

Hematological Profile of Sickle Cell Anemia Subjects in Central India: A Cross Sectional Analysis

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ABSTRACT

Background: Sickle cell disease has high prevalence in Central India, ranging from 9.4-22.2% in different communities. Chronic normocytic normochromic hemolytic anemia is the typical finding in Sickle Cell Anemia (SCA). The hematological profile worsens during the complications. Thus knowledge of the average values of hematological parameters will be of utility to the clinicians.

Methods: A cross sectional study was carried out in the Department of Pathology at a Medical Institute in Central India over the period of one and half years. Two ml of venous blood sample was collected in dipotassium ethylene diamine tetraacetic acid (K2 EDTA) bulb for complete blood count from SCA patients in steady state and analysed by automated hematology cell counter. All statistical analysis was done after recording the complete data of hematological parameters on Excel worksheet.

Result: This study had lower average values of total hemoglobin, Red Blood Cell (RBC) count and hematocrit. Age wise increase in hemoglobin and hematocrit was noted till fourth decade. Higher values of Red Cell Distribution Width (RDW) and Reticulocyte count; and normal values of RBC indices, Platelet count, Total Leukocyte Count and Granulocyte % was seen.

Conclusion: The average value of hematological parameters suggest moderate normocytic normochromic anemia in SCA patients in steady state. A larger scale work is recommended in this region for a baseline hematological profile for guiding the clinicians in management of these patients.

Keywords: Hematological Profile, Sickle Cell Anemia, Steady State, Central India.

Introduction

Sickle cell disease (SCD), a group of related blood disorders which are caused by sickle hemoglobin (HbS), is clinically one of the most important hemoglobinopathies. It was first recognized as a hematological disorder more than 100 years ago and a molecular disease in 1949.^[1] Sickle cell anemia (SCA i.e. SS), the homozygous state for HbS, is the most common and severe form. SCD also includes compound heterozygous states for HbS and other hemoglobinopathies, such as HbC and sickle cell – β - thalassemia. The gene for HbS occurs commonly, but not exclusively, in individuals of African ancestry.^[2] Sickle cell disease is prevalent in many parts of India including Central India, where the prevalence in different communities has ranged from 9.4-22.2%,^[3] and the average frequency of SCD gene ranges between 22 to 44 %.^[4] Also 50% of world population of SCD resides in India.^[4] Blood picture in sickle cell anemia is of hemolytic anaemia, characterized by low haemoglobin levels, reticulocytosis, elevated serum levels of lactate dehydrogenase and low serum haptoglobin levels, present in all major forms. A moderately severe normocytic, normochromic anemia manifests in these patients by 3 months of age,^[5] and persists throughout life.^[6] The hematological profile worsens during

the devastating complications clinically manifesting as hemolytic anemia, an increased susceptibility to infections and vaso-occlusion followed by ischemic tissue injury with organ dysfunction and early death.^[7]

Thus current study attempts to report and compares the hematological profile of SCA patients in steady state with other studies in same region.

Materials and Methods

The present cross sectional study was carried out in the Department of Pathology, at a Medical Institute in Central India over the period of one and half years. The hospital of this institute caters to the population residing in the adjoining districts of Central India.

Inclusion criteria:

- Confirmed patients of sickle cell anemia diagnosed by haemoglobin electrophoresis and HPLC.
- Informed consent was sought from all cases.

Exclusion criteria:

- Patients with history of complications in past two years.

- Patients with chronic conditions like renal failure, which can affect the hematological findings.
- Patients who had received blood transfusion within past three months.
- Cases from whom informed consent could not be obtained.
- The heterozygous & double heterozygous patients.
- Sufficient blood sample could not be collected for hematological evaluation.
- Patients on hydroxyurea.
- Patients who had no easily assessable unpunctured vein for procuring blood sample.

From the patients selected for this study detailed history was elicited to reconfirm steady state, and to obtain information on all SCD related symptoms.

Two ml of venous blood sample was collected in EDTA bulb for complete blood count (CBC) and analysed by automated hematology cell counter (ERMA IMC, Tokyo, particle counter). Parameters including Hemoglobin (Hb), Red Blood Cell Count (RBC ct), Hematocrit (Hct), Red Blood Cell (RBC) Indices [Mean Cell Volume (MCV), Mean Cell Hemoglobin (MCH), Mean Cell Hemoglobin Concentration (MCHC)], Red Cell Distribution Width (RDW), Reticulocyte Count (Retic %), Platelet Count (Plt Ct), Total Leukocyte Count (TLC) and Granulocyte% (Gran%) obtained were noted.

All statistical analysis was done after recording the complete data on Excel worksheet.

Result

A total 65 SCA patients in steady state attending OPD during the study period were included. There were 31

males and 34 females (Table 1) with age ranging from 11 months to 43 years. Maximum number of males (n=9) as well as females (n=12) were seen in 13-20 years age group (Table 1). The age and sex related changes in the hematological parameters of SCA patients are documented in Table 2. Average Hb observed in males and females was 8.93 ± 2.11 gms/dl and 8.05 ± 1.88 gms/dl respectively (Table 2). Steady rise in hemoglobin levels with increasing age are recorded in both genders till the fourth decade; in fifth decade slight fall in the hemoglobin is seen both sexes. Least average hemoglobin is seen in females of age upto 5 years (6.2 ± 1.5 gms/dl).

Low average RBC count is noted in both the genders and in all the age groups (overall in males -3.36 ± 0.58 millions/ μ l & females -3.24 ± 0.62 millions/ μ l). Average RBC count is seen to be decreasing with increasing age in females till third decade. Age related rise in hematocrit was observed till fourth decade with a small dip in 13-20 years in females. The hematocrit values - overall average, in males and in females was lower. MCV, MCH, MCHC are showing almost steady rise with increasing age in females till fourth decade. Average values of all these RBC indices overall, in males and females approximated to normal. The RDW & Reticulocyte count are increased in both genders and all ages. In contrast, the platelet count, TLC and Gran% are within normal range.

Discussion

The importance of baseline haematological values of any patient of sickle cell disease lies in their use in monitoring the status and management of these patients. Also chronic normocytic normochromic hemolytic anemia is the typical finding in SCA. This study has more number of female subjects (n=34) than male (n=31). Maximum patients are in

Table 1: Age and Gender wise Distribution of the Sickle Cell Anemia cases.

Age group	Sickle cell anemia (n=65)		Total
	Males	Females	
0-5	4	3	7
6-12	6	6	12
13-20	9	12	21
21-30	7	9	16
31-40	4	3	7
41-50	1	1	2
Total	31	34	65

Table 2: Hematological Parameters of Sickle Cell Anemia cases: age and gender wise average values.

Sr no	Parameter	Sex	0-5 years (Mean \pm SD)	6-12 years (Mean \pm SD)	13-20 years (Mean \pm SD)	21-30 years (Mean \pm SD)	31-40 years (Mean \pm SD)	41-50 years (Mean \pm SD)	Overall (Gender wise) (Mean \pm SD)	Overall (Mean \pm SD)
1	Hb gms/dl	M	7.08 \pm 2.33	7.5 \pm 0.65	8.2 \pm 0.75	10.5 \pm 2.39	11.43 \pm 0.41	10.5	8.93 \pm 2.11	8.47 \pm 2.03
		F	6.2 \pm 1.5	6.7 \pm 1.76	7.2 \pm 1.13	9.5 \pm 0.77	10.93 \pm 0.45	10.1	8.05 \pm 1.88	
2	RBC ct Millions /cumm	M	3.31 \pm 0.25	3.08 \pm 0.42	3.21 \pm 0.43	3.67 \pm 0.84	3.61 \pm 0.73	3.32	3.36 \pm 0.58	26.55 \pm 3.74
		F	3.46 \pm 1.45	3.41 \pm 0.79	3.18 \pm 0.56	3.12 \pm 0.33	3.24 \pm 0.45	3.2	3.24 \pm 0.62	
3	HCT %	M	25.1 \pm 5.64	26.53 \pm 3.68	26.08 \pm 3.75	30.47 \pm 5.497	29.7 \pm 3.45	28.1	27.57 \pm 4.55	3.29 \pm 0.60
		F	23.2 \pm 3.08	25.73 \pm 3.62	24.65 \pm 2.44	26.12 \pm 1.79	26.67 \pm 1.498	26	25.62 \pm 2.55	
4	MCV fl	M	71.77 \pm 20.89	86.12 \pm 4.54	81.15 \pm 4.82	83.95 \pm 8.10	83.59 \pm 8.13	84.6	81.96 \pm 9.59	81.73 \pm 13.55
		F	75.06 \pm 28.64	77.73 \pm 11.86	78.57 \pm 8.05	84.09 \pm 5.04	83.04 \pm 7.04	81.3	81.57 \pm 15.87	
5	MCH pg	M	22.14 \pm 6.37	24.46 \pm 1.21	25.68 \pm 1.87	30.52 \pm 4.17	32.58 \pm 5.86	31.6	27.16 \pm 4.99	26.43 \pm 5.22
		F	19.01 \pm 4.00	22.85 \pm 4.03	22.69 \pm 1.36	30.61 \pm 2.69	34.09 \pm 3.35	31.6	25.76 \pm 5.42	
6	MCHC gms/dl	M	32.18 \pm 12.295	28.47 \pm 2.05	31.71 \pm 2.68	36.38 \pm 4.08	38.76 \pm 3.44	37.4	33.29 \pm 5.88	32.65 \pm 5.998
		F	24.35 \pm 9.55	29.697 \pm 5.17	29.10 \pm 2.75	36.43 \pm 2.79	41.03 \pm 0.90	38.9	32.07 \pm 6.13	
7	RDW	M	14.28 \pm 2.72	21.05 \pm 5.64	15.3 \pm 4.78	19.03 \pm 4.74	16.75 \pm 2.34	23.6	17.31 \pm 4.68	16.78 \pm 4.03
		F	17.53 \pm 5.83	15.32 \pm 2.35	17.16 \pm 3.995	15.12 \pm 1.54	14.37 \pm 1.63	15.9	16.34 \pm 3.41	
8	Retic ct %	M	6.88 \pm 5.92	3.88 \pm 0.25	3.5 \pm 2.57	4.67 \pm 2.75	5 \pm 1.96	4	4.64 \pm 3.06	4.82 \pm 2.93
		F	4.5 \pm 4.27	5.33 \pm 5.05	5.05 \pm 1.62	4.3 \pm 1.44	4.33 \pm 1.04	7	4.98 \pm 2.87	
9	PLT ct 1000 /cumm	M	249.75 \pm 44.13	254 \pm 140.198	244.67 \pm 118.04	307.33 \pm 165.50	212.25 \pm 94.49	460	259.73 \pm 114.2	244.88 \pm 111.55
		F	148.67 \pm 36.46	224.33 \pm 97.81	220.46 \pm 103.74	278.2 \pm 132.83	209.67 \pm 86.41	432	232.31 \pm 109.91	
10	TLC 1000 /cumm	M	6.5 \pm 0.49	7.875 \pm 0.998	7.38 \pm 1.20	7.467 \pm 1.24	7.48 \pm 0.63	6.8	7.31 \pm 0.97	7.08 \pm 0.898
		F	6.5 \pm 0.87	7.33 \pm 0.84	7.07 \pm 0.92	6.7 \pm 0.47	6.53 \pm 0.78	5.9	6.91 \pm 0.83	
11	GRAN %	M	36.5 \pm 4.04	58.5 \pm 6.03	66.33 \pm 6.95	64.33 \pm 11.59	58.5 \pm 3.697	65	57.73 \pm 12.24	58.61 \pm 12.12
		F	35.67 \pm 4.51	53.5 \pm 9.69	67.36 \pm 6.07	62.4 \pm 8.14	63.67 \pm 9.50	47	59.28 \pm 12.21	

Hb – Hemoglobin.; RBC ct - Red Blood Cell Count.; Hct – Hematocrit.; MCV - Mean Cell Volume.; MCH - Mean Cell Hemoglobin.; MCHC - Mean Cell Hemoglobin Concentration.; RDW - Red Cell Distribution Width.; Retic % - Reticulocyte Count.; Plt Ct - Platelet Count.; TLC - Total Leukocyte Count.; Gran% - Granulocyte%.

Table 3: Comparison of Hematological Parameters in studies of Central India.

Sr no	Parameter	Present study (n=65)	Kohchale et al 2015 (n=24) (Mean + SD)	Kulkarni et al 2014 (n=48) (Mean + SD)	Swarnkar et al 2010 (n=58) (Mean + SD)	Shrikhande et al 2007 (n=) (Mean + SD)
1	Hb	8.47± 2.03	10.33± 2.511	Decreased (9)	6.4±1.96	6.95 ± 2.01
2	Hct	26.55±3.74	26.444 ± 7.958	--	20.84±6.40	--
3	RBC ct	3.29±0.60	3.6337 ± 1.3203	Lower	--	2.58 ± 0.75
4	MCV	81.73±13.55	76.589 ± 10.497	--	82.91±5.43	87.63 ± 13.29
5	MCH	26.43±5.22	--	--	25.78±1.86	
6	MCHC	32.65±5.998	34.969 ± 1.294	--	26.02±1.78	31.01 ± 1.68
7	RDW %	16.78±4.03	17.341 ± 2.276	--	--	--
8	Retic ct %	4.82±2.93		Slightly raised	3.81±1.29	--
9	Plt ct	244.88±111.55	217.93±101.46	--	275±130	--
10	TLC	7.08±0.898	7.089±2.769	Normal	11.547±5.891	--
11	Gran%	58.61±12.12	40.726±16.419	--	--	--

13-20 years age group followed by 21-30 years age group. No patients are more than 50 years, may be due to apathy towards them which may be due to economic constraints, other reason may be death before reaching this age.

Total hemoglobin is low in all SCA patients, possibly on account of chronic hemolysis. In comparison to other studies in this region, the average value is less than that reported in Gadchiroli region,^[8] but more than that reported by other two,^[9-10] as seen in Table 3. By 10 to 12 weeks of age mild hemolytic anemia is apparent in SCA.^[11-12] Here, in the first five years of life clinically moderate anemia was seen in both genders. Lower level of hemoglobin seen in age upto 12 years could be due to additional nutritional requirement in childhood and recurrent infections along with pre existing mild hemolysis. Rapid increase in hemoglobin was noted afterwards till 40 years age. In males it may be due to enhancing effect of testosterone on hematopoiesis, as there is increase in the level of this hormone with onset of puberty. In females it may be due to increasing awareness for nutrition and medical attention in child bearing age group. The age wise changes in hemoglobin are similar to Shrikhande et al,^[10] and those in females are similar to Hayes et al.^[13]

The average RBC count is higher, and lower than one study each. The average hematocrit is found similar to,^[8] and higher than one other work.^[9] As expected, the hematocrit, MCV, MCH and MCHC are higher in males than females. Overall MCV is similar to other studies of this region,^{[9-10], [14]} except one.^[8] Observations of decreased MCV are also there, justified by concurrent iron deficiency.^[15-16] Increased MCV has also been reported.^[13] This may be owing to increased requirement of folate due to hemolysis

and concurrent folate deficiency. Thus attention towards proper nutrition and supplementation of folate, and iron if required, is re-emphasized. Other RBC indices, increased RDW and Reticulocyte count are more or less similar to other works. These are indicative of ongoing hemolysis, increased production of young RBCs. Platelet count, TLC and Gran% are found normal, indicating their changes might suggest complications. Thrombocytosis was found in steady state by a few, similar to increased TLC.^[17-18] As there are few differences in the hematological findings in the SCA patients found in studies from Central India, larger scale work with more number of cases should be done in this region for validating previous results and for getting a baseline hematological profile for guiding the clinicians in management of these patients.

Conclusion

This study showed lower values of total hemoglobin, RBC count and hematocrit. Age wise increase in hemoglobin and hematocrit was noted till fifth decade. Observations in other studies with MCV values deviating from normal range call for extra attention towards proper nutrition and supplementation of folate, and iron if required. Higher values of RDW and Reticulocyte count were seen; whereas values of RBC indices, Platelet count, TLC and Gran% were in the normal range. These findings are almost same as that of other similar works of Central India. A larger scale work is recommended in this region for a baseline hematological profile for guiding the clinicians in management of these patients.

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