A Study on Hemoglobin Electrophoresis Profile in Patients with Moderate to Severe Anemia

Bushra Khanam[1], Sudhir Maurya[2], Prakhar Gupta[3], Shainila Shaikh[4]

ABSTRACT

Introduction: Hemoglobinopathy patients can benefit temporarily with nutritional supplementation and blood transfusions but long term outcome can be better if specific diagnosis is made and specific therapy or precautions are undertaken. The aim of the study was to determine frequency of hemoglobin disorders in patients presenting with moderate to severe anaemia using hemoglobin electrophoresis.

Material and Methods: Indoor patients from departments of internal medicine and paediatrics with moderate to severe anemia (without other chronic illness), in a hospital in rural area, were included in the study. Hemoglobin electrophoresis was performed on them to evaluate for presence of hemoglobin disorders. WHO reference range was taken for anemia classification.

Results: Out of 335 samples included in the study, 144 (43%) were found to have hemoglobinopathies with sickle-beta thalassemia being the most common occurrence followed by beta-thalassemia carrier and sickle cell disorder. Beta-thalassemia major was less common. Out of 144 patients with hemoglobinopathies, 86 were males and 58 females. Mean hemoglobin levels at presentation were also calculated and beta-thalassemia presented with the lowest mean hemoglobin (3.7 g/dl).

Conclusion: Recent statistics (NFHS-4) suggest that half of the children and females and about one-fourth of males in India are suffering from some degree of anemia. These figures can have serious economic as well as health related implications, especially for a developing nation like India. When properly managed, the outcome and quality of life of patients with hemoglobin disorders can be improved and since, a significant percentage of patients in our study were found to have hemoglobinopathies of varying severity, it would be advisable to perform investigations to determine specific cause of anemia especially in rural areas where supportive management stays the mainstay of treatment in most scenarios.

Keywords: Hemoglobin Electrophoresis, Moderate to Severe Anemia

INTRODUCTION

Recent most statistics (National Family Health Survey-4, 2015-16) suggest that 58% of children in 6-59 months of age range, 53% of females and 22.7% of males in the age group 15-49 years are anemic in India. For a developing country like India, these figures have important health and economic consequences, especially in rural areas. WHO reports suggest that about half of the world's anemia is due to nutritional deficiency, predominantly iron deficiency states.[1] There have been numerous studies and surveys on nutritional anemias but not much has been studied about hemoglobinopathies in anemic patients especially in rural areas. Hemoglobinopathy patients can benefit temporarily with nutritional supplementation and blood transfusions but long term outcome can be better if specific diagnosis is made and specific therapy or precautions are undertaken.[2,3] We carried out this study to determine frequency of hemoglobin disorders in patients who presented to us with moderate to severe anemia with various manifestations and also to determine which disorder manifests more severely.

MATERIAL AND METHODS

The study was performed in a hospital in a rural area in Indore district of Madhya Pradesh on indoor patients in departments of internal medicine and paediatrics. In total, 335 patients who had moderate to severe anemia were studied. Out of 335 patients, 162 were males and 173 were females. Age group varied from infants to middle-aged adults.

Study Design: The patients whose hemoglobin concentrations fell in the range of moderate to severe anemia and were not having any other chronic illness were included in the study. Hemoglobin range for anemia was taken according to WHO recommendations[1] (table-1).

Hemoglobin electrophoresis was performed to identify variant and abnormal hemoglobins, including hemoglobin A_1 (HbA_1), hemoglobin A_2 (HbA_2), hemoglobin S (HbS), hemoglobin F (HbF) and hemoglobin C (HbC).

The following reference range was taken[4]:

- HbA_1: 95%-98%
- HbA_2: 1.5%-3.5%
- HbF: < 2% (age-dependent)
- HbC: Absent
- HbS: Absent

RESULTS

Of the 335 samples tested for hemoglobin abnormalities, 144 (43%) were found to have hemoglobinopathies. Among the ones with hemoglobinopathies, 86 (60%) were male and 58 (40%) were female. Among the 162 males tested, 86 (53%) had hemoglobin disorders while among 173 females

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Age	Mild	Moderate	Severe
6- 59 month	10-10.9	7-9.9	<7
5-11 year	11-11.4	8-10.9	<8
12-14 year	11-11.9	8-10.9	<8
Female >14 years	11-11.9	8-10.9	<8
8-10.9	11-12.9	8-10.9	<8

Table-1: Haemoglobin concentration(g/dl) for diagnosis of anemia and assesment of severtity acording to world health organisation

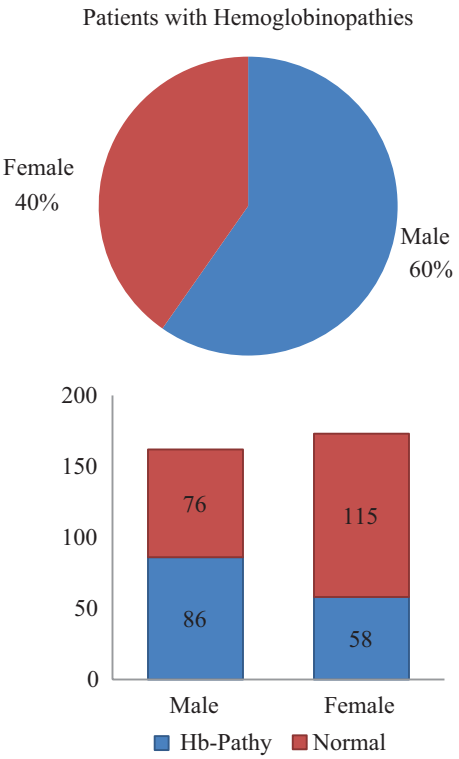

Figure-1: Break-up according to gender

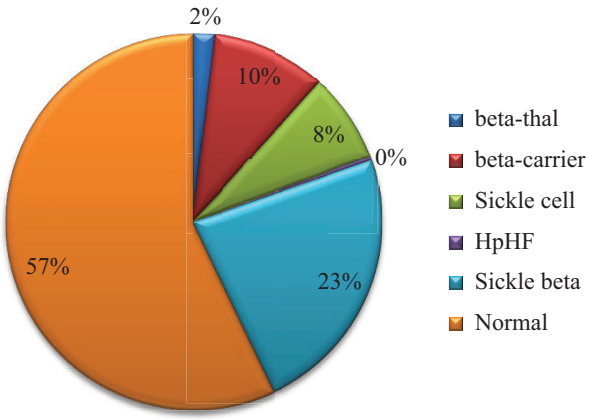

Figure-2: Results of hemoglobin electrophoresis

tested, 58 (33%) were positive for hemoglobinopathies (figure-1). These results suggest that the likelihood of hemoglobinopathies in severe anemia patients is higher among males while females show a higher percentage of anemias due to other causes, predominantly nutritional causes with iron deficiency being the most common culprit.

Of the 335 samples tested, 191 were normal (57%) and the most common disorder was sickle-beta thalassemia 78

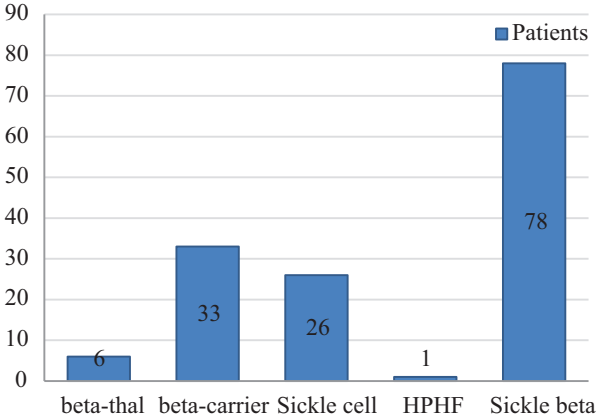

Figure-3: Graph representing the specific numbers of patients with various hemoglobinopathies in our study

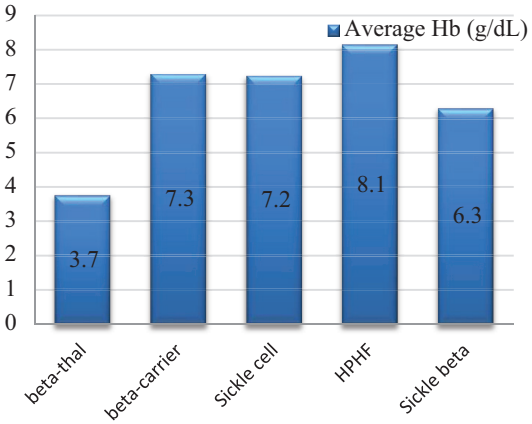

Figure-4: Average hemoglobin concentrations of various hemoglobinopathies in our patients

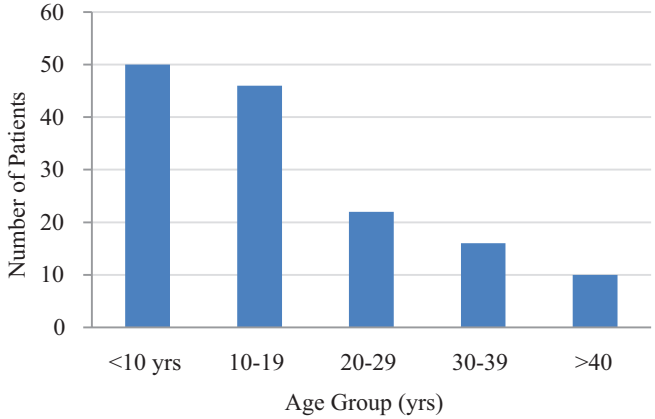

Figure-5: Showing number of patients with various hemoglobinopathies in different age groups.

(23%) followed by beta-thalassemia carrier and sickle cell disorder (including both trait and disease) being 10% and 8% respectively. Beta-thalassemia major was found in 2% of sample and 1 patient had Hereditary persistence of fetal hemoglobin (HPHF) (figure-2).

Beta-thalassemia major patients presented with most severe anemia with average hemoglobin concentration being just 3.7 g/dL. The patients with sickle-beta thalassemia had an average concentration of 6.3 g/dL while sickle cell disorder had an average of 7.2 g/dL. Beta-thalassemia carrier patients had an average 7.3 g/dL and one with HPFH had hemoglobin

8.1 g/dL (figure-3).

Most of the patients who presented with severe anemia and were diagnosed with hemoglobinopathy were less than 20 years of age. Only 10 patients were more than 40 years of age (figure-4).

DISCUSSION

Anemia is a major public health issue in India. National Family Health Survey (NFHS-4 from 2015-16) showed that 58% of children in 6-59 months of age range, 53% of females and 22.7% of males in the age group 15-49 years are anemic in India. In this observational study conducted among patients presenting with moderate to severe anemia as per WHO guidelines, a significant percentage of patients were found to have various types of hemoglobinopathies. This is of particular interest in rural areas where, even today, specific laboratory investigations are not routinely prescribed and such cases might go unnoticed or under-treated. This study was conducted because of the observation that most of the patients who had history of being diagnosed with severe anemia recently or in the past were given blood transfusions and/or iron supplements while ignoring the need for finding out the actual cause for such degree of anemia.

In India, females are more affected with anemia than males[5,8,15] and the reasons range from high cost of healthcare facilities, poor food quality and the low status of women.[5] This condition becomes worse in rural areas as demonstrated by Kaur and Kochar[6] in their study and also attributed poor nutritional status to lower hemoglobin levels in females. A study from Central India also concluded that females have a higher prevalence of anemia than males especially those falling under moderate to severe category.[7] Various studies[5,9,10] have indicated higher prevalence of malnutrition among females than males especially in poor social-economic status populations. This suggests that causes other than nutritional may be more important in male anemic patients and the results of this study also suggest the same as 53% of male patients had hemoglobin disorders.

Central India and some other tribal areas of India are known to have a considerable degree of prevalence of hemoglobinopathies.[11,12,13] Sickle cell disorders as well as beta-thalassemias are especially prevalent in such areas. With proper and early diagnosis and providing specific treatment, the severity of anemia in these disorders can be reduced as well as frequency of complications can be brought down.[2,3] This is of significance in a developing nation like India where health issues can have major social and economic impact. And since almost half of the population of India was found to be anemic, there is a need to address the approach towards anemia related disorders.

Beta-thalassemia and sickle cell anemia are both genetic/hereditary disorders and are present in general population in varying prevalence. Some populations/communities have higher prevalence of these disorders due to preference to consanguineous marriages.[15] Such trend has a possibility of breeding between populations having mutations for both the diseases and resulting in a population having higher prevalence of sickle-beta thalassemia as compared to general population. This is important particularly in this study as sickle-beta thalassemia was the most common hemoglobin defect observed in this study.

Beta thalassemia syndromes are a group of hereditary disorders resulting from genetic deficiency in the synthesis of beta-globin chains.[16] In the homozygous state (i.e., thalassemia major), it causes severe, transfusion-dependent anemia, whereas the heterozygous state (trait or thalassemia minor), causes mild to moderate microcytic anemia. Those presenting with clinical severity lying between that of thalassemia major and minor are said to have thalassemia intermedia. Patients with thalassemia minor generally don't require specific therapy whereas those with thalassemia major are transfusion dependent and need iron chelation therapy. Splenectomy, allogenic stem cell transplantation and supportive measures are also required.

Sickle cell disease/anemia (SCD) and its variants are hereditary/genetic disorders resulting from the presence of a mutated form of hemoglobin i.e., hemoglobin S (HbS).[16] Sickle cell disorders can cause significant morbidity and mortality. Morbidity, frequency of crisis, degree of anemia, and the organ systems involved vary considerably from individual to individual. SCD is suggested by the typical clinical picture of chronic hemolytic anemia and episodes of vaso-occlusive crisis. Electrophoresis is used to confirm the diagnosis by showing presence of homozygous HbS and can also document other hemoglobinopathies like HbSC, HbS-beta+ thalassemia. Management involves preventing/treating infections, management of vaso-occlusive crises, chronic pain syndromes, maintaining hydration, prevention of stroke and renal damage, managing chronic anemia etc. and stem cell transplantation.

Apart from various pharmacological and non-pharmacological measures for hemoglobin disorders, patient education about the illness is also of paramount importance especially counselling about various risks associated with the disease and measures to prevent marriages between at-risk populations as it has been shown that supervision of at-risk population and conducting premarital genetic screening/counselling results in reduction of burden of disease.[2] This can only be made possible if proper investigations are carried out to determine cause of severe anemia and needed measures are undertaken to eventually reduce the burden of the disease.

CONCLUSION

As determined by the study, there's a considerable chance that the patients presenting with moderate to severe anemia can have some underlying genetic/hereditary disorder instead of nutritional causes of anemia. Therefore, steps are needed to be taken for proper diagnosis and management of patients with anemia especially in rural areas in order to reduce burden of the disease as well as cost of treatment and general outcome of the patient.

REFERENCES

1. WHO, UNICEF, and UNU, Iron Deficiency Anaemia: Assessment, Prevention and Control, A Guide for Programme Managers, WHO, UNICEF, UNU, Geneva, Switzerland, 2001, http://www.who.int/nutrition/publications/micronutrients/anaemiairon deficiency/WHO NHD 01.3/en/index.html.
2. Memish ZA, Saeedi MY. Six-year outcome of the national premarital screening and genetic counselling program for sickle cell disease and β-thalassemia in Saudi Arabia. Annals of Saudi Medicine. 2011;31:229-235.
3. Samuel Charache, M.D., Michael L. Terrin, M.D., Richard D. Moore, M.D., George J. Dover, M.D., Franca B. Barton, M.S., Susan V. Eckert et al. Effect of Hydroxyurea on the Frequency of Painful Crises in Sickle Cell Anemia. N Engl J Med 1995; 332:1317-1322.
4. Ferri FF. Ferri's clinical advisor: instant diagnosis and treatment. St. Louis: Mosby 2012:v.
5. Kawaljit Kaur. Anaemia 'a silent killer' among women in India: Present scenario. Euro J Zool Res 2014, 3:32-36
6. M Kaur; GK Kochar, Mal J Nutr 2009;15:175 – 184
7. Gupta Sanjay Kumar, Agarwal Sanjay S, Kaushal Rituja, Jain Ambuj, Gupta Vineet Kumar, Khare Neeraj. Prevalence of Anemia among rural population living in and around of rural health and training center, Ratua Village of Madhya Pradesh. Year: 2014 Volume: 5 Issue Number:1 Page: 15-18
8. The International Institute for Population Sciences(IIPS),Mumbai, India; ORC Macro, Calverton, Maryland, USA and the East-West Center, Honolulu, Hawaii, USA.National Family Health Survey-4 (2015-16)
9. Kshatriya GK, Acharya SK. Gender Disparities in the Prevalence of Undernutrition and the Higher Risk among the Young Women of Indian Tribes. Correa-Velez I, ed. PLoS ONE. 2016;11:e0158308.
10. Patel KA, Langare SD, Naik JD, Rajderkar SS. Gender inequality and bio-social factors in nutritional status among under five children attending anganwadis in an urban slum of a town in Western Maharashtra, India. Journal of Research in Medical Sciences : The Official Journal of Isfahan University of Medical Sciences 2013;18:341-345.
11. Thakur S, Sharma R, Raw SN. Incidence of Thalassemia and Sickle Cell Disease in Chhattisgarh, Central India: Using Hardy Weinberg Equations. J Mol Genet Med 2015;9: 155.
12. Kamble M, Chatruvedi P. Epidemiology of sickle cell disease in a rural hospital of central India. Indian Pediatr. 2000;37:391-6.
13. Mohanty, D., Colah, R.B., Gorakshakar, A.C. et al. J Community Genet 2013;4: 33.
14. Mittal R, Marwaha N, Basu S, Mohan H, Ravi Kumar A. Evaluation of iron stores in blood donors by serum ferritin. Indian J Med Res. 2006;124:641-6.
15. M H Steinberg, B G Forget, D R Higgs, R L Nagel Disorders of Hemoglobin: Genetics, Pathophysiology, and Clinical Management J R Soc Med. 2001 Nov; 94(11): 602–603.
16. Williams Hematology, 8e Lichtman MA, Kipps TJ, Seligsohn U, Kaushansky K, Prchal JT. Lichtman M.A., Kipps T.J., Seligsohn U, Kaushansky K, Prchal J.T. Eds. Marshall A. Lichtman, et al. New York, NY: McGraw-Hill, 2010

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