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SCREENING AND DIAGNOSIS OF BETA-THALASSEMIA DEPENDING ON HBA2 AND BLOOD FILM IN BAGHDAD CITY

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ABSTRACT

Background: Thalassemia is a group of inherited disorders that cause chronic anemia due to reduced or no production of hemoglobin. There are two types, α-thalassemia and β-thalassemia, based on genetic mutations and affected globin-chain subunits. **Aim:** This study in central Iraq aimed to increase awareness about different aspects of thalassemia and determine the prevalence, diagnosis, and trends of patients in Iraq based on blood film and HBA2%. **Material and method:** This retrospective study analyzed data from 53 thalassemia patients at Al-Kharama Teaching Hospital in Baghdad during 2020. The researchers examined complete blood counts and blood films for erythrocyte morphology and conducted HPLC analysis to measure HBA2%. They determined the beta-thalassemia types based on HBA2 percentage, complete blood count, blood film examination, and MCV/MCH rates. Data analysis was performed using SPSS version 26, and comparisons were made to evaluate the relationship between beta-thalassemia types and HBA2 percentages. **Results:** The study revealed that globally, thalassemia, particularly β-thalassemia, is the most prevalent genetic blood disorder, with a carrier population exceeding 150 million across 60+ countries. Among the 53 subjects in this study, incidence rates were as follows: β-thalassemia minor (64.2%), β-thalassemia intermedia (26.4%), and β-thalassemia major (9.4%). Comparable rates were observed in Missan Province, Iraq, as well as Lebanon and Pakistan. Factors such as consanguineous marriages, a lack of effective prevention programs, and poor legislation were identified as contributors to the high prevalence of thalassemia in Iraq. The study emphasizes the immediate need for a comprehensive preventive program involving carrier diagnosis, differentiation from iron-deficiency anemia, genetic counseling, prenatal diagnostics, and public education.

INTRODUCTION

Thalassemia is a common disorder in some areas of Asia, the Middle East, Mediterranean countries, and North and Central Africa. It is also becoming more prevalent in North Europe and North America due to migration.[1,2] This

challenges policymakers and healthcare professionals in providing equal access to high-quality thalassemia prevention, diagnosis, and treatment.[3]

Thalassemia is a group of inherited disorders that cause chronic anemia due to reduced or no production of hemoglobin.[1] There are two types, α-thalassemia and β-thalassemia, based on the genetic mutation and affected globin-chain subunits. Over 200 different mutations can be caused by the ß-globin gene on chromosome 11 p15. Most ß-thalassemia mutations involve changing one letter of the genetic code. β-thalassemia is caused by mutations resulting in a single nucleotide substitution.[4]

There are three main β-thalassemia phenotypes based on clinical presentation. The β-thalassemia trait, or the minor, is a β-thalassemia minor, results from inheriting a single β-thalassemia mutation and is characterized by mild anemia.[5] In contrast, some rare mutations synthesize unstable β-globin variants, causing dominant β-thalassemia with more severe symptoms.[7]

Diagnosing thalassemia involves examining blood film showing specific features like Hb C crystals, target cells, and microcytosis.[8,9] Patients with thalassemia have reduced hemoglobin levels.[8] The pattern of hemoglobin in β-thalassemia varies depending on the type.[9] In severe cases, regular transfusions can support average growth and development for up to 10 to 12 years.[6]

Symptoms of thalassemia can appear at birth or develop within the first two years of life. However, some people with a single gene disorder may not show symptoms.[10] Thalassemia is a significant problem in Iraq due to limited resources during war and insecurity.[11]

The most effective test for identifying carriers of β-thalassemia is a quantitative HbA2 measurement. Several methods, such as capillary electrophoresis, cation exchange HPLC, and microchromatography, are accurate and quick.[12]

This study in central Iraq aims to increase awareness about different aspects of thalassemia. It is the first of its kind in this setting, while a previous study focused on thalassemia prevalence in the Baghdad governorate.[13] The objectives of this study were to determine the prevalence, diagnosis, and trends of patients with thalassemia in Iraq depending on the blood film and HBA2%.

MATERIALS AND METHOD

This study was retrospective. All thalassemia patients registered at Al-Kharama Teaching hospital in Baghdad during 2020 were included. Data were obtained from the patient's files and records of the thalassemia center located in this hospital.

Fifty-three (53) samples of different ages, males, and females were collected, and their information was recorded. The complete blood count (CBC) of all patients was examined, a blood film for erythrocyte morphology and HPLC analysis for HBA2% were extracted.

The beta-thalassemia types were determined based on the percentage of HBA2, the complete blood count, the differential blood film examination and the rate of MCV and MCH. Data of this study was expressed as mean ± SD, demographic and clinical features of the study.

Data were analyzed using SPSS version 26, and comparisons were made between the types of beta-thalassemia and the percentage of HBA2 present in each class.

RESULTS

During the study period, 53 patients were collected from those who visited Al-Karama teaching hospital. Among these patients, 22 (21.5%) were normochromic normocytic, 31 (58.5%) were microcytic hypochromic, as shown in [Table 1]. Data depicted in [Table 2] demonstrated the thalassemia types. β-thalassemia minor was diagnosed in 34 (64.2%), β-thalassemia trait was seen in 14 (26.4%), whereas β-thalassemia major was detected in 5 (9.4%) [Table 2] and [Figure 1]. In [Table 3] the correlation between the morphology seen by blood film and the type of thalassemia was depicted. The number of β-thalassemia minor patients that have normochromic normocytic picture were (22), whereas the number of β-thalassemia minor patients that have microcytic hypochromic were 12. β-thalassemia trait patients were (14) compared to β-thalassemia major patients which were (5) [Figure 2,3]

We also conducted the relationship between the type of thalassemia and the percentage of HBA2. These data indicated that type β-thalassemia trait has more HBA2 percentages compared to the rest of the thalassemia types. The percentage of MCV and MCH in microcytic hypochromic is significant compared with normochromic normocytic 64.7 FL and 21.5 Pg respectively.

Table 1: Classification of thalassemia according to Blood Film.

Morphology of the blood film	Frequency	Percent	P-Value	Difference
Normochromic Normocytic	22	41.5	>0.05	17%
Microcytic Hypochromic	31	58.5		
Total	53	100.0		

Table 2: Descriptive Statistics of thalassemia Types.

The type of Thalassemia	Frequency	Percent	Valid Percent
β-thalassemia Minor	34	64.2	64.2
β-thalassemia Intermedia	14	26.4	26.4
β-thalassemia Major	5	9.4	9.4
Total	53	100.0	100.0

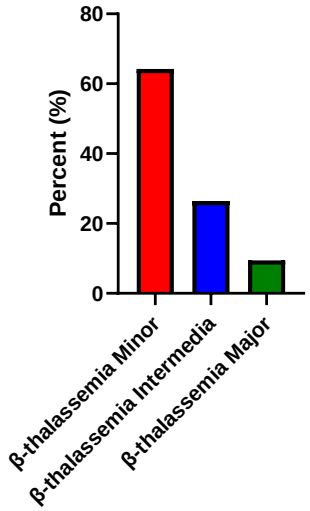

Figure 1: Descriptive statistics of thalassemia Types.

β-thalassemia Minor is the most prevalent type (approximately 64%.)

Table 3: Correlation between morphology and type of thalassemia.

Morphology	β-thalassemia Minor	β-thalassemia Intermedia	β-thalassemia Major	Total
Normochromic Normocytic	22	0	0	22
Microcytic Hypochromic	12	14	5	31
Total	34	14	5	53

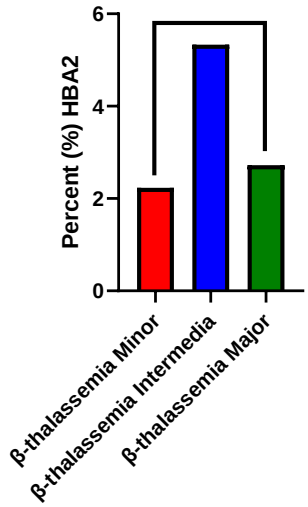

Figure 2: Correlation between thalassemia Type and percentage of Hemoglobin A2.

β-thalassemia minor mean of hemoglobin A2 was approximately 2.23%.

β-thalassemia trait is the most significant with percent reach approximately 5.33%.

β-thalassemia major mean is approximately 2.72%.

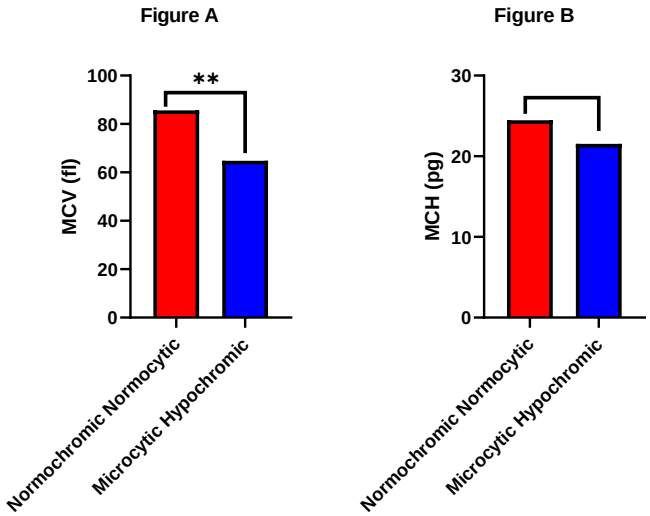

Figure 3.

A) Correlation between the blood indices morphology of the blood film and the percentage of MCV.

MCV in normochromic normocytic was approximately 85.6 FL microcytic hypochromic MCV reached approximately 64.78 FL.

B) Correlation between the blood indices morphology of the blood film and the percentage of MCH.

MCV of normochromic normocytic was approximately 24.47 pg. microcytic hypochromic MCH reached 21.54 pg.

DISCUSSION

Thalassemia, a genetic blood disorder, has been identified as the most prevalent globally. Specifically, β-thalassemia is the most common autosomal single-gene disorder found in over 60 countries, with a carrier population of up to 150 million.[14] In this particular study, out of 53 subjects, the incidence of thalassemia types was as follows: β-thalassemia minor in 34 individuals (64.2%), β-thalassemia intermedia in 14 individuals (26.4%), and β-thalassemia major in 5 individuals (9.4%). Comparable incidences were noted in Missan province, Iraq, with 77.1% and 19.7%, respectively.[15] In Lebanon, the reported incidences were 64% and 36%[16] and in Pakistan, they were 93% and 7%.[17] The prevention of thalassemia major can be achieved by avoiding marriages between carrier parents or by conducting prenatal diagnoses in high-risk mothers. If two carrier parents marry, there is a 25% chance of producing thalassemic offspring, a 50% chance of producing a carrier who can pass on the disease if they marry another carrier, and a 25% chance of normal offspring. The study found that the number of affected males was significantly higher, with no patients above the age of 30 years.[18] The incidence of β-thalassemia did not significantly differ between urban and rural populations, possibly due to common consanguineous marriages in Missan province.[15]

Thalassemia syndromes, especially thalassemia minor, were found to be the most frequent hemoglobinopathy in the present study. The prevalence of thalassemia syndromes increased from 30.8/100,000 in 2015 to 37.3/100,000 individuals in 2020.[19] The high rate of thalassemia in Iraq may be attributed to factors such as high numbers of consanguineous marriages, a shortage of effective prevention programs, and poor legislation. Many other studies also observed a significant difference in thalassemia prevalence between families with consanguineous and nonconsanguineous marriages.[20,21]

According to the Iraq Family Health Survey, about 63% of all marriages in Iraq were between relatives in central and southern governorates and about 45% in northern governorates (Kurdistan region).[22] Another reason for the predominance of transfusion-dependent thalassemia is the higher necessity of blood transfusion of these patients compared to other types of hemoglobinopathy.[23] The changing patterns of the prevalence of Thalassemia in different parts of the world are affected mainly by changes in the birth number of new patients. They are primarily influenced by population migration, prevention programs, and different survival rates of patients with β-thalassemia.[24]

The study did not provide precise numbers for HbH (hemoglobin H) and HbE (hemoglobin E) conditions individually but combined them as variable types.

In terms of age distribution among patients, approximately 44.45% were between 6 and 15 years old, 23.20% were between 1 and 5 years old, 21.60% were between 16 and 25 years old, and 7.92% were over 25 years old. Another study conducted in Iraq reported different age distribution percentages for thalassemic patients.[15]

CONCLUSION

Thalassemia and other inherited hemoglobin disorders pose a significant public health challenge, leading to substantial financial and psychological burdens on affected families and placing a considerable strain on the region's financial resources in the absence of an effective prevention program.

This study's main goal was to determine how common hemoglobinopathies are in Baghdad. A rise in the prevalence of hemoglobinopathies was found in the data. The frequency of consanguineous marriages due to cultural customs, the lack of thorough and efficient preventative initiatives, and inadequate legislation are some of the causes of this increase. The study's results clearly suggest an immediate and efficient preventive program be implemented. This initiative should include the community-wide diagnosis of carriers (TT individuals), precise recommendations for differentiating between TT and iron-deficiency anemia, premarital carrier couple identification, genetic counseling services, and prenatal diagnostics. Clearly defined legislative measures must also be implemented with thorough recommendations for educating the public about Thalassemia and other hereditary illnesses.

In the present study, authors explored the roles of mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and hemoglobin A(2) (HbA(2)) in the laboratory screening of thalassemia, and to find optimal screening modality for different conditions. The present data showed that MCV and MCH are suitable for epidemic screening in a large population, physical examination and premarital check-up. Hb electrophoresis and thalassemia gene diagnosis are recommended for subjects with positive MCV and MCH indexes. Diagnoses of α and β-thalassemia gene are recommended for pregnant women with positive MCV and MCH indexes.Identical observation war proofed in.[25]

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Conflicts of interest

There are no conflicts of interest.

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