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Hematological Indices to differentiate Iron Deficiency Anemia and β-thalassemia trait.

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Abstract

Background: Red cell indices are cost effective in differentiating iron deficiency anemia from β-thalassemia trait as both conditions have similar findings- microcytic hypochromic blood picture. One year cross sectional comparative study was done in department of pathology BMCRC-Ballari. Complete blood count and red cell indices were evaluated. Out of 110 cases studied 36 cases were of β-thalassemia trait and 74 cases were of iron deficiency anemia. Five indices were calculated and subjected to HPLC for confirmation. In the present study Shine and Lal index showed highest sensitivity for diagnosis of β-thalassemia trait and Mentzer index showed highest specificity. Positive Predictive Value was highest for Mentzer index and Negative Predictive Value was highest for Shine and Lal index. Youden's index was highest for Metzer index. In present study Metzer index was most reliable and cost effective indices for screening of β-thalassemia trait.

Keywords: Red cell indices, Iron deficiency anemia, β-thalassemia trait, HPLC.

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INTRODUCTION

Hemoglobinopathies are the most common inherited diseases affecting the structure, function and production of hemoglobin. Hemoglobinopathies are classified into structural hemoglobinopathies, thalassemias, thalassemic hemoglobin variants and hereditary persistence of fetal hemoglobin and acquired hemoglobinopathies. Thalassemia affects the hemoglobin genes and results in ineffective erythropoiesis. Further classified into Alpha thalassemia(Alpha globin gene deletion) and Beta thalassemia (point mutation in Beta globin gene). Based on zygosity of beta globin gene mutation Beta thalassemia is categorized into three groups 1- Beta thalassemia major, Beta thalassemia intermedia and Beta thalassemia minor.

As there is one mutated gene/ under produced beta chains in thalassemia minor the symptoms and signs are mild, hematological findings are similar to microcytic hypochromic anemia. Microcytic hypochromic blood picture is seen in both iron deficiency anemia and thalassemia patients. iron deficiency anemia can be validated from iron studies and ferritin levels. Whereas Beta thalassemia is confirmed by electrophoresis, when levels of HbA2 is>3.5% which is diagnostic of Beta thalassemia trait. As Electrophoresis is costly, screening test such as RBC indices -Mentzer Index, Green and King index, Shine and Lal index, Srivastva index and RDWI are cost-effective and rapid preliminary tests in early diagnosis of Beta thalassemia trait, as patients requires multiple blood transfusions and chelation therapy.

MATERIALS AND METHODS

This is a cross-sectional comparative study conducted at BMCRC-Ballari. Anemic patients during one year period were studied, clinical and hematological profiles and HPLC was performed.

Inclusion criteria: Anemic patients with microcytic hypochromic blood picture.

Exclusion criteria: Anemic patients with normocytic and macrocytic blood picture, patients with anemia of chronic disease and children below 6months were excluded from the study.

Blood samples were run on Erba –H560 hematology analyzer and complete blood count was obtained. Microcytic hypochromic blood picture samples were screened using the following indices: Mentzer Index, Green and King index, Shine and Lal index, Srivastva index and RDWI as given in table 1. Serum iron, TIBC and serum ferritin were assessed. Further the samples were subjected to HPLC for HbA2 estimation. Levels >3.5% were diagnosed as beta thalassemia trait.

Table: 1 RBC indices formulas with Cut-Off values for IDA and BTT

Index	Formula	Cut-Off IDA	Cut-Off BTT
Mentzer [2]	MCV/RBC	>13	<13
Green and King [3]	(MCV × MCV × RDW)/(100 × HB)	>65	< 65
Shine and Lal [4]	MCV × MCV × (MCH/100)	>1530	<1530
Srivastava [5]	MCH/RBC	>3.8	<3.8
RDWI		> 220	< 220

RESULTS

During the study period, totally 110 cases of microcytic hypochromic anemic patients were analysed. There was slight female predominance (52.7%) in the number of cases studied. Majority of cases presented with generalized weakness and fatigue (77.2%), followed by shortness of breath. Cases that were flagged positive by the use of CBC indices were sent for high performance liquid chromatography for confirmation. 59. % of cases were confirmed to be of beta thalassemia trait. CBC parameters in case of IDA and Beta thalassemia trait are depicted in table 2

Table: 2 Comparison of RBC parameters in case of IDA and Beta thalassemia trait

	Beta thalassemia trait		Iron Deficiency Anemia	
	Mean value	Standard deviation	Mean value	Standard deviation
HB (g/dL)	9.8	0.61	10.45	0.60
RBC (×106/mm^3)	5.62	0.52	4.81	0.58
HCT (%)	35.6	4.12	33.4	4.02
MCV (fL)	65.1	4.01	67.12	5.62
MCH (pg)	17.1	3.11	18.23	3.42
MCHC (%)	27.06	3.92	28.17	4.62
RDW (%)	13.1	0.71	12.81	0.69

Table 3 shows Sensitivity , Specificity, Positive Predictive Value, Negative Predictive Value and Youden's index to differentiate IDA and Beta thalassemia trait

Index	Sensitivity	Specificity	PPV	NPV	Accuracy	Youden's index	Area under curve	Std error	P value
Mentzer [2]	95.13	20.23	81.9	61.2	60.12	18.12	0.591	0.066	0.162
Green and King [3]	94.82	15.21	80.12	50.1	58.02	9.01	0.561	0.062	0.518
Shine and Lal [4]	100	4.01	77.02	100	52.80	3.90	0.520	0.058	0.699
Srivastava [5]	88.41	13.9	76.41	30.12	51.42	0.20	0.488	0.061	0.851
RDW	97.92	8.1	79.01	68.71	56.12	5.81	0.521	0.065	0.612

Shine and lal index showed highest sensitivity and negative predictive value of 100%. Mentzer index showed highest specificity of 20.3%, Positive Predictive Value of 81.9% and accuracy of 60.12%.

DISCUSSION

In the present study mean RBC count in βTT group was 5.62 million/ cu.mm similar to studies done by Shrivastav et al5 and Bhushan R et al 6. In the present study Shine and Lal index showed highest sensitivity of 100%, followed by RDW index (97%) and Mentzer (95.13%). A high specificity of 20.23% was shown by Mentzers index followed by Green and King index 15.21%.

As limited number of cases flagged negative by RBC indices would be the cause for low specificity in our study. In this study Mentzer index showed highest PPV of 81.9% followed by Green and King index. Shine and Lal index showed high negative predictive value of 100%, followed by RDW index (68.71%).

Study conducted by Al Fadhli et al 7showed Mentzer index to have the highest sensitivity(85.7%), while Shine and Lal index showed the highest specificity(97.8%). Rathod et al 8 study showed highest sensitivity for Shine and Lal index(99%) similar to our study.

Diplani et al9 study showed Mentzer index to have the highest sensitivity(89%), specificity of 87.9% and Positive predictive value of 83.2%. Similarly studies done by Jahangiri et al 10 and Sehgal et al 11 showed Shine and Lal to have the highest sensitivity.

CONCLUSION

From the present study we conclude that Mentzer index followed by Green and King index are the best index to differentiate Beta thalassemia trait from iron deficiency anemia. Therefore CBC parameter can be used for initial screening of patient with microcytic hypochromic blood picture to rule out Beta thalassemia trait as it is cost-effective compared to HPLC.

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