HEMATOLOGICAL PROFILE OF SICKLE CELL DISEASE: A HOSPITAL BASED STUDY AT CIMS, BILASPUR, CHHATTISGARH

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ABSTRACT: Hematological profile of total 1260 individuals were tested for Sickle Cell Disease who attended CIMS OPD, Bilaspur during a period of May 2008 to October 2009 is presented here. At least 4.44% of the total subjects tested were identified as homozygous for sickle cell gene (SS) and 35% were with sickle cell trait (AS). The patients were confirmed by examining the blood samples for solubility test and hemoglobin electrophoresis using cellulose acetate membrane. Among the SS patients about 58% were males and 42% were females and their ages vary from 7 months to 65 years. The SS patients showed comparatively low level of hemoglobin as well as the RBC count in both the sexes than the AS or normal subjects (AA). PCV was higher in males (31.44±3.1%) than in females (28.62±3.6%). Average MCH and MCHC did not show any significant difference between the sexes. MCV and MCHC were found to be quite higher in SS subjects than AS or AA. Thus in absence of any definite data this investigation may put some insight on the incidence of sickle cell disease in Chhattisgarh.

Key words: sickle cell disease, hematological profile, Chhattisgarh.

INTRODUCTION

The sickle cell disease (SCD) is a widespread genetic disorder characterized by red blood cells assuming an abnormal, rigid, sickle shape that results in a risk of serious complications. It occurs in high frequency in many tropical countries of the world. The sickling occurs due to a mutation in the hemoglobin gene. Homozygosity of the gene, contributed by both the parent, results into sickle cell anemia, whereas persons with one recessive gene are called carrier or trait shows asymptomatic sicklemia[1]. Sickled hemoglobin polymerizes under deoxy condition and therefore obstructs small blood vessels. Thus poor perfusion results in acute and chronic tissue damage. The problems of SCD arise in people from their early childhood, deteriorating the quality of life and also reducing the life expectancy of the patients. While the carrier leads a normal life, the diseased person suffers from various complications such as anemia, frequent infection, fever, hand-foot syndrome, stroke, acute chest pain, vasoocclusive crisis, spleenomegaly, hepatomegaly, renal failure, leg ulcers etc[2]. About 50% of world population of SCD cases is found in India[3]. Estimates indicate that the trait is predominant among the tribal population of central India[4,5]. The prevalence rate of this trait has been reported in Madhya Pradesh ranging from 10-30% among different castes and tribal groups[6,7]. Earlier unpublished reports on this trait in Madhya Pradesh show that the trait is also widespread among the scheduled castes and backward class communities even in higher rates compared to the tribals. Approximately three million population of central India belong to the high risk communities of sickle cell traits. In central India various clinical case studies on SCD have been conducted by different workers especially in Madhya Pradesh, Maharastra and Orissa, whereas a very few reports are available on Chhattisgarh which is not enough to demonstrate the status of the disease in this newly created state[8]. In this current study we attempted to report the hematological profile of sickle cell disease among the various communities of people at Chhattisgarh visiting the OPD of CIMS, Bilaspur.

MATERIAL AND METHOD

This study has been carried out with the collaborative effort of the Chhattisgarh Institute of Medical Sciences (CIMS) and Guru Ghasidas Central University, Bilaspur. Patients included in this study did not show any symptoms related to SCD or other diseases which could affect the hematological parameters. The subjects who had transfused recently (less than 3 months) were excluded from the study. A total of 1260 individuals, ages between 7 months to 65 years, from different districts of Chhattisgarh state were attended during May 2008 to October 2009. Blood samples were collected from patients during their OPD visit using EDTA as chelator and analyzed on KX21 Sysmex auto analyzer. For detecting sickle cell hemoglobin in carrier (AS) and homozygous (SS) state hemoglobin electrophoresis technique was done on hemolysate prepared with EDTA at alkaline pH (pH-8.6) on cellulose acetate membrane. Quantification of hemoglobin was done on Genio automatic electrophoresis system using Beta-thal short program. Statistical analysis (by Sigma Plot 8 software) was conducted using paired t-test and $p<0.05$ is considered as significant.

OBSERVATIONS

Total 56 subjects were found to be homozygous (SS) for sickle cell anemia and 441 with sickle cell traits. Out of the total SS subjects, 32 are males and 24 are females. More number of male cases was observed in the age group 0-10 years while female cases were found in between 20-30 years of age. Number of patients in the pediatric (0-10 yrs), adolescent (11-20 yrs) and reproductive (21-40 yrs) age groups are predominant in our study.

Table 1 demonstrates the age and sex related changes in the hematological parameters of SS patients. It shows that HbA2 is lower in the pediatric age group; then gradually increases until 30 years of age and again starts falling with increasing age.

Total hemoglobin is low in the pediatric age group, then increased significantly ($p<0.00003$ in male and $p<0.00006$ in female) and remains steady in the reproductive age groups till 40 years, then gradually decreases in the post reproductive age. Amount of hemoglobin varies with the total number of RBC count. RBC count is more during reproductive age (male - 3.93 ± 0.96 million/mm^3 and female - 3.27 ± 0.64 million/mm^3) and remains steady until 40 years and then gradually decreases with increasing age. Males shows significantly ($p<0.011$) higher value of hemoglobin (8.18 ± 1.3 gm/dl) than the females (7.54 ± 1.2 gm/dl). Average RBC count is also found to be higher in males (3.01 ± 0.6 mill/mm^3) compared to the females (2.77 ± 0.7 mill/mm^3) but insignificant ($p<0.093$) (Table 2). The packed cell volume (PCV) is slightly lower in males (32.4 ± 4.47%) than in females (32.8 ± 3.88%) of pediatric age groups and then becomes consistently higher in males until 40 years of age (male – 35.7 ± 5.42% and female - 32.75 ± 4.24%). PCV falls in SS patients after 40 years. The average sex related difference in PCV has been observed in SS patients. Males show significantly ($p<0.036$) higher value of PCV (31.44±3.1%) than the females (28.62±3.6%) (Table 2). Age related rise in mean corpuscular volume (MCV) was quite evident in both the sexes however males shows prominent increase than females from 10 to 30 years of age. Mean corpuscular hemoglobin (MCH) is found to be higher at the reproductive (male – 35.33 ± 4.89 pgm and female - 34.12 ± 3.96 pgm) than the pediatric (male – 26.2 ± 4.41 pgm and female – 30.30 ± 3.89 pgm) and post reproductive (male – 27.57 ± 3.52 pgm and female – 26.25 ± 3.78 pgm) age groups. Females of the adolescent and pediatric age show comparatively higher value of MCH than the males. Average MCV in males (90.64±8.2 fl) is quite lower than females (96.57±10.4 fl) but statistically insignificant ($p<0.138$) while MCH is slightly higher in females (30.72 ± 4.1 pgm) compared to the males (29.59±3.2 pgm). No age and sex related difference in mean corpuscular hemoglobin concentration (MCHC) has been observed in diverse age groups.

Table 1: Age and sex related distribution of different hematological parameters of the SS patients.

Age groups	Sex	Number of SS	HbA_2 (%)	Hb (gm/dl)	RBC (mill/mm^3)	PCV (%)	MCV (fl)	MCH (pgm)	MCHC (%)
0-10 yrs	M	11	1.79±0.48	6.37±1.42	2.67±0.48	32.4±4.47	83.05±9.07	26.2±4.41	31.8±3.88
	F	7	2.23±0.82	5.88±1.86	2.31±0.44	32.8±3.88	88.67±8.23	30.30±3.89	30.03±4.26
11-20 yrs	M	7	3.38±0.92	7.74±1.14	2.72±0.62	26.64±3.14	97.06±10.54	29.52±3.67	30.98±4.65
	F	4	2.04±0.56	7.38±1.44	2.79±0.36	24.2±2.88	98.94±11.76	32.60±4.62	32.92±5.27
21-30 yrs	M	8	2.42±0.53	10.66±2.09	3.93±0.96	25.17±4.64	103.09±13.22	35.33±4.89	31.8±4.76
	F	9	3.02±0.78	8.27±1.23	3.27±0.64	21.37±3.56	100.82±11.86	34.12±3.96	32.75±4.49
31-40 yrs	M	2	1.85±0.80	10.17±2.24	3.02±0.72	35.7±5.42	89.43±10.34	27.57±3.52	30.7±3.78
	F	3	2.22±0.66	9.37±1.98	2.97±0.36	32.75±4.24	91.95±9.72	26.25±3.78	31.85±3.36
41-50 yrs	M	3	1.51±0.45	7.12±1.55	2.85±0.33	31.17±5.12	85.13±11.08	26.33±4.13	30.83±4.27
	F	0	-	-	-	-	-	-	-
51-65 yrs	M	1	2.1	6.79	2.81	27.2	87.40	31.2	27.2
	F	1	2.2	7.04	2.36	19.8	94.20	30.1	28.3

Table 2: Sex related average hematological parameters of SS patients.

Sex	Number	HbA_2	Hb (gm/dl)	RBC (mill/mm^3)	PCV (%)	MCV (fl)	MCH (pgm)	MCHC (%)
Males	32	2.14±0.58	8.18±1.31	3.01±0.6	31.44±3.1	90.64±8.2	29.59±3.2	31.58±3.8
Females	24	2.34±0.61	7.54±1.23	2.77±0.7	28.62±3.6	96.57±10.4	30.72±4.1	31.13±3.9

A comparative account of the hematological parameters of SS, AS and AA (normal) subjects have been presented in Table 3. It shows that hemoglobin concentration and RBC count both are found to be significantly low in the SS subjects ($p<0.05$) as compared to the AS or AA. The PCV also found to be low ($p<0.05$) in the SS patients compared to the AA subjects while the value of MCV is significantly higher in SS patients ($p<0.05$) as compared to the AA. However, MCH is shown to be quite higher in SS subjects (but insignificant, $p<0.221$) than the AA subjects. Here also MCHC does not indicates any remarkable difference among the three groups.

Table 3: Comparative hematological parameters in SS, AS and AA subjects.

Hb phenotypes	Number	Hb (gm/dl)	RBC (mill/mm^3)	PCV (%)	MCV (fl)	MCH (pgm)	MCHC (%)
SS	56	7.9 ± 1.2	2.92 ± 0.43	30.18 ± 2.9	93.9 ± 9.3	29.7 ± 3.2	31.4 ± 3.6
AS	441	10.3 ± 2.4	3.87 ± 0.22	31.48 ± 4.1	89.4 ± 8.7	26.3 ± 3.9	30.7 ± 4.3
AA	763	10.8 ± 2.1	3.84 ± 0.88	34.65 ± 3.4	83.1 ± 9.1	27.1 ± 5.7	30.9 ± 4.7

DISCUSSION

This present study demonstrates the hematological profile of sickle cell anemia or traits among the different communities at Bilaspur and its surrounding districts of Chhattisgarh state. It has been estimated that about 50% of the total world population of SCD patients resides in India especially in the central zone. Chhattisgarh is a newly created state of central India and most of the people of this region either belong to the tribal or backward classes. Occurrence of SCD is found to be very high in this state, however no thorough work has been done yet except a few[8]. Studies on the tribal populated regions of the states of Maharastra, Gujarat, Orissa, Madhya Pradesh and Tamil Nadu have been reported by several workers[5,6,7,10]. In this current report we attempted to show the hematological parameter of SCD and carrier states of patients visiting CIMS OPD. Most of the patients (about 51%) attended were from Bilaspur district and the rests were from Durg (12%), Jangir (11%), Rajnandangaon (3%), Raigarh (6%), Korba (7%), Sarguja (2%), Kawardha (4%), Koriya (3%) and Jashpur (1%) districts. Among the SS and AS subjects about 62% belongs to the backward caste, a comparatively higher number as against the scheduled castes and tribes which were about 18% and 15% respectively. This data indicates that sickle cell gene is predominant among the backward and scheduled caste populations, even in higher numbers than the adjoining tribal population at Bilaspur and its surrounding districts, at least in our case. Some early unpublished data indicated that about 15% of the state population belongs to the sickle cell carrier and 1.27% with sickle cell disease. It already has attained alarming proportions with more than 50% children dying before the age of 5 and many others early of their youth.

In this current investigation hematological profile of 56 SS subjects have been presented. Data indicated more number of males as compared to the females with SS or AS conditions. The patients diagnosed with SS hemoglobin were visited OPD for the frequent occurrence of fever and some other minor complications. Blood examinations revealed anemic conditions and therefore thorough investigation detected the sickle cell disease or traits. The SS patients experiences great clinical complications than the traits or carriers of this disease who generally leads a normal life. Hemolysis is a constant finding in SCD, with approximately one third of the RBCs undergoes hemolysis during oxygenation and deoxygenation process or may be phagocytosed by the macrophages. Our study indicated the SCD patients with anemic conditions having low levels of total hemoglobin and RBC count than the AS or AA, as has been observed by other workers[9,10,11]. Total hemoglobin is low at the pediatric age probably because of repeated infections by pathogens, inadequate nutrition or excessive need for growth. Hb level then starts rising gradually after 14 years of age and reaches its peak till 40 years of age. After that, the level gradually falls during post reproductive period. Rise in total hemoglobin in the reproductive age possibly as a result of hormonal changes in males[12] and nutritional requirements and use of medications during pregnancy in females.

A fall in total hemoglobin in the late age may involve various reasons in addition to renal failure[13]. SS patients often suffer from iron deficiency anemia could be due to low dietary intake or malabsorption from the intestine[14]. In an early report on Orissa state indicated that the incidence of iron deficiency anemia was about 23% among the SS patients[15]. This could be the possible reason for higher incidence of reduced hemoglobin level in SS than in AS or AA subjects. Our data shows an age related rise in PCV and MCV in both the sexes as has been observed by other workers[9,13]. While rise in PCV is more in males, MCV in contrast found to be higher in females. In the SCD patients Vit B-12 and folic acid are maintained in a critically balanced state. Increased demand in erythropoesis due to chronic hemolysis or pregnancy in females causes deficiency state and leads to macrocytosis[16]. A higher value of PCV and MCV could be due to the macrocytosis in both the sexes. A rise in the MCH level in SS subjects might also due to the same reason. An early study with some Jamaican SS patients showed higher values of MCV and MCH in them as against the normal subjects which strongly in support of our findings[16]. There is no age or sex related difference could be observed in MCHC value of SS patients in our study.

About 17% of the state's population is affected with Sickle cell anemia. The state government has recently directed all government hospitals to make it mandatory to screen blood samples for the fatal diseases. The commonly occurring diseases among the socially and economically weaker sections of society, is spreading fast due to lack of effective intervention by different government agencies. If remain ignored it will result in extinction of some castes and tribals from this state.

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