Original Article

Comparison of the Diagnostic Value of Mentzer Index and RDW Index in the Screening of Beta Thalassemia Trait and Iron Deficiency Anemia

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Abstract

Background: *Beta thalassemia trait is one of the common forms of hemoglobinopathies in Bangladesh. Individuals having beta-thalassemia trait have microcytic hypochromic anemia and asymptomatic course may be similar as that of iron deficiency anemia (IDA).So, it is important to differentiate between beta- thalassemia trait and non-thalassemia microcytosis as both conditions share common characteristics. Though the definitive diagnosis those patients of thalassemia trait is possible only by Hb-electrophoresis their certain blood indices which can differentiate between thalassemia trait and iron deficiency anemia. Mentzer index and RDW index are such index.*

Objectives: *The aim of our study was to evaluate the reliability of Mentzer index and RDW index in the differentiation of iron deficiency anemia and beta thalassemia trait.*

Materials and Methods: *This study was an observational study done on 120 patients. Only those patients who have been found to be having iron deficiency anemia by iron studies and cases of beta thalassemia trait who have been diagnosed by electrophoresis were included in this study. Those Patients who have received blood transfusion within 3 months study were excluded from the study. Mentzer index and RDW index of all the patients were calculated and the results were analyzed.*

Results: *Mentzer index more than 13 presumed iron deficiency anemia and less than 13 presumed thalassemia traits. Similarly, RDW index more than 220 presumed IDA and RDW index less than 220 presumed BTT are found to be reliable screening tool to differentiate in between iron deficiency anemia and thalassemia.*

Conclusion: *Iron deficiency anemia and thalassemia trait can be reliably differentiated by Mentzer index and RDW index. In resource poor and developing countries it can be used as screening tool.*

KeyWords: *Mentzer Index, RDW index, Microcytic Hypochromic Anemia, Thalassemia Trait.*

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Introduction

Mild microcytic hypochromic anemias due to Iron Deficiency (IDA) and Beta Thalassemia Trait(β -TT) continue to be a cause of significant burden to the society, particularly in the LMIC(Low and Middle Income Countries) as β -TT is often misdiagnosed as iron deficiency anemia in children as because both of the conditions may have similar hematologic features on Complete Blood Count (CBC), and IDA is much more prevalent. So, it is important to differentiate between thalassemic and non-thalassemic microcytosis as both conditions share many characteristics and have important different clinical implications. Thus a correct diagnosis in patients with microcytic anemia can provide an indication for supplementing iron to IDA patients, for avoiding unnecessary iron therapy in thalassemia carriers and of course also for preventing severe and lethal forms of thalassemia syndrome in the framework of premarital counselling in high-prevalence areas.[1]

Iron deficiency anemia(IDA) and beta thalassemia trait (BTT) are the two most frequent disorders presenting clinically with mild microcytic hypochromic anemia.[2] Lack of sufficient dietary iron resulting IDA is the most common hematological disorder. It has been estimated that 30% of the world population suffers from IDA with majority of the affected people living in the developing countries. In β-TT there is impaired globin chain synthesis resulting in decreased hemoglobin leading to microcytic hypochromic anaemia.1.5% of world population carries genes for β-thalassemia.[3] Thalassemia traditionally has a high prevalence in some parts of the world (Mediterranean regions up to 8%; countries of Middle East up to 10%; India 3%-15%;

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South east Asia up to 9%),where it represents a major public health problem.Non endemic countries such as Northern Europe and North America are also involved in Thalassemia related problems as a result of demographic changes caused by migration and intermarriages of different ethnic population.[4, 5] Nowadays a population migration has spread thalassemia genes over nearly the entire globe.[6] so it is important to differentiate between thalassemic and non-thalassemic microcytosis as both conditions share many characteristics and have important clinical implications.[7] Thus a correct diagnosis in patient with microcytic hypochromic anemia can provide an indication for supplementing iron to a IDA patients, for avoiding unnecessary iron therapy in thalassemia carriers and of course also for preventing severe and lethal forms of thalassemia syndrome in the framework of premarital counseling in high prevalence areas.[1] A definitive differential diagnosis between β-TT and IDA is based on the result of Hb-A 2electrophoresis,serum iron profile.[8] However, these investigations are money and time consuming and areas where thalassemia is endemic often have low health care resources ad these assays may not be generally available.[1] Thus, various discrimination indices have been proposed to distinguish between β-TT and IDA. These indices are derived from several simple Red blood cell(RBCs)indices, like RBCs count , Mean cell volume(MCV),mean corpuscular hemoglobin(MCH),RBCs distribution width(RDW) and Hemoglobin(Hb), as these are provided by electronic cell counters.[9] The purpose of using indices to discriminate anemia is to detect subjects who have a highly probability of requiring appropriate follow up and to reduce unnecessary investigative cost.[10]

Material and Methods

This observational study was conducted on 120 patients with microcytic hypochromic anemia, 50 male and 70 female aged from 1year to 81years recruited from hematology outpatient department,Khwaja Yunus Ali Medical College Hospital, during the period from 1st October 2020 to 29th July 2022.
Inclusion criteria: Microcytic hypochromic anemia due to iron deficiency and BTT

Exclusion criteria:
- Lead poisoning
- History of previous blood transfusion within 3 month.
- Other forms of hemolytic anaemia.

Beside meticulous history and thorough clinical examination, all the studied cases were subjected to the following investigations Complete Blood Count (CBC), Blood Film. Serum iron,Serum Ferritin,Total Iron Binding Capacity (TIBC),Hb electrophoresis, and the other discrimination indices were calculated by using RBCs indices as defined below:
-Mentzer
Index (MI): MCV/RBC[11]

Interpretatiions:
High: >13
Low: <13
RDW INDEX(RDWI):MCVxRDW/RBC.[12]

Interpretations:
High:>220
Low:<220
Evaluation of red cell distribution width (RDW):Red cell distribution width quantitatively measures RBCs size variation, computed directly from the RBCs histogram and is calculated as a standard statistical value, the coefficient of variation of the volume distribution.[13] In general, an elevated RDW has been associated with anemia from various deficiencies such B12, folate or iron.[14] So RDW as a measure of the degree of variation in red cell size, has been reported to be a good discrimination index to differentiate between BTT and IDA.[15] BTT were diagnosed by hemoglobin electrophoresis as patient with HbA2

Statiscal analysis:
Sensitivity & specificity of testing values; Mentzer index & RDW index between two groups were analyzed.

Results

Out of many patients in hematology out patient department we found 120 patients are within inclusion criteria. In our study we run our samples through a 5 part cell counter (SYS MEX-XN 1000) which revealed decreased Hb, PCV, MCV,MCH MCHC.The complete blood count indices and peripheral smear examination of these 120 patients revealed microcytic hypochromic anaemia. Out of 120 patients of microcytic hypochromic anaemia (according to table-1) 107 persons were IDA (46 male& 61 female), and 13 person were beta- thalassemia trait (4 male & 9 female).

Table I: Distribution of a total 120 study population.

Disease	Male	Female	Total
IDA	46	61	107
BTT	4	9	13
Total	50	70	120

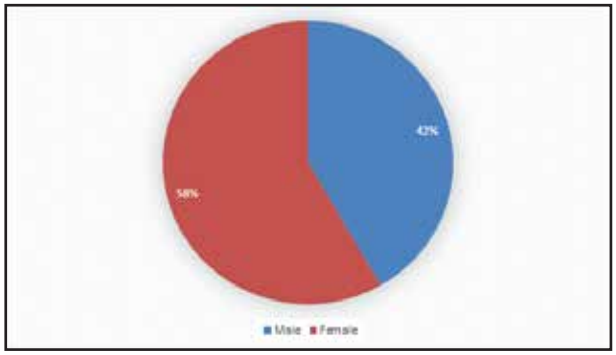

Figure 1: Total population 120 where male 50 (42%) & female 70 (58%)

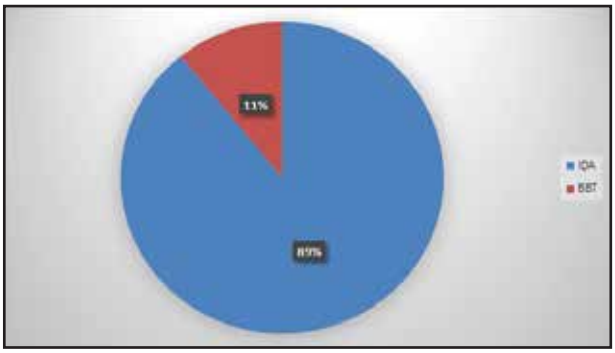

Figure 2: Total population 120 where IDA 107(89%) & BTT 13(11%).

Table II: Comparison of Mentzer index & RDW Index for differentiating IDA & BTT

		IDA	BTT
Mentzer	Mentzer Index High (>13)	78(a)	2(b)
Index	Mentzer Index low (<13)	29(c)	11(d)
RDW Index	RDW Index High(>220)	92(a')	1(b')
	RDW Index low(<220)	15(c')	12(d')

Sensitivity of Mentzer index = (a/a+c) x 100 = (78/ 107) x 100 = 72.8 %
Specificity of Mentzer index = (d/b+d) x 100 = (11/ 13) x 100 = 84.6 %
Sensitivity of RDW index = (a'/a'+c') x 100 = (92/ 107) x 100 = 86 %
Specificity of RDW index = (d'/b'+d') x 100 = (12/ 13) x 100 = 92.3 %

Among 120 patients with microcytic hypochromic anemia, we found IDA 107 patients through estimation of serum ferritin and serum iron, IDA 78 patients showed Mentzer index>13 and the remaining 29 patients showed Mentzer index<13. On the other hand, by doing Hb-electrophoresis we found 13 patients BTT among them 11 patients show Mentzer index<13and the other 2 show Mentzer index>13. In our study with RDW index, we found 92 IDA patients show RDW index>220 and other 15 IDA patients show RDW index<220. According to this calculation, the sensitivity of the Mentzer index is 72.8% and the specificity 84.6%. On the other hand sensitivity of the RDW index is 86% and Speciicity 92.3%. Thus our study shows Mentzer index and RDW index are reliable tools for the diagnosis of IDA and to differentiate it from BTT.

Discussion

Beta thalassemia trait and Iron deficiency are among the most common causes of microcytic hypochromic anemia in Bangladesh. Distinguishing BTT from IDA has important clinical application because each disease has an entirely different cause, prognosis and treatment. Patients of beta-TT are usually asymptomatic or they present with a similar clinical picture as that of IDA. Misdiagnosis of beta-TT has consequences for offspring leading to beta thalassemia disease.

In iron deficiency anemia reduced PCV, MCV, MCH, and MCHC are seen but the diagnosis is confirmed by carrying out iron studies. The classical findings seen in iron deficiency anemia are reduced serum ferritin and serum iron and increased total iron binding capacity. Confirm diagnosis of beta-TT can be done by measuring the HbA2 concentration of lysed RBCs via electrophoresis. Therefore, it is necessary to select an appropriate individual for a detailed examination on the basis of the CBC & Mentzer Index. The diagnosis of thalassemia is dependent upon the demonstration of increased HbA2 levels in the blood (>3.5%) on Hb electrophoresis and mutation analysis.[16]

Though the definitive test for thalassemia is Hb electrophoresis, it is difficult to perform this test in all patients as they are costly. Also, Hb electrophoresis is not readily available at smaller setups in peripheral areas. For this reason, the Mentzer index is used as a diagnostic screening tool to differentiate between iron deficiency anemia and thalassemia trait.[17]

Originally described by Mentzer in 1973 Mentzer index is useful to differentiate between iron deficiency anemia and thalassemia trait. Similarly, our study also shows Mentzer index sensitivity of 72.8% and specificity of 84.6% to differentiate between IDA and BTT.

In 2009, Eshani et al. showed that the best discrimination index according to Youdens criteria was the Mentzer index (90.1%), followed by the Eshani et al index (85.5%). In their study, Mentzer and Eshani et al were able to correctly diagnose 94.7% and 92.9% of cases respectively.[18] Our present study has consistency with that study. RDW is a measure of anisocytosis, increases in IDA and it is a normal or mild increase in BTT. Though RDW has been reported to be a good discrimination index to differentiate BTT and IDA.[19] In 2009, Ayatunnesa et al, showed RDWI as a good discriminator between BTT and IDA. They found sensitivity and specificity of more than 80% in differentiating IDA & BTT. In our study similarly, we found sensitivity of RDWI 86% and specificity 92.3%. These results are consistent with the findings of Demir et al and Sirdah et al.[20, 21]

Conclusion

Beta thalassemia trait and iron deficiency anemia are conditions causing microcytic hypochromic anemia. However, the definitive diagnosis depends upon iron studies and Hb-electrophoresis, where Mentzer index and RDW index can be used to screen the patient.

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