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ORIGINAL ARTICLE

Evaluation of Srivastava index to distinguishing Beta-Thalassemia Trait from Iron Deficiency

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ABSTRACT

Objective: To assist in the differential diagnosis of beta thalassemia trait and iron deficiency anaemia, many alternative red blood cell index-based formulae were examined.

Methods: The Rawalpindi PEMH performed this study from June 2021 to March 2022. For individuals with beta- thalassemia trait and iron deficient anaemia, age and gender were not considered. More than five millilitres of blood were drawn from each patient in order to determine the haemoglobin content, the number of red blood cells, how they were distributed, and the average cell volume. Five alternative formulas may be used to differentiate these two circumstances. Shine and Lal index, Mentzer index, Srivastava index and Green & King index are among the most well- known ones. Youden's index was included in the calculation of sensitivity, specificity, and positive and negative predictive values (PPVs).

Results: The iron deficiency anaemia rate was 70%, and the beta thalassemia phenotype was 30% among the 1500 participants. This indicator has a sensitivity of 100% and specificity of 93.3% when it comes to discriminating between beta-thalassemia trait and iron deficiency anaemia.

Conclusion: The red cell distribution width index may be used to differentiate between beta thalassemia trait and iron deficiency anaemia. If a haemoglobin electrophoresis is not available, a diagnosis of beta thalassemia may still be made.

Keywords: Srivastava index, beta-thalassemia, Anemia, Cell redness, Hb electrophoresis,

INTRODUCTION

It is the most prevalent cause of hypochromic and microcytic anaemia, beta-thalassemia trait (BTT). [1]. In a WHO study, more than half of all instances of anaemia are caused by iron deficiency (IDA). Anemia is a major cause of death and disease in developing and poor countries. Untreated, it may cause developmental delays in children, a decline in IQ, an increase in mortality, and even cause death in certain cases [2]. Pregnant women who have several pregnancies and poor health are more likely to suffer from iron deficiency anaemia (IDA) [3]. Haemoglobin production of the normal globin peptide chains is hindered in thalassemic haemoglobinopathy, a hereditary hemoglobinopathy, because of this impairment (Hb). It's the most important differential while evaluating a child with anemia [4].

The form of thalassemia observed varies by race, however it is a common genetic condition with population -dependent frequency and severity. One in five people on Earth has Hb production faults, and seven percent are Hb disease carriers [5]. 80 percent of the infants born each year with severe haemoglobinopathies are from poor or impoverished nations (annually 0.3-0.5 million) [6].

The thalassemia gene is present in a small percentage of the populations of the Eastern Mediterranean, Southeast Asia, and Sub-Saharan Africa [7]. 8 People from thalassemia-endemic countries have migrated to North America and Europe, where the prevalence of thalassemia is now much higher than previously anticipated [8]. The Middle East is responsible for 10% of all Thalassemia cases in the globe, while Southeast Asia and the Mediterranean account for 9% and 8%, respectively [9]. As the most common genetic disease in Pakistan, around 115,000 new instances of homozygote thalassemia are diagnosed each year. Pakistan; around 5% of Pakistanis are heterozygous for beta thalassemia [10]. Analyzing iron and ferritin using electrophoresis as well as haemoglobin alpha 2 (HbA2). For the BTT diagnosis, it is possible to assess HbA2 levels using cellulose acetate, gel electrophoresis, and high-performance liquid chromatography [11,12].

BTT and IDA may be distinguished using a variety of electronic haematological cell counter red cell indices. Indi ces are used to differentiate between BTT and IDA in order to save both time and money. It may be difficult to distinguish between BTT and IDA without using red cell indices [13,14]. The MCV, MCH, MCHC, and RDW indices and factors, as well as the red cell distribution width, may be used to discriminate between BTT and IDA (RDW). Finding the most BTT patients while simultaneously removing those with IDA as a factor to consider when determining the optimal discrimination index (high specificity). In this study, five indices-based formulae were tested for their sensitivity and specificity[15,16].

MATERIAL AND METHODS

Pakistan's emirate military hospital in Rawalpindi (PEMH) performed this study between June 2021 and March 2022. Prior to blood samples being obtained, patients and their parents were given the option to provide their informed consent. The study's subject group included patients with microcytic hypochromic anaemia who were sent to the PEMH pathology lab for Hb electrophoresis. The research included both male and female patients between the ages of 1 and 12. Patients who had had blood transfusions within the previous four weeks or who were in a life-threatening condition were ruled out of the trial. Blood samples were collected through aseptic EDTA and plain gel tubes are used for biochemical and haematological analysis after venipuncture. Blood iron levels were measured in gel tubes after 5 minutes of spinning at 2800 RPM with Merck kits on Rayto (RT- 9200) chemical analyzers.

Analyses of blood parameters such as haemoglobin (Hb), RBC count, and RBC indices such as MCV and MCHC were carried out using an automated haematology analyzer from Tokyo (Nihon Kohden). An alkaline technique is required to estimate HbA2 levels using BTT. It was discovered through the use of Cellulose Acetate Electrophoresis (Wealtech, United States).

SPSS 22 was used for the statistical analysis. It was determined that several BTT indices had a high screening efficiency using the ROC curve. Several previously suggested methods were used to estimate the findings' sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) (NPV). 22,23

RESULTS

We generated and tallied the five discrimination indices that were utilized in the assessment (Table-1). 1050 of the 1500 blood

samples examined were found to have IDA, and 450 of them were shown to have BTT following Hb electrophoresis 70 percent of the 1500 people studied had iron deficiency anemia, and 30 percent had beta a thalassemia phenotype. Beta thalassemia trait and iron deficiency anaemia may be distinguished using the red cell distribut ion width index, which has a sensitivity and specificity of 100% and 93%, respectively. (Table-2).

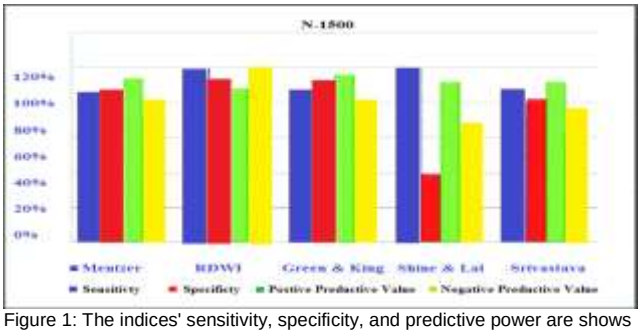

Figure 1: The indices' sensitivity, specificity, and predictive power are shows

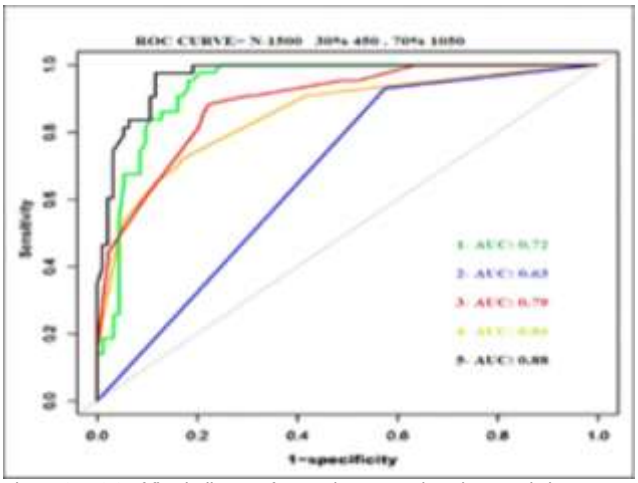

Figure-2: ROC of five indicators for receiver operating characteristic.

Table 1: Hematological and red cell parameters and indicators developed by Srivastava

Hematological Indices	Methods	BTT Cut off value	IDA Cut off value
Srivastava	MCH/RBC	< 3.8	> 3.8
RDWI	MCV x RDW/RBC	< 220	> 220
Shine & Lal	MCV x MCV x MCH/100	< 1530	>1530
Mentzer	MCV/RBC	< 13.0	> 13.0
Green & King	MCV x MCV x RDW/Hb x 100)	< 72	> 72

BTT: The trait of beta thalassemia IDA stands for iron deficiency anaemia. Hemoglobin (Hb), sometimes known as haemoglobin, A red blood cell is referred to as an RBC Cell volume is known as MCV. Mean Cell Haemoglobin (MCH) RDW: The breadth of the red cell distribution.

Table 2: In BTT and IDA declared patients, a wide variety of biochemical and haematological data may be seen

Factors	IDA (n=1050) Mean ± SD	BTT(n=450) Mean ± SD
Hb (g/dL)	9.25 ± 1.1	10.7 ± 1.2
RBC (×106/L)	4.0 ± 0.3	6.3 ± 0.7
HbA2 (%)	2.0 ± 0.3	6.1 ± 0.8
MCV (fl)	55.3 ± 5.2	67.2 ± 6.2
MCH (pg)	21.1 ± 3	19 ± 1
RDW (%)	20.2 ± 1.9	14.2 ± 1.4
Serum Iron (ng/mL)	7.54 ± 3.2	33.75 ± 22.9

A blood disorder characterised by the presence of beta thalassemia trait IDA: a lack of iron anaemia Haemoglobin, or Hb, is a kind of haemoglobin. A red blood cell is referred to as an RBC Mean cell volume is abbreviated as MCV. Mean Cell Haemoglobin (MCH)
The red cell distribution width (RDW).
The Srivastava index correctly identifies 90.25% patients standing inferior only to RDW Index which has 100% and 93% sensitivity and specificity, that were both sensitive and specific could only be found in a small number of cases (Figure-1). For diagnostic purposes, RDWI is superior than other methods, according to the ROC curve (Figure-2).

DISCUSSION

Pakistan, a mostly agricultural country, struggles with IDA, the world's most frequent nutritional deficiency. According to the W.H.O, the prevalence of IDA in Pakistani women of childbearing age is 52%, in children between the ages of 65-78, and in teens between the ages of 12 and 17. [11] There are two primary causes of microcytic anaemia. All ages and all health conditions are affected by anaemia, including BTT and IDA [17]. It is critical to distinguish between BTT and IDA in laboratory data due to the high frequency with which their findings overlap and resemble one another. [24] These clinical conditions, on the other hand, have a wide range of outcomes, etiologies, and treatment choices18. They both have low haemoglobin, microcytosis, and hypochromia in their red cell indices. One of the main goals of this research was to discover the best formula for separating BTT from IDA [19]. Hypochromic microcytic anaemia patients may be divided into two major groups using this formula, which can be used to request particular tests, such as serum iron (SI) and haemoglobin electrophoresis. Saving time and money while also reducing diagnostic costs are all advantages of using this method 20.

In an attempt to distinguish between BTT and IDA, scientists have used a number of mathematical formulas, but none has shown to be 100 percent correct. It was shown that RBC indices-based equations had varying sensitivity, specificity, positive predictive value (PPV) and negative predictive value. Five different formulations of BTT were evaluated on each hypochromic microcytic sample [21]. The 30% which had 100% sensitivity and 93% specificity, was one of the most reliable markers. According to preliminary research, RDWI is capable of telling the difference between these two possibilities.

Additionally, a group of Spanish haematologists discovered that the most trustworthy indicator was RDWI, stating it one of their conclusions [22]. all Findings from our analysis show the Srivastava index to be second only to the RDWI in terms of discriminative value. In spite of the fact that another study 44 stated that the Shine and Lal method was the best indicator of BTT, this formula was only 38 percent specific. This index was shown to be the best discriminator in one research however RDWI came out on top of the others in our evaluations. Shine and Lal, Srivastava and Mentzler's equations were shown to have a strong discriminative function [23]. Hypochromic and microcytic anaemia may be attributed to BTT or IDA in more than 60% of cases. There was no variation in any of the formulae's output. [26] Specifying cutoff values for each group is critical since various research may apply different values[24].

In our investigation, we found that a larger sample size is necessary to accurately determine the sensitivity and sensitivity of various formulae in discriminating between BTT and IDA.

CONCLUSION

In conclusion, blood cell count based indices can segregate individuals with hypochromic microcytic anaemia and can predict their chances of having BTT or IDA. According to our result the percentage of correctly diagnosed patient were highest with RDWI followed by Mentezer and Srivastava index. This formula may be utilized for mass screening of microcytic hypochromic anaemia in

places where Hb electrophoresis is not available.

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