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Evaluation of the Transfusion Protocol in the Neonatology Department of the Yopougon University Hospital

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Abstract

Introduction: Transfusion of packed red blood cells (PRBCs) is a common practice in neonatology, particularly in premature newborns. This study's objective was to assess the application and adequacy of departmental guidelines regarding RBC transfusion in newborns. **Methods:** This was a retrospective, cross-sectional, descriptive and analytical study of hospitalized newborns transfused between January 1, 2023, and December 31, 2024, in the neonatology department of the Yopougon University Hospital, relocated to Béago. The transfusion indication in effect in the department was pallor and anemia in premature infants, with a threshold of 10 g/dL. **Results:** We collected data on 239 patients who received transfusions out of a total of 5880 hospitalized newborns, representing a hospital frequency of 4.06%. In 63.1% of cases, patients were admitted before one week of age. Fifty-four percent of patients had low birth weight at admission. Respiratory distress and pallor on clinical examination were the most common signs, found in 57.7% and 33.89% of cases, respectively. Among them, 61.9% received at least two transfusions, with an average hemoglobin level of 10.13 g/dL before transfusion and 14.7 g/dL afterward. Among premature infants (27.7%), transfusions were also given between 11 - 13 g/dl in the presence of signs of decompensation. The average hemoglobin level after transfusion was 14 g/dl. The mortality rate was 30.5%; factors associated with death were low birth weight and low gestational age. **Conclusion:** Double transfusion significantly improved patients' hemodynamic and respiratory status. We recommend that all newborns under 32 weeks of gestation weighing less than 2500 g with a hemoglobin level below 10 g/dL receive two blood transfusions, if necessary, with a target hemoglobin level of 13 g/dL.

Keywords

Neonatology, Newborn, Blood Transfusion, Prematurity, Red Blood Cells

1. Introduction

Blood transfusions save lives and improve health, but many patients who need transfusions do not have access to them in time. Worldwide, the World Health Organization (WHO) emphasizes strengthening national transfusion systems, particularly in developing countries, to ensure equitable and safe access [1]. In France, blood transfusion is an essential practice in the care of newborns, particularly premature babies and those with serious medical conditions. It is governed by strict protocols and optimal national recommendations [2]. In Côte d'Ivoire, blood transfusions are common in newborns with anemia, particularly in premature babies, with a prevalence of 56% in premature babies at the Yopougon University Hospital [3] [4] and 53% in full-term newborns [5], and 17.8% in premature babies at the Cocody University Hospital [6]. At Bouaké University Hospital [7], the prevalence was 10.2% among low birth weight infants. Blood transfusion is the treatment of choice for severe anemia in the neonatal period, thus justifying the implementation of a management protocol.

At Yopougon University Hospital, the blood transfusion protocol for premature newborns in the neonatal unit is to transfuse twice at least 12 hours apart any premature baby born before 32 weeks of gestation with a hemoglobin level below 10 g or signs of cardiorespiratory decompensation within the first 15 days of life [4].

In full-term newborns, blood transfusions were performed in cases of anemia with signs of decompensation or when hemoglobin levels were below 10 g/dL. The target hemoglobin level was 13 g/dL [5]. A rigorous evaluation of the neonatal transfusion protocol at Yopougon University Hospital, particularly the adequacy of hemoglobin thresholds in line with WHO/international recommendations, was necessary. The aim of the study was to contribute to the improvement of professional practices in blood transfusion in hospitalized newborns. The overall objective of the study was to evaluate the blood transfusion guidelines for premature and full-term newborns at the Yopougon University Hospital.

2. Method

The study was conducted in the neonatal unit of the Yopougon University Hospital, which was relocated to Béago. We conducted a retrospective cross-sectional study with descriptive and analytical objectives concerning hospitalized newborns who received transfusions in the neonatal unit relocated to Béago. The study was conducted over a 24-month period from January 2023 to December 2024. The study population consisted of the records of newborns hospitalized and transfused

during the study period. All records of hospitalized newborns who received a red blood cell transfusion either initially or during hospitalization during our study period were included. We used an exhaustive sampling method. All hospitalized newborns with a documented red blood cell transfusion and a complete medical record including a pre-transfusion blood count (Hb ≤ 10 g/dl) with or without signs of decompensation and a follow-up blood count were included. All newborns who received a non-erythrocyte transfusion or who did not have a blood count before or after transfusion were excluded from the study. The variables studied were demographic and clinical characteristics: initial hemoglobin level; number of transfusions; and volume of blood transfused. Data were collected from the medical records of newborns available in computerized and physical archives during the specified period. A standardized anonymous data collection form with a unique identifier was used to collect the information.

2.1. Statistical Methods

The data were entered into Microsoft Excel version 2016, then exported and analyzed using SPSS 20 software. The multivariate analysis was set at 5%. To evaluate transfusion efficacy, we performed a logistic regression to compare the post-transfusion hemoglobin threshold of transfused newborns who reached the threshold proposed by the protocol with those who did not reach the threshold proposed by the protocol. A p-value of $p < 0.05$ was used as the threshold for statistical significance in the logistic regression analysis.

2.2. Ethical Considerations

We ensured strict anonymity for newborns. The information collected from the files was confidential.

3. Results

3.1. Epidemiological Characteristics

During the study period, 239 patients received transfusions out of a total of 5880 hospitalized newborns, representing a hospital frequency of 4.06%. Our study showed a predominance of males, who accounted for 54% of the sample, and females, who accounted for 46%. The sex ratio was 1.17. Sixty-three point three percent of hospitalizations occurred in the first week of life between D0 and D7, with 34.3% admitted on D0. Thirty-six point eight percent were admitted after 7 days of life. Newborns were referred by healthcare professionals from various healthcare facilities in 85.8% of cases, and 14.2% came directly from home.

3.2. Anamnestic Data

60.84% of mothers were multiparous. Regarding prenatal care, 40.6% of mothers had attended between two and four prenatal consultations. Third-trimester hemorrhage was found in 3.3% of cases, with 10.8% of placenta praevia. The maternal

transfusion rate before birth was 2.51%. Mothers gave birth vaginally in 72.8% of cases. Regarding medical history, 20.1% of newborns had been hospitalized prior to admission to the neonatal unit at Béago, and in 60% of cases, the diagnosis was neonatal infection.

3.3. Clinical Data

46.75% of newborns were premature, while 53.25% were born at term. Low birth weight (less than 2500 g) accounted for 54% of newborns. The three main clinical signs found on admission of anemic newborns were respiratory distress (57.7%), pallor (33.89%), and cardiovascular signs (24.69%) [TRC less than 3 seconds (81.36%) and tachycardia (18.64%)].

3.4. Transfusion Practice

The average hemoglobin level was 10.12 g/l. The clinical reasons for blood transfusion were pallor in 64.4% of cases, premature infant anemia in 35.56%, bradycardia in 30.5%, tachypnea in 24.7%, tachycardia in 12.1%, and bradypnea and apnea in 8.6%. Of the 239 patients, 61.9% received at least two transfusions and 38.1% received one transfusion. Among premature infants (27.7%), transfusions were given between 11 - 13 g/dl in the presence of signs of decompensation. Similarly, 13.3% of full-term newborns were transfused between 11 - 12 g/dl in the presence of signs of poor clinical tolerance. The average Hb level after transfusion was 14.73 g/dL ± 4, with extremes ranging from 8.4 to 16 g/dL; 71.20% of our patients had a control hemoglobin level above 13 g/dL, 25.30% had levels between 10 and 13 g/dL, and 3.5% had levels between 8 and 10 g/dL.

3.5. Patients Outcome

The average length of hospital stay was 10 days. The frequency of complications during or after transfusion was 31.8%, including 89.55% desaturation, 7% convulsions, and 3.4% cardiopulmonary arrest. Thirty point five percent of our patients died after transfusion. Factors associated with death were gestational age and low hemoglobin levels, which are risk factors for transfusion, whereas birth weight ≥ 2500 g and receiving two or more transfusions was associated with a lower risk of mortality compared to receiving only one were protective factors (Table 1).

Table 1. Factors influencing death.

	Deceased		P Value	Odds ratio	Confidence Interval
	No	Yes			
Hemoglobin level					
8 - 10	1	7	< 0.0001*	21.53	[2.55, 455.5]
10 - 13	42	16	0.65	1.17	[0.60, 2.27]
≥ 13	123	40	Unspecified	-	-

Continued

Gestational age in weeks					
< 28	2	6	0.007*	8.70	[1.79, 42.18]
[28; 32]	27	19	0.044*	2.04	[1.02, 4.08]
[32; 34]	25	10	0.72	1.16	[0.52, 2.58]
[34; 37]	18	4	0.44	0.64	[0.21, 1.99]
[37; 42]	90	31	Ref	-	-
Non précisé	4	3	0.32	2.18	[0.46, 10.23]
Birth weight in g					
< 1000	0	8	-	-	-
[1000 - 1500]	22	20	0.2202	1.6162	[0.7502; 3.4817]
[1500 - 2500]	48	27	Unspecified	-	-
≥2500	87	17	0.0031	0.3474	[0.1722; 0.7008]
Not specified	9	1	0.1336	0.1975	[0.0237; 1.6442]
Number of blood transfusions					
1 transfusion	48	43	Unspecified	-	-
2 transfusions	84	25	0.0004	0.3322	[0.1810; 0.6098]
≥2 transfusions	34	5	0.0006	0.1642	[0.0589; 0.4575]

4. Discussion

Our study has methodological limitations due to its retrospective nature, which did not allow for the exhaustive collection of all information. Duplicates consisted of records of newborns who had been hospitalized in the department for the first time and returned for a second hospitalization under a different name because they had been registered with the civil registry.

4.1. Prevalence

The hospital frequency of neonatal anemia reported in our study (4.06%) was identical to that found in certain series from Côte d'Ivoire and Mali. Indeed, Traoré S *et al.* [8] at Bouaké University Hospital reported 3.8% and Diallo D *et al.* reported 3.8% in Mali [9]. In our study, the majority of hospitalizations occurred in the first week of life. In Ivory Coast, Lasme E *et al.* at Yopougon University Hospital showed that 74.19% of newborns were admitted within the first 24 hours of life [4]. These high rates of hospitalization in the first few weeks could be explained by increased monitoring of at-risk newborns in the maternity ward, or by perinatal complications requiring immediate hospitalization.

4.2. Anamnestic and Clinical Data

The number of prenatal consultations (2 to 4) attended by only 40.6% of mothers in the study was similar to that reported by Cissouma *et al.* (80.33%) [10]. These

figures were lower than the WHO recommendations, which advocated a minimum of eight consultations [11]. Early screening for maternal anemia, a major cause of anemia in newborns, was compromised. Our study revealed a maternal transfusion rate of 2.51%; some anemic newborns were born from complicated pregnancies that required maternal transfusion. This finding is confirmed in Mali in a cohort that reported an association between maternal transfusion and neonatal anemia (20.5%) Ouattara [12]. Similarly, in Guinea, there was a significant increase in the risk of neonatal anemia in cases of maternal transfusion in the third trimester, according to the study by Baldé [13].

In our study, 46.75% of newborns were premature. This rate was higher than that reported by H Torchin *et al.* in France, who found that 7.4% of hospitalized newborns were premature, 95% of whom were moderately or late preterm [14]. The lower the weight of the newborns, the more likely they were to receive frequent transfusions.

Regarding previous hospitalizations, 20.1% of newborns had been hospitalized, and in 60% of cases, the diagnosis was a neonatal infection. N'guessan *et al.* [15] at Yopougon University Hospital found that neonatal infection accounted for more than half of the causes of hospitalization in newborns who had received transfusions. For LAhanda [16] in Cameroon, the main predictors of blood transfusion were gestational age (<33 weeks) and birth weight (<1500 g). Our main reasons for referring newborns were prematurity (26.4%), respiratory distress (23.4%), pallor, and fever (11.14%). These results were consistent with several studies conducted in Côte d'Ivoire at the Bouaké University Hospital [7] and in Burkina Faso [17].

4.3. Clinical Signs That Justified the Blood Transfusion

The study of clinical signs found on admission of anemic newborns in our series revealed three major manifestations: respiratory distress (57.7%), pallor (33.89%), and cardiovascular signs (24.69%), including a TRC of less than 3 seconds (81.36%) and tachycardia (18.64%). Respiratory distress was the main warning sign and was found in more than half of cases (57.7%). Cissouma A *et al.* [10] in Sikasso reported respiratory distress in 50% of cases. Skin and mucosal signs were also present in 57.7% of cases, dominated by pallor in 58.8%, a classic sign of anemia confirming its central place among the clinical signs of neonatal anemia. Dick *et al.* [3] observed pallor in more than 40.6% and jaundice in 15.6% of cases in anemic newborns at the Yopougon University Hospital. Its high frequency in our series confirmed its value as a warning sign in our resource-limited settings. Among the cardiovascular signs, 81.36% had a skin recoloration time of more than 3 seconds, which proved to be of particular importance. According to Dick, prolonged capillary refill time, tachycardia, and cold extremities were early signs of circulatory failure in anemic newborns [3]. In descending order, the clinically observed abnormalities were represented by the triad of hypothermia, pallor, and jaundice [3].

4.4. Transfusion Criteria

Our transfusion criteria were mainly pallor and anemia in premature newborns. A transfusion threshold of 10 g/dl was generally used, regardless of the presence of clinical signs of decompensation. This strategy is part of the standard management of neonatal anemia, adapted to the realities of our department. In some full-term newborns, red blood cell transfusion was indicated for hemoglobin levels between 11 and 12 g/dl, but only in the presence of clinical signs of poor tolerance, such as persistent tachycardia or respiratory distress. Conversely, in some premature infants, transfusion could be justified for higher hemoglobin levels (11 to 13 g/dl) when clinical signs suggestive of hemodynamic decompensation were present. Countries in Europe and America with advanced logistics for the precise control of hemodynamic disorders take into account clinical criteria such as heart rate, respiratory rate, lack of weight gain, pallor, and cyanosis [18]. Severe anemia accounted for 15.5%, and moderate anemia accounted for 44.4%.

4.5. Transfusion Practice

The average hemoglobin level was 10.12 g/L, and 61.9% of our patients received at least two transfusions. This was in accordance with the protocol in force in the department, which recommended two transfusions for new anemia patients requiring transfusions [4]. The procedures were followed, with 38.1% of newborns who received only one transfusion being at greater risk of death. The double transfusion recommended in the protocol is linked to the fact that in the study by Lasme *et al.* in 2011 [4], 81% of newborns remained anemic after the first transfusion, including 42% with hemoglobin levels below 10 g/dl. In the current study, where 61.9% of newborns received at least two blood transfusions, only 28.8% had a hemoglobin level below 13 g/dL at follow-up, with 3.5% below 10 g/dL. The two transfusions were spaced at least 12 hours apart, and each transfusion was performed over a period of four hours, minimizing the risk of circulatory overload.

4.6. Patients Outcome

Our results were consistent with those of many authors who obtained mean hemoglobin control levels above 13 g/dL. The principle of two transfusions significantly corrected anemia and reduced mortality.

Thirty point five percent of our patients died, and the mortality rate among anemic patients decreased compared to the studies by Lasme [4] and Guellil [19], which reported rates of 33.3% and 45.7%, respectively. Some of our deaths occurred during transfusion. Extreme prematurity was associated with significantly higher mortality, while a weight greater than 2500g was a protective factor, reducing the risk of mortality.

5. Conclusion

Blood transfusion is a major weapon in the therapeutic arsenal for neonatal anemia. The main indications for transfusion were pallor and anemia in premature

infants. The transfusion threshold was 10 g/dl with or without signs of decompensation, in accordance with the protocol in force. The transfusion thresholds were higher than the established standards. These criteria revealed the need for a more refined adjustment of the transfusion threshold in the protocol under study, with individualized management taking into account gestational age, birth weight, clinical status, and etiological context. We recommend that all newborns under 32 weeks of gestation weighing less than 2500 g with a hemoglobin level below 10 g/dL receive two blood transfusions if necessary, with a target hemoglobin level of 13 g/dL. For hemoglobin levels between 11 and 13 g/dL, transfusion will be discussed based on the patient's cardiovascular and respiratory status. Care must always be patient-centered.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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