HP Groups

Research Article

Clinical, Laboratorial Characteristics and Treatment Result of Anemia in Preterm Neonates in Haiphong Children's Hospital In 2015-2016

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Summary

Anemia in preterm neonates in Haiphong was studied by a retrospective, descriptive analysis including 113 eligible patients recruited between January 2015 and December 2016. Data on the clinical, laboratorial characteristics and treatment result of anemia was assessed. The sexual ratio (male/female) was 1.3/1. Most of patients were born in rural areas (60.2%) with mild anemia (56.6%). The most common causes of hospitalization were cyanosis (38.1%) and rapid breathing or apnea (56.6%). The clinical symptoms frequently presented in the preterm infants with anemia were pallor (75.2%), rapid breathing or apnea (57.5%) and low weight (50.4%). These patients had high risk of comorbidities such as respiratory diseases and other infections. RBC count result was mostly at the level of $2-3 \times 10^{12}/L$, with the average value was $2.58\pm0.595 \times 10^{12}/L$. The average value of Hb concentration was 99.81 ± 10.406 g/L. Blood transfusions were applied in most of patients (97.3%) with the average number of transfusions was 1.66 ± 0.167 times and the average of volume of transfusions was 21.55 ± 8.71 ml/kg. The treatment outcome was: 67.3% of patients acquired stable status; 18.5% were unresponsive and transferred to the Vietnam National Children's Hospital for further treatment; 14.2% of the preterm infants were died.

Keywords: Anemia; Blood transfusion; Preterm infant

Abbreviations

NICU: Neonatal Intensive Care Unit; WHO: World Health Organization; RBC: Red Blood Cell; Hb: Hemoglobin; Hct: Hematocrit

Introduction

Following WHO's report, globally, anemia affects 1.62 billion people (95% CI: 1.50-1.74 billion), which corresponds to 24.8% of the population (95% CI: 22.9-26.7%), with the highest prevalence is in preschool-age children (47.4%, 95% CI: 45.7-49.1) [1]. Among this group, neonatal anemia, including anemia in preterm neonates, defined as a Hemoglobin (Hb) or Hematocrit (Hct) concentration of >2 standard deviations below the mean for postnatal age, is a major problem encountered in neonatal intensive care units. Moreover, long-term anemia has been reported to potentially affect both brain growth and other components of chronic disease on the premature infant [2]. Up to now, there isn't any published research on anemia in preterm neonates in Haiphong- the third largest city in Vietnam. Therefore, we proceed with this topic with two goals:

- Describe the clinical and laboratory characteristics of anemia in preterm neonates at Haiphong Children's Hospital in 2015-2016

- Comment on the results of treatment of anemia in the above subjects

Materials and Methods

A retrospective, descriptive analysis was conducted at the Neonatal Intensive Care Unit (NICU) in Haiphong Children's Hospital. The NICU received the out-born infants transported from all the hospitals and medical centers in Haiphong and nearby areas. The diagnosis of anemia was based on clinical manifestations: pallor, cyanosis, signs of acute anemia (tachycardia, cardiac failure, respiratory distress, etc.). The infants were evaluated for a complete blood count and red cell indices to establish a diagnosis of anemia with the main criteria: Hb<110g/l. This criteria is applied for the diagnosis of anemia in children less than 5 years old in Haiphong Children's Hospital, following the WHO recommendation [1,3].

A total of 113 eligible patients were recruited between January 2015 and December 2016. According to gestational age, the subjects were classified into three groups as follows: group 1: 21 week's≤gestational age <28 weeks (n=5); group 2: 28 week's≤gestational age <32 weeks (n=51); group 3: 32 week's≤gestational age <38 weeks (n=57).

According to the Hb concentration, the subjects were classified into four groups as follow: group 1- mild anemia: 90 g/l≤Hb< 110 g/l; group 2 - moderate anemia: 70 g/l ≤Hb< 90 g/l; severe anemia: 30 g/l≤Hb< 70 g/l; group 4 - decompensated anemia: Hb< 30 g/l.

Depending on each patients, the infants were received the treatment of anemia by whole blood and/or RBC transfusion. The

treatment outcome was evaluated as: stable, unresponsive or death. All the unresponsive cases of anemia were transferred to the Vietnam National Children's Hospital.

This study has been approved by the Research Ethics Committee of Haiphong Medical and Pharmaceutical University.

Statistical analysis: The Statistical Package for the Social Sciences (SPSS) program (16.0 for Windows software, LEAD Technology, Inc.) was used for analysis.

Results

General characteristics of the infants

The prevalence of anemia in preterm newborns is higher in male than that of females (56.6% vs. 43,4%, respectively). Most children are born in rural areas and have a gestational age of 28-37 week's (Table 1). Most preterm neonates at gestational age group 3 had mild anemia, while most of patient at gestational age group 2 had moderate anemia (Table 2).

Characteristics		n (%)
Sex	Male	64 (56.6)
	Female	49 (43.4)
Geographic distribution	Rural	68 (60.2)
	Urban	45 (39.8)

Table 1: General characteristics of the infants in all groups.

Severity of anemia	Total n (%)	Gestational age group		
		Group 1 n (%)	Group 2 n (%)	Group 3 n (%)
Mild anemia	64 (56.6)	0 (0)	21 (18.6)	43 (38)
Moderate anemia	48 (42.5)	5 (4.4)	29 (25.7)	14 (12.4)
Severe anemia	1 (0.9)	0 (0)	1 (0.9)	0 (0)

Table 2: Severity of anemia according to the gestational age group.

Clinical characteristics of anemia in preterm infants

The most common causes of hospitalization were cyanosis (38.1%) and rapid breathing or apnea (56.6%) (Table 3). The clinical symptoms frequently presented in the preterm infants with anemia were pallor (75.2%), rapid breathing or apnea (57.5%) and low weight (50.4%) (Table 4). These patients had high risk of comorbidities such as respiratory diseases and other infections (Table 5).

Laboratorial characteristics of anemia in preterm infants

Erythrocytes count result was mostly at the level of 2-3 x 10^{12}/L (Table 6). The average value of the whole research population was 2.58±0.595 x 10^{12}/L. The average value of Hb concentration was 99.81±10.406 g/L (Table 7).

Treatment of anemia

Blood transfusions were applied in most of patients (97.3%) with the average number of transfusions was 1.66±0.167 times and

Symptoms	n (%)
Rapid breathing or apnea	64 (56.6)
Cyanosis	43 (38.1)
Jaundice	2 (1.8)
Others: cough, anorectal malformations	4 (3.5)

Table 3: Table of causes for hospitalization.

Symptoms	Severity of anemia			Total n (%)
	Mild n (%)	Moderate n (%)	Severe n (%)	
Pallor	50 (44.2)	34 (30.1)	1 (0.9)	85 (75.2)
Rapid breathing or apnea	26 (23.0)	38 (33.6)	1 (0.9)	65 (57.5)
Slow reflexes	26 (23.0)	26 (23.0)	1 (0.9)	53 (46.9)
Tachycardia	6 (5.3)	12 (10.6)	1 (0.9)	19 (16.8)
Low weight	34 (30.1)	23 (20.3)	1 (0.9)	57 (50.4)

Table 4: Distribution of clinical symptoms according to the severity of anemia.

Comorbidities	n (%)
Respiratory diseases (respiratory distress syndrome, pneumonia)	46 (40.7)
Infections (septicemia, skin infection)	7 (6.2)
Respiratory diseases and other infections	49 (43.4)
Jaundice	11 (9.7)

Table 5: Distribution of patients according to the comorbidities.

RBC	Severity of anemia			Total n (%)
	Mild n (%)	Moderate n (%)	Severe n (%)	
>3 x 10^{12}/L	23 (20.4)	5 (4.4)	0 (0)	28 (24.8)
2-3 x 10^{12}/L	36 (31.8)	42 (37.2)	1 (0.9)	79 (69.9)
<2 x 10^{12}/L	5 (4.4)	1 (0.9)	0 (0)	6 (5.3)

Table 6: Distribution of the level of anemia according to the result of RBC count.

Index	X±SD
RBC(10^{12}/L)	2.58±0.595
Hb (g/L)	99.81±10.406
Hct (L/L)	0.258±0.024
MCV (fL)	101.92±7.012
MCH (pg)	32.37±3.409
MCHC (g)	336.35±17.639

**Table 7:** The average value of the RBC count and red cell indices.

the average of volume of transfusions was 21.55±8.71 ml/kg. Patients were treated by whole blood and/or packed-cell transfusions (Table 8 and Table 9). The treatment outcome was: 67.3% of patients acquired

	n (%)
Number of patients received blood transfusion	111 (97.3)
Total blood transfusion	83 (73.5)
RBC transfusion	50 (44.2)

Table 8: Treatment of anemia by transfusion.

Transfusion indices	Gestational age group (X±SD)		
	Group 1	Group 2	Group 3
Volume of transfusion (ml/kg)	27.50±5.568	22.92±10.765	19.88±6.118
Number of transfusions/patient	3.25±1.893	1.98±1.244	1.26±0.642

Table 9: Volume and number of transfusions according to the age of infants.
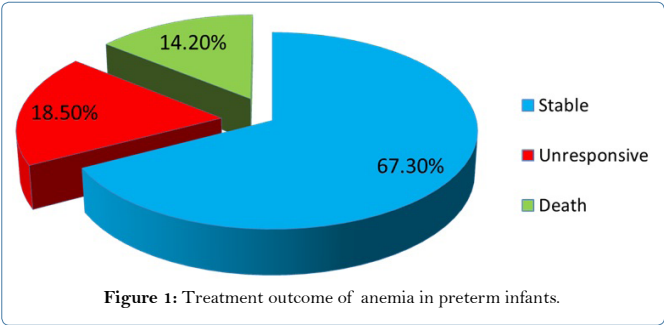
Figure 1: Treatment outcome of anemia in preterm infants.

stable status; 18.5% were unresponsive and transferred to the Vietnam National Children's Hospital for further treatment; 14.2% of the preterm infants were died (Figure 1).

Discussions

General characteristics of the infants

In our research, almost of patients were from the rural areas (60.2%). In both of the 2 groups of patients from rural and urban areas, mild anemia is the most frequent. A study by Khoi HH et al., also reported consistent results with our study, showing that the anemia in neonates was more recurrent in the rural than in the urban regions [4]. Anemia was more frequently observed in male patients than in female, which is possibly related to the increasingly imbalanced sex ratios at birth occurring in this region of Viet Nam [5,6]. According to the gestational age of the preterm infants, anemia was most seen in the group 3: 32 weeks≤ gestational age <38 weeks (50.4%). At the 32nd week of gestation, plasma volume increases by about 50% while the red cell volume also increases, but the increase is moderate (about 20%) and delayed [7]. Consequently, the total blood volume increases with hemodilution, leading to the higher risk of anemia in the preterm neonates of group 3.

Even that Haiphong is in Southeast Asia - one of the thalassemia endemic regions, unfortunately, we couldn't access the rate of thalassemia among the groups of patients due to the lack of a routine hemoglobin electrophoresis for anemia cases in Haiphong Children's Hospital [8].

Clinical characteristics of the patients

The leading causes for hospitalization in this study were respiratory stress and cyanosis. Pallor is the most common clinical manifestation in our research (75.2%), followed by respiratory stress (rapid breathing or apnea: 57.5%) and delayed reflexes (46.9%). A study of Wardrop CA. et al., showed that 50% of the preterm neonates have abnormal clinical signs related to anemia such as pallor, tachycardia, rapid breathing and delayed reflexes [9]. This abnormality is due to the function of Hb - the main oxygen-carrying protein in blood. Lacking of Hb could lead to the insufficient support of oxygen delivery to tissue, pallor, respiratory stress and tachycardia [10].

In our study, 50.4% of preterm neonates with anemia also have low body weight. This data is supportive for the fact that anemia is significantly associated with being born small [11]. In Anemia Of Prematurity (AOP), mean Hb concentration reportedly falls to approximately 8 g/dL in infants with a birth weight of 1000-1500 g and to 7 g/dL for infants weighing less than 1000 g [12].

We noticed that infants with anemia have high risk of comorbidities such as respiratory diseases (respiratory distress syndrome, pneumonia) or respiratory diseases combined with other infections (sepsis, skin infection) (40.7% and 43.4%, respectively). Due to the prematurity of respiratory and immunity system in preterm infants, it is comprehensive that the associated diseases mentioned above appeared frequently in this study [13]. It has been reported that the correction of infant anemia is associated with a reduction in the increased morbidity (fever, respiratory tract infections and diarrhea) [14,15].

Laboratorial characteristics on the patients

The complete blood count returned that the average amount of RBC was 2.58±0.6 x 10^{12}/L, and almost of the infants with anemia at mild or moderate level. 69.95% infants with moderate anemia have moderate reduction level of RBC (2-3 x10^{12}/L). The average values of important RBC indices were as following: Hb: 99.81±10.41 g/l; MCV: 101.92±7.01 fL; MCH: 32.57±3.41 pg; MCHC: 336.35±17.64g. Our data is consistent with the data reported by a research of Hasanbegovic et al., in Bosnia and Herzegovina: the group of infants≤ 32 gestational weeks has average amount of RBC: 2.6±0.62 x10^{12}/L and Hb: 96±12g/l [16].

Treatment outcome

All the infants included in this study received the treatment of anemia according to the Pediatric treatment guideline of Haiphong Children's Hospital. As a result, 97.3% of the patients were given transfusion of whole blood and/or RBC. Whole blood transfusion was more frequently applied than packed red blood cell transfusion (73.5% vs. 44.2%, respectively), because many preterm neonates were lack of not only RBC but also of coagulation factors (reduction of fibrin, plasminogen or prothrombin up to 15-20%, data not shown). Some infants needed more than one transfusion and finally received both whole blood and RBC supply. As this study was carried out in the principal pediatric hospital of the city which has stable blood products supply, almost of the anemia cases were treated by a reasonable transfusion following the general guideline of the hospital. According to the gestational age of the infants, blood transfusion was applied to all the patient of group 1 (21-28 GW), 98% of group 2 (28-32 GW) and 96.5% of group 3 (32-37 GW).

The global view of treatment outcome in our research is reported as following: 67.3% of patients were stable; 18.65% was unresponsive to the treatment and needed to be transferred to the Vietnam National Children's Hospital; the percentage of death cases was 14.2%. Almost of patients in the gestational age group 2 and 3 became stable after the treatment (64.3% and 81.6%, respectively). Among the group 1 (under 28 GW), 60% of infants were unresponsive and transferred while 40% were death. Trung LN. et al., also reported consistent data: 48.3% of anemia cases in infants at 26-28 GW were death and this number in the group 29-31 GW was 8.1% [17]. It is also noticed that the percentage of mild anemia is higher in the infants with older gestational age,

and the responsiveness to the treatment is better in the group with older age than in the younger age group.

Conclusion

Our study provides details on clinical, laboratorial characteristics and treatment outcome of anemia in preterm neonates of a big city in Vietnam. Anemia in preterm infant still appears as a major challenge for public health. Anemia is often associated with other comorbidities, leading to a worse prognostic and high death rate in the preterm neonate. The mortality rate remained fairly high despite the availability of active treatment and carein a big city of the country. This reality highlights the importance of preventing anemia during pregnancy, especially in the rural area of a developing country like Vietnam.

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