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Abnormal Hematological Characteristics among Sudanese Children with Down Syndrome

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Abstract

Hematological reference values are very important for diagnosing and interpreting the results and decision-making to assess the hematological parameters among children diagnosed with Down Syndrome in Khartoum State-Sudan. A total of 60 subjects were enrolled in the study. Of them, 30 individuals were patients with Down Syndrome, and 30 apparently healthy individuals were considered control throughout the period from (September 2020 to December 2020). A total of 2.5 ml of venous blood were collected in EDTA containers and investigated using SysmexKX-21N analyzer; the data were analyzed using SPSS – Independent T-test at a 5% level of significance. study revealed that the mean of MCHC and Platelets count for Down Syndrome patients were significantly (P value≤0.00) decreased (32.10±2.42, and 183.27±99.10). Moreover, no significant change in RBCs count, HB, MCV, HCT, MCH, and WBCs values for both groups. The study concluded that Down Syndrome has an obvious effect on some hematological profiles by decreasing Platelets and MCHC. Still, there is no effect on RBCs TWBCs and other RBCs indices.

Keywords: Down syndrome, Hematological profile, CBC, Sudan

Introduction

Down's syndrome (DS) is one of the most prevalent chromosomal alterations worldwide, frequently referred to as trisomy 21 (Yang *et al*., 2002). About one in per 700 infants born may indeed be affected by the syndrome, which is caused by genetic material from chromosome 21 that contributes to the folate-methylation pathway, which is critical for the production of hemoglobin and the construction of deoxyribonucleic acid (DNA). The most widely recognized theory is that anatomical changes in the thymus are the primary source of immunological problems. Consequently, it seems that thymic abnormalities seen in DS patients impact T lymphocyte activity, resulting in a cytokine network disequilibrium (Bloemers *et al*., 2010; Nisihara *et al*., 2014). The measures employed in evaluating thymic function in DS fetuses have altered: aberrant thymic morphology and a reduced lymphocyte T receptor excision circles (TREC) frequency used as thymic efficacy biomarkers. Because certain regulating genes for thymocyte division and proliferating are found on chromosome 21, so this is probable. It is not known, although it is probable that T and B cells are also biologically dysfunctional in addition to thymus disorders (Illouz *et al*., 2021). Initial dementia is related with intellectual disability, morphological dysmorphism, digestive system disorders, heart defects, endocrine anomalies, immunological dysfunction, and neurological impairments (Kusters *et al*., 2011). In terms of the hematological system, children with DS are more likely to have macrocytosis, inadequate platelet counts, and a higher risk of leukemia (Gensous *et al*., 2020). Individuals with DS, just like overall population, may be at risk for IDA and related disability. Anemia is a widespread condition that affects children and pregnant women in all countries, but notably in underdeveloped ones (Webb *et al*., 2007). According to several studies, DS children are more likely to have hematopoietic problems like anemia. This could be due to the combination of genes on chromosome 21, which are involved of the folate-methylation cycle, that is required for the synthesis of hemoglobin and deoxyribonucleic acid (DNA) (Malinge *et al*., 2009). A few of these genes code for proteins and ribonucleic micro acids (RNAs), and their modifications may not only harm the hematopoietic system, but also alter hematopoietic cell development (Trotta *et al*., 2011). As a result, children with DS are expected to have a 10% to 20% greater risk of having leukemia and myelodysplastic syndromes disorders than children without the condition (Lange, 2000; Roberts *et al*., 2013). Moreover, quite a few researches have studied into whether DS affects CBC parameter standard levels in children with the syndrome (McCann & Ames, 2007; Webb *et al*., 2007; Tenenbaum *et al*., 2011), as no previous studies was done in Sudan. Hence our study aimed to assess the hematological parameters among children diagnosed with Down Syndrome in Khartoum State-Sudan.

Materials and Methods

Study Design

A descriptive cross-sectional study was carried out from September to December 2020 to investigate the hematological

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characteristics among down syndrome patients attending the Sudan center for a down syndrome located in Alhage Yusuf (Khartoum). Any complaints from infections such as (viral and bacterial infection) that could clearly affect the CBC results were excluded from participation in the study.

Study Population and Sample Size

Thirty convenience non-probability samples were collected from down syndrome patients and 30 samples from apparently healthy individuals.

Sample Collection

Venous blood was collected using a sterile disposable plastic syringe after cleaning the venepuncture area with 70% ethanol. The blood was added to the anticoagulant at the ratio of 1.5 mg of EDTA to 2.5 of blood.

Diagnostic Technique

The sample probe fluid overloads blood into the sample rotor valve. Then the blood is therefore diluted in 1:500 with 1.996 mL of solvent and delivered to the reaction chamber as a diluted sample (1st dilution step). The specimen is then transported to the transducer's compartment and expelled via the opening in the second phase in the transducer chamber. At this time, parameters are counted by the Direct Current detection method.

Data Collection Tools

The primary data will be collected using a self-administrated questionnaire; this was specifically designed to obtain information that helps in this study.

Data Analysis

The data were analyzed using the SPSS – Independent T-test at a 5% level of significance. The data were presented as means and SD, and the confidence interval was used to show the precision of the study results. The mean was used because is more informative and can be used for inferential statistic of population

Ethical Consideration

All individual was informed about the research objective and procedure during the interview period. Ethical approval was taken from AAU ethical committee.

Results and Discussion

A total of 60 subjects were enrolled in the study; 30 individuals were patients with Down Syndrome and selected according to inclusion criteria from the Sudan center for Down Syndrome and 30 apparently healthy individuals were considered as control. 22 (73.3%) of patients were males their age group range between 1-30 years' old Mean ±SD (12.50±5.07), where 17 (56.7%) were in age group between 11-20 years old. No statistically significant difference was observed between patients and control regarding age and gender; all data are summarized in **Table 1**.

Table 2 compares the mean (SD), means differences of WBCs, RBCs, Hb, HCT, MCV, MCH, MCHC, and platelet count between cases and control groups. Where there were no observable differences in the mean level of all investigated variables. However, there was a significant decrease in MCHC mean level (32.10±2.42, and 33.98±1.00), and platelets mean level was (183.27±99.10 and 254.37±77.59) between DS patients and control (0.000) and respectively. **Tables 3 and 4** illustrated the comparison of the mean (SD), means differences, between gender and age group among Down Syndrome patients; there were insignificant differences regarding all hematological parameters.

Table 1. Demographic Data among Study Groups

	Case N=30 (%)	Control N=30 (%)	P value
Gender			
Male	22 (73.3%)	15 (50%)	**0.532**
Female	8 (26.7%)	15 (50%)	
Age groups			
1- 10 years old	10 (33.3%)	13 (43.3%)	
11-20 years old	17 (56.7%)	8 (26.7%)	**0.629**
20-30 years old	3 (10%)	9 (30%)	
Total	**30 (100%)**	**30 (100%)**	

Table 2. Mean Levels of Hematological Parameters in Case and Control Groups

Variables	Case	Control	P value
TWBCs	6.33±2.13	6.18±1.81	0.765
RBCs	4.49±0.69	4.73±0.52	0.127
HB	12.68±2.15	13.30±1.37	0.188
HCT	38.52±5.24	39.17±3.76	0.581
MCV	82.04±9.75	83.08±4.23	0.593
MCH	26.85±4.43	27.42±4.94	0.637
MCHC	32.10±2.42	33.98±1.00	**0.000**
Platelets	183.27±99.10	254.37±77.59	**0.000**
Age (Year)	12.50±5.07	13.83±8.51	---

- T-rest was used to calculate P-value
- A P-value less than 0.05 is considered significant
- Mean± Standard deviation
- Minimum-maximum between the brackets

Table 3. Mean Levels of Hematological Parameters in Case regarding Gender

Variables	Male (n=22)	Female (n=8)	P-value
TWBCs	6.02±1.99	7.20±2.41	0.185
RBCs	4.61±0.63	4.13±0.74	0.091
HB	12.93±2.36	11.96±1.31	0.280

HCT	39.40±5.58	36.09±3.35	0.128
MCV	81.53±8.79	83.45±12.61	0.641
MCH	27.03±4.085	26.34±5.54	0.711
MCHC	32.18±2.69	31.88±1.56	0.764
Platelets	188.64±105.53	168.50±82.63	0.631

Table 4. Mean Levels of Hematological Parameters in Case regarding Age

Variable	A Group (n=10)	B Group (n=17)	C Group (n=3)	P-value
TWBCs	6.07±2.58	6.12±1.70	8.43±2.46	0.204
RBCs	4.90±0.57	4.28±.70222	4.25±0.36	0.062
HB	13.22±2.06	12.44±2.32	12.20±1.60	0.626
HCT	39.67±5.64	38.31±5.21	35.80±4.42	0.534
MCV	81.47±8.48	82.88±10.89	79.20±9.30 (69.40-87.90)	0.824
MCH	26.91±3.95	27.12±4.82	25.07±4.76	0.771
MCHC	32.67±1.30	31.85±2.96	31.60±2.15	0.665
Platelets	170.70± 74.89	185.65± 111.99	211.67± 119.976	0.822

*Group A (1-10 years old, Group B (11-20 years old), Group C (20-30) years old.

Down syndrome is a common chromosomal disorder characterized by genes on chromosome 21 involving the folate-methylation cycle required for hemoglobin synthesis and Biogenesis, as consequences may affect hematopoiesis. So a cross-sectional descriptive study was conducted in Khartoum to assess hematological parameters among Sudanese Down Syndrome patients.

The present study revealed that the mean (SD) of TWBCs count in Down Syndrome patients was 6.33 (3.00-11.00) and in control was 6.18 (3.40-10.90), as well as the mean (SD) of RBCs in Down Syndrome patients was 4.48 (3.10-5.62 and in control was 4.7290 (3.57-5.71) (p. Value 0.127); these results approved that Down Syndrome did not affect TWBCs, and RBCs count (P. value 0.765), which was agreed with the findings reported by Nisihara (2015). However, it conflicts with the study by Mang *et al*., who noted that leukopenia and neutropenia were significantly more common among DS children (Mang *et al*., 2019), and anemia and iron deficiency are common in children with Down syndrome in the general public (Tenenbaum *et al*., 2011). Malfunction of the trisomic thymus and significant cytokine production dysregulation are hypothesized to be the cause of DS-associated leukopenia (Laura Barreiro Arcos *et al*., 2010). This conflict in our results and that reported in the literature may be attributed to the sample size and the degree of chromosomal mutation among selected participants.

Furthermore, we could not find a significant difference in the incidence RBCs indices (MCV: P. value (0.581), MCH: P. value (0.637) HB (P. value=0.593), and HCT: P. value (0.188) these findings disagreed with the finding reported by Nisihara (2015). Interestingly our findings showed that Down Syndrome had a significant effect on MCHC (P. value≤ 0.000), this result was agreed with the finding reported by Kolialexi (2007), who stated that in DS, iron metabolism problems emerge early weeks of gestation. The result displayed in **Table 2** showed the mean (SD) of platelets count in Down Syndrome patients was significantly much lower 183.2 than in control was (254.37) (Hitzler *et al*., 2003). Children with Down syndrome are more likely to have hematological abnormalities, including anemia and leukopenia. It is also expected that such conditions might necessitate alterations in cell counts in a test like total blood counts (CBC). As a result, DS children are expected to have a 10% to 20% higher risk of acquiring leukemia and myeloproliferative disorders than children who do not have the syndrome (Manna *et al*., 2016). Ethnic disparities in anemia are probably secondary to socioeconomic factors that influence compliance to Health Ministry iron supplementation guidelines. Based on these results, the study recommended that: Regular assessment of hematological parameter for Down Syndrome patients avoid the complications that result from an alteration in these parameters. Further study should be done with a large sample size because of the scarcity of information on the prevalence of anemia in DS patients of various ages and the severe implications of IDA.

Conclusion

The study concluded that Down Syndrome has an obvious effect on some hematological profiles by decreasing the level of Platelets and MCHC. Still, there is no effect on RBCs TWBCs and other RBCs indices.

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