (PMTCT) of HIV at centers such as the University College Hospital, Ibadan which is a major training institution for obstetricians. The pregnant HIV positive parturient may be at increased risk for blood transfusion requirement due to various haematological abnormalities such as bone marrow depression, anaemia<sup>9</sup> and haemosuppressive effects of anti-retroviral agents such as zidovudine or antiviral agents like ganciclovir.<sup>10,11</sup>

Availability of blood and blood products for transfusion remains a major challenge in resource poor setting such as Nigeria. Factors that have been noted to contribute to delay in blood transfusion include

constraints in blood banking and donation as well as cost (economic) and religious issues.<sup>12</sup> This study was carried out to determine risk factors for blood transfusion in patients who had Caesarean delivery at our institution. In addition, we also compare blood transfusion rates in HIV negative patients with HIV positive patients. It is hoped that knowledge of blood transfusion predictors in this patient population will promote proper use of the few blood units available in low resource settings such as ours.

## PATIENTS AND METHODS

This prospective cross-sectional study was carried out at the University College Hospital, Ibadan. Approval was obtained from the Institutional Ethics Committee. All women who had Caesarean Section [CS] were eligible for participation; however, a total of 706 pregnant women who had CS were recruited using non-probability sampling method. Written informed consent was obtained from participants. Data was collected over a six month period (March – August 2011). Participants were followed-up from the date of delivery till the end point of the study which was either satisfactory post-operative clinical status up to 48 hours post-delivery or unstable blood pressure (low or high blood pressure) or delayed recovery from anaesthesia requiring intensive care unit admission until discharge to the ward, or death.

The dependent variable was the patient's blood transfusion status, that is, whether or not blood was transfused intra-operative or post-operative. This was categorized into two: Blood transfusion status (Received or Not received). Estimation of blood loss was by visual inspection of the number of soaked gauze pieces, abdominal packs and volume of blood in the suction bottle. The need for blood transfusion in an individual participant was determined by the attending anaesthetist (mostly senior registrars) based on the estimated blood loss and the clinical status of the participant. The attending anaesthetist also requested for blood from the blood bank. Haematologists were invited for specialized care of patients who developed features of Disseminated Intravascular Coagulopathy (DIC).

The independent variables included; preoperative haematocrit level (Packed Cell Volume), haematocrit level up to 26% or less than 26% was used to determine association between preoperative anaemia and the risk of blood transfusion in the analysis. Other independent variables included years of experience of the lead obstetrician, indication for Caesarean Section (CS), CS type (primary or repeat) and HIV status. With regards to the years of experience of the lead obstetrician, 4

years was identified as the dividing line because it is expected that by this time, residents should have received adequate training to acquire the necessary skills to perform Caesarean Section.

The analysis was done with Chi-square model which was used to determine the association between blood transfusion status and the independent variables. Thereafter, variables found to be statistically significant in the analysis ( $p < 0.05$ ) were entered into multiple logistic regression models to predict the strength of associations between these variables and blood transfusion status. Data was analysed with STATA software package version 12.0 (StataCorp, 4905 Lakeway Drive, College Station, Texas, USA).

### *Definition of Term*

In this study, unstable blood pressure was defined as wide variations in systolic and diastolic blood pressure such that the measurement could be low or high within minutes. These variations were often due to severe acute blood loss, on-going administration of intravenous fluids, blood or vasopressors combined with rapid physiological changes in the peri-partum period. No single blood pressure measurement can be used as the cut-off point.

## RESULTS

A total of 1,370 patients were admitted for delivery during the study period and 712 patients had Caesarean section. The study involved 706 pregnant women who had Caesarean delivery.

Table 1 depicts the patients' characteristics. The mean age of the women was  $30.9 \pm 4.9$  years and the modal parity was 0 ( $n=243$ , 35.8%). There was no significant difference between the mean age of women who received blood transfusion and those who did not. At least 60% of the women had more than 10 years of formal education.

Of the 706 patients who were recruited into the study, 181 (25.6%) had elective CS while 525 (74.4%) had emergency CS. Caesarean sections were performed under spinal anaesthesia in 624 patients (88.4%), 80 patients (11.3%) had general anaesthesia while 2 patients (0.3%) had combined spinal and epidural anaesthesia as shown in Table 2.

Anaesthesia was converted from regional (spinal) to general anaesthesia in 5 multiparous patients requiring Caesarean hysterectomy due to uncontrollable haemorrhage and 3 patients required re-exploration (exploratory laparotomy) under general anaesthesia (ketamine was used as sole anaesthetic agent for Total

**Table 1:** Selected maternal clinical and demographic characteristics

Variable	All participants N=706	No Blood N= 642	Received blood N=64	p value
<b>Mean age (<math>\pm</math> S.D)</b>	30.95 $\pm$ 4.9	31.09 $\pm$ 4.54	31.24 $\pm$ 4.77	0.310
<b>Mean Preop- PCV (<math>\pm</math> S.D)</b>	33.7 $\pm$ 4.2	34.15 $\pm$ 3.6	28.77 $\pm$ 6.5	< 0.0001
<b>Mean EBL (<math>\pm</math> S.D)</b>	604.10 $\pm$ 399.0	538.05 $\pm$ 214.1	1266.72 $\pm$ 908.1	< 0.0001
<b>Age</b>				
15-24	58 (8.4%)	52 (88.1%)	7 (11.9%)	0.408
25-29	210 (29.7%)	196 (93.3%)	14(6.7%)	
30-34	266 (37.7%)	242(91.0%)	24 (9.0%)	
35-45	171 (24.2%)	152 (88.9%)	19(11.1%)	
<b>Parity</b>				
Para 0	243(35.8%)	232 (95.5%)	11 (4.5%)	0.0001
Para 1-4	418 (61.7%)	376 (90.0%)	42(10.0%)	
Para $\geq$ 5	17 (2.5%)	11 (64.7%)	6 (35.3%)	
<b>Level of education</b>				
No schooling	3 (0.47%)	3(100.0%)	0(0.0%)	0.0001
Primary	15(2.4%)	15(100.0%)	0(0.0%)	
Secondary	160(25.2%)	133(83.1 %)	27(16.9%)	
Higher	457(72.0%)	429(93.9%)	28(6.1%)	

Intravenous Anaesthesia (TIVA) due to critical clinical status of the patients) on account of uterine atony and Post-Partum Haemorrhage (PPH).

Women who were transfused were more likely to be of higher parity, to have lower preoperative mean PCV and higher estimated blood loss. The data showed that 5.7% (n = 40) and 7.5% (n = 53) of the women received intra-operative and post-operative blood

transfusion respectively. Also 90.9% (642) of the women did not receive either intra-operative or post-operative blood transfusion. Only 5.0% (35) received one unit of blood either intra-operative or postoperative while 4.1% (29) received at least 2 units of blood in the intra- and post-operative period. The findings revealed that 9.1% (64) of women who had CS received blood transfusion as shown in Table 2. Of the 64 women who had blood transfusion, 49 (76.6%) had emergency CS while 15 (23.4%) had elective CS.

**Table 2:** Caesarean section type, Anaesthetic technique and blood transfusion status

Variable	Frequency	Percentage
<b>CS Type</b>		
Elective LSCS	181	25.6%
Emergency LSCS	525	74.4%
<b>Mode of anaesthesia</b>		
Spinal anaesthesia	619	87.7%
General Anaesthesia (GA)	80	11.3%
Spinal converted to GA	5	0.7%
Combined spinal/ anaesthesia	2	0.3%
<b>Transfusion status</b>		
No blood transfused	642	90.9%
<sup>a</sup> Intraop. Transfusion only	40	5.7%
<sup>n</sup> Postop. Transfusion only	53	7.5%
*Both intraop, and postop.	64	9.1%

\* Total "40 + 53 due to overlap

<sup>a</sup> - Intraoperative

<sup>n</sup> - Postoperative

Table 3 shows the variables found to be significantly associated with blood transfusion: preoperative PCV < 26% (p<0.001), years of experience of lead surgeon (p=0.013), antepartum haemorrhage as an indication for CS (p<0.001) and estimated blood loss (p<0.001). HIV status (p=0.391) and CS type (primary or repeat) (p=0.248) were not associated significantly with blood transfusion. Women with PCV < 26% were more likely to be transfused (63.4% vs. 6.2%) compared to their counterparts. The likelihood of blood transfusion [Odd ratio (OR)] was highest when estimated blood loss of at least 1000ml was used as control regression model 1(OR = 43.07; 95% Confidence Interval (C.I.) = 17.22 – 107.76). The likelihood of blood transfusion was higher in participants with preoperative PCV < 26% when this was used as control in regression model 2 (OR = 33.8, 95% C.I. = 11.8 – 97.0). The odds reduced when both preoperative PCV and years of experience of the lead resident obstetrician were used

**Table 3:** Association between independent variables and risk of blood transfusion

Variable	All participants N=706	No Blood N= 642	Received blood N=64	p value
<b>HIV Status</b>				
Negative	641(90.8%)	581 (90.5%)	60 (93.8%)	0.391
Positive	65 (9.2%)	61 (9.5%)	4 (6.2 %)	
<b>Preoperative PCV (N=695)</b>				
<26	33(4.7%)	12 (36.4%)	21 (63.6%)	< 0.001
≥ 26	662 (95.3%)	620 (93.7%)	42 (6.3%)	
<b>CS Type</b>				
Primary	475	434 (91.4%)	41 (8.6%)	0.248
Repeat (twice)	162	149 (92.0 %)	13(8.0%)	
More than twice	69	59 (85.5%)	10 (14.5%)	
<b>Years of experience of lead surgeon</b>				
< 4 years	563 (79.7%)	529 (94.0%)	34 (6.0%)	0.013
4 years	143 (20.3%)	123(86.0%)	20(14.0%)	
<b>Indication for CS</b>				
Antepartum haemorrhage	638 (90.3%)	600 (94.0%)	38 (6.0%)	<0.001
No APH	68 (9.6%)	42 (61.8%)	26 (38.2%)	
<b>Estimated Blood Loss</b>				
≤ 500 ml	381(54%)	365 (95.8%)	16 (4.2%)	<0.001
501- 999	266 (37.7%)	253 (95.1%)	13(4.9%)	
≥ 1000	59 (8.4%)	24 (40.7%)	35 (59.3%)	

as control in the regression model 3 (OR = 28.33; 95% C.I. = 10.68 – 75.10). Of the 33 patients with PCV less than 26%, 8 were HIV positive (24.2%) and 8 (24.2%) had sickle cell anaemia (HBSS).

According to the years of experience of the lead surgeon, the senior surgeon who had at least 4 years' experience are more likely to be in attendance when

blood transfusion is required at surgery; 14.0% compared to 6.0% of those women delivered by lead surgeon who had less than 4 years' experience. While blood is more likely to be transfused in women who had antepartum haemorrhage, the percentage of women who received blood transfusion increased with the estimated blood loss in millilitre (ml).

**Table 4:** ICU admission and blood transfusion status

Variable	All participants N=706	No Blood N= 642	Received blood N=64	p value
<b>ICU admission Status</b>				
No ICU admission		628 (97.8%)	49 (76.6%)	0.001
ICU admission for monitoring		6 (0.9%)	8 (12.5%)	
ICU admission for V & M		8 (1.3%)	7 (10.9%)	
<b>Indications for ICU admission (N=29)</b>				
Unstable BP		14	15	
Delayed recovery from GA		3	5	
Severe pre-eclampsia		8	6	
HB SS (bone pain crisis)		3	1	
Pulmonary Oedema		0	2	
		0	1	

Table 4 shows the proportion of women admitted into ICU and the indication for admission. Of the 64 patients who had CS and received blood transfusion, 15 (23.4%) were admitted into Intensive Care Unit (ICU) as against only 2.0% of those who did not receive blood transfusion (n=14). All the other patients in this study were discharged from the labour ward to the general obstetrics wards in stable and satisfactory clinical status. Of the 29 patients admitted into the ICU, 7 deaths were reported while the remaining 22 patients improved clinically and were subsequently discharged to the ward fully conscious and with stable vital signs. The mortality in this cohort of patients was 1.7% (n=12), 7 deaths in the ICU and 5 deaths in the labour ward.

## DISCUSSION

In a resource poor setting, making group specific blood available for caesarean section is often a major challenge to the care-provider and is a cause of delay in proposed emergency or elective surgeries. In this study, the transfusion rate was 9.1% for all deliveries indicating that only few patients may actually require blood transfusion during Caesarean section. The transfusion rate is not as high as those reported from other resource poor countries which averaged 12.5% and 25.2%.<sup>2,8</sup> The variation in the transfusion rate may be due to blood transfusion practices among the care providers or the transfusion policy of each hospital. However, a look at the predisposing factors suggests a similar trend of preoperative anaemia, antepartum haemorrhage and blood loss at surgery being major determinant factors for peri-operative (Caesarean section) blood transfusion. It is noteworthy that more patients required Caesarean section (712) compared to those who had normal delivery (658). This observation is because our institution, a tertiary medical facility is a major referral for difficult and high risk obstetric cases. Also, the use of non-probability sampling method may account for these findings.

Preoperative anaemia has remained a major predictor of blood transfusion in studies from developed and resource poor countries.<sup>4,8,11-13</sup> Preoperative anaemia may result from anaemia in pregnancy and antepartum haemorrhage. Possible causes of anaemia include nutritional deficiency, parasitic infestations, HIV infection and haemoglobinopathies.<sup>14</sup> The care provider should make every effort to optimise the patient's PCV before delivery.

A major predictor of blood transfusion in this study is preoperative packed cell volume of less than 26% with the odd ratio being 33.8. This finding supports the need to intensify efforts at improving antenatal care services, ensuring access to haematinics and treatment

of common ailments that may predispose the pregnant patient to anaemia. It has been found that presence of HIV is an additional risk factor for anaemia of pregnancy.<sup>4,13</sup> In this study, of the 33 patients with an haematocrit of less than 26%, 8 (24.2%) were HIV positive. However, being retroviral positive was not significantly associated with the risk of blood transfusion.

Blood loss during surgery is another major determinant of blood transfusion requirement at surgery. The blood loss often commenced preoperatively as a result of antepartum haemorrhage (placenta praevia, abruption) as found in this study where 38.2% of women with this diagnosis received blood transfusion. The odds of receiving blood transfusion increased with a blood loss of at least 1000 ml (OR = 43.07) and a preoperative PCV of less than 26%. This finding is consistent with previous reports from Akinola *et al*<sup>2</sup> and Imarengiaye *et al*.<sup>3</sup> Our findings suggest that the transfusion trigger is higher for women with preoperative haemorrhage and anaemia presenting for operative delivery in our institution, or in the alternative it may support the fact that such women present late to the hospital when transfusion becomes inevitable. The history of previous (repeat) Caesarean was not found to be significantly associated with blood transfusion in this study. While previous Caesarean section may increase the need for blood transfusion at operative delivery as reported by Imarengiaye *et al*;<sup>3</sup> our findings are supported by the study by Saidu *et al*<sup>15</sup> who found no association between repeat Caesarean section and the risk of blood transfusion. The experience of the lead surgeon may play a significant role at determining the quantity of blood loss at surgery. This study showed that, Caesarean sections performed by surgeons with more than 4 years' experience were likely to require blood transfusion (14% of parturient compared to 6.0%). A possible explanation for this finding is that lead surgeons with more years of experience are likely to be in attendance at surgery where blood transfusion is required because of the complexity that may be associated with such surgery. However, when the lead resident obstetrician experience and preoperative PCV were used as control, the likelihood of blood transfusion was reduced (OR = 28.33). A possible limitation of this study was the assumption of 4 years' experience for the lead obstetrician which does not take cognizance of resident who have learnt the caesarean section skills before commencing residency training. Blood transfusion may significantly affect morbidity and mortality in patients presenting for Caesarean section. In this study, 66.6% of deaths were as a result of severe haemorrhage or complications arising from the blood loss such as respiratory

insufficiency and Disseminated Intravascular Coagulation (DIC). In addition, parturient with massive haemorrhage may also require critical care as noted in a recent editorial<sup>14</sup> and as shown in this study where 15 (23.4%) of patients who received blood transfusion on account of severe haemorrhage were admitted into the intensive care unit. Further study using objective blood loss estimation techniques are required to provide accurate estimates of blood loss during caesarean section in our patient population. The indications for ICU admission is similar to the findings of previous report from our institution and others.<sup>16,17</sup> It is noteworthy that 48.2% (14) of the patients were admitted on account of delayed recovery from anaesthesia. The possible explanation for this finding is the use of ketamine anaesthesia for some of these patients and the fact that some of the eclamptics were also heavily sedated with diazepam. This study did not fully explore other causes of delayed recovery from anaesthesia and further research in this area is suggested. The provision of a High Dependency Unit (HDU) within the labour ward complex has been previously suggested<sup>16</sup> and may reduce the admission of patients with delayed recovery from anaesthesia into ICU.

Five multiparous patients required Caesarean hysterectomy on account of severe haemorrhage and uterine atony. Uterine atony may predispose to postpartum haemorrhage and in this cohort, 3 patients required re-exploration on account of uterine atony. Ozumba *et al*<sup>8</sup> recommended the use of potent oxytocics including titrated infusion to keep the uterus contracted and control postpartum haemorrhage. However, despite the use of oxytocic including intravenous oxytocin (bolus doses and infusion), ergometrine and misoprostol some patients may still require re-exploration to secure haemostasis.

## CONCLUSION

Preoperative haematocrit of less than 26%, antepartum haemorrhage, increasing parity and the experience of the lead obstetrician were found to significantly predict the need for blood transfusion. We will like to recommend that experienced surgeons should be readily available to attend to parturient with preoperative anaemia and antepartum haemorrhage presenting for Caesarean section.

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