




Severe Anemia among Blood Donors in an Area Where Blood Donation Is Sought to Save the Lives of Children with Severe Malaria—Anemia in Blood Donors

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Abstract: Introduction: Severe anemia caused by severe malaria remains concentrated in children under 5 years old in Africa. In addition to blood-transfusion-related infections that pose a health concern, transfusion of severely anemic blood to a patient with severe anemia is another important concern. **Method:** Following the observation of a case of severe anemia in a blood donor, we conducted a secondary data analysis from a previous study to assess the frequency of anemia in blood donors in San, Mali. **Results:** In total, out of 140 volunteers, 13 (9%, 95% CI: 5.43–15.41) blood donors had moderate to severe anemia, based on Mali hemoglobin (Hb) normal values (10.5–16.5 g/dL, MRTC-GLP laboratory). In particular, we observed one case of severe anemia with an Hb level of 6.5 g/dL. **Conclusions:** To the best of our knowledge, this is the first report of severe anemia in blood donors in a malaria endemic area in Mali.

Keywords: severe anemia; blood donor; malaria

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1. Introduction

Blood transfusion is an essential adjunct treatment for the survival of countless patients. Severe cases of malaria remain concentrated in children under 5 years of age in Africa, with severe anemia being a common manifestation [1]. At the pediatric ward of the Reference Health Centre of San in Mali (West-Africa), severe malaria is the leading cause of death in children under five (Pediatric Registry, not published) and blood transfusion is used to reduce infant mortality from severe anemia. Although blood transfusion-related infections remain a health concern [2,3], another concern is transfusing anemic blood to a patient with severe anemia. In the pre-transfusion work-up, it is essential to estimate the donors hemoglobin (Hb) level in order to reduce the risk of donor anemia as the Hb of a blood donor drops by 1 to 1.5 g/dL after each donation [4]. Moreover, transfusing anemic blood is of little benefit to the recipient.

In the present study, following the observation of a case of severe anemia in a blood donor, we conducted a secondary data analysis to determine the proportion of anemic blood donors. The data used were from a previous study (ancillary to PYRAPREG, grant number: RIA2017MC-2025-PYRAPREG) conducted in the San Health District in Mali to investigate the impact of pregnancy and malaria infection on the variation of neutrophil levels. In the original study, we compared the neutrophil count of blood donors with that of pregnant women. The objective of the current work was to assess the prevalence of anemia in blood donors.

2. Methods

After consenting to participate in the study and signing the informed consent form, a venous sample was collected in a ethylenediamine tetraacetic acid (EDTA) blood collection tube and the Hb level of the sample was measured in g/dL using CELL-DYN Emerald 22 analyzer (<https://www.corelaboratory.abbott/int/fr/offering/brands/cell-dyn/cell-dyn-emerald22>). The definition of anemia was based on the Malian normal Hb range provided by the Malaria Research and Training Center (MRTC)—GLP laboratory:

- Anemia: Hb level < 10.5 g/dL;
- Normal Hb level: $10.5 \text{ g/dL} \leq \text{Hb level} \leq 16.5 \text{ g/dL}$.

Donors with Hb levels between 6.5 and 7.9 g/dL were considered severely anemic.

Although not yet published, these values better reflect the reference values of blood donors in Mali.

In addition of full blood count, a thick blood smear test was carried out for malaria screening. The slides were stained in 10% Giemsa solution for 15 minutes and were read using an Olympus CX33 microscope (Olympus corporation, Tokyo, Japan). For pre-transfusion infections screening, all the participants were tested to human immunodeficiency virus (HIV), syphilis, hepatitis B virus (HBV) and hepatitis C virus (HCV).

Ethics: This was a secondary analysis of a study approved by the Ethics Committee of the University of Sciences Techniques and Technologies of Bamako (N° 2021/163/CE/USTTB, 28 June 2021). All participants provided a signed informed consent form before their participation in the study.

Statistics: We performed a descriptive analysis of the age and the hematological parameters of the participants in this study. The proportion of blood donors with anemia was calculated and compared to the proportion of donors with normal Hb levels using the Chi2 test. 95 % confidence

intervals (95%CI) for proportions were calculated by using the Clopper-Pearson method. The threshold of statistical significance was set at 0.05. Statistical analyses were performed using R version 3.6.3 (Designed By Ross Ihaka and Robert Gentleman at the University of Auckland in New Zealand).

3. Results

In total, data from 140 blood donors were analyzed in this study. They were all negative for the four pre-transfusion screened infections, namely: HIV, syphilis, HBV and HCV. Their thick blood smear test for malaria screening was negative. The youngest blood donor was 18 years old and the oldest was 51 years. The median age of the volunteers in this study was 33 years whether the donor was anemic or not (Table 1). All participants in this study were male.

Table 1 also shows that the lowest Hb level observed in the blood donors participating in this study was 6.5 g/dL. The volunteer was 41 years old and apparently in good health. The median Hb level found in this study was 12.4 g/dL. With a minimum value of 1,900,000 per μL , some blood donors had a low red blood cell (RBC) count considering the country standards (3,820,000–5,870,000 per μL) (MRTC-GLP laboratory). The median white blood cell (WBC) counts 4150 per μL (interquartile range: 3400–5000 μL) found in the participants of this study was below the country normal range (3300–11,500 per μL). However, the median percentage of neutrophils 40.9% (interquartile range: 34.1–47.4%) found in this study participants was within the normal range of Malians adult (25–66%). Similarly, the median platelet counts 210,500 per μL (interquartile range: 177,750–251,250 per μL) found in the participants of this study was within the normal range for the country (88,000–460,000 per μL) (MRTC-GLP laboratory).

Table 1: Demographical and hematological characteristics.

	Minimum	1st Quartile	Median	Mean	3rd Quartile	Maximum
Age (years)	18.0	26.8	33.0	33.2	39.0	51.0
Hb (g/dL)	6.5	11.4	12.4	12.5	13.5	16.5
RBC (n per μL)	1,900,000	3,167,500	3,550,000	3,639,786	4,062,500	5,660,000
Platelet (n per μL)	97,000	177,750	210,500	216,657	251,250	421,000
WBC (n per μL)	2000	3400	4150	4284	5000	8000
Neutrophils (%)	9.3	34.1	40.9	40.8	47.4	66.4
Lymphocytes (%)	26.8	40.1	46.6	46.5	52.02	77.3
Monocytes (%)	1.9	7.2	8.7	8.9	10.3	18.4
Eosinophils (%)	0.1	1.4	2.7	3.5	4.4	28.2
Basophils (%)	0.0	0.1	0.2	0.2	0.3	0.7

Hb= hemoglobin, RBC= red blood cell, WBC= white blood cell, n= number.

Our data showed also that 13 of the 140 (9.3%, 95%CI: 5.43 – 15.41) (Table 2) blood donors who took part in this study were anemic. Donors with normal Hb levels were significantly more numerous than those with anemia ($p < 0.0001$).

Table 2: Frequency of anemia among blood donors.

	Number	Percentage (95%CI)
Anemia	13	9.3 (5.43–15.41)
Normal Hemoglobin level	127	90.7 (84.59–94.57)
Total	140	100.0

p -value < 0.0001 .

4. Discussion

This study reported a case of severe anemia (Hb level = 6.5g/dL) in the blood donors in San Health Reference Center. By reducing oxygen-carrying capacity, anemia has serious implications for health, both in terms of morbidity and mortality [5]. According to the United Kingdom (UK) blood transfusion guidelines, a man must have 13.5 g/dL to be eligible to donate blood [6]. Considering the normal values of the country (Hb normal range = 10.5–16.5 g/dL, MRTC-GLP laboratory), 13 of the 140 (9.3%) blood donors in this study were anemic. This observation is in line with Keita (2011) who found 10.2% cases of anemia among blood donors at the National Blood Transfusion Centre in Bamako, Mali [7]. These donors with anemia will have aggravated their anemia [4] while their action will not have helped the patients who receive their blood. Worse, the failure to correct the anemia of the unfortunate recipients of anemic blood could lead doctors to make a questionable decisions that could further compromise the vital prognosis of these patients. The application of systematic Hb testing of blood donors ensures the good quality of blood products and the safety of donors.

5. Conclusions

To the best of our knowledge and belief, this is the first report of severe anemia among blood donors in a malaria endemic area such as Mali. Our data suggest the usefulness of including a systematic screening for anemia in pre-transfusion assessment. Further studies are needed to determine the proportion of anemia among blood donors in other areas of Mali but also in Sub-Saharan Africa countries where malaria is one of the main causes of severe anemia and where hemoglobin measurement is not part of the pre-transfusion assessment. Additionally, as malaria is one of the leading causes of anemia, it is essential to screen for malaria in the pre-transfusion assessment.

Author Contributions: M.D., H.D.F.H.S., A.D., M.V., P.F.M. and K.K. were responsible for the conception and design of this analysis. M.D., M.B.T., H.D., M.K., B.K., M.D.S., B.T. and B.B. contributed to the data collection. M.D. did statistical analysis and wrote the first draft of the paper. All authors read and approved the final manuscript.

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