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Original Research Article

Role of Red Cell Distribution Width Index for Differentiation of Iron Deficiency Anaemia and Beta Thalassemia Trait

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Abstract

Background: Iron deficiency anaemia (IDA) and β thalassemia trait (βTT) are the two most common causes of microcytic hypochromic anaemia. βTT is an important differential diagnosis of IDA . It is important to distinguish between these two conditions for appropriate treatment. Red blood cells (RBCs) indices are a simple, easy and cost effective method. Red cell distribution width index (RDWI) can be easily derived from these parameters helps in diagnosis.

Objective: We aimed at finding out reliable and cost effective method in the differentiation of iron deficiency anaemia and beta thalassemia trait in the adult population.

Methods: A total of 110 cases (age range 20–45 years) from the hospital record are taken into the study. Cases diagnosed as IDA and βTT on the basis of serum iron, ferritin levels and Hb electrophoresis. Haemoglobin, RBC count, MCV, MCH, MCHC and RDW was noted from Swelab Alfa analyser value, whereas RDWI was calculated for all the samples.

Results: A total of 110 individuals with microcytic hypochromic anemia, 60 were diagnosed having IDA, whereas 50 were having βTT. There is female preponderance is seen in both types of anaemia. RBC count is higher in βTT. In both IDA and βTT haemoglobin and ranges from 6–7g/dl. The derived index RDWI showed better discriminative effect between βTT and IDA, as this index had both sensitivity and specificity equal or more than 85%.

Conclusion: RDWI is simple cost effective and reliable index for differentiation of IDA and βTT.

Keywords: Iron deficiency anaemia; β thalassemia trait; RDWI.

Introduction

Anaemia is a public health problem in most of the developing countries. Iron deficiency anaemia iron deficiency anaemia (IDA) may occur as a result of an dietary iron deficiency, malabsorption, hookworm infestations and chronic blood loss due to many factors.[1] Thalassemia's are group of genetic disorders of haemoglobin synthesis due to the reduction of one or more of the globin chains production.[2] It is necessary to differentiate IDA from βTT because each has different cause and prognosis. Iron therapy is indicated in IDA and contraindicated in βTT. And also the misdiagnosed βTT as IDA may get married to a βTT, resulting in thalassemia major in the offspring.

The automated blood cells analysis which is a rapid and cost-effective. Most of these analysers measure the red blood cell (RBC) count, the mean cell volume (MCV), and Hb concentration

haematocrit (HCT), mean cell haemoglobin (MCH), MCH concentration (MCHC) and RDW (Red cell distribution width).

The RDWI (Red cell distribution width index), can be easily calculated as (MCV x RDW/RBC).[3] Our study aimed at diagnostic utility of RDWI and RDW in the differentiation of IDA and βTT.

Materials and Methods

This is a retrospective study conducted in department of pathology at S. Nijaligappa Medical College and Hospital, Bagalkot.

Cases diagnosed as IDA and βTT on the basis of Hb electrophoresis, serum iron and ferritin levels were taken.

Serum ferritin less than 12ng/ml is taken as IDA and patients with HbA2 more than 4.0% (As per D–10 BIO-RAD Instrument) is considered as Beta thalassemia.

The haemoglobin, RBC count, MCV, MCH, MCHC and RDW were measured by counter automated cell counter (Swelab Alfa) are collected from the hospital record from January 2017 to January 2019.

A total of 110 cases studied which includes 60 cases of IDA and 50 cases of βTT.

Age group included in the study is from 20 to 45 yrs.

Cut off value of RDW (%) and RDWI are >14 and >220 for IDA respectively. Similarly for βTT RDW (%) and RDWI are <14 and <220 for IDA respectivelyare taken.[3]

Statistical Analysis

The analysis of the data carried out on SPSS 16.

The frequency and percentages were calculated for qualitative data and mean and standard deviation for quantitative data.

The student t-test was used to investigate the difference between CBC parameters of IDA and βTT and P values <0.05 was considered to be as significant.

Results

Among 110 cases 34 among 60 cases of IDA were female and 30 cases among 60 βTT werefemale. Female preponderance was noted in our study in both types of anaemia with mean age group is 26 yrs. RBC count was higher in βTT with range of 5.5–6.2x10^{12}/L as compared to RBC count in IDA is with range of 3.65–4.9x10^{12}/L. There is no significant difference is seen in haemoglobin in both IDA and βTT which ranges from 6–7g/dl. MCV and MCHC are higher in IDA than β-TT. RDW in IDA is 13.2–13.9 and in βTT is 10.5–19.6.

All the above mentioned parameters are statistically significant with p value <0.05 expect for MCHC which is statistically insignificant with P value of 0.1.

The derived index RDWI showed better discriminative effect between βTT and IDA, as this index had both sensitivity and specificity equal or more than 85% in detection of βTT and IDA. Sensitivity and specificity of RDWI for detection of βTT was found 85% and 91.0%. Again for IDA, sensitivity and specificity were found 85.0% and 91.0% respectively.

Youden's index (YI) takes into account both sensitivity and specificity and gives an appropriate measure of the validity of a particular technique. (This is calculated with formula YI = Sensitivity + specificity –100)

YI of RDWI was found 77.0, which could be a reliable discriminator between βTT and IDA. Although there are several methods to differentiate between βTT and IDA our present study we tried to evaluate a simple, cost effective, easy and less time consuming index.

Table 1: Complete blood count (CBC) parameters in both the iron deficiency anemia (IDA) and beta- thalassemia trait (βTT).

	IDA		βTT		
CBC Parameteres	**Range**	**Mean ±SD**	**Range**	**Mean ±SD**	**P-Value**
Hemoglobin (g/dl)	6.8–7.9	6.9 ± 0.9	6.5–7.7	7.2 ± 0.3	0.02
RBC (1012 /l)	3.65–4.9	4.4± 0.8	5.5–6.2	5.6±0.6	0.00
MCV (fl)	62.3–79.4	67.9±8.4	51.1–57.9	57.0±7.0	0.00
MCH	18.2–28	23.4 ±2.5	14.7–25.5	19.4±3.3	0.00
MCHC	23.8–39.7	30.9 ±4.1	26.3–38.9	32.0±3.6	0.13
RDW	13.2–13.9	13.8 ±1.4	10.5–19.6	15.3±2.5	0.00
RDWI	19.1–21.1	21.6±4.6	9.7–18.6	16.0±4.0	0.00

[Data is expressed as range, mean ± SD. IDA- Iron deficiency anemia; βTT-beta-thalassemia trait; Hb-hemoglobin; RBC-red blood cell count; MCV-mean corpuscular volume; MCH-mean corpuscular hemoglobin; MCHC-mean corpuscular hemoglobin concentration; RDW-red cell distribution width; RDWI-Red cell distribution width index.Note: p<0.05 is significant]

Table 2:

Parameters		Sensitivity(%)	Specificity(%)	Youdens' Index
RBC	IDA	83.3	85	68.3
	β TT	85	83.3	
MCV	IDA	76	84	60
	β TT	84	76	
RDW	IDA	78	77.5	55.5
	β TT	77.5	78	
RDWI	IDA	91	85	77
	β TT	85	91	

[Data is expressed assensitivity , specificity and Youdens' Index. IDA-Iron deficiency anemia; βTT-beta-thalassemia trait; RBC-red blood cell count; MCV-mean corpuscular volume; RDW- red cell distribution width; RDWI- Red cell distribution width index]

Discussion

Both βTT and IDA have an entirely different cause, prognosis and treatment. Hence distinguishing them has important clinical implications.

IDA shows female preponderance, with the most common cause being blood loss in adults and is usually from genital tract in women.[1] Similar female preponderance is seen in our present study in both IDA and βTT.

RBC count of more than $5.0x10^{12}$/L is seen in patients of βTT.[2] Our present study shows higher RBC in βTT with range of $5.5–6.2x10^{12}$/L than IDA.

In study done by Jameel T et al MCH and MCHC shows not much difference in two groups. The Haemoglobin A2 value above the cut-off limits and serum ferritin below the cut-off limits indicates coexisting IDA and βTT. RDW indicates anisocytosis. RDW is almost equally elevated in both IDA and βTT, with YI of 64, which is not a good descriminator.3Similarly our present study shows YI of 55.5. Also study done by Kumar A et al shows YI for RDW of 39.3.[4]

Study done by Zaghoul A et al shows mean age of 30.4+/–15.1. Out of 91 cases of IDA 21 are men and 70 are women with M:F of 1:3.3 and in βTT out of 123 cases 58 are men and 65 are women with male to female ratio of 1:1.1.[5]

In our study the sensitivity of 85% and specificity of 90% were observed for RDWI this is in accordance with observations made by quite few studies.[6,7,8] And YI of 77 which shows RDWI is better index for differentiating IDA and βTT.

The discriminating function of various indices dependent on age of a patient. It has been observed that the most accurate discriminant index for patients older than 10 yrs are total RBC count and RDWI and younger than 10 years is total RBC count.[9,10]

In a study done by Zhang et al Haemoglobin in βTT shows gender difference, where Haemoglobin is found to be higher in men compared with women. Whereas no significant difference is found in MCV, MCH, HbA and HbA2 between two genders.[11]

In India because of high prevalence of IDA, differential diagnosis of βTT is often complicated.[12] Study done by Matos FJ et al shows a new index Matos and Carvalho index to discriminate between iron deficiency anemia and thalassemia trait which has high sensitivity to detect IDA(99.3%%).[13]

Careful interpretation is required in condition with borderline HbA2. Iron deficiency may lead a low HbA2 and hence may mask a thalassemia trait whereas B12/folate deficiency may lead to slightly raised HbA2 leading to false diagnosis of a trait.[14]

Automated red cell parameters are routinely examined and offer a rapid and reliable method for BTT screening. Adequate utilization of these parameters can facilitate identification of the majority of BTT cases at no additional cost to the healthcare system.[15]

Although various standard cut offs of the indices available are good for screening purposes, but it is more useful to take out one's own most suitable values as the prevalence of nutritional anaemia and demographics varies from region to region.[16]

These formulas neither accounts for nor excludes the presence of any other disorder, it is useful when the differential diagnosis is narrowed down to βTT and IDA, which enables the clinician to reach a prompt accurate diagnosis, reduce unnecessary diagnostic testing and avert inappropriate treatment, application of formula could result in a considerable reduction in health care costs.

Conclusion

Since prevention is the most effective way in controlling β-thalassemia, an appropriate, reliable and cost effective way to screen the carriers can be done through a careful examination of their haemogram parameters and RBC indices, so calculated RDWI is simple, easy , useful ,cost effective and reliable index for differentiation among IDA and βTT, as compared to RDW for primary screening of microcytic hypochromic anaemia in IDA and βTT.

Conflict of interests: The authors declare that they have no conflict of interests.

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