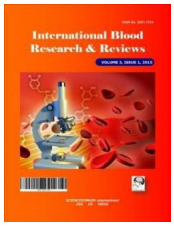

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Relationships between Blood Transfusion, Severity of Injury and Outcome of Severely Injured Patients Admitted to a Trauma Intensive Care Unit in Nigeria: An Observational Study

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Authors' contributions

Both the authors made substantial contributions in the study design, implementation and write up.

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ABSTRACT

Background: Anaemia is common in critically ill trauma patients admitted into the Intensive Care Unit. The aetiology of the anaemia in trauma patients is often multi-factorial, usually resulting from the trauma event, from subsequent interventions and from complications that may arise such as severe sepsis and multiple organ failure. Treatment of anaemia in severely injured patients admitted into the Intensive Care Unit often necessitates blood transfusion. Presently, there is a dearth of quality studies on blood transfusion and outcome among trauma patients especially in Nigeria. This article is aimed at evaluating the association between red blood cell transfusion and severity of injury in adult patients admitted to a trauma ICU.
Methods: Prospective observational study without intervention on transfusion pattern in adult patients admitted to the trauma ICU of a dedicated trauma Hospital in Nigeria between the periods October 1, 2010 and September 30, 2011.
Results: One hundred and fifty eight (158) patients (30.4%) out of the 664 patients admitted into the trauma ICU during the period of observation received a total of 447 units of blood. The mean age of patients that were transfused was 34.7 ±11.2 years, a mean injury severity score (ISS) of 24.1 ± 9.9, and an average frequency of transfusions of 3.5 ± 2.0 units. The mean pre-transfusion

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[Hb] for all patients was 66.5 g/L ± 10 g/L. The need to receive blood transfusion was significantly correlated to the Injury Severity Score (rho = 0.29, p < 0.001) but not with Simplified Acute Physiology II Score (p >0.05). Blood transfusion was significantly associated with longer stay in the ICU (4.5 ± 4.0) days versus (3.5 ±2.8) days, P < 0.0001) and longer hospital stay (21.9 ± 17.5) days versus (8.6 ±7.2 days) for transfused and non-transfused patients respectively. This relationship increases with the number of blood transfused (p< 0 0.0001). Also the risk of developing some complications in patients with severe injury admitted into the ICU increases with transfusion, OR (CI) of having a complication between the patients that received transfusion and those that were not transfused was 20.808 (12.6951 - 34.1062), {(z stat.) = 12.040, p <0.0001} Whereas there was association between blood transfusion and higher mortality (4 versus 2) respectively, this association was not statistically significant (*p*> 0.05) for the patients that received blood transfusion and those that did not.

Conclusions: Anaemia often requiring RBC transfusion is common in patients admitted to the trauma ICU, and the anaemia increases progressively during the course of ICU admission. Older patients and patients with higher severity of injury have higher tendency to receive blood transfusion in the trauma ICU. Despite that blood transfusion can be life-saving; it is associated with identifiable adverse consequences which is dose dependent.

Keywords: Trauma; trauma ICU; anaemia; RBC transfusion; severity of injury; outcome.

1. INTRODUCTION

1.1 Background

Blood transfusion in humans can be beneficial in certain situations but it is also associated with some deleterious consequences, [1-6]. Evolving evidence on the benefits and hazards associated with the use of allogenic blood transfusion, has led to various changes and recommendations to ensure optimal benefits of this practice [7,8].

Blood transfusion is often inevitable in the critically ill patients in whom anaemia is often common [4,9]. Studies have shown that up to 40% of critically ill patients received red blood cell (RBC) transfusion during admission to the intensive care units (ICU) [4,10]. Over the years evidence support the adoption of restrictive transfusion protocols [4,10] because of the associated hazards identified with blood transfusion which include mild and major transfusion reactions from blood group incompatibility, anaphylactic reactions, infections, pulmonary embolism and other pulmonary complications.

The tendency to transfuse blood to critically ill patients in the ICU appears to increase with the length of stay in the ICU. An audit found that 55% of patients admitted to the ICU for more than 24 hours have haemoglobin concentrations [Hb] levels less than 90 g/L necessitating transfusion in a good number of the patients in an attempt to keep the [Hb] above 100 g/L [11]. Another study reported that between 73% and 85% of patients with prolonged stay in the ICU received blood transfusion [12]. MacIver et al. [13] derived a mean transfusion requirement of 0.34 units of RBC per day in the ICU. An audit in Scotland found that 90% of patients admitted to the ICU were anaemic at the time of ICU discharge [14].

Anaemia in critically ill patients may result from overt or occult blood loss, decreased RBC production, increased RBC destruction or spurious anaemia from large volume infusion of resuscitation fluids [15]. Other causes of anaemia in critically ill patients include sepsis [4,16] decreased production of endogenous erythropoietin and immune associated functional iron deficiency [4]. Repeated interventions whether for diagnostic or therapeutic purposes can lead to appreciable loss of blood in patients admitted in the ICU [4,17]. Vincent et al. [4] observed that the volume of blood lost to sampling of patients in ICU averages 41 mls in 24 hours. Other identified sources of blood loss in critically ill patients to include gastrointestinal bleeding from stress ulceration [17], bleeding from repeated change of wound dressings, repeated surgical interventions and extra corporeal major organ support such as renal dialysis [15]. Impaired erythropoiesis attributed to persistent inflammatory state has also been identified in critical ill patients [6,18]. The numerous causes of anaemia in patients admitted into the ICU including those with severe injury often necessitate blood transfusion in these patients.

Anaemia however, is not the only reason for transfusion of blood or blood products in ill patients admitted into the ICU. Other conditions that may necessitate transfusion of blood products in patients in the ICU include on-going blood loss to restore blood volume, blood component transfusions to replace specific component deficiencies, plasmapheresis to reduce the load of certain unwanted toxins or agents in the blood, and recently stem cell therapy as treatment of certain illnesses [4,15]. The current recommendation emphasizes on the transfusion of the particular component that is deficient in the patient [19].

In Nigeria and perhaps in most other developing countries, the practice of blood component therapy is still not readily available or at best still rudimentary, as such most centres still practice the use of whole blood or at best sedimented red blood cells for the treatment of most conditions requiring transfusion [20,21]. Blood transfusion despites its benefits, has been associated with some poorer outcome such as increased mortality, higher risk of infections and other complications and prolonged hospitalization in patients admitted into the ICU [8,9,10,11].

2. PATIENTS AND METHODS

2.1 Aim

This study, aims to evaluate the relationship between the blood transfusion, severity of injury and outcome of severely injured patients admitted into a trauma ICU in Nigeria.

2.2 Design and Setting

This study was undertaken as prospective observational research without intervention at the Teme Hospital, a dedicated trauma centre in Nigeria. Study was approved by the Management and the Research and Ethical Review Committee of the hospital. Since this study was designed as an observational survey without direct intervention or interaction with the patients, waiver for informed consent from the patients was obtained. However, patients' identity remained confidential throughout the study.

2.3 Patients' Characteristics

All the adult patients admitted into the trauma ICU with injury severity score (ISS) above 15 between October 1, 2010 and September 30, 2011 were included in the study. The subset of recruited patients that received blood transfusion was identified. The subset that did not receive blood transfusion served as control to ensure if any of the observed difference in outcome may be related to the blood transfusion. Patients below the age of 18 years, patients with bleeding disorders such as haemophiliacs and patients who received blood transfusion within 90 days preceding admission into the ICU were excluded from study analysis.

To ensure that patients with similar anatomical and physiological similarities were compared, Injury severity score (ISS) and the Simplified Acute Physiology Score II (SAP II) were calculated for each of the transfused patients and patients that did not receive any transfusion. The indication for blood transfusion, the pre-transfusion haemoglobin, the number of units and volume of blood transfused to each patient was recorded. Any observed transfusion reaction was recorded. The 28 day- all cause mortality, length of stay in the ICU, length of stay in the hospital were all noted and complication resulting from the treatment or the injury such as wound infection, delayed wound healing which were the measures of outcome assessment were recorded.

2.4 Statistics

Power calculation undertaken to determine appropriate sample size required to identify significant differences at a Confidence level of 95% %, alpha of 0.05 and (+/- 5) Confidence Interval (CI) using the National Statistical Service statistical software freely available online [22]. Data was managed using Microsoft Excel version 2010 (Microsoft Headquarters Redmond WA, USA) and analysed with statistical package for windows version 20 (IBM SPSS Statistics for Windows, Version 19.0. Armonk, NY: IBM Corp.). Descriptive statistics were generated and presented in the form of frequencies and percentages using tables, and charts as considered appropriate. Categorical data were presented as proportions and percentages whereas continuous variables were presented as means with standard deviations and median with inter quartile range as considered appropriate. Chi square (X^2) was used to test for any observed differences for categorical data while Student t-test was used to compare observed differences in means. Analysis of variance (ANOVA) was used to determine the levels of significance for observed differences in variables among multiple groups. Correlation analysis was done using Spearman's (rho) and Pearson's

correlations as deemed necessary. A p-value of ≤ 0.05 is considered statistically significant. Odd ratios (OR) with corresponding Confidence interval (CI) was calculated for occurrence of adverse consequences following blood transfusion in recruited patients.

3. RESULTS

A power calculation showed that a sample size of 461 was adequate to identify any significant differences including provision for 20% attrition. Six hundred and sixty four (664) patients with severe injury ware admitted into the Trauma ICU of the Hospital between the periods October 1, 2010 and September 30, 2011. Of this number, only 520 patients who met the inclusion criteria were recruited. One hundred and fifty eight patients (158, 30.4%) of the included patients were transfused with a total of 447 units of blood. Some of the patients had multiple blood transfusions.

The age distribution of the patients (Table 1) showed that the age group 20 to 29 years had the highest admission (n = 206 {39.6%}) as well as the highest transfusion rates (n = 47{9.0%}) in the ICU, followed closely by patients between the ages of 30 to 39 years (n = 131 {25.2%}) and transfusion rates (n = 39 {7.5%}, although this finding was not statistically significant (p=0.107). Eighty one (15.6%) amongst the patients included in the study were older than 50 years and transfusion rates (n=28 {9.4%}). The mean age of the subjects transfused, 34.7 ± 11.2 years was slightly higher than the subjects non-transfused in the study 33.1 ± 10.4 years, and with the mean age of 33.6 ± 11.2 years for all subjects (Table 1).

Table 2 shows the total number of transfusions (447) and the distribution of pre-transfusion haemoglobin level in the patients, with 302 (67.6%) having [Hb] of <70 g/L, 120 patients (26.8%) had [Hb] levels between 70 and 100 g/L, while 25 patients (5.6%) had [Hb] of >100 g/L. The mean pre-transfusion [Hb] for all patients = 66.5 g/L ± 10 g/L. The mean transfusion trigger for patients younger than 50 years was 63 ± 14 g/L, while the mean transfusion trigger for patients older than 50 years was 68 ±15 g/L. The lowest recorded mean [Hb] in the ICU for non-transfused patients = 109 ± 25 g/L.

3.1 Relationship between the Units of Blood Transfused and Severity of Injury

The distribution of the Injury Severity Score (ISS) shows that the mean ISS of the transfused patients (24.1 ± 9.9) was significantly higher than that of the patients who were not transfused (21.8 ± 8.0), p = 0.0006. The majority of persons (83 {16.0%}) admitted into the ICU with more severe injury (ISS>25) received more blood transfusion as compared to those with ISS ≤25 (p> 0.05). Also, the average number of units of transfusion per patient was insignificantly higher amongst the group with ISS >25 (3.7 ± 1.4) as compared with the number of units received by the patients with ISS <25 (2.4 ± 0.7), p >0.05. The patients older than 45 years received more units of transfusion as compared with persons below 45 years (3.7 ± 2.0 units, 2.9 ± 1.9 units) respectively p = 0.23 (Table 3).

3.2 Severity of Physiological Deraignment Shown by Simplified Acute Physiology (SAP) II Score

The mean SAP II Score for the transfused patients was 16.0 ± 8.1 while that of the patients that did not receive blood transfusion was 14.1 ± 6.5. The observed difference was not statistically significant (p = 0.08). The average units of transfusion in patients with SAP II Score less than 15 was 3.1 unit per patient and 3.5 units per patient for the group with SAP II Score greater than 15. This observed difference was not statistically significant (p = 0.54) (Table 4).

Table 1. Age distribution of blood transfusion recipients among patients admitted to the ICU

Age group (years)	Transfused (%)	Non-transfused (%)	Total (%)	p-value
<20	20 (3.8.0)	21 (4.0)	41 (7.8)	
20 -29	47 (9.0.)	159 (30.6)	206 (39.6)	
30 -39	39 (7.5)	92 (17.7.2)	131 (25.2.)	
40 - 49	24 (4.6)	37 (7.1)	61 (11.7)	*0.107*
50 -59	9 (1.7)	30 (5.8)	39 (7.5)	
>60	19 (3.7)	23 (4.4.)	42 (8.1.4)	
Total	158 (30.4)	362 (69.6.0)	520 (100.0)	
Mean Age±(SD) (years)	34. 7 ± 11.2	33.1 ± 10.4	33.6 ± 11.2	

Table 2. Distribution of the pre-transfusion hemoglobin [Hb] levels

Hb (g/L)	Frequency (n)	Percentage (%)
< 70	302	67.6
70 – 100	120	26.8
> 100	25	5.6
Total	**447**	**100.0**

3.3 Relationship between Blood Transfusion and All-cause 28 Days Mortality

It is observed that 4 of the 158 persons that received blood transfusion died within 28 days of admission whereas 2 persons among the 362 patients that were not transfused in the ICU died within the same period. This observed higher risk of dying among the transfused patients was not statistically significant, *P* = 0.058, (Table 5).

3.4 Relationship between Blood Transfusion and Length of Admission in the Hospital

As shown in Table 6, the mean length of stay in the ICU (LOIS) for the patients that received transfusion was 4.5 ± 4.0 days and 3.5 ± 2.8 days for those that did not receive transfusion. This difference was statistically significant (*P* =0.001).

A review of the relationships between the length of hospital stay both in the ICU and total hospital admission showed a strong association between the length of stay in the ICU (LOIS) and the overall hospital admission (LOS), and the number of units of blood received by the transfused patients, Pearson's coefficients (R = 0.62, P < 0.00001) and R = 0.3, P = 0.005) respectively, (Table 6).

Table 3. Distribution of the severity of injuries using injury severity score (ISS) in patients

Characteristics	Patients transfused (n,%)	Patients not transfused (n,%)	Total (n, %)	*p-value*
ISS range ≤25	75 (14.4)	190 (36.6)	265 (51)	
ISS range >25	83 (16.0)	172 (33.0)	255 (49.0)	*0.29*
Total	**158 (30.4)**	**362 (69.6)**	**520 (100.0)**	
Mean ISS ± SD	24.1 ± 9.9	21.8. ± 8.0		*0.0006**
Median ISS (IQR)	25 (4-57)	20 (4 - 50)		
Average frequency of transfusions by ISS	**3.5 ± 2.9 units per patient**			
(ISS ≤25)	2.4±0.7 units			
(ISS >25)	3.7±1.4 units			*<0.05**
Average frequency of	**Transfusions by Age**			
(Age range ≤45)	2.9 ± 1.9 units			*0.23*
(Age range >45)	3.7 ± 2.0 units			

**P < 0.05*

Table 4. Distribution of SAP II score in admitted patients

SAP score	Transfused (%)	Non- transfused (%)	Total (%)
<10	69 (13.3)	168 (32.3)	237 (45.6)
10 - 20.	50 (9.6)	129 (24.8.)	179 (34.4)
21-30	23 (4.4)	42 (8.1)	65 (12.5)
31 – 40	9 (1.7)	17 (3.3)	26 (5.0)
> 40	7 (1.4)	6 (1.2)	13 (2.6)
Total	158 (30.4)	362 (69.6)	520 (100)
Mean SAP II Score	16.0 ± 8.1.	14.1 ± 6.5	*P* = 0.08

Table 5. Showing blood transfusion and 28-day mortality

Status of patient	Transfused	Not –Transfused	Total
Dead	4	2	6
Survived	154	360	514
Total	158	362	520

X^2 = 3.593, P = 0.058 (OR = 0.21, CI – 0.39 – 1.18 P = 0.08)

Table 6. Length of ICU admission (LOIS) and hospital stay (LOS)

LOIS(days)	Transfused	Non- transfused	Total
Mean	**4.5 ± 4.0 days**	**3.5 ±2.8 days**	**p =0.001**
LOS(days)	**Transfused (%)**	**Non-transfused (%)**	**Total (%)**
< 14	49 (9.4)	296 (56.9)	265 (66.3)
14 -28	59 (11.4)	37 (7.1)	96 (18.5)
29 -42	14 (2.7)	20 (3.9)	34 (6.6)
>42	36 (6.9)	9(1.7)	45 (8.6)
Total	**158 (30.4)**	**362 (69.6)**	**390 (100.0)**
Mean	**21.9 ± 17.5 days**	**8.6 ±7.2 days**	

X^2 = 140.772 P <0.0001

Table 7. Distribution of recorded complications

Complication	Transfused	Non transfused	Total	Odd ratio	Confidence interval	P -value
Wound infection	52	30	82	5.43	3.2937 - 8.9485	<0.0001
Sepsis / septic syndrome	22	9	31	6.34	2.8498 - 14.1258	<0.0001
Chronic osteomyelitis	13	5	18	6.40	2.2416 - 18.2806	= 0.0005
Readmission	25	13	38	5.05	2.5076 - 10.1551	< 0.0001
Others	20	14	34	3.60	1.7696 - 7.3339	= 0.0004

*Transfusion reactions: * Major 2, ** Minor 13*

3.5 Relationship between Blood Transfusion and Development of Complications

The patients that received blood transfusion in the ICU had more complications as compared to the group that did not receive blood transfusion. The OR (CI) of having a complication between the patients that received transfusion and those that were not transfused was 20.808 (12.6951 - 34.1062), {(z stat.) = 12.040, p <0.0001}. Some of the observed complications included wound infection (OR = 5.43 {CI = 3.294 - 8.949}), sepsis and septic syndrome (OR = 6.34, CI = 2.850 - 14.126), chronic osteomyelitis (OR = 6.40, CI = 2.242 - 18.281), readmission (OR = 5.05, CI = 2.508 - 10.155) and other complications such as, pneumonia, transfusion reaction, pulmonary embolism, deep venous thrombosis, etc (OR = 3.60, CI = 1.770 - 7.334). The risks for the listed complications were significantly higher amongst the patients that were transfused as compared to those that did not receive blood transfusion (p < 0.001). There were two cases of major transfusion reactions during transfusion necessitating the discontinuance of the transfusion and 13 cases of mild transfusion reaction which were treated and the transfusion continued till completion, (Table 7).

4. DISCUSSION

Reasons for transfusion in trauma patients are often multi-factorial, which may include acute and continuing blood loss from the primary injury, post trauma interventions for investigations and treatments, subsequent complications such as severe sepsis and or multiple organ failure [4,15,16].

The result of this study showed that 30.4% of the patients (n= 158) admitted into the trauma ICU received red blood cell (RBC) transfusion at various times during the course of their admission. The findings from this study corroborate the results of Vincent et al. [4] who had reported that 37% of patient admitted into the 1CU had blood transfusion during their first 28 days of ICU admission. Another study, had reported a transfusion rate of 44% [23], while Vincent et al in Sepsis Occurrence in Acutely ill Patients (SOAP) study reported a transfusion rate of 33% in European hospitals [24].

The pattern of transfusion in patients admitted to the ICU in most centres is often related to local protocol which often is closely tied to pre-determined levels of [Hb] called (transfusion trigger) and the development of clinical symptoms in the particular patients. The mean

pre-transfusion [Hb] observed in this study (66.5 ± 10 g/L) was a clear shift from the normal paradigm of the traditional "10/30" [Hb] / PCV cut off commonly practiced in the region [20,21] but is in keeping with the recommendations of Napoliteno et al. [25] that transfusion should be considered when the [Hb] drops below 70 g/L in stable patients admitted to the ICU. Whereas Czer and Shoemaker had hypothesized that the optimal haematocrit was 32% [26], Simon et al. [27] had recommended that until [Hb] dropped to 60 g/L, transfusion should be withheld. This observation was at variance with pre-transfusion [Hb] of 90 g/L reported by Hebert et al. [28] which was the first randomised controlled trial (RCT) that demonstrated that most critically ill patients can tolerate [Hb] lower than 100 g/L. Subsequent studies by other authors [4,6,29] even reported lower pre-transfusion [Hb] following the earlier report by Hebert et al. [28]. The pre-transfusion [Hb] of 66.5 g/L recorded in this study indicates the adoption of a more prudent approach to transfusion in critically ill trauma patients. The reasons for the lower transfusion trigger in this study may be attributed to lower mean age of the included patients (33.6. ± 11.2 years) and the fewer associated co-morbidities in the patients in this study. The other reasons may be related to the fact that quality allogenic blood is relatively in short supply in the region [21,30] and the strict adherence to the hospital's transfusion protocol which recommends transfusion only in cases of on-going blood loss, symptomatic anaemia in ICU or those with a [Hb] lower than 70 g/L. This approach may be the better and pragmatic policy in blood management especially in the region where there is relative scarcity of affordable quality allogenic blood.

The age distribution of the patients in this study clearly demonstrated that the young and active population constituted the majority of those admitted into a trauma ICU. This may be because of their higher risk exposure. Whereas the younger adult patients are more likely to be admitted into trauma ICU, older patients admitted into the ICU were more likely to receive blood transfusion both in the dose and frequency of transfusion. Amongst the group that received blood transfusion, the patients older than 45 years had an average transfusion of 3.7 ± 2.0 units per patient as against 2.9 ± 1.9 units per patient for persons younger than 45 years, however, this finding was not statistically significant ($p = 0.15$).

The main indication to transfuse patients in the ICU from this study was low [Hb]. About 25% of the patients in this study received blood transfusion for resuscitation in cases of on-going blood loss with unstable haemodynamic status irrespective of the levels of the [Hb]. This included patient whose pre-transfuse [Hb] were greater than 70 g/L. Whole blood transfusion was given to treat cases of coagulation defects only in less than 5% of the cases while about 70% of the transfusions were given for the treatment of anaemia especially in patients with [Hb] less than 70 g/L. Napolitano et al. [24] had recommended that RBC transfusion should be considered in critically ill patients if [Hb] falls below 70 g/L. He also recommended that the use of only [Hb] as a trigger for transfusion should be avoided; rather the decision to transfuse patients in trauma ICU should be individualized and based on haemodynamic status of the patient, duration and extent of anaemia and cardio-pulmonary physiologic parameters.

The total number of transfusions recorded was 447 units among the 158 patients that received blood transfusion and the mean number of RBC transfusions was 3.5 units per patient. In a similar study, Vincent et al had reported a mean transfusion frequency of 2.2 per patient [24] while Shapiro et al had reported a mean transfusion frequency of 4.8 units per patient [31]. Only 2 patients received transfusion that qualifies massive blood transfusion. The reason for this pattern may be related to relative scarcity of allogenic blood in the locality necessitating a prudent approach. In addition, the lack of optimal pre hospital care may have ensured that patients with very severe injuries that may have required massive blood transfusion never make it to the hospital by the process of natural selection.

The observed mean ISS of 24.1 ± 9.9 and median ISS of 25 as well as the higher SAPII Score amongst the transfused patients in this study as compared to 21.8 ± 8.0 and median ISS of 20 in non-transfused patients would imply that the patients that received blood transfusion were more ill and more severely injured. This observed difference in the mean ISS between the two groups were statistically significant ($p = 0.0006$) confirming higher anatomical injury corroborating the result by Beale et al. [29] which also looked at transfusion practices among trauma patients. As logical as it may appear, some authors had argued that blood transfusion may be a marker for severity of injury in patients admitted to trauma ICU, as such higher risk of poorer outcome. However, the SAPII Score in this study which indicated the physiological status among

the two groups was not statistically different (*P*=0.08). This indicates that the blood transfusion may actually not be a marker for the severity of injury but may be a neglected risk factor on its own for poorer outcome among persons admitted into trauma ICU. This corroborates earlier report by Croce et al. [32] which showed that in a matched group of patients with similar ISS, blood transfusion was independently associated with adverse outcome.

In this study, there was no significant difference in the number of transfusions received between the patients with ISS less or equal to 25 (2.4 units) and the more severely injured patients with ISS more than 25 (3.7 units), p >0.05. Apart from the observed difference in the transfusion frequency between the very severely injured and the patients that had moderate severe injuries, there was a positive significant correlation between the ISS and number of transfusions for the transfused patients (Spearman's correlation coefficients $r = 0.28$; $p < 0.001$). Beale et al. [29] had reported a significant correlation between the volume of transfusion and ISS (Spearman's correlation coefficient = 0.25 $p = 0.011$). The association between number of units received by the transfused patients and SAP II Score was weaker and not statistically significant ($r = 0.056$, $P = 0.61$).

The observed positive correlation between length of hospital stay (LOS) and blood transfusion was similar to the results of other authors [6,29,31]. The positive association may not be unconnected to the severity of the injuries which significantly correlated to the need for blood transfusion (Pearson correlation, $r = 0.466$, $p < 0.001$). The average length of hospital stay (LOS) was statistically significantly higher in transfused patients (21.9 ± 17.5 days) compared to non-transfused patients (8.6 ± 7.2 days) [$p<0.001$]. The average length of stay in the ICU (LOIS) was also statistically significantly higher amongst the transfused patients (4.5 ± 4.0 days) compared to the non-transfused patients (3.5 ± 2.8 days) [$p<0.001$]. The variation in the length of hospital stay from this study corroborates the result by Vincent et al which had observed statistically significant difference in the length of hospital stay and length of ICU stay among the patients that were transfused compared to those that were not [24].

A clear finding from this study is the direct association between blood transfusion and development of adverse consequences and complications among the group of patients that received blood transfusion in the ICU. This association was statistically significant for various complications such as wound infection, development of sepsis and septic syndrome, development of chronic osteomyelitis in the case of associated fractures and complications necessitating readmission into the hospital ($p < 0.001$ in all cases). Similarly, Vincent et al. [4] had reported that the number of transfusion a patient received was independently associated with increased ICU stay, longer hospital stay, higher risk of developing complications and higher risk of death. The risk of death among transfused patients in the ICU although higher in this study, the difference was not statistically significant between the group that were transfused and those that were not. This confirms that whereas blood transfusion may be a risk factor in the development of complications among transfused patients, it may not play a significant role in the cause of death among patients admitted in the ICU as compared to the severity of injury and quality of care the patient received.

5. LIMITATIONS OF THE STUDY

Since this is an observational study without randomisation or blinding in any form, its findings cannot be used to draw strong conclusions on the relationship between blood transfusion and outcome. It is recommended that better designed study preferably a randomised controlled and blinded study be undertaken to establish the actual cause and effect relationship between blood transfusion and development of adverse consequences in patients admitted into trauma ICU.

6. CONCLUSION

Anaemia is a common finding among critically ill patients admitted to a trauma ICU in Nigeria. This anaemia often develops while the patient is in the ICU and progressively increases during the course of ICU admission. Up to 30% of such patients admitted into the ICU with severe injury require RBC transfusion. The need for RBC transfusion is higher in elderly patients, and patients with more severe injuries as evidenced by higher ISS and SAP II Score.

Blood transfusion was associated with poorer outcome as evidenced by longer ICU stay, longer

in-hospital stay, higher risk of developing complications and higher mortality. Whereas the association between transfusion and longer ICU and hospital stay, and risk of developing complication was statistically significant, the association between blood transfusion and mortality among trauma patients admitted into the ICU was not statistically significant.

Since blood transfusion has been shown to be associated with adverse consequences, not readily available to most patients and increases cost of care in Nigeria, a pragmatic approach to blood management may be the adoption of a more restrictive blood transfusion approach until better designed and robust studies in the region provide superior evidence.

CONSENT

It is not applicable.

ETHICAL APPROVAL

Study was approved by the Management and the Ethical Review Committee of the Teme Hospital Nigeria. Since this study was designed as an observational survey without direct intervention or interaction with the patients, waiver for informed consent from the patients was obtained. However, patients' identity remained confidential throughout the study.

AVAILABILITY OF DATA AND MATERIAL

The data that support the findings of this study are available from the authority of the hospital but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of the authority.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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