

Determination of Frequency of Thalassaemia Trait in a Rural Tertiary Care Hospital of India by Using Various Red Cell Indices as Screening Tool

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ABSTRACT

Background: Thalassemias are among the most common genetic disorders in humans. The blood picture of thalassaemia trait and iron deficiency anaemia is that of microcytic hypochromic anaemia and hence it is of utmost importance to differentiate between these two conditions. The patients with beta thalassaemia trait who are treated under the mistaken diagnosis of iron deficiency may develop siderosis leading to cardiac arrhythmias, congestive heart failure and ultimately death. Thalassaemia trait being common in this particular area, the present study was conducted in a rural tertiary care hospital of Western Maharashtra, India with an aim to determine the frequency of thalassaemia trait and to differentiate thalassaemia trait from iron deficiency anaemia.

Methods: Blood sample of the patients was collected in K3 EDTA tubes and the various parameters were checked by an automated cell counter. By using these parameters, values of the 4 indices were calculated. These included the England and Fraser's index, the Mentzer's index, Red cell distribution width and RBC count.

Results: During the study period out of 3362 patients who underwent haematological investigations, 14.87% had microcytic hypochromic anaemia. Depending on the positivity of the indices, probable numbers of cases of thalassaemia trait were calculated. 6.2 % cases are most probably of thalassaemia trait by using all the four indices.

Conclusion: Red cell distribution width, RBC count, England and Fraser's index, and Mentzer index can be used as initial discrimination between the iron deficiency anaemia from thalassaemia trait. For confirmation of thalassaemia trait HbA2 estimation is essential.

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Introduction

Thalassemias are among the most common genetic disorders in humans. India is an ethnically diverse country with thalassaemia gene frequency of 0-17% i.e. on an average 3%. There are 30 million carriers of thalassaemia gene and 10,000 children are born with it per year.^[1] Thalassemias are a diverse group of hereditary disorders in which there is reduced synthesis of one or more of the globin polypeptide chains.^[1] Alpha and beta thalassemia trait are generally asymptomatic and have a normal life expectancy.

Thalassemia patients may present with mild chronic anaemia with microcytic hypochromic red cell morphology. The blood picture of thalassaemia trait and iron deficiency anaemia is that of microcytic hypochromic anaemia and hence it is of utmost importance to differentiate between these two conditions. The patients with beta thalassemia trait who are treated under the mistaken diagnosis of iron deficiency may develop siderosis leading to cardiac arrhythmias, congestive heart failure and ultimately death.^[2] Other conditions having a similar blood picture are sideroblastic anaemia and anaemia of chronic disorders.

HbA2 estimation remains the gold standard test for identification of thalassaemia trait. HbA2 estimation can be done by any of the three methods like electrophoresis, column chromatography or high pressure liquid chromatography (HPLC).^[3] Iron deficiency anaemia can be diagnosed by using tests like serum iron, serum ferritin, and total iron binding capacity (TIBC). Since thalassemia is an inheritable disease, its prevention is possible by making an antenatal diagnosis.

Every patient visiting the hospital undergoes common hematological tests, amongst which complete blood count is done on automated cell counter. The results are obtained within no time and are economical as well. Red cell parameters obtained from automated cell counters could be effectively used to identify thalassemic patients and differentiated from iron deficiency anemia. Four indices - England and Frazer's index, Mentzer's index, red cell distribution width (RDW) and red blood cell (RBC) count have good sensitivity and specificity to differentiate thalassaemia from iron deficiency anaemia.^[4] Thalassemia trait being common in this particular area, the present study was conducted in a rural tertiary care hospital of Western Maharashtra, India with an aim to determine the frequency of thalassaemia trait and to differentiate thalassemia trait from iron deficiency anaemia.

Materials and Methods

The present study was conducted in the Department of Pathology, Rural Medical College and Hospital, Pravara

Institute Medical Sciences, Loni, Maharashtra, India. The study is a part of short term student project supported by Indian Council of Medical Research, New Delhi. The protocol of the study was approved by the Institutional Ethics Committee. A total of 500 patients who satisfied the following inclusion and exclusion criteria were enrolled in the study. The informed consent was obtained from each participant.

Inclusion criteria

1. Out patients of either sex, irrespective of their socioeconomic status.
2. All the patients undergoing hematological investigation.
3. Patients with hemoglobin count < 12 gm/dl in females and <13 gm/dl in males.
4. Mean corpuscular volume (MCV) < 76 fl.
5. Mean corpuscular hemoglobin (MCH) < 26 pg.

Exclusion criteria

1. Patients below the age of 6 months.
2. Patients with normal hemoglobin count.

Blood sample of the patients was collected in K3 EDTA tubes and the various parameters were checked by an automated cell counter (Sysmex KX 2000i). By using these parameters, values of the 4 indices were calculated.

1. The England and Fraser's index was reflected by the following equation:

$$DF \text{ (Differentiating factor)} = \text{MCV-RBC}(5 \times \text{Hb}) - 3.4,$$

Where, MCV is the mean corpuscular volume and Hb is hemoglobin. The thalassemia minor was indicated if the result was less than zero, while values of zero or greater demonstrated iron deficiency anemia.^[4, 5]

2. The Mentzer's index was obtained when the MCV was divided by the red cell count.

If the result was lesser than 13, thalassemia minor was recognized, and if more than 13, it was suggestive of iron deficiency anaemia.^[4, 6]

3. Red cell distribution width (RDW-CV) is measure of anisocytosis. In thalassemia trait, it was less than 18 and in iron deficiency anemia it was more than 18.^[4, 7]
4. RBC count was high normal to elevated in thalassemia trait despite anemia while it was low in IDA.

If the value of RBC count was more than $4.9 \times 10^{12}/L$, it was suggestive of thalassemia trait and if less than $4.9 \times 10^{12}/L$, then it was iron deficiency anemia^[8].

Results

During the study period out of 3362 patients who underwent haematological investigations, 500(14.87%) had microcytic hypochromic anaemia whereas the remaining 2862 (85.13%) showed macrocytic or normocytic normochromic anaemia. The frequency of thalassaemia trait is shown in Figure 1. Depending on the positivity of the indices, probable numbers of cases of thalassaemia trait were calculated. 6.2 % cases are most probably of thalassaemia trait by using all the four indices while the other 93.8% cases were considered to be of iron deficiency anaemia. 14.4% cases appear to be of thalassaemia trait by using any three indices while 85.6% of cases were considered to be of iron deficiency anaemia. By using any two indices 24.2% cases are most probably of thalassaemia trait and the remaining 75.8% cases were considered to be of iron deficiency anaemia. 65 % cases appear to be of thalassaemia trait by using any one index.

Table 1 shows age wise distribution of thalassaemia trait and iron deficiency anaemia cases. The age group of 12-30 years showed the presence of maximum number of cases for thalassaemia trait. Sex wise distribution of thalassaemia trait and iron deficiency anaemia cases is shown in Figure 2. Female preponderance is indicated for thalassaemia trait with 67.74%.

Figure 3 shows the comparison of RDW index with the other indices. 48.4% cases appear to be positive for thalassaemia trait by using RDW index. The comparison of RBC count with other indices is shown in figure 4. Positivity of RBC count was 29.2% for thalassaemia trait. Figure 5 shows the comparison of Mentzer’s index with the other three indices. Mentzer index showed thalassaemia trait in 17.6% cases. 14.6% thalassaemia cases were detected by England and Frazer’s index alone. Its comparison with other indices is shown in Figure 6.

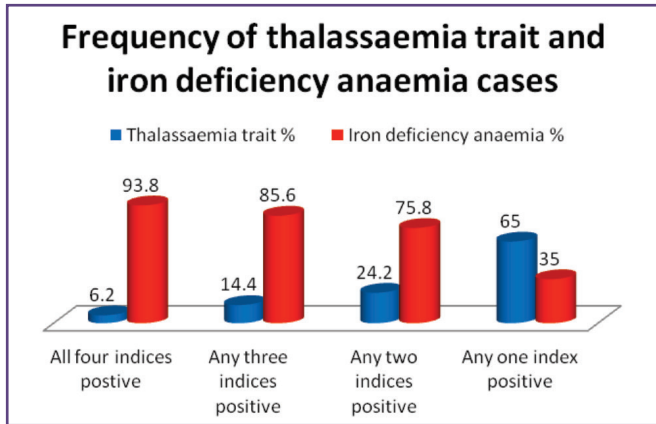


Fig. 1

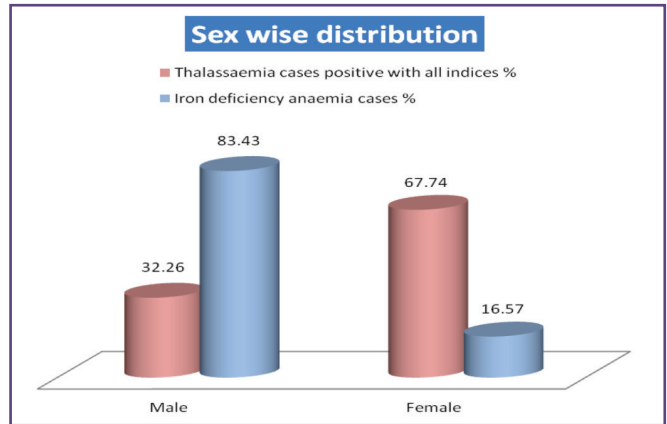


Fig. 2

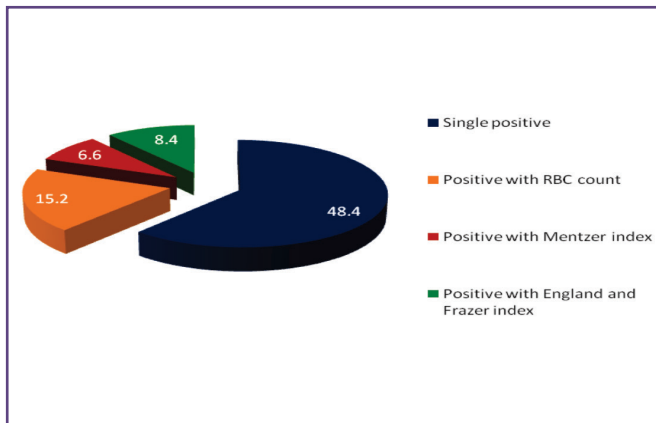


Fig. 3: Comparison of RDW index with the other indices.

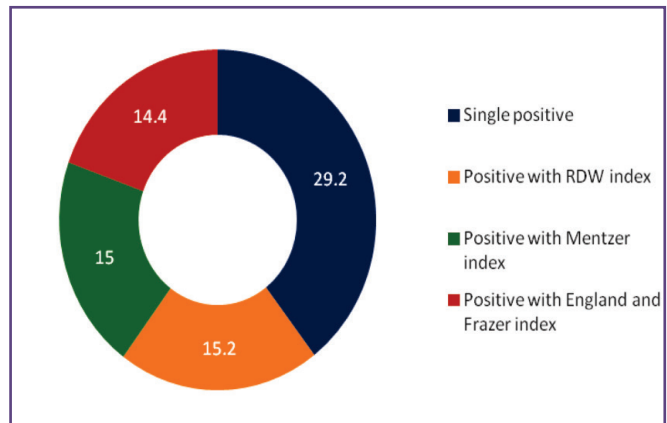


Fig. 4: Comparison of RBC count with other indices.

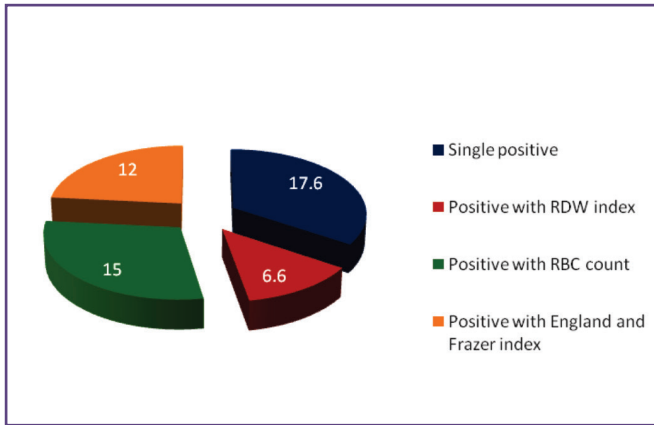


Fig. 5: Comparison of Mentzer's index with the other three indices.

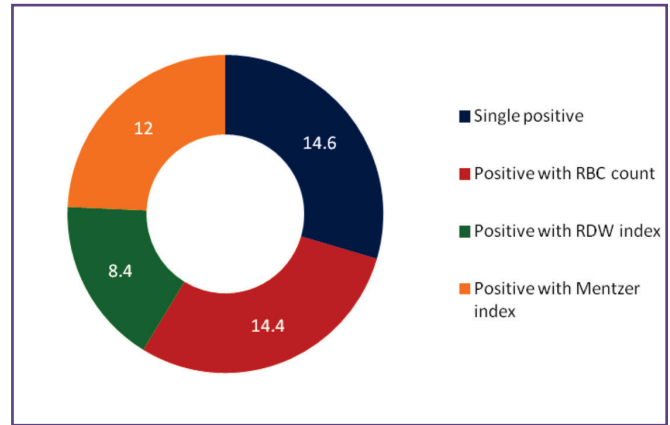


Fig. 6: Comparison of England and Frazer index with the other three indices.

Table 1: Age wise distribution of thalassaemia trait.

Indices	<12 years	12 to 30 years	31 to 60 years	>60 years
Positive cases for thalassaemia %	0.4	3.2	2.2	0.4
Thalassaemia cases positive by RDW %	3.6	30.6	11	3.2
Thalassaemia cases positive by RBC count %	3.2	14.2	9.2	2.6
Thalassaemia cases positive by Mentzer's index %	1.6	8.6	6.6	0.8
Thalassaemia cases positive by England and Frazer index %	2.2	6.4	5.4	0.6

Discussion

Thalassaemia syndromes are heterogeneous group of Mendelian disorders characterized by lack of or decrease synthesis of globin chain that forms haemoglobin tetramer. [1] Control of thalassaemia in an entire community is a complex task requiring consideration of social, economical, and demographic factors. In the present study, microcytic hypochromic anaemia was detected in 14.87% of patients who underwent haematological investigations. Similar observation was noted by George et al. [9]. In our study female preponderance for thalassaemia trait was noted, this observation was in contrast of Okuno Chou et al. [10]

Roberts and Badawi (1985) [11] evaluated importance of RDW in a group of anaemic patients. They found elevated mean RDW values in iron deficiency anaemia patients whereas in thalassaemia trait patients it was near normal. In our study 48.4% cases were positive for thalassaemia trait by using RDW index. Bessman et al [12] reported RDW to have good sensitivity for detection of thalassaemia trait. Studies of researchers like Roberts and Badawi (1985) [11] and Kotwal and Dasgupta (1999) [8] underscored RDW

as an important indicator of thalassaemia trait in initial screening programme.

RBC count was one of the indices used for discriminating iron deficiency anaemia from thalassaemia trait. When compared with other indices positivity of RBC count was 29.2% for thalassaemia trait. Madan et al [12] studied red cell indices and discriminate function for the detection of beta thalassaemia trait in a population with high prevalence of iron deficiency anaemia. They observed increase in RBC count in thalassaemia trait.

Mentzer et al [5] suggested a simple index for distinguishing iron deficiency anaemia from thalassaemia trait. In our study Mentzer index showed thalassaemia trait in 17.6% cases. Various researchers reported Mentzer's index to have good sensitivity for detection of thalassaemia trait.

England and Fraser [7] introduced a discriminant factor (DF) to differentiate between iron deficiency and heterozygous beta thalassaemia. Before introduction of DF, it was often impossible to differentiate between these two conditions. In present study 14.6% thalassaemia cases were detected by England and Frazer's index.

Thus, it is understood that, the number of cases positive for thalassaemia trait goes on increasing by using decreasing the number of indices used for calculating the same. Hence, the reliability appears to be low and so only a single index cannot be used for the differentiation between thalassaemia trait and iron deficiency anaemia.

Conclusion

From the present study, it can be concluded that, RDW-CV, RBC count, England and Fraser's index, and Mentzer index can be used as initial discrimination between the iron deficiency anaemia from thalassaemia trait in cases of microcytic hypochromic anaemia. For confirmation of thalassaemia trait HbA2 estimation is essential.

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Competing Interests

Not declared

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