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PREVALENCE OF HEMOGLOBIN S TRAIT AMONG BLOOD DONORS IN TERTIARY CARE CENTER OF CENTRAL INDIA- A CROSS-SECTIONAL STUDY

Pathology

Dr. Vijay Kapse Associate Professor, Department Of Pathology, Pt. Jawahar Lal Nehru Medical College, Raipur, C.G.

Dr. Vanita Bhaskar* Assistant Professor, Department Of Pathology, Pt. Jawahar Lal Nehru Medical College, Raipur, C.G. *Corresponding Author

Dr. Renuka Gahine Director Professor And Head Of Department Of Pathology, Pt. Jawahar Lal Nehru Medical College, Raipur, C.G.

Dr. Apurva Agrawal Assistant Professor, Department Of Pathology, Pt. Jawahar Lal Nehru Medical College, Raipur, C.G.

ABSTRACT

Background: Sickle cell trait (SCT) or Hemoglobin S (HbS) trait is due to inheritance of an abnormal hemoglobin (Hb) gene from one parent and a normal gene from the other. Individuals with SCT may find themselves in the blood donor population without knowing their 'carrier' status and this may have severe consequences on health of a recipient, particularly if they happen to be a sickle cell disease patient. The aim of the study is to determine the prevalence of HbS trait among blood donors. Result: This cross-sectional study was performed for two years and 1 month i.e November 2016 to November 2018. A total of 36093 healthy blood donors were included in the study. Total Replacement Donor (RD) were 21941 (60.7%) and 14152 (39.20%) were voluntary Donors (VD). Two (2) ml of venous blood was collected from each donor into K3EDTA tubes and analyzed using Solubility test and confirmed by Hb Electrophoresis study. Out of 36093 blood donors 874 (2.42%) donors were found positive for Sickle Cell Trait. Conclusion: The results of the study showed the existence of SCT among the blood donor population sampled. Taking blood from such people can harm health of the recipient if they happen to be Sickle Cell Disease (SCD) patients. It is therefore recommended that blood donors as well as donated blood units should be screened for SCT to avoid causing any harm to the recipient.

KEYWORDS

Hemoglobin, Blood donor, Sickle Cell Disease, Electrophoresis, Genotype, Homozygous, Heterozygous.

INTRODUCTION:

Sickle Cell Disease (SCD) refers to a group of disorders that affects hemoglobin (Hb), causing them to form abnormal hemoglobin S (HbS) molecules[1,2]. Affected people inherited the abnormal gene (HbS) from both parents. A person who inherits 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 [3]. The gene for Sickle Cell Disease is more common in Sub-Sahara Africa, Mediterranean countries, the Middle East and India[4]. In India, the sickle cell gene is distributed mainly in Madhya Pradesh, Chhattisgarh, Maharashtra, Orissa, Jharkhand, parts of Andhra Pradesh, Kerala, Karnataka and Tamil Nadu. In some communities, the prevalence of the Sickle Cell Trait is as high as 30% of the total population. Due to a large population, and consanguinous marriage in many communities, there is always a chance of high prevalence of genetic disorders in Chhattisgarh which is one of the growing states of India. The incidence of genetic blood disoders in Chhattisgarh is considered high. According to the screened population it is observed that the prevalence of SCD was 2.1% and Sickle Cell Trait was 10% among different tribes [5].

Sickle Cell Disease is a major public health concern, having socio-economic implications for the affected child as well as their family. Patients with SCD are often hospitalized for long periods[6-8]. Blood transfusion is an important act that saves millions of lives each year [9]. It is estimated that over 90 million blood units are collected worldwide each year[10]. However, transfusing blood containing HbS to a SCD patient can increase the proportion of sickled red cells in the person's circulation, inducing further sickling and causing occlusions in the microcirculation[11]. This deprives the tissues and organs of oxygen, resulting in vaso-occlusive crisis and affecting proper management of the patient[12]. In view of the above, this study sought to determine the prevalence of HbS trait among blood donors to help in ensuring efficient and safe blood donation and transfusion[1].

METHODS AND MATERIALS:

Study setting/participants: The study subjects were apparently healthy individuals between the ages of 18 and 60 years who came to donate Blood at Model Blood Bank, Dr BRAMH, Raipur. They included voluntary and replacement blood donors.

Study design: The study was a cross-sectional study carried for 2 years and 1 months from November 2016 to November 2018. All the subject's blood bags collected were subjected to Hb S Solubility Test and all the positive test were subjected to Hb Electrophoresis study.

Total of 36,093 subjects, involving 21,941(Replacement donors and 14,146 Volunatory donors were screened for Sickling. Two millilitres (2 ml) of blood was collected from each of the donors during blood donation into labelled tri-potassium ethylene diamine tetra-acetic acid (K3EDTA) tubes and mixed gently. Samples were processed within 24 h after collection.

Hb Solubility test

Principle: Sickle cell hemoglobin is insoluble in the deoxygenated state in a high molarity phosphate buffer. The crystals that form refract light and cause the solution to be turbid.

Reagents: Phosphate buffer. Anhydrous dipotassium hydrogen phosphate, 215 g; anhydrous potassium dihydrogen phosphate, 169 g; sodium dithionite, 5 g; saponin, 1 g; water to 1 litre. This solution is stable for 7 days.

Method

1. 2 ml of reagent taken into three 12 _ 75 mm test tubes.
2. The reagent was allowed to warm to room temperature.
3. 10 ml of packed cells (from EDTA-anticoagulated blood) was added to one tube, 10 ml of packed cells from a known Sickle Cell Trait subject as a positive control was added to the second tube and 10 ml packed cells from a normal subject as a negative control was added to the final tube.
4. All tubes were mixed well and were allowed to stand for 5 min.
5. Tubes were held 2.5 cm in front of a white card with narrow black lines and read for turbidity, in comparison with the positive and negative control samples.
6. If the test appears to be positive, it was centrifuged at 1200 g for 5 min. A positive test will show a dark red band at the top, whereas the solution below will be pink or colourless.

Interpretation and Comments

A positive solubility test for sickling indicates the presence of Hb S. A positive solubility test merely indicates the presence of a Sickle

Haemoglobin and does not differentiate between Homozygous or compound Heterozygous. All positive Sickle Tests must be confirmed by electrophoresis or High Performance Liquid Chromatography (HPLC)[13].

We sent the positive cases for Hb electrophoresis study.

Hb Elecrophoresis

Cellulose Acetate Electrophoresis at Alkaline pH

Haemoglobin electrophoresis at pH 8.4–8.6 using cellulose acetate membrane is simple, reliable and rapid. It is satisfactory for the detection of most common clinically important haemoglobin variants.

Principle

At alkaline pH, haemoglobin is a negatively charged protein and when subjected to electrophoresis will migrate toward the anode. Structural variants that have a change in the charge on the surface of the molecule at alkaline pH will separate from Hb A. Haemoglobin variants that have an amino acid substitution that is internally sited may not separate and those that have an amino acid substitution that has no effect on overall charge will not be separated by electrophoresis[13].

RESULTS:

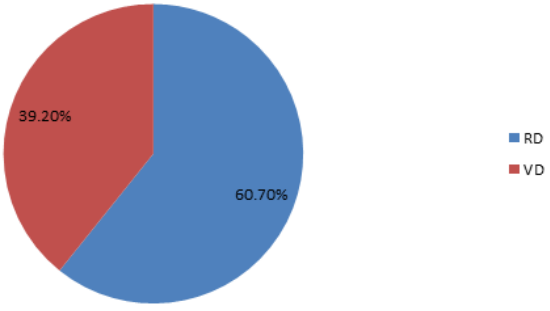
Total of 36,093 donors, involving 21,941(Replacement donors and 14,146 Volunatory donors were included in the study conducted

1) Total no. of donation= 36,093.

RD=21,941(60.7%)

VD=14,152(39.20%)

Chart 1: Total RD and VD Donors



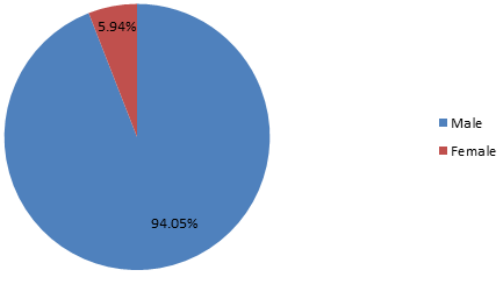
2) Total Sickling PositiveDonors : 874/36093(2.42%)

Male=822/874(94.05%)

Female=52/874(5.94%)

Male: Female ratio of sickle positive cases =15.8:1

Chart 2: Total Sickling postive cases

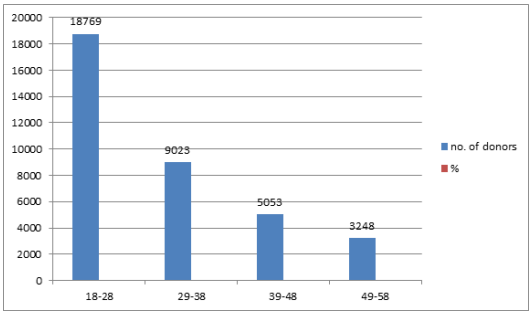


3) Age of donors

Donors age ranged between 18-58 years in the study.

S.no	Age group	No. of donors	%
1	18-28	18769	52
2	29-38	9023	25
3	39-48	5053	14
4	49-58	3248	09
Total		36093	100

Maximum donors were of age range between 18-28 years.



DISCUSSION AND CONCLUSION:

Blood transfusion is a therapeutic procedure but can be harmful instead of saving lives. Every blood donation and transfusion carries a potential risk for both the donor and recipient[14,15]. The Blood Transfusion Services therefore, have a duty of care towards blood donors and recipients to make sure of minimizing the risk.

Total of 36,093 donors, involving 21,941 Replacement donors (RD) and 14,146 Volunatory donors (VD) were included in the study conducted. Total Sickling Positive Donors found in this study were 874/36093(2.42%). Out of 874 Sickling positive cases 822 were male i.e 822/874(94.05%) and 52/874(5.94%) were females. Male is to female ratio of sickling positive cases came to be 15.8:1. None of the above cases were aware of their Sickling status as they had not been screened before. Age distribution showed that, the age group of 18-28 years had the highest number of blood donors (52%) which is similar to the findings in a study by Omisakin et al [16],that had age group of 15–24 years (53.8 %) with the highest number of donors. None of them were aware of their Sickle status as they had not been screened for it before which is similar to our study.

In study done by Antwi-Baffour et al[1] only 4 (2.7 %) of the donors had knowledge of their sickle cell status and Hb genotype. This is because individuals with SCT are usually asymptomatic with most of their hematological parameters such as hemoglobin and red blood cell indices within the normal range [17].

In our study we got Sickling positivity in 2.42% of the total donors. The prevalence of SCT— (AS) of 11.3 % in study done by Antwi-Baffour et al[1] was found to be lower than the 25–30 % quoted for Ghana and 20–40 % for Africa in general [7,18]. Also, considered low in relation to studies done by Omisakin et al. and Zaccheaus et al. which had prevalence of HbS trait as 26.1 and 19.68 % respectively [16,19]. This could be explained by the fact that know Sicklers do not come forward for blood Donation as well as those who come are screened out during donor screening.

It is therefore reasonable to consider the possibility of implementing a practice of routine screening for sickle cell trait in blood donors prior to donating blood or of donated blood units. This way transfusion of HbS containing blood to recipients, with Sickle cell disease which can induce further sickling in sickle cell patients, may be avoided. This will go a long way to help in the proper management of sickle cell disease patients and to establish a useful diagnosis of SCT in blood donors.

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