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Pattern, Complications and Social Problems of Blood Transfusion in the Neonatal Unit of a Tertiary Hospital in Southern Nigeria

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Authors' contributions

This work was carried out in collaboration between both authors. Author BAW conceived & designed the study, did some aspects of literature search/review, collation of data, wrote some aspects of the manuscripts. Author WW did some aspects of literature search/review, wrote some aspects of the manuscripts. Both authors read and approved the final manuscript.

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ABSTRACT

Introduction: Blood transfusion is a life-saving procedure best carried out as soon as it is recommended to avoid morbidity and mortality.
Aim: To determine the Pattern, complications and social problems of blood transfusion in a neonatal unit in Southern Nigeria.
Methodology: A prospective descriptive study of 179 neonates admitted in the neonatal unit of the Rivers State University Teaching Hospital over a period of 3years.

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Results: Out of 179 neonates for which blood transfusion was recommended, 172(96.1%) received blood transfusion whereas 7(3.9%) did not. Majority of the children transfused were preterm 144(80.4%), delivered via Caesarean section 108(60.3%) and weighed < 2.5kg 144(80.4%). Most were admitted in their first week of life 143(79.9%) with morbidity pattern for most babies transfused being prematurity, neonatal sepsis and neonatal jaundice. Most transfusions occurred after the first week of admission with first degree relatives 76(45.2%) and commercial donors being the most source of blood transfused. Non-availability of donors and compatibility issues were the commonest reasons for use of commercially donated blood. Most received single blood transfusion 72(71.2%), sedimented cells 160(89.3%) and within 24hours following its recommendation. The reasons for transfusion beyond 24hours were financial constraints 31(57.4%) and no donor 26(48.1%). Commonest reasons for not consenting to blood transfusion were social; financial constraint 4(57.1%) and religious reasons 2(28.6%). Only 1(0.6%) neonate had obvious blood transfusion reaction while 22(13.2%) had post transfusion malaria.

Conclusion: Not all neonates who required blood transfusion received it. The commonest morbidity pattern among recipients were prematurity, neonatal sepsis and neonatal jaundice. Financial constraint was the commonest reason for both delayed blood transfusion and for not consenting to blood transfusion thus policies must be made to ensure ready availability and accessibility of blood in hospitals including the National Health Insurance Scheme in order to reduce neonatal morbidity and mortality.

Keywords: Blood transfusion; complications; neonate; pattern; social problems.

1. INTRODUCTION

Blood transfusion is a common life-saving procedure used to replace lost or inadequate blood and blood components. The neonatal period encompasses the first four weeks after birth or first 28 days of life and comprises of preterm (delivery at less than 37 completed weeks of gestation), full term (delivery at 37-42 completed weeks of gestation) and post-term (delivery after 42 completed weeks of gestation). Neonates have huge need for blood transfusion(s) due to their small blood volume and immature bone marrow activity [1]. Their immature immunologic system also predisposes them to common illnesses that could lead to blood losses and haemolysis. Preterm babies are particularly at risk of being transfused [2-4] because of their lower haemoglobin level at birth, lower levels of erythropoietin as well as reduced bone marrow activity [5]. It has been estimated that > 90% of extreme low birth weight (ELBW) babies and about 60% of very low birth weight (VLBW) babies will receive at least 1 red blood cell (RBC) transfusion during their stay in the neonatal unit [6].

Blood transfusion may involve different blood components or products such as red blood cell concentrate or packed cells, platelet concentrates, fresh frozen plasma (FFP) and cryoprecipitates. Of these components, red blood cell (RBC) concentrate is most commonly transfused [7,8,9,10]. It is worthy of note that the type of blood component transfused depends on the disease condition.

Blood transfusion rates reported within Nigeria vary from one facility to another ranging from 11.7% in Sagamu [11] to 55.6% in Delta State [12]. In addition, indications of blood transfusion vary from one neonatal unit to another. Studies showed that the most common indications of blood transfusion in neonates are anaemia especially anaemia of prematurity, [12-14] neonatal jaundice [11,15] and neonatal sepsis [13]. These represent the leading causes of neonatal morbidity and mortality thus prevention would lead to drastic reduction in blood transfusion among this age group [16,17].

Anaemia simply defined as reduced haematocrit (Hct) or haemoglobin (Hb), one of the commonest indications of blood transfusion may result from blood loss (from frequent blood sampling or during surgery), increased red blood cell (RBC) destruction or decreased RBC production. It is noteworthy that feto-maternal transfer of iron from the placenta occurs mainly towards term hence predisposing preterm babies to anaemia. Anaemia reduces oxygen delivery to tissues, resulting in both compensatory responses as well as acute or chronic consequences which could lead to poor growth, decreased activity and limited cardiovascular reserve which blood transfusion aims to correct [18].

Although blood transfusion is a safe procedure, there could be complications. There is however very minimal risk of complications because blood grouping and cross-match to ensure compatibility as well as blood screening against common transfusion-transmitted infections are routinely carried out before this procedure is undertaken. It is pertinent to note that donors who fail the screening test are not allowed to donate their blood and such blood are not used if already donated. Complications of blood transfusion include both infectious (transfusion-transmitted infections) such as hepatitis B & C, HIV/AIDS, syphilis, West Nile virus, malaria etc and non-infectious serious hazards of transfusion (NISHOTs) [4]. Transfusion reaction also includes febrile non-haemolytic transfusion reaction (FNHTR), allergic/urticarial/anaphylactic reaction, acute non immune transfusion reactions and fluid overload with heart failure (Transfusion associated circulation overload or TACO) [6,19]. Other complications of blood transfusion observed in the neonatal unit includes necrotizing enterocolitis (NEC), bronchopulmonary dysplasia (BPD), retinopathy of prematurity (ROP) and long-term neurodevelopmental problems [20].

Blood is best transfused as soon as it is recommended in order to reduce morbidity and mortality. This is however, not always the case as blood may not be readily available, parents may refuse to consent to blood transfusion on grounds of religion, fear of the procedure, fear of side effects or parents may be financially incapacitated to pay for the screening and/or blood especially in the absence of health insurance. Blood transfusion in developing countries may also be ineffective due to unavailability/inefficient blood bank system in addition to unavailability of the correct blood products required by the child [21].

There is paucity of data on the pattern, complications and social problems of blood transfusion in Rivers State hence the need for this study. The findings from this study will be useful in decision making on strategies necessary in reducing the need for blood transfusion, prompt availability of blood and specific blood products for transfusion when needed and ensuring safety of blood transfusion.

2. MATERIALS AND METHODS

This was a prospective descriptive study conducted over 4 years in the neonatal unit of the Rivers State University Teaching Hospital (RSUTH) from 27th January, 2020 to 26th January, 2024. The neonatal unit of the RSUTH, one of the units in the Department of Paediatrics admits neonates (0 – 28days old) delivered within and outside the hospital. This unit which runs 24 hours is overseen by 3 consultants, resident doctors, house officers, nurses and other support staff. Sick neonates are admitted into this unit via the labour ward, labour ward theatre, postnatal ward, children emergency room and the Paediatric outpatient clinic. Other clinical departments of the hospital include Obstetrics & Gynaecology, Internal medicine, Surgery, Family medicine, Pathology, Anaesthesiology etc. The RSUTH, a state-owned teaching hospital is a 375-bed hospital and a referral centre from all the Primary Health Centres in the 23 Local Government Areas, general hospitals as well as private health facilities in and around the state.

A minimum sample size was obtained using the formula:

[22] $n=z^2(pq)/e^2$

where

n=minimum sample size
z= 1.96 at 95% confidence limit thus $z^2=3.841$
p=prevalence of blood transfusion, 11% was the prevalence of blood transfusion documented in a study in Makurdi, [23] Nigeria thus p=0.11
q=1-p (0.89)
Minimum sample size, n=150
Attrition = 19% of minimum sample size = 28.5 ~ 29
Thus, minimum sample size + Attrition = 179

Inclusion criteria were all babies 0-28 days old admitted in the neonatal unit in whom blood transfusion was prescribed and consent given by parents/caregivers to participate in the study whereas babies whom blood transfusion was not prescribed or whose parents/caregivers did not give consent to be recruited for the study were excluded.

A total of 179 neonates admitted into the neonatal unit who required blood transfusion and whose parents consented to the study were consecutively recruited into the study.

Before the study was carried out, 2 research assistants were recruited and the study properly explained to them.

A pretested proforma was used to obtain the sociodemographic data of the neonates & the parents/caregivers, the maternal obstetric history, medical diagnosis of the neonate, indications of blood transfusion, blood type, ease & challenges of procuring blood and the frequency of blood transfusion. The neonates were monitored for development of blood transfusion reactions which were managed according to the units' standard operating practice in the event they occurred.

Data was entered into an Excel sheet and analysis done using the Statistical Package for Social Sciences (SPSS) version 23. Results were presented in simple frequencies, percentages, pie and bar charts. Test of association was done using Chi square test and Fishers' Exact test. Statistical significance was set at *P* value < .05 at 95% confidence interval.

3. RESULTS

3.1 Neonatal Socio-demographic Characteristics

Blood transfusion was recommended for 179 neonates during the period of study of which 172 (96.1%) were transfused. Majority 143(79.9%) presented within the 1st day of life, were males 97(54.2%) with M:F ratio of 1.2:1. Most were delivered at less than 37weeks gestation 144(80.4%) with mean gestational age of 32.6 ± 4.1weeks, via Caesarean section 108(60.3%) and in RSUTH 133(76.4%). Birth weights of most neonates were less than 2.5kg 144(80.4%) with median birth weight of 1.5(0.9) kg, Table 1.

3.2 Family Socio-demographic Characteristics

Majority of the mothers of neonates transfused were of age group 30-39 years 104(58.1%), had tertiary level of education 89(49.7%) and were mainly involved in business/trading 73(40.8%). Most fathers had tertiary level of education 104(58.1%) and were involved in business/trading 65(36.2%), Table 2.

3.3 ABO Blood Group of Neonate and Blood Transfused

Most neonates had blood group O, 113(63.2%) while blood group AB 5(2.8%) was the least. Most neonates were transfused with blood group O blood 155(86.6%) while no neonate was transfused with blood group AB 0(0.0%), Fig. 1.

Table 1. Neonatal socio-demographic characteristics

Variables	Frequency, n=179 (%)
Age at presentation	
0-24hours	143 (79.9)
>1-7days	23 (12.8)
>7days	13 (7.3)
Sex	
Male	97 (54.2)
Female	82 (45.8)
Gestational age (weeks)	
<37	144 (80.4)
37-42	35 (19.6)
Mode of delivery	
SVD	69 (38.6)
CS	108 (60.3)
Instrumental	2 (1.1)
Place of delivery	
RSUTH	133 (76.4)
PHC/General hospitals	18 (10.3)
Private hospital	14 (8.0)
TBA	9 (5.3)
Birth weight (kg)	
<2.5	144 (80.4)
2.5-3.9	27 (15.1)
≥4	8 (4.5)

SVD=Spontaneous vaginal delivery, CS=Caeserean section, RSUTH=Rivers State University Teaching Hospital PHC=Primary Health Care, TBA=Traditional birth attendant

Table 2. Family socio-demographic characteristics

Variables	Frequency, n=179 (%)
Mother's age group	
20-29	63 (35.2)
30-39	104 (58.1)
≥40	12 (6.7)
Mother's level of education	
Primary	8 (4.5)
Secondary	82 (45.8)
Tertiary	89 (49.7)
Mother's occupation	
Business/Trader	73 (40.8)
Civil servant/Public servant	28 (15.6)
Professionals	9 (5.1)
Artisans	28 (15.6)
Student/unemployed/housewife	41 (22.9)
Father's level of education	
Primary	7 (3.9)
Secondary	68 (38.0)
Tertiary	104 (58.1)
Father's occupation	
Business/Traders	65 (36.2)
Civil servant/Public servant	52 (29.1)
Professionals	15 (8.4)
Artisan	39 (21.8)
Student/unemployed/retired	8 (4.5)
Presence of pregnancy complications	
Yes	119 (66.5)
No	60 (33.5)

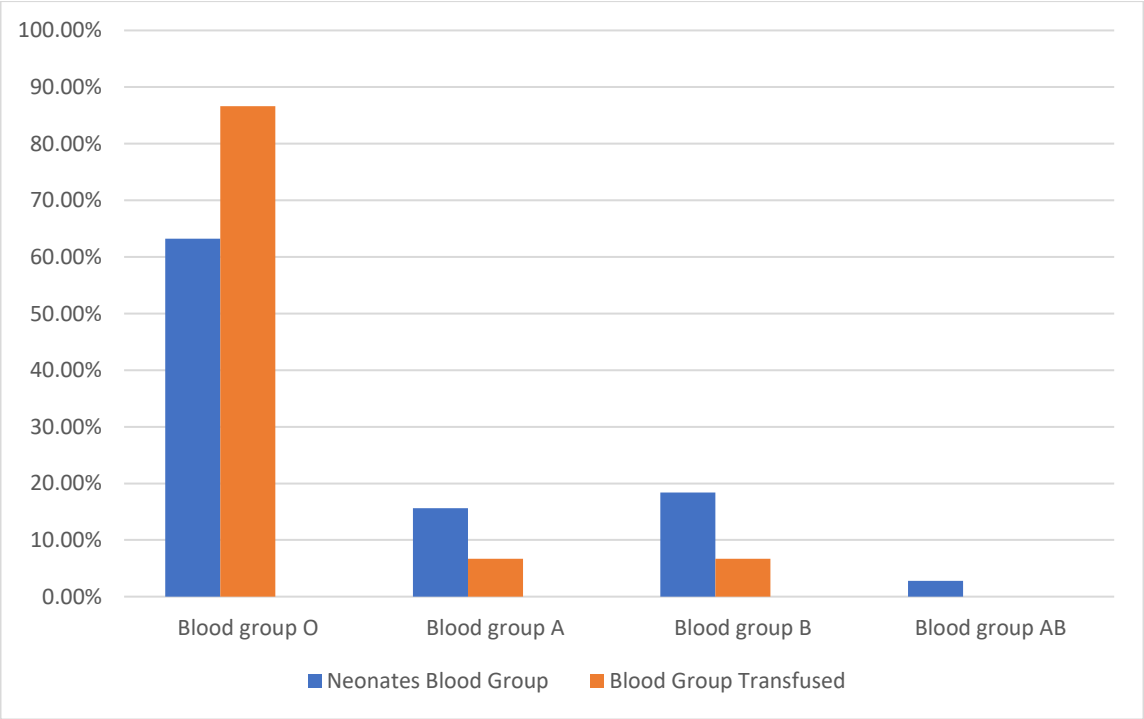

Fig. 1. ABO Blood group of neonates and blood type transfused

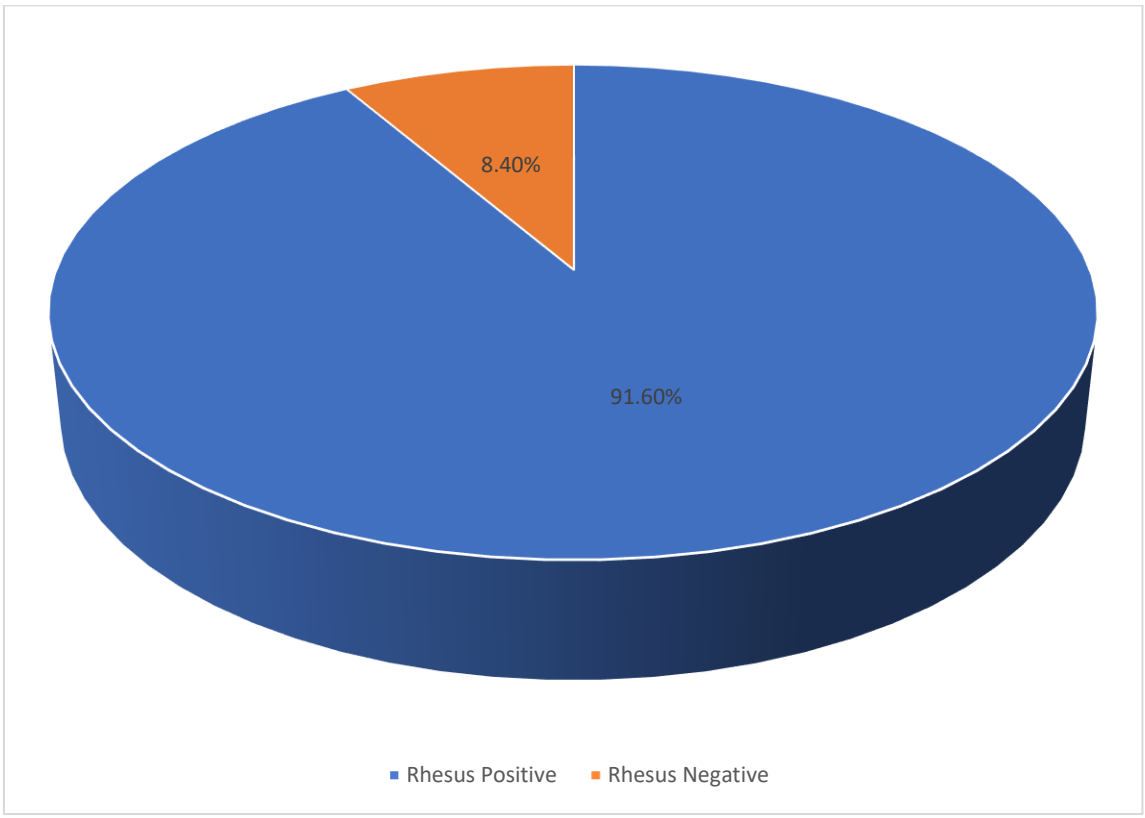

Fig. 2. Rhesus blood group of neonates

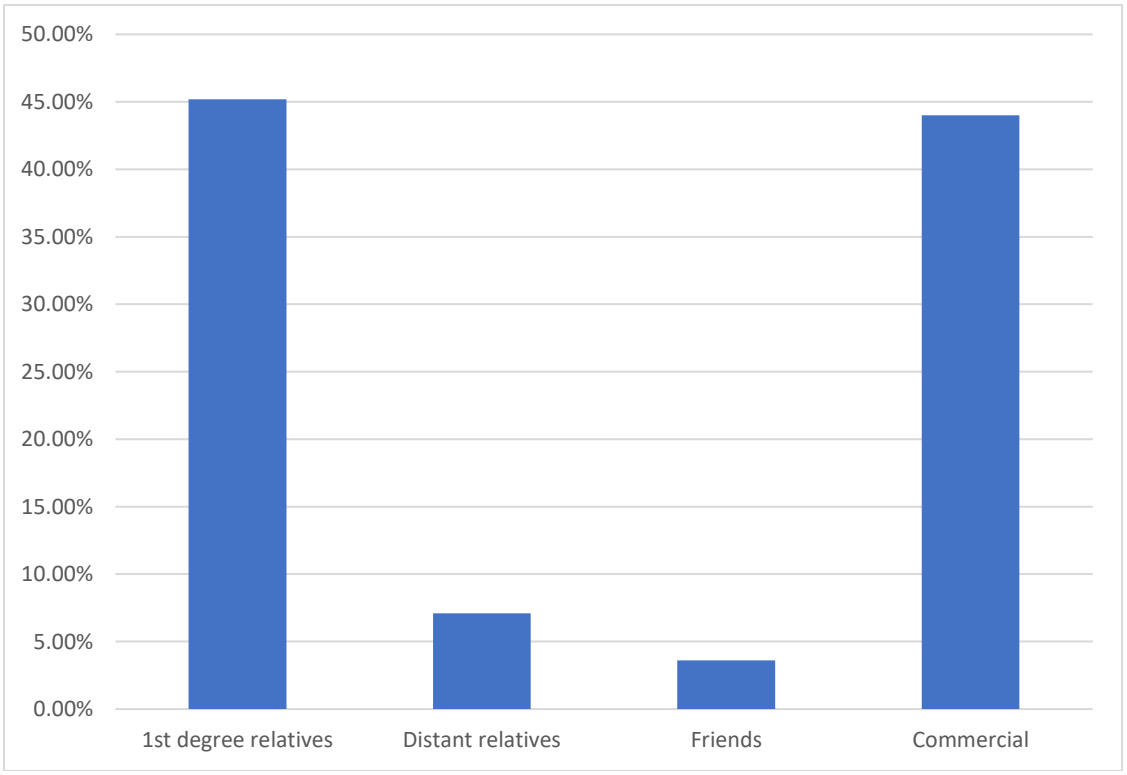

Fig. 3. Blood donor

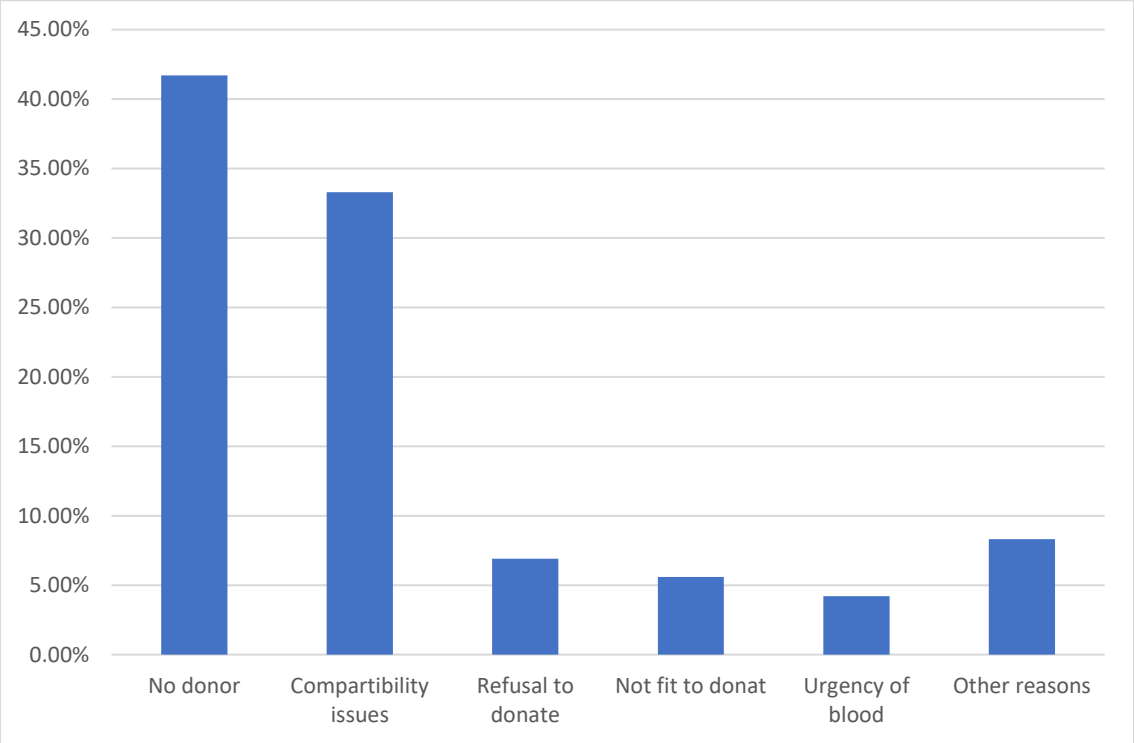

Fig. 4. Reasons for use of commercial blood donors

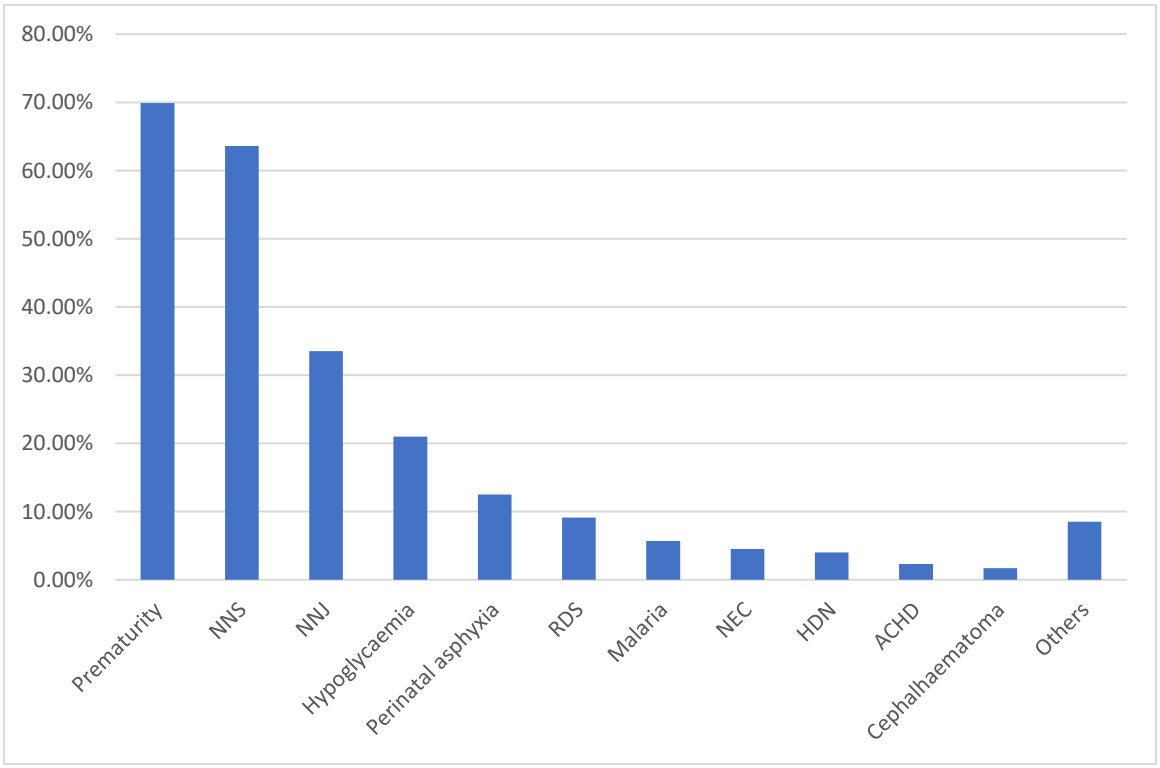

Fig. 5. Morbidity pattern of newborns transfused

NNS=Neonatal sepsis, NNJ=Neonatal jaundice, RDS=Respiratory distress syndrome, NEC=Necrotizing enterocolitis,
ACHD=Acyanotic congenital heart disease

3.4 Rhesus Blood Group of Neonates

Majority of neonates had Rhesus positive blood group 164 (91.6%), Fig. 2.

3.5 Blood Donors

Majority of the blood donated were from 1st degree relatives (father, mother, brother, sister) 76(45.2%) followed by blood from commercial donors from the blood bank 74(44.0%), Fig. 3.

3.6 Reasons for use of Commercial Blood Donors

The commonest reason for the use of blood from commercial blood donors was no available donor 30(41.7%) followed by compatibility issues 24(33.3%), Fig. 4.

3.7 Pattern, Social Problems and Complication(s) of Blood Transfusions

Of 172 neonates transfused, 160(89.3%) received sedimented blood (in place of packed cells) and had one blood transfusion 72(41.9%). Most neonates were transfused between 1-6hours 61(34.5%) and 7-24hours 61(34.5%) of blood transfusion recommendation while 7 (4.0%) neonates were not transfused. The commonest reasons for delayed blood transfusion beyond 24hours after recommendation were no money 31(57.4%), no donor 26(48.1%) and no intravenous access 11(20.4%). Commonest reason for not consenting to blood transfusion was no money 4(57.1%). Only 1(0.6%) neonate had blood transfusion reaction which was high fever and 22(13.2%) had post transfusion malaria, Table 3.

3.8 Morbidity Pattern of Newborns Transfused

The commonest morbidity observed in newborns transfused was prematurity followed by neonatal sepsis and neonatal jaundice, Fig. 5.

3.9 Association between the Age at Blood Transfusions and Morbidity Pattern of Newborns Transfused

Prematurity, cephalhaematoma and Haemorrhagic disease of the newborn were significantly associated with the age at blood transfusion (*P* value <0.001, 0.008, 0.004 respectively), Table 4.

Table 3. Pattern, social problems and complications of blood transfusion

Variables	Frequency, n=179 (%)
Type of blood transfused, n=172	
Sedimented blood.	160 (93.0)
Whole blood	12 (7.0)
Number of transfusions, n=172	
One	72 (41.9)
Two	36 (20.9)
Three	26 (15.1)
≥Four	38 (22.1)
Age of patient at transfusion (days), n=172	
0-7	36 (20.9)
>7	143 (83.1)
Time between blood transfusion prescription and transfusion (hours)	
< 1	4 (2.3)
1-6	61 (34.5)
7-24	61 (34.5)
25-48	21 (11.7)
>48	25 (14.0)
Never transfused	7 (4.0)
Reasons for delayed blood transfusion beyond 24 hours	
No money	31 (57.4)
No donor	26 (48.1)
No intravenous access	11 (20.4)
Blood type not available	4 (7.4)

Variables	Frequency, n=179 (%)
Delay in giving consent	2 (3.7)
Others	4 (7.5)
Reasons for not consenting to blood transfusion, n=7	
No money	4 (57.1)
Religion forbids it	2 (28.6)
Died on arrival of blood	1 (14.3)
Presence of blood transfusion reaction, n=172	
Yes	1 (0.6)
No	171 (99.4)
Presence of post transfusion malaria, n=167	
Yes	22 (13.2)
No	145 (86.8)

Table 4. Association between the age at blood transfusions and morbidity pattern of newborns transfused

Variables	Age at transfusion (days)		Test of significance
	0-7, n (%)	>7 days, n(%)	*P* value
Prematurity	14 (39.9)	109 (76.2)	**<0.001*** OR(95%CI):1.4(1.17-1.82)
Cephalhaematoma	3 (8.3)	0	**0.008*** OR(95% CI):1.3(1.16-1.44)
Malaria	2 (5.6)	8 (5.6)	1.000
NNJ	15 (41.7)	44 (30.8)	0.237
NNS	21 (58.3)	91 (63.6)	0.568
HDN	5 (13.9)	2(1.4)	**0.004*** OR(95%CI):3.9(2.25-6.98)
Perinatal asphyxia	6 (16.7)	16 (11.2)	0.397
ACHD	1 (2.8)	3 (2.1).	1.000
RDS	1 (2.8)	15 (10.5)	0.200
NEC	2 (5.6)	6 (4.2)	0.663

NNJ=Neonatal jaundice, NNS-Neonatal sepsis, HDN=Haemorrhagic disease of the newborn, ACHD=Acyanotic congenital heart disease,
RDS=Respiratory distress syndrome, NEC=Necrotizing enterocolitis

Table 5. Association between time taken for blood availability and morbidity pattern of transfused newborns

Variables	Time taken for blood availability (hours)			Test of significance
	0-24, n (%)	24-48, n (%)	>48, n (%)	*P* value
Prematurity	85 (67.5)	18 (85.7)	18 (60.0)	0.139
Cephalhaematoma	3(2.4)	0	0	1.000
Hypoglycaemia	24 (19.0)	7 (33.0)	5 (16.7)	0.290
Malaria	6 (4.8)	1 (4.8)	3 (10.0)	0.442
NNJ	43 (34.1)	10 (47.6)	5 (16.7)	0.056
NNS	82 (65.1)	11 (52.4)	17 (56.7)	0.427
HDN	6 (4.8)	0	1 (3.3)	0.839
Perinatal asphyxia	16 (12.7)	0	6 (20.0)	0.082
ACHD	4 (3.2)	0	0	1.000
RDS	11 (8.7)	2 (9.5)	2 (6.7)	1.000
NEC	4 (3.2)	2 (9.5)	2 (6.7)	0.184

NNJ=Neonatal jaundice, NNS=Neonatal sepsis, HDN=Haemorrhagic disease of the newborn, ACHD=Acyanotic congenital heart disease
RDS=Respiratory distress syndrome, NEC=Necrotizing enterocolitis

3.10 Association between Time Taken for Blood Availability and Morbidity pattern of transfused Newborns

None of the disease conditions were significantly associated with the time taken for availability of the blood for transfusion (*P* value >0.05), Table 5.

4. DISCUSSION

Blood transfusion in the Special Care Baby Unit of the Rivers State University Teaching Hospital was observed more among the male neonates which was also the case in other studies in Nigeria [11,13,23,24] and Bagdad, Iraq [25]. This could be explained by the fact that male neonates are more predisposed to infections than females as well as have more severe illnesses and poorer prognosis [26]. Ogunlesi and Ogunfowora [11] in their 12-month retrospective study in Sagamu, south west Nigeria showed that a significantly higher proportion of male babies had blood transfusion. In contrast to the above findings, Ayede and Akingbola [13] in Ibadan, south west Nigeria in their cross-sectional study carried out over a decade earlier reported an equal male:female ratio whereas Aboladje et al, [12] in Delta state, Nigeria documented a female predominance. This 6-months retrospective study unlike the present study which was prospective over a 4 years period could have accounted for this difference.

Most neonates transfused in the present study were delivered via Caesarean section. This was not consistent with the retrospective study carried out in Makurdi, [23] north central Nigeria where neonates delivered vaginally were mostly transfused. The finding of the present study was not unexpected as about 2/3rd of the mothers of the neonates had pregnancy complications that may have warranted surgical interventions (Caesarean section). It is noteworthy that the operational deliveries are also associated with more blood losses when compared with vaginal deliveries.

More than 2/3rd (80.4%) babies with low birth weights < 2.5kg received blood transfusion in the present study as similarly reported by Joel-Medewase et al. [24] and Hameed et al. [25]. This validates findings by Ogunlesi and Ogunfowora [11] which showed that a significantly higher proportion of preterm babies had blood transfusion. It is important to state that the need for blood transfusion is inversely proportional to the size (birth weight) and gestational age of the neonates because of their smaller circulating blood volume [27]. The finding of the present study however contrast the finding by Ochoga et al. [23] in which babies with normal weights were mostly transfused. The reason for this difference could not be ascertained. There is therefore need to promote policies and programs that will reduce prematurity and the deliveries of low birth weights babies.

Majority of the neonates transfused had blood group O. This was also the case in other parts of Nigeria [12-14,23,28]. This is not surprising as blood group O is the commonest blood group type and thus the correct representation of the larger society. Other studies [12,13,23] also corroborated blood group AB as the least blood group observed in neonates in the present study. Rhesus D positivity was predominant in the present study accounting for 91.6% of the Rhesus blood group type in keeping with the general population pattern. In Ibadan, [13] south west Nigeria, Rhesus positivity accounted for up to 96% while in Calabar, [28] 96.4%. Similarly, majority of blood donated were of blood group O whereas no blood group type AB was donated as also documented by Ayede and Akingbola [13].

Most of the blood transfused in the present study were sedimented cells (in place of packed cells due to its' unavailability) as also observed in Makurdi, [23] north central Nigeria. In contrast, fresh frozen plasma (FFP) was the predominant blood cell component transfused in Tehran, [29] Iran whereas packed cells were the commonest in Egypt [30]. This difference could be attributable to the fact that other blood cell types like FFP, cryoprecipitate, platelet concentrates and packed cells were not used for transfusion despite their indications in the present study because of their unavailability. This is unacceptable in this present age therefore Government must rise up to the task of providing facilities to make available these blood components which are of essence in the care of new born babies which would improve neonatal morbidity and mortality.

Most neonates in the present study had a single blood transfusion as also observed by Ochoga et al. [23] and Aboladje et al. [12] in Makurdi, north central and Delta State in south south Nigeria respectively. Single transfusion is preferred when compared to multiple transfusions as babies are exposed to less complications as well as reduced cost and duration of hospital stay. It is noteworthy

that multiple transfusion especially in preterm babies could depress endogenous erythropoietin production which further suppresses the bone marrow [31].

Complications of blood transfusion was minimal (0.6%) in the present study with only one child having a febrile illness during the procedure. There was no rash, rigors, jaundice or oliguria resulting from blood transfusion. Ayede and Akingbola [13] in their cross-sectional study in Ibadan, south west Nigeria documented that 5% of neonates transfused had fever during transfusion with absence of other symptoms and signs suggesting a reaction. Diab et al. [30] in Egypt however, recorded a much higher blood transfusion complication of 31.4% with the commonest being sepsis (11.8%), hyperkalaemia, (5.9%) and hypocalcaemia, fever, thrombocytopaenia, hypersensitivity reactions (3.9% each). In contrast, Aboladje et al. [12] in their study in Delta State, south south Nigeria did not record any blood transfusion reaction. Febrile non-haemolytic transfusion reaction (FNHTR) is characterized with a rise in body temperature < 2^{o}C in the absence of haemolysis. It is mediated by inflammatory cytokines released from white blood cells either during blood storage or by preformed recipient antibodies reacting with the white blood cells in the infused blood component. Allergic reactions are rare in the newborns however. Blood transfusion thus has potential risk and adverse effects and so must be administered only when indicated and neonate should be closely monitored during and after transfusion. Complications can also be minimized by carrying out grouping and cross-match of both maternal and baby blood samples. This is because neonates do not produce red blood cell antibodies hence presence of antibodies would be of maternal origin [32]. In addition, the immaturity of the immune system of neonates could also account for the low rate of blood transfusion reaction experienced [13].

Prematurity, neonatal sepsis and neonatal jaundice were the commonest morbidity pattern among transfused neonates in the present study. Similar reports were also documented in Ogbomoso, [24] south west and Delta state, [12] south south Nigeria. In the study in Sagamu [11] south west Nigeria, a significantly higher proportion of babies with prematurity and neonatal jaundice had blood transfusion, however neonatal sepsis was not significantly associated with blood transfusion. These findings were not surprising as preterm neonates have much lower blood levels due to inadequate maternofetal transfer of iron and reduced production of endogenous erythropoietin. Additionally, preterm babies usually have an exaggerated physiologic anaemia with nadir about the 4^{th} – 8^{th} week of life [33]. Neonatal sepsis could lead to haemolysis of the red blood cells thus leading to anaemia. Neonatal jaundice also could arise as a result of haemolysis from ABO blood group or Rhesus blood group incompatibility among other causes. Blood transfusion is therefore necessary as a life-saving procedure as it increases cardiac output and delivery of oxygen to tissues [34]. It also removes toxins like unconjugated bilirubin from the body thereby averting irreversible brain damage [34]. Early diagnosis and prompt treatment as well as prevention of these morbidities will thus lead to marked reduction of blood transfusion.

In the present study, more than 10% (11.7%) of the babies were transfused after 24 hours of prescription. This would be considered late as blood transfusion is a life-saving procedure and therefore requires urgent attention and action. The commonest reason for this delay in the present study was financial constraints and unavailability of a blood donor. Thus, the importance of the full implementation of the National Health Insurance scheme (NHIS) in Nigeria and encouragement of the populace to freely donate their blood to the blood bank cannot be over emphasized (non-renumerated blood donation). Presently, majority of patients in Nigeria pay their hospital bills out of pocket leading to unnecessary delays in the commencement of treatment and even deaths. In the present study, the commonest sources of blood for transfusion were 1^{st} degree relatives and commercial donors. The choice of commercial donors was due to unavailability of non-renumerated donors and compatibility problems. It is worthy of note in the present study that close to 4% of neonates were not transfused as parents did not consent to the procedure. Reasons majorly were financial constraints and religious basis. Mass enlightenment campaigns on the importance of blood transfusion as a life-saving procedure will thus create awareness thereby increase acceptance of blood transfusion in the society. Poverty alleviation by the government must be carried out to reduce neonatal morbidity and mortality resulting from failure of blood transfusion.

The present study showed that neonates with haemorrhagic disease of the new born were almost four times more likely to receive blood transfusion within the first week of life as well as those with cephalhaematoma. This is not surprising as these conditions usually present within the first week of life and bleeding disorders in neonates usually require urgent blood transfusion as they could lead to circulatory collapse or severe hypoxaemia which could lead to death [35]. Cephalhaematoma could lead not only to severe anaemia but also severe neonatal jaundice requiring exchange blood transfusion.

Interestingly, premature neonates were significantly more likely to be transfused after the first week of life. This is not unexpected as premature babies are at risk of anaemia of prematurity. This physiologic phenomenon is experienced usually between 4-12 weeks of age as a result of inadequate materno-fetal iron transfer as well as poor production of endogenous erythropoietin in the postnatal period [36,37]. It is pertinent to note that in developed countries, recombinant human erythropoietin is commonly used thus preventing repeated blood transfusion [38]. This is however not the case in developing countries including Nigeria where the use of erythropoietin is rare as it is not readily available and in centres where it is available, it is expensive thus out of reach of the poor [13].

5. CONCLUSION

Male neonates, low birth weight babies and those delivered via Caesarean section were mostly transfused with prematurity, neonatal sepsis and neonatal jaundice being the commonest morbidity pattern. Slightly more than 10% (11.7%) babies had their blood transfusion delayed beyond 24hours, reasons being financial constraint and no donor. There was minimal blood transfusion reaction being 0.6%.

Blood transfusion although a life-saving procedure, is not without risk thus good clinical practice must be undertaken to ensure blood transfusion safety and child must be monitored closely during and after the procedure. The NHIS must be made compulsory in Nigeria and voluntary blood donation must be encouraged to avert delays.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

We hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

ETHICAL APPROVAL AND CONSENT

The study was duly explained to the parents/caregivers and thereafter written consent was obtained before each baby was recruited. Ethical clearance was obtained from the Research Ethics committee of the hospital.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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