

Evaluation of Baseline Hematologic Parameters of Steady State Sickle Cell Disease Patients at the Chantal Biya's Foundation, Yaounde- Cameroon.

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Abstract

Introduction

Sickle cell disease is a genetic abnormality involving hemoglobin. Although it is primarily a red blood cell disorder, the white blood cells and platelets are also affected by the mutation. The consequence hemoglobin S causing polymerization of hemoglobin, results in hemolysis and anemia. This study aims to provide baseline hematologic parameters in steady state sickle cell disease patients compared with the reference values of normal healthy subjects used at the Chantal Biya Foundation (CBF), in order to monitor other sicklers in Cameroon.

Methodology

A comparative analysis of sickle cell hematologic parameters with control hematologic parameters of normal healthy subjects (reference values of healthy subjects used at the Chantal Biya Foundation) was carried out.

Results

A total of 62 sickle cell disease patients in steady state who complied with the selection criteria were recruited. Of the 62, 29 were females and 33 were males. The age range was from 1 year to 19 years and an average age of 6 ± 4.19 SD. Results from sickle cell patients showed an increase in white blood cells (WBCs), neutrophils and lymphocytes and a great decrease in the mean values of hematocrit Hct. as well as RBC indices; no great or slight difference in the values of basophils compared with the reference values of normal healthy subjects in the CBF Yaoundé, 2015.

Conclusion

Sickle cell disease patients in steady state have lower values of red cells parameters, but higher values of white cells and platelets count when compared with the reference values of normal healthy subjects at the Chantal Biya Foundation.

Key Words: Sickle cell disease patients, Baseline, Hematologic parameters, Steady state.

Introduction

Sickle cell crises are major causes of morbidity and mortality in sickle cell patients. It is a hereditary disorder of hemoglobin synthesis caused by a mutation in the globin gene that changes the sixth amino acid from glutamic acid to valine in the beta globin chain resulting in abnormal sickling of red blood cells [i]. Various conditions precipitate sickling of these abnormal red cells such as: dehydration, infections by microorganisms like bacteria, parasites, viruses and fungi as well as low oxygen conditions [ii]. Abnormal sickling of red cells predisposes to crisis such as; vaso-occlusive crisis, aplastic crisis, (splenic) sequestration crisis and hyper hemolytic crisis [iii]. A child has to inherit two sickle genes- one from each parent to get the sickle cell disease. About 300,000 children are born every year with sickle cell disease, with the vast majority (80 to 90 percent) in Africa and India [iv]. In sub-Saharan Africa, 50 to 90 percent of the children born with sickle cell disease die before the age of 5 years [v]. According to WHO, 1.1% of couples worldwide are at risk of having children with hemoglobin disorder and 27 per 1000 conceptions are affected. Affected birth is estimated at 25 per 1000. Hemoglobin disorders contribute the equivalent of 3.4% of mortality in children aged 0- 5 years worldwide and 6.4% in Africa [vi].

Sickle cell disease has a wide range of clinical presentations. The clinical presentation varies from one individual to another. Although sickle cell disease is a red cell disorder, it is well established that white cells and platelets play significant roles in the pathophysiology of the disease. Consequently, leucocyte and platelet count in the stable state can be used together with clinical parameters to predict the outcome of this disorder [vii] [viii] [9]. Although largely established as indices of clinical outcome in sickle cell disease, these parameters have not been widely evaluated in Africa and especially in Cameroon. Given that biological parameters vary with race, sex, age and ethnic groups, it is relevant to know these variations in each country and if possible, in different regions of a country in order to provide standard values. Knowledge of the baseline values of biological parameters could help predict and prevent outcomes of the disease, in case of any variation of one of the parameters. Since sickle cell disease patients frequently fall into crises, their baseline hematologic parameters at steady state is not known in Cameroon as patients mostly come to treatment centres only when in crisis and clinicians focus more on helping the patients out of the crisis as soon as possible by either doing a blood transfusion, putting them on non-steroidal anti-inflammatory drugs (NSAIDs) such as diclofenac or naproxen to manage acute pains and also placing them on antibiotics to prevent infections. In Cameroon, equipment to detect hemoglobinopathies are inaccessible and most patients do not know their hemoglobin electrophoresis status. It is therefore of great importance to know baseline hematologic parameters in steady state sickle cell disease patients as this will permit us to predict the hemoglobin electrophoresis status of general patients as well as follow up clinical outcomes of known SCD patients. Hematologic parameters of sickle cell disease patients in steady state at the Chantal Biya's Foundation were assessed in order to provide a range of baseline values that can be used to monitor other sickle cell disease patients.

Material And Methods

A comparative descriptive study design was carried out at the Chantal Biya's foundation (CBF)-Mother and child centre, Yaoundé, Cameroon. Authorization for research was obtained from the director of the CBF. Oral informed consent was administered to the parents of children with sickle cell disease (SCD) who came for their regular checkup at the CBF. Sixty-two patients were recruited for the study over a 3 months period (February to May, 2015). Patients included were confirmed consenting cases of steady state (Steady state was defined as no manifest crisis for at least 2 weeks after the last episode, and 4 months after the last blood transfusion) and greater than 1 year of age. They were regular attendees of sickle cell clinic at the CBF. Blood samples were collected from patients during their visit using EDTA tubes as chelator and analyzed on PENTRA 60 C+ auto analyzer to test for full blood count parameters. The patients were stratified into females and males.

Statistical analysis was conducted using Microsoft Excel 2007 soft-wares. Clinical and hematologic parameters were expressed as means and standard deviations and compared in the two groups of SCD patients (stratified according to gender). The results were compared to the reference value of normal healthy subjects used at the CBF.

Results

A total of 62 sickle cell disease patients in steady state who were eligible according to the criteria were recruited for their hematological parameters. Of the 62, 29 (47%) were females and 33 (53%) were males. The age ranged from 1 year to 19 years and the average age was 6 ± 4.19 SD years. Mean (SD) ages of females was 6.8 ± 4.9 (SD) years where as mean (SD) age of males was 5.3 ± 3.4 (SD) years. Majority of the subjects for both males and females was observed in the age group 4 to 6 years, as shown in Table 1.

Table 1: Age and sex related distribution of the study subjects

Age groups (years)	Sex	Number of SS patients
1-3	F: 8 M: 9	17
4-6	F: 10 M: 11	22

7-10	F:5 M:9	14
>10	F: 6 M:3	9

Table 2 shows the means plus standard deviations of the hematologic parameters of the overall population. These results were then compared to the reference value of normal healthy subjects used at the CBF shown in table 4.

Table 2: Overall mean (SD) values of hematologic parameters of study subjects

Parameters	Range of Values	Total Mean \pm SD
RBC (T/L)	1.85 – 4.26	2.81\pm0.6
Hb (g/dl)	04.8 – 9.8	7.4\pm1.0
MCV (FL)	51 – 176	82.3\pm15.9
Hct. (%)	09.8 – 27	22.1\pm3.1
MCH (Pg)	17 – 33.9	25.9 \pm 3.7
MCHC (g/dl)	09.25 – 36	32.7 \pm 3.6
WBC (G/L)	5.1 – 49.4	15.1\pm7.4
Neutrophils (G/L)	1.4 – 21.7	6.6 \pm 3.6
Lymphocytes (G/L)	1.4 – 16.2	6.2 \pm 3.3
Eosinophils (G/L)	0.0 – 4.8	0.7 \pm 1.3
Monocytes (G/L)	0.0 – 0.4	1.4 \pm 1.1
Basophils (G/L)	0.0 – 0.4	0.1 \pm 0.1
Platelets count (G/L)	112 – 835	441 \pm 164.6
Reticulocytes count/ μ l	23660 – 723520	287932.4\pm185354.1

Table 3: Overall average (SD) values of hematologic parameters of females and males

Parameters	Range of values		Mean values \pm (SD)	
	Female	Male	Female (n=29)	Male (n=33)
RBC (T/L)	1.93 – 4.26	1.85 – 4.02	2.92 \pm 0.7	2.71 \pm 0.6
Hb (g/dl)	5.3 – 9.2	4.8 – 9.8	7.5 \pm 0.9	7.3 \pm 1.1
MCV (FL)	51 – 176	65 – 100	83.1 \pm 21.6	81.6 \pm 9.4
Hct. (%)	9.8 – 27	16 – 27	22.1 \pm 3.4	22.1 \pm 2.9
MCH (Pg)	17 – 33.7	21.5 – 33.5	26.3 \pm 4.1	27.2 \pm 3.4
MCHC (g/dl)	28.5 – 36	9.3 – 36	33.1 \pm 1.9	32.5 \pm 4.6
WBC (G/L)	6.6 – 49.4	5.1 – 29.7	15.9 \pm 9.1	14.3 \pm 5.1
Neutrophils(G/L)	1.5 – 21.7	1.4 – 15.4	6.9 \pm 4.1	6.1 \pm 2.9
Lymphocytes (G/L)	1.4 – 16.2	2.2 – 15	6.1 \pm 3.5	6.2 \pm 3.3
Eosinophils (G/L)	0.0 – 4.6	0.0 – 3.9	0.7 \pm 1.1	0.6 \pm 0.9
Monocytes (G/L)	0.0 – 4.8	0.0 – 2.8	1.2 \pm 0.1	1.3 \pm 0.7
Basophils (G/L)	0.0 – 0.4	0.0 – 0.4	0.1 \pm 0.8	0.01 \pm 0.1

Platelets count (G/L)	140 – 811	112 – 1429	461±156.7	455.7±241.7
Reticulocytes count/ µl	23660-723520	69440 - 699300	304404.3±204032.2	275795.3±175058.9

Table 4. The range of reference values of hematologic parameters in normal healthy subjects used in the Chantal Biya's Foundation.

Parameters	Range of values				
	1yr –3yrs	4yrs – 6 yrs	7 yrs– 10 yrs	Female (> 10yrs)	Male (> 10 yrs)
RBC (T/L)	3.6 -5.2	4.1 – 5.3	4 – 5.4	4.0 – 5.0	4.0 – 6.2
Hb (g/dl)	10.5 – 13.5	10.5 – 13.5	12 – 14, 7	11.5 - 15	13 – 17
MCV (FL)	70 - 86	73 – 89	77 - 91	82 - 98	85 – 95
Hct. (%)	36 - 44	36 – 44	37 - 45	37 - 47	40 – 50
MCH (Pg)	23 - 31	24 – 30	24 - 25	27 - 32	27 – 32
MCHC (g/dl)	32 - 36	32 – 36	30 - 35	32 - 37	32 – 37
WBC (G/L)	6.0 – 15	5.0 – 13	4.5 - 11	4 - 10	4 – 10
Neutrophils (G/L)	1.5 – 8.5	1.5 – 8.5	2.0 – 6.0	2.0 - 7.5	2.0 – 7.5
Lymphocytes(G/L)	4.0 – 10. 5	4.0 – 8	2.0 – 5.0	1,5 – 5.0	1.5 – 5.0
Eosinophils (G/L)	0.05 – 0.7	0.02 – 0.65	0.1 – 0,4	0.1 – 0.4	0.1 – 0.4
Platelets (G/L)	150 - 450	150 - 450	150 - 450	150 - 450	150 - 450

Discussion

There were more males as compared to females in the present study which correlates with the results of Sanjeev et al, [10] who stated that it might be due to the fact that the male child gets more attention as compared to the female child. Also, the fewer children in the greater age range, >10 years, was accounted for the fact that these children were of the school age and were more conscious on handling their status making their checkup to be scheduled only after 3 months or when crisis arose.

Results obtained from this study show much disparity of hematologic parameters of steady state sickle cell disease patients when compared to the reference values of normal healthy subjects used at the Chantal Biya Foundation Mother and child centre, Yaoundé. Tables 2 to 4 show an increase in WBCs, Neutrophils and lymphocytes and a great decrease in the mean values of Hct. as well as RBC and its indices, but no great difference in the mean value of basophils, and reticulocytes count was higher than normal when compared with the reference values of normal healthy subjects used at the CBF Yaoundé, 2015.

The general mean of RBC and Hb of sickle cell disease patients in steady state were lower (2.81 ± 0.6 T/L, 7.5 ± 1.03 g/dl respectively) than the lower limits of the reference value of normal subjects used at the CBF Yaoundé, 2015 (tables 2 and 4). This low value could be due to active hemolysis in these patients, since their red cells are sickle and has a shorter life span. The low mean Hb value is close to the reports of *Omoti, 2005* [11], which was 7.54 ± 2.26 g/dl and *Akinsegun et al, 2012*[9] which was 7.93 ± 1.47 . There was no great difference in the overall mean hemoglobin of females (7.5 ± 0.9 g/dl) and males (7.3 ± 1.1 g/dl).

The general mean Hct. (22.1%) was lower than the lower limit of the reference value (36%) of normal healthy subjects used at the CBF Yaoundé, 2015 (tables 2 and 4). This great decrease may be due to the

active anemia present in sickle cell disease patients or on its effect on the bone marrow and the kidney due to its multisystem nature [11]. The general mean Hct. value obtained from the study was lower than that of other studies (24% and 24.44%) [12][13] and higher than the report of *Obeagu et al, 2014* [12] (20.0 %). This could be as a result of changes in diet and management of the patients. There was no difference in the overall Hct. (22.1%) in both females and males.

The overall mean values of MCV (82.3±15.96 FL), MCH (25.9±3.7 Pg) and MCHC (32.7±3.6 g/dl) were found to be within the range of the reference value (MCV ; 70 – 86 FL, MCH ; 23 – 31 Pg, and MCHC ; 32 – 36g/dl) of normal healthy subjects used at the CBF Yaounde, 2015 (Tables 2 and 4).

The overall mean WBC (15.1 ±7.4 G/L) was greater than the upper limit of the reference value of normal subjects used in the CBF Yaoundé, 2015 (tables 2 and 4). This drastic increase could be as a result of some oxidative stress [12]. The overall mean value of females (15.99 ± 9.1G/L) was higher than those of the males (14.3±5.1G/L) (Tables 3). This WBC value is higher than those reported by *Obeagu E.I et al.,* [12] as 12.6 G/L and by *Omoti, 2005* [11] as 12.72 ± 7.98 G/L. This could be as result of age difference in the studies or the environment

The general mean neutrophils and lymphocytes found in this study were (6.6 ± 21.7G/L, 6.2 ± 16.2 G/L) respectively. This high value is because the generation of a convert inflammatory response leads to the release of cytokine mediators whose main function is neutrophil production by the bone marrow [11]. These values are similar or slightly higher to the report of *Omoti, 2005* [11] which was 5.2 ± 1.6 G/L, 6.5 ± 1.6 G/L for neutrophils and lymphocytes, respectively.

Overall eosinophil and monocytes (0.7 ±1.3 and 1.4 ±1.1 respectively) were slightly higher than the reference values of normal healthy subjects used at the CBF Yaounde,2015 (tables 2 and 4), meanwhile there was no difference in the mean basophil compared to the reference value of normal subjects used at the CBF Yaoundé, 2015. The females had slightly higher mean values than the males.

Overall mean platelet 441 ± 164.6 G/L was found to be within the range of the reference value (150 – 450 G/L) of normal subjects used in the CBF Yaoundé, 2015 (tables 2 and 4), but most sickle cell disease patients had a platelet count of greater than upper limit (450 G/L) of the reference value of normal subjects used at the CBF Yaoundé, 2015 (table 4). The females had higher mean platelet than the males. The high reticulocytes count in these patients indicates that the bone marrow is producing more red blood cells to compensate for the massive destruction of red blood cells in steady state.

Conclusion

Sickle cell disease patients in steady state have lower red cells parameters, and higher White cell parameters when compared to reference values of normal healthy subjects used at the Chantal Biya Foundation. Females had slightly higher hematologic parameters than the males, whereas this is not the case with normal healthy males and females.

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