Health Sciences & Disease
The Journal of Medicine and Biomedical Sciences

Article Original

Sickle Cell Haemoglobin in Blood Donors: a Cross-Sectional Study at Douala City

Hémoglobine à cellules falciformes chez les donneurs de sang : une étude transversale à dans la ville de Douala

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Keywords. Sickle cells trait - Blood donors – Cameroon - Transfusion
Mots-clés. Trait drépanocytaire - Donneurs de sang – Cameroun - Transfusion

RÉSUMÉ

Objectif. La drépanocytose est un groupe d'anomalies qui affectent l'hémoglobine (Hb), formant des molécules d'hémoglobine S (HbS). La transmission de l'HbS par le don de sang peut avoir de graves conséquences sur la santé des receveurs. Le but de cette étude était de déterminer la prévalence et les facteurs associés à l'HbS chez les donneurs de sang pour assurer une transfusion sanguine efficace et sûre. **Méthodes.** Une étude transversale a été réalisée du 02 au 30 juillet 2021. Les participants étaient des donneurs de sang fréquentant la banque de sang de l'Hôpital Laquintinie qui ont été recrutés consécutivement. Tous les échantillons ont été analysés pour le groupe sanguin, les biomarqueurs viraux, la syphilis et l'HbS. Les données recueillies ont été analysées à l'aide du logiciel Statistical Package for Social Sciences (SPSS) version 16.0. Les facteurs associés à l'HbS ont été analysés avec l'odds ratio et l'intervalle de confiance. Le seuil de significativité a été fixé à 5 %. **Résultats.** Au total, 92 donneurs ont été inclus dans notre étude avec un âge moyen de 31,26 ± 7,95 ans et une prédominance masculine (84, 91,3%). L'HbS a été trouvée chez 20 (21,7 %) participants. Concernant le profil des donneurs porteurs d'une HbS, la majorité étaient des hommes (18,90,0%), avaient un groupe sanguin O positif (12, 60,0%) et la syphilis était la principale infection (3, 15,0%). Il n'y avait pas de différence significative entre les groupes d'âge, le sexe, les groupes sanguins et la prévalence des infections pour la répartition de l'HbS. **Conclusion.** Un nombre élevé d'HbS a été rapporté dans notre étude. Compte tenu de ces résultats, nous suggérons que les donneurs de sang fassent l'objet d'un dépistage systématique de l'HbS dans les banques de sang de nos régions.

ABSTRACT

Objective. Sickle Cell Disease is a group of disorders that affect the hemoglobin (Hb), forming abnormal hemoglobin S (HbS) molecules. Transmission of HbS through blood donation may have severe consequences on the health of the recipients. The aim of this study was to determine the prevalence and the associated factors of HbS among blood donors to ensure efficient and safe blood transfusion. **Methods.** A cross-sectional study was carried out from the 02 to 30 July 2021. Participants were blood donors attending the Laquintinie Hospital blood bank who were recruited consecutively. All samples were analyzed for blood group, viral biomarkers, syphilis and HbS. Data collected was analyzed using Statistical Package for Social Sciences (SPSS) version 16.0. Associated factor to HbS was analyzed with Odds Ratio and confidence interval. The significance threshold was set at 5%. **Results**. A total of 92 donors were enrolled in our study with a mean age of 31.26 ± 7.95 years and a male predominance (84, 91.3%). The HbS was found in 20 (21.7%) participants. Concerning the HbS donor's profile, the majority were males (18, 90.0%), had O positive blood group (12, 60.0%) and syphilis was the main infection (3, 15.0%). There was no significant difference between age groups, gender, blood groups and in the prevalence of infections for the HbS in the participants. **Conclusion.** A high number of HbS was reported in our study. Considering these findings, we suggest that blod donors be routinely screened for the HbS in blood banks in our areas.

INTRODUCTION

Sickle cell disease (SCD) is a group of disorders that affects hemoglobin the (Hb), forming abnormal hemoglobin S (HbS) molecules [1]. Affected people that inherit an abnormal gene from one parent and a normal gene from the other has a Sickle Cell Trait (SCT) or is said to be a carrier of SCD. The gene for sickle cell disease is more common in Sub-Sahara Africa, Mediterranean countries, Middle East and India [2]. This hemoglobinopathy is a major public health problem in Africa [3, 4]. In Ghana, about 25–30 % of the population carry the SCT and 2 % of newborns have SCD [3, 5]. With a prevalence of 11% of SCD in the general population in

Madagascar, carriers of the SCT may unknowingly be found among voluntary blood donors since the majority of them are asymptomatic [6]. In Cameroon, about 20 to 25% of the population carries the SCT [3, 7]. Blood transfusion remains a major component of the therapeutic management of many clinical situations such as SCD [3, 5]. HbS may have severe consequences on the health of the recipients particularly if they have SCD; it will increase the proportion of HbS already present in the circulation [7, 8]. In addition, transfusion of blood containing HbS does not give the same therapeutic effects as a normal blood bag, because of the leukoreduction issue during the phase of preparation of blood products and decrease in red deformity [8, 9]. Studies to determine the frequency of this hemoglobinopathy are rare in blood donors in our context. The aim of this study therefore was to determine the prevalence of HbS and its associated factors among blood donors to ensure efficient and safe blood transfusion.

POPULATION AND METHODS

Study design

The study was a cross-sectional study carried out from the 02 to 30 July 2021 (4 weeks).

Study setting/participants

The study subjects were individuals aged 18 to 60 years who came to donate blood at Laquintinie Hospital, only those who were eligible were included in our study. Also participants who did not give their consent for the study were excluded.

Assessment

We used a consent form and a medical questionnaire to include participants. Those who were not able to donate blood were excluded. Sociodemographic characteristics (age, gender and type of donor: replacement donor or benevolent donor) of the participants were collected.

Sample collection/analysis

Participants were recruited at the blood bank using convenience sampling method. Five milliliters (5 ml) of blood was collected from each of the participants during blood donation into labelled tri-potassium ethylene diamine tetra-acetic acid tubes and mixed gently. All samples were analyzed directly for ABO blood and Rhesus D, Antigen p24 and Antibodies anti- human immunodeficiency virus 1 and 2 (HIV), *Treponema pallidum* Antibodies, Surface antigen of Hepatitis Virus B (HBSAg) , Hepatitis Virus C antibodies (HCVAb) and HbS.

Blood grouping test

The ABO blood group and rhesus D were determined in blood donors and patients using both the Beth-Vincent and Simonin-Michon methods simultaneously either in tubes or on plate with commercial sera anti-A, anti-B, anti-AB and anti-D (Fortress diagnostic, Antrim, United kingdom) and A, B and O test red blood cells which were prepared locally. The results were considered as valid, if the cross-reading of the two methods gave a concordant result.

Microbiological analysis

Infections were explored by using the Enzyme Linked Immunosorbent Assay: HIVAg and Ab (HIV (Ag/Ab) 4th gen, Fortress diagnostic, Antrim, United kingdom), HBsAg (Fortress diagnostic, Antrim, United kingdom), and HCVAb (ANTI-HCV, Fortress diagnostic, Antrim, United kingdom), test; while *Treponema Pallidum* Ab was assessed via haemagglutination assay (TPHA, Fortress diagnostic, Antrim, United kingdom), The pint was considered unsafe if the tests were reactive.

Sickling

Rapid sickle cell hemoglobin-S (dithionate qualitative solubility) test (Bio Lab Diagnostics India Private Limited, 2020) determines Hb containing variants in whole blood using visual inspection for turbidity. This reaction is due to the difference in lysis of the insoluble HbS and soluble form of HbA following a mixture of blood and a working solution in a test tube. Sensitivity and specificity of this reagent are respectively 63.64% and 100% [9].

Constitution of the kit and testing reagents

The HbS dithionate qualitative solubility kit comprises: reagent 1 composed of phosphate buffer; reagent 2 composed of 0.5 g sodium dithionate and reagent 3 composed of 0.5 g of white saponin. The working solution was obtained by transferring the contents of reagent 2 and reagent 3 to a bottle of reagent 1, and was gently mixed for 15 minutes. 2 mL of the working reagent was added to 50 µL of whole blood. These were mixed well by gently shaking and incubated at 25°C for 10 minutes. The contents were visually examined; if the background of the rapid sickle cell tube reader was visible, the test was negative and was classified AA, while if the background was not visible in the positive sample (HbAS or HbSS) positives results were classified as HbS (figure 1).

Procedure

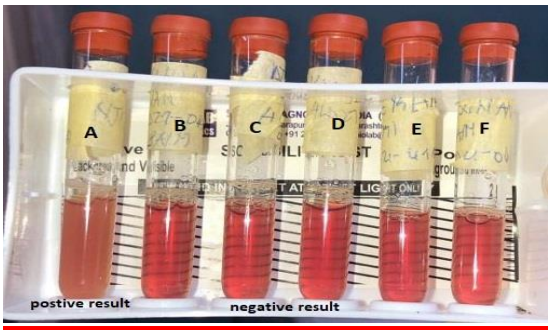

Figure 1. Results for blood obtained from a person without and with sickle cell trait (tube A is positive and classified SCT, tubes B to F are negative)

Two test tubes readings were done independently with unaided readers, and in case of a discrepancy, a third reader was considered, and a result was concluded. To ensure quality of the test results, experimental procedures were conducted according to the manufacturers' instructions. Known HbAS and HbSS blood samples were used as positive controls.

Data analysis

Data collected was entered into Microsoft Office Excel 2010 and analyzed using Statistical Package for Social Sciences version 16.0 (SPSS 16.0). Categorical variables were presented as frequencies and percentages. Continuous variables were presented as means and standard deviation. The strength of association was assessed using the odds ratio and the confidence interval at 95 %. The level of statistical significance was set at a p-value of < 0.05.

RESULTS

A total number of 150 prospective mainly replacement blood candidates were presented during the study period. About 115 (76.67%) of these donors consented to take part in the study. Out of these, a total of 92 (80.0%) donors were able to donate and were included in this study with 91 (98.9%) replacement donors (figure 2).

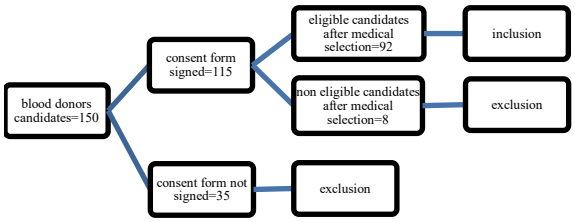

Figure 2. Scheme of participants' inclusion

Among blood donors, 8 (8.7%) were females and 84 (91.3%) were males. The mean age of the participants was 31.26 ± 7.95 years, ranging from 19 to 57. Regarding the age group, we had 42 (45.7%) patients aged [18-30], 38 (41.3%) aged [31-40], 11 (11.9%) aged [41-50], 1 (1.1%) aged [51-60] O positive blood group was the mostly represented with 53 (57.6%) donors. We had 11 (12%) pints reactive to syphilis as the most represented infection (5/11, 45.4%) (**Table 1**). Regarding Hemoglobin profile, 72 (78.3%) were AA and 20 (21.7%) had HbS.

Concerning the HbS donor's, the majority were males (18, 90.0%), had O positive blood group (12, 60.0%) and syphilis was the main infection (3, 15.0%).

No statistically significant difference was found between age group, gender, blood groups and infections for the S trait repartition (**Table I**).

Table I. Factors associated to HbS of the blood donors in our study

Variable	HbS (N=92)		OR (CI 95%)	*p*
	No (n, %)	Yes (n, %)		
Gender				
Male	66 (78.6)	18 (21.4)	1.22 (0.23-6.58)	1
Female	6 (75.0)	2 (25.0)		
Age (years)				
<30	34 (82.9)	7 (17.1)	1.66 (0.59-4.65)	0.447
≥30	38 (74.5)	13 (25.5)		
Blood group				
O+	41 (77.4)	12 (22.6)	0.88 (0.32-2.42)	1
A+	14 (70.0)	6 (30.0)	0.56 (0.18-1.73)	0.361
B+	14 (93.3)	1 (6.7)	4.59 (0.56-37.22)	0.177
AB+	3 (75.0)	1 (25.0)	0.83 (0.08-8.40)	1
Infection				
HBV	1 (50.0)	1 (50.0)	0.27 (0.02-4.48)	0.389
HCV	3 (100.0)	-	-	1
HIV+HCV	1 (100.0)	-	-	1
Syphilis	2 (40.0)	3 (60.0)	0.16 (0.02-1.05)	0.067
Safe pint	65 (80.2)	16 (19.8)	2.32 (0.60-8.91)	0.246

HIV= Human Immunodeficiency Virus 1 and 2, HBV= Hepatitis B Virus, HCV = Hepatitis C Virus, AA= Hemoglobin A, HbS= Hemoglobin S, OR=Odds Ratio, CI=Confidence Interval

DISCUSSION

Blood transfusion has a potential risk for both donors and recipients [10]. The aim of the study was to determine the prevalence of sickle cell trait and its associated factors among blood donors. A total 92 blood donors mainly replacement donors were involved in this study, of which 8 (8.7%) were females and 84 (91.3%) were males giving a male to female ratio of 21:1. Antwi et al had a male to female ratio of 4:1 from a ghanian population of 150 [11]. Fenomenana et al. A study in Madagascar also had a male predominance (77.28%) in donors with a sex ratio of 3.4 in a population of 427 donors; this sex-ratio is lower than our sex-ratio [8].The greater proportion of male donors compared to females in our study may be attributed to the fact that females have physiological conditions like lactation and menstruation that do not allow them to donate blood like men [12]; it can also be explained by the fact that men are mostly solicited in replacement donation. Age distribution also showed that, the age group of 18–28 years had the highest number of blood donors (28.7 %) which is similar to the findings of Fenomenana et al, Antwi et al and Omisakin et al [8, 11, 12]. SCT are usually asymptomatic with most of their hematological parameters such as hemoglobin and red blood cell indices within the normal range [13]. The prevalence of HbS was 21,7% which was greater than the 1.7 % observed by Fenomenana [8] and the 11.3% observed by Antwi et al [11] but close to the 25–30 % quoted for Ghana [5], the 26.1% obtained by Omisakin et al, the 19.7 % obtained by Zaccheaus et al [12, 14] and the 20–40 % for Africa in general [15]. This could be due to the large number of replacement donors who are mostly members of the same family, especially because the S trait is inherited and also due to the fact that there was no difference between SCD and SCT in our study. Despite the fact that there was no difference between SCT and SCD in our study, our results are comparable to the results obtained in different

countries, and it could be explained by the fact that it is rare to find known SCD candidates for blood donation since it is an asymptomatic disease. In our study population, 98.9% were HbS compared to the 89.3 % obtained by Antwi and the 85.71% obtained by Fenomenana [8, 11]. The distribution of HbS did not differ from one blood group to another, and the prevalence of infections did not differ from HbS to AA donors. No particular associated factor was observed. People carrying the sickle cell trait, are numerous. It is therefore reasonable to consider the possibility of implementing in practice routine screening for sickle cell trait in blood donors prior to donating blood or donated blood units thus the blood bank will avoid serving blood containing to sickle cells patients. The level of HbS should also be monitored. The limits of our study were; the small size of the study population, the lack of differences between SCT and SCD, the absence of electrophoresis apparatus to confirm the results, some false negative SCT may have been ignored due to the low sensibility of the test, and other hemoglobinopathies may have been present which were not part our study. However, no other study has reported the prevalence of HbS among blood donors in Cameroon.

CONCLUSION

The significant number of HbS reported in our study show that, the deliverance of these blood pints containing HbS may cause some problems to recipients especially Sickle Cell patients, thus it can increase the HbS level in them. To avoid risk due to blood transfusion, screening of HbS in donors may be a good approach. Furthermore, the effect of HbS as well as other hemoglobinopathies should be monitored in recipients especially those suffering from SCD in our context.

Acknowledgments

The authors thank the Douala Laquintinie Hospital staff for their kind assistance and advice

Authors' contributions

MSCI, LSA, initiated the project.

MSCI, LSA conducted biological tests.

MSCI, LSA, VVE conducted statistical analyzes. MSCI, LSA, VVE, KGCM, NA, NMP, EEEL, EG, EBB wrote and corrected the manuscript. EEN supervised the study. All the authors read and approved the final manuscript.

Competing interests

The authors report no conflict of interest in this work.

RÉFÉRENCES

1. Steinberg MH. Management of Sickle Cell Disease.Wood AJJ, éditeur. N Engl J Med . avr 1999;340(13):1021-30.
2. Michlitsch J, Azimi M, Hoppe C, Walters MC, Lubin B, Lorey F, et al. Newborn screening for hemoglobinopathies in California.Pediatr Blood Cancer.avr 2009;52(4):486-90.
3. WHO/TIF Meeting on the Management of Haemoglobin Disorders (2007: Nicosia C, Organization WH, Federation TI. Management of haemoglobin disorders: report of a joint WHO-TIF meeting, Nicosia, Cyprus, 16-18 November 2007. World Health Organization; 2008.
4. Barden EM, Kawchak DA, Ohene-Frempong K, Stallings VA, Zemel BS. Body composition in children with sickle cell disease.Am J ClinNutr.juill 2002;76(1):218-25.
5. Alvarez OA, Hustace T, Voltaire M, Mantero A, Liberus U, Saint Fleur R. Newborn Screening for Sickle Cell Disease Using Point-of-Care Testing in Low-Income Setting. Pediatrics.oct 2019;144(4):e20184105.
6. Makani J, Williams TN, Marsh K. Sickle cell disease in Africa: burden and research priorities. Ann Trop Med Parasitol.janv 2007;101(1):3-14.
7. Zemel BS, Kawchak DA, Fung EB, Ohene-Frempong K, Stallings VA. Effect of zinc supplementation on growth and body composition in children with sickle cell disease.Am J ClinNutr.févr 2002;75(2):300-7.
8. Fenomanana J, Rakotoniaina I, Manantsoa SN, Randriamahenina H, Randriamanantany ZA. Prévalence du trait drépanocytaire chez les donneurs de sang au centre régional de transfusion sanguine de la région Haute Matsiatra, Madagascar. Pan AfricanMedical Journal. 24 août 2020;36(1).
9. Mandu K, Tusuubira SK, Mwambi B, Webbo F, Atuhairwe C, Taremwa IM. To test or not: occurrence of sickle cell trait and assessment of the awareness toward its screening among patients attending Magale Health Center IV, Namisindwa District, Eastern Uganda. J Blood Med. 2018;9:219-25.
10. Khan S, Attaullah S, Ayaz S, Niaz Khan S, Shams S, Ali I, et al. Molecular epidemiology of hcv among health care workers of khyberpakhtunkhwa. Virol J. 8 mars 2011;8:105.
11. Antwi-Baffour S, Asare RO, Adjei JK, Kyeremeh R, Adjei DN. Prevalence of hemoglobin S trait among blood donors: a cross-sectional study. BMC Res Notes. déc 2015;8(1):583.
12. Omisakin C.T, Esan A.J, Ogunleye A.A, O. Ojo-Bola, Owoseni M.F, Omoniyi D.P. Glucose-6-Phosphate Dehydrogenase (G6pd) Deficiency and Sickle Cell Trait among Blood Donors in Nigeria. AJPHR. 27 mars 2014;2(2):51-5.
13. G Schilirò , F F Comisi, R Testa, S P Dibenedetto, P Samperi, S Marino. Hematological findings in 375 Sicilians with Hb S trait. Haematologica. avr 1990;75(2).
14. Jeremiah ZA. Abnormal haemoglobin variants, ABO and Rh blood groups among student of African descent in Port Harcourt, Nigeria. African health sciences.sept 2006;6(3):177.
15. World Health Assembly 59. Sickle-cell anaemia: report by the Secretariat. 2006; Available on: https://apps.who.int/iris/handle/10665/20890 consulted the 18 jan 2022