

# RDWI is Better Discriminant than RDW in Differentiation of Iron Deficiency Anaemia and Beta Thalassaemia Trait

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## Abstract

*Iron deficiency anemia (IDA) and beta-thalassemia trait (BTT) are the common causes of microcytic hypochromic anaemia. Several discrimination indices have been introduced to discriminate quickly these similar entities via parameters obtained from automated cell counter. The purpose of the study was to compare the value of two discrimination indices, red cell distribution width index (RDWI) and red cell distribution width (RDW) in differentiation of BTT and IDA. This study consists of 57 cases of BTT and 72 cases of IDA. Severe anaemia (<7.0 gm/dl) had been excluded because these cases are not confused with BTT cases in practice. Sensitivity, specificity, positive and negative predictive values and Youden's index of both indices in differentiation of BTT and IDA had been calculated. RDWI appears to be reliable and useful index for differentiation of iron deficiency anaemia and beta thalassaemia trait. Again RDWI is better than RDW in differentiating BTT from IDA.*

**Key words:** Microcytic hypochromic anemia, discrimination indices.

## Introduction

Microcytic hypochromic anaemia is a very common haematological abnormality in clinical practice<sup>1</sup>. Two most common causes of microcytic hypochromic anaemia are iron deficiency anaemia (IDA) and beta thalassaemia trait (BTT), which are sometimes difficult to differentiate clinically and by routine laboratory examination<sup>2,3</sup>. The differentiation between BTT and IDA relies on the measurement of serum ferritin, serum iron and HbA<sub>2</sub> levels. But these methods are expensive and time consuming<sup>4</sup>. Again morphological appearance of red cells in blood film in IDA and BTT mimics so closely that it becomes sometimes very difficult in differentiating these two conditions<sup>5</sup>. New automated blood cell counter provide an index of red cell volume distribution width (RDW), an important parameter in differentiation of IDA and BTT<sup>6</sup>. The RDW

quantitatively measures red blood cell size variation, computed directly from the RBC histogram and is calculated as a standard statistical value, the coefficient of variation of the volume distribution<sup>7</sup>. McClure et al showed that RDW is the first index of the routine blood cell count to become abnormal during the development of iron deficiency<sup>8</sup>. Another red cell discriminant function, red cell distribution width index (RDWI) had been described by Jayabose et al<sup>9</sup> would be reliable discrimination index in differentiation of BTT and IDA<sup>10-11</sup>. RDWI is a cell counter based formula, calculated as  $(MCV \times RDW / RBC)^9$ . The purpose of the study was to compare diagnostic value RDWI and RDW in differentiation of IDA and BTT.

## Materials and Methods

This present cross-sectional study was carried out in the Department of Clinical Pathology, BSMMU, Dhaka in collaboration with Department of Haematology and Haematology, BSMMU, Dhaka. The newly clinically diagnosed cases of BTT and IDA were selected for this study. Cases were selected as beta thalassaemia trait and iron deficiency anaemia on the basis of two standard tests, Hb electrophoresis and serum ferritin estimation. Patients with HbA<sub>2</sub> more than 3.5% were identified as BTT cases and

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patients with serum ferritin less than 12 ng/ml were identified as IDA cases. After taking informed written consent, a total 129 patients of 1 to 60 years of age were selected in this study. Among them 57 cases were BTT and 72 cases were IDA. Complete blood counts including red cell indices were obtained by automated analyzer in all the patients. Differentiation between IDA and BTT were done by using red cell distribution width (RDW) and red blood cell distribution width index (RDWI), these were calculated from parameters provided by automated analyzer. The differential value of RDW and RDWI were given in Table-I.

**Table-I**

*Value of discrimination indices used in evaluation*

Indices	In favour of IDA	In favour of BTT
RDWI (MCV X RDW / RBC)	>220	<220
RDW (%)	>14	<14

Then all the data were analyzed by standard statistical methods using SPSS 16 software. Validity of both discrimination indices in differentiation of BTT and IDA were evaluated by calculating their sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and Youden's index (YI).

### Results

Fifty seven cases were identified as BTT in which mean Hb A<sub>2</sub> level was found 4.5% and 72 cases were identified as IDA whose mean serum ferritin was 9.3 ng/ml. On the other hand mean serum ferritin level in BTT was found 76.1%. The mean haemoglobin level was found 9.8 gm/dl in case of IDA and 10.2 gm/dl in cases of BTT. Mean MCV was found 71.8 fl in IDA cases and 63.9 fl in BTT cases (Table-II). There were

significant differences of Hb level and MCV, found in between BTT and IDA. Another important red blood cell parameter for detection of IDA and BTT is RDW. In the present study the mean RDW was found 16.4% in case of BTT and 16.9% in case of IDA. The results were not statistically significant ( $p=0.269$ ).

**Table-II**

*Statistics of different values of red blood cell parameters in BTT and IDA cases*

Test	Case	Mean	Std Deviation
Hb (gm/dl)	BTT	10.2	±0.8
	IDA	9.8	±0.9
MCV (fl)	BTT	63.9	±7.5
	IDA	71.8	±6.4
MCH (pg)	BTT	19.9	±2.9
	IDA	22.8	±2.8
MCHC (gm/dl)	BTT	31.1	±1.6
	IDA	31.6	±1.8
RDW (%)	BTT	16.4	±2.5
	IDA	16.9	±2.9

In the present study, RDWI came out as good discriminators between BTT and IDA, as this index had both sensitivity and specificity more than 80% in detection of BTT and IDA. Sensitivity, specificity of RDWI index for detection of BTT was found 80.7%, 84.7%. Again for IDA, sensitivity and specificity was found 84.7% and 80.7% respectively. Youden's index (YI) takes into account both sensitivity and specificity and gives an appropriate measures of validity of a particular technique. YI of RDWI was found 65.4, which could be reliable discriminator between  $\beta$  thalassaemia trait and iron deficiency anaemia. On the other hand the sensitivity, specificity of RDW for BTT cases were found, 17.5%, and 84.7% respectively and for IDA sensitivity was 84.7% and specificity was 17.5%. Ultimate Youden's index was found 2.3, which would not be a good discriminator of BTT and IDA (Table-III).

**Table-III**

*Sensitivity, specificity, PPV, NPV and YI of two discrimination indices in diagnosis of BTT and IDA*

Indices	Differential value	Cases (%)	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Youden's index
RDWI (MCV x RDW/RBC)	<220	BTT	80.7	84.7	80.7	81.3	65.4
	>220	IDA	84.7	80.7	81.3	80.7	
RDW (%)	<14	BTT	17.5	84.7	47.6	43.5	2.3
	>14	IDA	84.7	17.5	43.5	47.6	

## Discussion

The most frequently encountered diseases with mild microcytic hypochromic anaemia are BTT and IDA<sup>2-3</sup>. The discrimination between IDA and BTT is important because MCV will not normalize in BTT if misdiagnosed as IDA and treated with iron<sup>4</sup>.

To differentiate between beta thalassaemia trait (BTT) and iron deficiency anaemia (IDA), physician needs a battery of examination including estimation of HbA<sub>2</sub>, peripheral blood film, serum ferritin, iron, TIBC (total iron binding capacity) levels and transferrin saturation<sup>12</sup>. But these are relatively expensive, time consuming and sophisticated techniques. Red blood cell volume distribution (RDW) curves generated easily by electronic cell counters and can reliably distinguish microcytosis caused by IDA and BTT<sup>13</sup>.

RDW is a measure of anisocytosis, increases in IDA and it is normal or mild increase in BTT. Though RDW has been reported to be a good discrimination index to differentiate BTT and IDA<sup>7</sup>. Our results found that RDW more or less equally elevated in BTT and IDA. The mean value of RDW, found in IDA and BTT were 16.9±2.9 SD and 16.4±2.5 SD respectively. The sensitivity, specificity of RDW in detection of BTT were found, 17.5% and 84.7% and for IDA sensitivity was 84.7% and specificity was 17.5%. Ultimate Youden's index was found 2.3, which would not be a good discriminator of BTT and IDA. Similar findings also reported by Ntaios et al<sup>4</sup> and AIFadhli et al<sup>14</sup>.

In this study, RDWI came out as good discriminators between BTT and IDA, had both sensitivity and specificity more than 80% in detection of BTT and IDA. Sensitivity and specificity of RDWI in detection of BTT were found 80.7% and 84.7% respectively and for detection of IDA were found 84.7% sensitivity and 80.7% specificity. These results are consistent with the findings of Demir et al<sup>10</sup> and Sirdah et al<sup>11</sup>. YI of RDWI was found 65.4, which could be reliable discriminator between BTT and IDA. There were few limitation of these study like, Haemoglobin E disease and traits were not included in this study.

## Conclusion

From this study it can be concluded that, RDWI appears to be reliable and useful index for initial screening of microcytic hypochromic anaemia and is better than RDW in differentiating IDA from BTT.

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