PREVALENCE OF IRON DEFICIENCY IN INDIVIDUALS WITH β-THALASSEMIA TRAIT

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ABSTRACT

Objective: To determine the prevalence of iron deficiency in β-Thalassemia trait individuals.

Material and Methods: This cross-sectional study was conducted from January 2018 to December 2019 in the department of Hematology, KRL hospital Islamabad. Serum ferritin level of all β-thalassemia trait individuals was performed to determine the iron status.

Result: We studied the iron status of 132 β-thalassemia trait individuals. Out of these 132; 75 were females and 57 were males. 30 (22.7%) individuals were found to be iron deficient. 26 (34.7%) females and 04 (7%) males were iron deficient.

Conclusion: It can be concluded that iron status should be investigated and promptly treated in individuals with β-thalassemia trait especially those with a low hemoglobin level for age and gender.

Key Words: β-thalassemia trait, Iron deficiency anemia.

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INTRODUCTION

Adult hemoglobin is a heterotetramer composed of two α-globin chains and two β-globin chains (α2β2), each of which contains an iron bound heme molecule capable of binding oxygen and facilitating oxygen transport [1]. β-thalassaemia trait (TT) is reduced production of single β-globin chain so a relatively reduced content of hemoglobin in red blood cells. Hence individuals with β-thalassemia trait have mild asymptomatic microcytic anemia throughout life [2]. β-thalassaemia is an autosomal recessive hemoglobinopathy and one of the commonest genetically transmitted disorders throughout the world [3].

Although there is no documented registry is available in Pakistan, an estimated prevalence of β-thalassaemia trait is around 5-7%, and 9.8 million carriers in the total population can be assumed [4]. Iron deficiency anemia (IDA), another cause of hypochromic microcytic anemia, is one of the most common types of nutritional anemia worldwide and considered a major public health problem in South Asia [5]. On an average, globally, approximately 50% of the anemias are attributable to iron deficiency. In Pakistan, recent statistics show a prevalence of around 45% IDA in Pakistan, and here the most vulnerable groups are pregnant women (56%) and school going children (53%) [6].

Despite the high prevalence of these two conditions, the possibility of the two coexisting is often underestimated and not appropriately addressed and treated [7]. Scarcity of local data on the coexistence of the two conditions motivated us to conduct this study.

MATERIAL AND METHODS

It is a prospective, cross sectional study. The study was conducted from January 2018 to December 2019 in the department of Hematology, KRL hospital Islamabad. One hundred and thirty-two people diagnosed as β-thalassaemia trait by hemoglobin electrophoresis performed by semi-automated Biotech Fischer Germany, were included after informed consent. After taking brief clinical information, complete hemogram by automated cell counter (Sysmax XP 100) and serum ferritin (SF) by electrochemiluminescence immunoassay (ECLIA) on automated Cobas e 411 were performed. All individuals diagnosed as β-thalassemia trait irrespective of age group or gender were included and individuals with any other hemoglobinopathy were excluded from the study.

Individuals having HbA2 level equal or more than 3.5% and less than or equal to 8.0% along with low MCV (<75 fl), low MCH (<25 pg) were diagnosed as β-thalassaemia trait and serum ferritin level ≤30 ng/ml was taken as cut-off for iron deficiency.

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Standard statistical methods like cross tabulation and independent sample "t" test were used for analysis of the data. SPSS 21 version software was used to data analysis.

RESULTS

Out of these 132 β-thalassaemia trait individuals, 57(43%) were males and 75 (57%) were females. The mean age ± standard deviation (SD) was 34±17.37years, ranges between 3-77years. The mean age ±SD of males and females were 35.26 ± 19.19 and 33.09 ± 15.92years respectively. The basic hemogram and biochemical parameters of all subjects are given in Table-I.

Table-I: Basic hemogram and biochemical parameters of all subjects.

Parameters (units)	Mean ± SD	Range
Hemoglobin (g/dl)	11.18±1.41	8.3–15.7
Red blood cell count (RBCx10^6/µl)	5.8±0.82	3.6-7.8
Mean cell volume (MCV) (fl)	62.55±4.1	52–74.6
Mean corpuscular hemoglobin (MCH) (pg)	19.23±1.66	15.3–25.4
Red cell distribution width (RDW) (%)	17.38±2.0	11.3–24.1
HbA2 (%)	5.62±0.91	3.5–7.4
Serum Ferritin (ng/ml)	139.39±209.08	5.10-1477.00

Out of 132 subjects, 30 (22.7%) had iron deficiency. Gender wise distribution of individuals, with and without iron deficiency is shown in Figure-I.

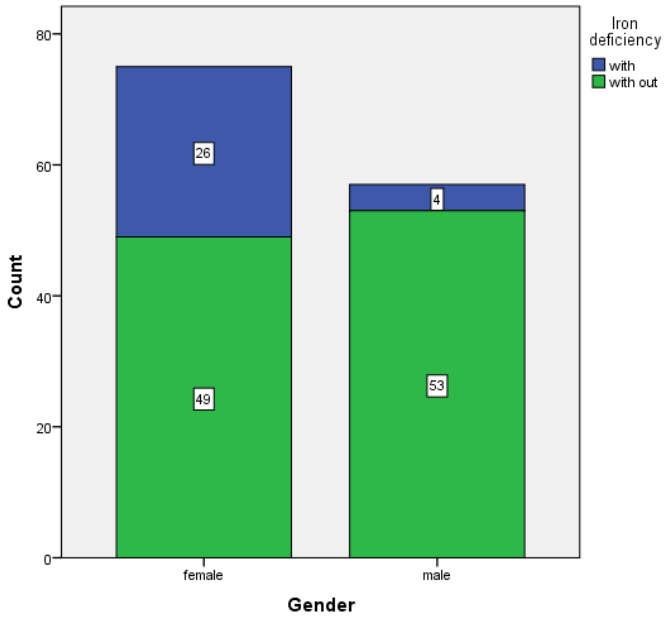

Figure-I: Gender wise distribution of individuals, with iron deficiency and without iron deficiency.

Comparisons of hematological parameters between the subjects with iron deficiency and without iron deficiency are shown in Table-II.

Table-II: Comparisons of hematological parameters of two groups

Parameters	With IDA (SF ≤30) Mean ± SD (range)	Without IDA (SF >30) Mean ± SD (range)	*t* value	*P* value
Hemoglobin (g/dl)	10.26 ± 0.79 (8.5–11.9)	11.45 ± 1.44 (8.3–15.7)	5.32	<0.01
MCV (fl)	61.41 ± 5.47 (54.3–74.6)	62.90 ± 3.56 (52.0–72.7)	1.26	>0.05
MCH (pg)	18.59 ± 2.65 (15.3–25.4)	19.43 ± 1.19 (16.8–22.7)	1.44	>0.05
RDW (%)	19.27 ± 2.05 (15.6–24.1)	16.8 ± 1.71 (11.3–22.4)	6.45	<0.01
RBCS (x10^6/µl)	5.60±0.81 (4.09-7.07)	5.91± 0.81 (3.66-7.86)	1.76	>0.05
HbA2 (%)	5.42±0.84 (3.5-6.9)	5.67±0.92 (3.5-7.4)	1.8	>0.05
Age (years)	26.37+14.93 (3-54)	36.28±17.46 (3-77)	2.82	<0.01

Statistically significant differences were found in age, hemoglobin and RDW level in the two groups. It was observed that β-thalassaemia trait individuals with coexistent iron deficiency had lower hemoglobin and raised RDW level and are relatively young compared to individuals without iron deficiency. There were no statistical differences found in RBC counts, MCV, MCHC and HbA2level between the two groups.

DISCUSSION

Out of the 132 β-thalassaemia trait, 30(22.7%) are found to be iron deficient. Out of 75 females 26 (34.7%) have iron deficiency while in males only 04(7.0%) out of 57 have iron deficiency. This reveals that the iron deficiency is more prevalent in the females as compared to males. There is a significant difference in mean age noted between β-thalassaemia trait with IDA and β-thalassaemia trait without IDA. β-thalassaemia trait individuals with IDA observed to be younger than without IDA. The reason could be the increased demand of iron in young and growing age [8]. It also illustrates increased iron demand in menstruating and pregnant females that are predominant gender wise in this group. Similar results were reported by Yousafzai Y M *et al*, they studied iron status of β-thalassaemia trait individuals of Peshawar, Pakistan and found 18.8% of them to be iron deficient [9].

Nearly the same trend of results was reported by Madan N *et al* where out of 463 subjects 126(27.2 %) were found to be iron deficient. A possible reason for lower percentage reported by us

could be due to small sample size and inclusion of few children (9.8%) in contrast to the above-mentioned study (19%) [10]. Quite similar results were reported by Dolai TK *et al* where 19.33% of β-thalassaemia traits were iron deficient. Similar to our study 29.67% (27/91) of females and 3.38% (2/59) of males were reported iron deficient in their study [11].

The incidence of concurrent thalassaemia trait and iron deficiency was reported to be quite high in a study conducted in Taiwan by Lin CK *et al* in 2014. They reported 33% of β-thalassaemia traits having IDA also. They found 52 iron deficient individuals out of 157β-thalassaemia traits. This high prevalence of coexisting IDA in β-thalassemia traits in their study could be due to relevant high percentage of female participants in their study [12]. In a study published in 2015 by Sharma P *et al* concomitant iron deficiency has been reported in 20.7% (156/752) TT individuals. They reported iron deficiency in 33.3% females (122/366) and 8.8% (34/386) males TT individuals, that is similar to our study [13].

Out of 132 six (4.5%) adults had serum ferritin more than 500ng/ml, predominantly they all were elderly males. No child with increased serum ferritin was found in our study and none of them have any symptoms of hemochromatosis. Madan N *et al* in 2014 reported elevated levels of serum ferritin in 2.6% of β-thalassaemia traits [10] however no subject with elevated serum ferritin level were reported by Dolai TK *et al* [11] and Lin CK et a [12]. In contrast to them, a local study by Yousafzai YM *et al* reported 10% individuals with high serum ferritin levels for age and gender [9], a possible reason for this high prevalence of raised serum ferritin in their study could be that they included increase percentage of male participants in their study. However similar to them we are unable to rule out iron supplementation or anemia of chronic disorder as the underlying reason for this high serum ferritin. As the serum ferritin is an acute phase reactant [14] and because of lack of availability of specific clinical data and laboratory test details, we could not rule out that this high serum ferritin was because of any underlying inflammatory/ infection process or because of positive effect on iron metabolism of hemoglobinopathies.

We have noted a significant statistical difference in hemoglobin (10.26 vs11.45) and RDW (19.27 vs 16.8) between β-thalassaemia trait with IDA and β-thalassaemia trait without IDA, while there is no significant difference noted in RBC count, MCV, MCH and HbA2 levels. For hemoglobin level, similar results were reported by Dolai TK *et al*, Madan N *et al* and Lin CK *et al*. This observation was also supported by an interventional study by Verma S *et al* where hemoglobin level of coexistent TT and iron deficient individuals were significantly improved by iron replacement therapy, that is (9.8vs10.8)gm/dl with P value<0.001 [15].

Similar to our results Dolai TK *et al* and Lin CK *et al* reported no difference between the two groups for MCV. In contrast to our study significant difference were reported in MCV between two groups by Madan N *et al*. We noted a significant raised RDW in thalassaemia trait with IDA than thalassaemia trait without IDA, however no significant differences were reported by Dolai TK *et al* and Lin CK *et al* between the two groups. RDW was also observed as a good discriminator between IDA and TT by Kumar A *et al*[16].In the study by Verma S *et al*, a significant reduction of RDW after iron replenishment in coexistent TT and iron deficient individuals also supports our observation [15].

Similar to our study, no significant difference of MCH noted in pre and post iron replacement therapy in iron deficient TT individual by Verma S *et al* [15]. In contrast to our study, Dolai TK *et al* and Madan N *et al* reported significant difference in MCH between two groups. It is documented in many studies that iron deficiency can suppress the level of HbA2, which can potentially confound the diagnosis of β-thalassaemia trait. Hence, iron deficiency should be identified and rectified in patients with suspicion of β-thalassaemia traits before testing for β-thalassaemia trait [15]. As prevalence of IDA is quite high in our general population so possibility of missing β-thalassaemia trait because of this confounding variable should also be considered. For this reason, the prevalence of IDA with co-existentβ-thalassaemia traits may be much higher. However we did not find any significant difference in the HbA2 level between the two groups. Similar to our study Madan N *et al* and Sharma P *et al* [13] did not report any significant difference in HBA2 level; however Lin CK *et al* reported significantly low level of HbA2 in β-thalassaemia trait with IDA.

We did not find statistically significant difference in RBC count while Lin CK *et al* reported significantly low RBC count in β-thalassaemia trait with IDA then β-thalassaemia trait without IDA.

CONCLUSION

It can be concluded that iron deficiency is one of the common co-existing conditions in β-thalassaemia trait. β-thalassaemia traits with especially low hemoglobin level should be promptly investigated and treated for iron deficiency. β-thalassaemia trait does not confer an advantage in maintaining iron balance.

AUTHOR CONTRIBUTION

Faiza Salman: Conceived and designed the study, data collection and analysis, drafting the article.

Faiza Fahim: Review of cases, proof reading and critical review.

Azhar Saleem: Literature review, data analysis

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