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Prevalence of hemoglobinopathies among marrying couples in Erbil province of Iraq

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Abstract:

BACKGROUND: Thalassemia is the most common genetic disorders worldwide, widely spread throughout the Mediterranean region including Iraq. One effective method to reduce incidence of thalassemias and sickle cell disease is premarital screening.

OBJECTIVE: The aim of this study was to determine the prevalence of β-thalassemia trait and other hemoglobinopathies among subjects attending the premarital screening center in Erbil.

MATERIALS AND METHODS: Over a period of 1 year, 6224 couples were screened for hemoglobinopathies. Screened subjects were categorized according to the result of complete blood count, serum ferritin, and hemoglobin (Hb) electrophoresis into six groups, namely, normal, β-thalassemia carriers, α-thalassemia carriers, sickle cell carriers, Hb-H (HbH) disease, and iron deficiency anemia.

RESULTS: The prevalence of β-thalassemia trait was 6.94% (864/12448) with nearly equal proportions between male and female (male to female ratio = 1:1.1). HbH disease and sickle cell trait were less common. Iron deficiency anemia was reported in 52 subjects (0.4%).

CONCLUSION: We found a relatively high prevalence rate of heterozygous β-thalassemia among the studied sample in comparison to prevalence figures from reports in the nearby geographic locations.

Keywords:

Erbil, hemoglobinopathies, iron deficiency anemia, marital screening, thalassemia

Introduction

Hemoglobinopathies, including hemoglobin (Hb) variants and thalassemias, are groups of inherited disorders of Hb synthesis arising from mutations and/or deletions of one or more of the globin genes resulting in production of structurally abnormal Hb variants in the former and reduced rate of synthesis of structurally normal globin chains in the latter.[1]

Although the carrier states of both conditions may be clinically silent, the homozygous or the doubly heterozygous states manifest clinically as anemia of varying degree of severity.[2]

The high incidence of consanguinity among our populations plays a very important role in maintaining the recessive pattern of inheritance and increases the risk of homozygous or doubly heterozygous clinically affected offspring creating great psychological and financial stresses on the families and great burdens on the financial resources of many countries in the region.

As a step aiming at prevention of the disease, in the end of 2009, the Department of Health in Erbil established its "premarital screening program." The premarital screening center of Erbil was principally designed to control β-thalassemias due to its high prevalence. However, marrying couples have to be screened additionally for hepatitis virus and identification of ABO/Rh. This center is the only authorized marriage screening

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center in Erbil. Its main aim is detecting carriers and providing advice to couples about the possibility of having homozygously affected offsprings. Couples may reconsider marriage when both carry the gene or they may be advised about antenatal diagnosis and thus can be given the advantage of therapeutic abortion when the fetus is homozygously affected. The importance of screening programs lies in the fact that they also provide a platform for increased awareness and education regarding thalassemia among the screened population.

Many reports on the frequencies of these disorders in the middle-east countries have been published. In Erbil and neighboring provinces, considerable number of researches has been done which studied the molecular pattern of thalassemia.[3,4] However, no accurate prevalence figures of the different hemoglobinopathies in Erbil province exist.

Materials and Methods

Over a period of 1 year, from October 2015 to October 2016, 6224 couples underwent routine compulsory premarital testing at Erbil marriage screening center. All of them were included in this study.

All participants had complete blood count on the same day of blood sampling using automated blood cell counter (Beckman coulter counter).

Individuals with low Hb and/or low red cell indices were further investigated by measurement of serum ferritin level and Hb electrophoresis. Serum ferritin was measured using standardized ELISA technique. Hb electrophoresis was performed using fully automated CAPILLARYS 2 systems Sebia MINICAP instrument.

Individuals were categorized as per the diagnostic criteria:[5]

1. Normal: When they had normal Hb, normal red cell indices, and normal Hb electrophoresis pattern
2. Iron deficiency anemia: When red cell indices and serum ferritin were low (mean corpuscular volume <80 fl, mean corpuscular HB <27 pg, and serum ferritin <15 μg/L) with normal electrophoretic pattern
3. β-thalassemia trait: When they had low red cell indices, normal or high-serum ferritin, and Hb-A2 >3.5 on Hb electrophoresis
4. Hb-H (HbH) disease: When they had low red cell indices, normal or high-serum ferritin level, HbH band on Hb electrophoresis, and a positive HbH inclusion test
5. Sickle cell trait: Hb electrophoresis pattern characteristic of sickle cell trait (HbA and HbS bands in about equal proportion)
6. α-thalassemia trait: When they had low red cells indices, erythrocytosis (red blood cell [RBC] >5 × 10^{12}/L), normal or high-serum ferritin, and normal Hb electrophoresis pattern (this diagnosis remained presumptive).

This study was approved by the Research Ethics Committee of the College of Medicine at Hawler Medical University and informed consent was obtained from all included participants.

Data were collected and statistically analyzed using Microsoft Excel 2010 and expected number of children born with homozygous hemoglobinopathy was calculated using Hardy–Weinberg equation.[6]

Results

This study screened 6224 couples who underwent premarital screening at Erbil marriage screening center. Their mean age was 25.47 ± 5.54 years ranged between 16 and 45 years.

As illustrated in Table 1, β-thalassemia trait was found to be the most common encountered type of hemoglobinopathies. Its prevalence was 6.94% (864/12,448) with male to female ratio of 1:1.1. Sickle cell trait encountered in eight subjects and three cases found to have Hb-H disease.

Four cases were empirically labeled as α-thalassemia trait based on normal Hb electrophoretic pattern, normal serum ferritin, and erythrocytosis in the presence of hypochromic microcytic RBCs morphology. Iron deficiency anemia was reported in only 52 cases, of them 43 were females.

Using Hardy–Weinberg equation, the predicted number of children born with homozygous hemoglobinopathy was 1.73/1000 new births.

β-thalassemia trait was reported in both partners in only 19 out of 6224 (3/1000) couples, and therefore, they are at risk of having homozygous or compound heterozygous β-thalassemia child.

Table 2 shows statistical summary of the hematological parameters and serum ferritin among the three predominant studied groups.

Table 1: Summary of screening results

Category	Male (%)	Female (%)	Total (%)
Normal	5798 (46.57)	5719 (45.95)	11,517 (92.52)
β-thalassemia trait	411 (3.3)	453 (3.64)	864 (6.94)
Sickle cell trait	4 (0.032)	4 (0.032)	8 (0.064)
HB-H disease	0	3 (0.028)	3 (0.024)
α-thalassemia trait	2 (0.016)	2 (0.016)	4 (0.032)
Iron deficiency anemia	9 (0.07)	43 (0.035)	52 (0.41)
Total	6224 (50)	6224 (50)	12,448 (100)

HB = Hemoglobin

Table 2: Summary of different hematological parameters and serum ferritin level among normal, β-thalassemia trait, and iron deficiency anemia individual

Parameter	Mean±SD		
	Normal individuals	β-thalassemia trait	Iron deficiency anemia
Age (years)	25.47±5.54	25.5±5.7	23.5±5.86
RBC ($\times10^{12}$/L)	5.03±0.48	6.18±0.68	4.26±0.29
HB (g/dl)	14.66±1.34	12.4±1.5	10.2±1.41
PCV (%)	41.9±3.8	36.0±4.4	30.9±3.39
MCV (fl)	83.5±4.6	62.2±4.6	69.3±6.0
MCH (pg)	29.3±1.23	20.9±1.6	22.48±2.45
MCHC (g/dl)	34.1±0.91	32.0±1.09	32.0±1.49
RDW (%)	13.8±1.06	17.1±2.3	19.04±1.51
WBC ($\times10^{9}$/L)	8.27±1.93	9.44±2.6	7.9±2.26
Platelets ($\times10^{9}$/L)	284.9±58.3	274.9±67.1	372.5±89.0
Ferritin (μg/L)	NA	48.9±28.7	5.8±2.99

RBC = Red blood cells, HB = Hemoglobin, PCV = Packed cell volume, MCV = Mean corpuscular volume, MCH = Mean corpuscular hemoglobin, MCHC = Mean corpuscular hemoglobin concentration, RDW = Red cell distribution width, WBC = White blood cells, SD = Standard deviation, NA = Not available

Discussion

β-thalassemia is prevalent in the Mediterranean, African, and Middle East countries, and it forms a real health problem in many of these countries[7] including Kurdistan region of Iraq. It is estimated that more than 1500 patients with thalassemia major are currently attending thalassemia centers in the three provinces of Iraqi Kurdistan.

This study intentionally analyzed data of apparently normal subjects who underwent premarital screening as they are considered to be fairly representative of all sections of the population. Besides, they also comprised a population group which could be easily accessible for investigations and counseling.

The current study verified that Kurdistan is among the high prevalent countries for β-thalassemia. There was no significant difference among males and females (male to female ratio was (1:1.1). Figures of this study are consistent with the result by Dr. Muhammad who screened university students in Erbil in 2008 and reported a prevalence figure of 7.04%.[8] Those figures indicate that the prevalence of carrier state for β-thalassemia is higher than what have been reported in Duhok and Sulamani, in the extreme North of Iraq, with respective figure of 3.7% and 4.14%.[9,10] Similarly, relatively lower prevalence rates were also reported from the center, Baghdad and the south, Basrah, 4.4% and 4.6%, respectively.[11,12]

In the current series, 3/1000 couples (19/6224) are at risk of having a child with homozygous or compound heterozygous β-thalassemia. In Duhok, where consanguinity rate is relatively higher, higher figure was 5/1000[9] while close figure was reported in Basrah.[11,12]

Compared to regional and neighboring countries, the carrier rate in our locality is higher than that what have been reported as illustrated in Table 3.

Table 3: Prevalence of β-thalassemia trait in some regional and distant countries

Author (years)	City/country	Prevalence rates of β-thalassemia trait (%)
Current	Erbil, Iraq	6.94
Muhammad (2008)[8]	Erbil, Iraq	7.04
Al-Allawi and Al-Dousky (2008)[9]	Dohuk, Iraq	3.7
Jalal *et al.* (2008)[10]	Sulaimani, Iraq	4.14
Yahya (1996)[11]	Baghdad, Iraq	4.4
Hassan *et al.* (2003)[12]	Basra, Iraq	4.6
Mseddi *et al.* (2005)[13]	Tunisia	3.1
Sarti *et al.* (2002)[14]	Padua, Italy	5.4
Khattak and Saleem (2002)[15]	Pakistan	3.4
Bashir *et al.* (1992)[16]	Jordan	3.5
Lau *et al.* (2007)[17]	Hong kong	3.09
Bolaman *et al.* (2001)[18]	Denizli, Turkey	2.2
Karimi and Rasekhi (2002)[19]	Iran	10

In this study, β-thalassemia trait was the most common type of the encountered hemoglobinopathies - 98.1% (972/990). This is similar to the results from regional states of Qatar (94.7%)[20] and Bahrain (93.8%).[21] Sickle cell trait was detected in only 10 subjects (0.07%) which is similar to that reported in Konya urban area in Turkey (0.05%)[22] while Hb-H disease was detected in only 4 subjects (0.028%).

Conclusion

β-thalassemia trait was the most common type of all hemoglobinopathies in our locality with prevalence rate of 6.94%. Premarital screening programs are essential for identification and prevention of high-risk marriages. Increasing awareness of the disease by education through medical fraternity and public media and the provision of facilities for antenatal diagnosis which is not currently available are essential to reduce the thalassemic

homozygous population. Future complementary control programs including genetic counseling and antenatal diagnosis will be very essential for eliminating the rates of thalassemia disease.

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Conflicts of interest
There are no conflicts of interest.

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