Research Article

Evaluation of red cell distribution width in the diagnosis of iron deficiency anemia

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ABSTRACT

Background: Iron deficiency anemia is the most common nutritional deficiency world over and in India. It is the most important cause of microcytic hypochromic anemia. Red cell distribution width (RDW) provides quantitative assessment of anisocytosis and could be helpful in differentiating iron deficiency anemia from other microcytic anemias. The objective behind this study was to assess the role of RDW as an early indicator in diagnosing iron deficiency anemia.

Methods: A total of 100 cases of microcytic anemia (MCV <80fl) were included in the study. RDW values were obtained on an automated hematology analyser. Sensitivity, specificity, positive predictive value, negative predictive value of RDW in iron deficiency anemia were studied.

Results: With cut off value of 14.5%, sensitivity and specificity of RDW as a test in diagnosis of iron deficiency anemia were 84.81% and 57.14% respectively and a positive and negative predictive value of 88.15% and 50% respectively.

Conclusions: RDW has a high sensitivity and can be used as a simple, economical, reliable automated red blood cell parameter for initial diagnosis of iron deficiency anemia.

Keywords: Red cell distribution width, Iron deficiency anemia, Microcytic hypochromic anemia

INTRODUCTION

Anemia is a major public health problem in developing countries.[1,2] The multitude of clinical presentations and pathogenesis makes the evaluation of anemias, ever challenging and significant.[3] Microcytic hypochromic anemia is one of the commonest hematological abnormality encountered in routine practice. Small red blood cells known as microcytes, with MCV <80 fl can arise from iron deficiency, chronic diseases, hemoglobinopathies, lead poisoning.[4-6] Iron deficiency anemia is the most prevalent microcytic hypochromic anemia worldwide including India.[6,7] All women of reproductive age group, pregnant females, infants, young children, adolescents and elderly are at a higher risk of nutritional anemias in developing nations because of increased demand and or low intake.[1,8,9] It, therefore, becomes necessary to point to a definitive diagnosis of microcytic anemias to differentiate iron deficiency anemias from other causes since pathogenesis, prognosis and treatment is different for every cause.[5,6]

Complete blood counts including red blood cell (RBC) parameters evaluated with the help of automated hematology analyzers form an integral part of routine hematological work up and thus are the backbone for

elucidating the diagnosis of anemias.[3] The RBC parameters gives an effective quantitative assessment of red blood cells. MCV facilitates the morphological diagnosis of anemia. However, red cell distribution width (RDW) is important and better index to characterize microcytic anemias and help in distinguishing between uncomplicated iron deficiency anemia from uncomplicated heterozygous thalassemia.[3,10,11] Various other methods are done for definite diagnosis like bone marrow iron stores, serum ferritin, serum iron, total iron binding capacity, serum transferrin saturation and hemoglobin electrophoresis. These methods are either invasive or expensive or not feasible due to lack of facilities as in India. RDW, alongside other red cell indices, can be cost effective in early diagnosis of iron deficiency anemia with sufficient accuracy and minimal testing.[6,7] The present study was undertaken to evaluate RDW as a screening test for diagnosis of iron deficiency anemia.

METHODS

This is an observational study in which we evaluated 100 cases of microcytic anemia with reduced mean corpuscular volume (MCV <80 fl), referred by different clinicians to a diagnostic setup in Jammu. The primary objective of this study was to explore the role of red cell distribution width (RDW) in diagnosing iron deficiency anemia (IDA). The cut off point for hemoglobin (Hb), MCV, RDW and serum ferritin were taken according to normal reference ranges for both sexes and different age groups, from Dacie and Lewis Practical Haematology.[12] The Hb concentration, MCV and RDW values in all cases were obtained by automated haematology analyzer.

The cases were further categorized into iron deficiency anemia and non-iron deficiency anaemia groups based on serum ferritin levels.

RESULTS

A total of 100 cases of microcytic anemia (MCV <80 fl) were included in the study. Out of those 100 patients, 62% were females and 38% were males. Age and gender wise distribution of cases is shown in Table 1. Maximum number of patients were in the age group of 0-10 years (22%) followed by 20% in the age group of 21-30 years and 16% in the age group of 31-40 years. Maximum male patients were seen in the age range of 0-10 years while maximum number of females was in the age group of 21-30 years followed by 31-40 years.

Out of 100 cases, 79% were found to have iron deficiency anemia and 21% were non-iron deficient anemia. Cut off value of RDW used in the evaluation of cases was 14.5%. Out of a total of 100 cases, RDW was abnormal in 76% of the cases. Values exceeding 14.5% were determined in 67 of the 79 iron deficient cases. 9 out of 21 non-iron deficient cases also showed RDW >14.5%. At the cut off value of 14.5%, the sensitivity and

specificity of RDW in diagnosing IDA was found to be 84.81% and 57.14%, respectively with a positive predictive value of 88.15% and a negative predictive value of 50%.

Table 1: Age and gender wise distribution of 100 cases of microcytic anemia.

Age (years)	No. of patients	Male	Female
0-10	22	14	08
11-20	11	04	07
21-30	20	02	18
31-40	16	03	13
41-50	08	02	06
51-60	12	06	06
61-70	07	05	02
>71	04	02	02
Total	100	38	62

DISCUSSION

Prevalence of anemia is high in India and is widely seen in all age groups; the major cause of which is iron deficiency anemia.[13] In our study, of the 100 anemic cases, females were 62% and males were 38%. Maximum number of female patients was in the age group of 21-30 years and maximum male patients were seen in 0-10 years age group. This observation is in concordance with observations made by Khatri et al, Aulakh et al and Choudhary et al.[2,6,9]

Iron deficiency anemia is the most important cause of microcytosis and hypochromia. Development of anemia is a late feature of IDA, so the estimated prevalence of iron deficiency is much higher than that of anemia in general population.[7,14,15] Thalassemia syndromes, inflammation, various chronic diseases and occasionally lead poisoning may cause difficulties of interpretation as they all morphologically show microcytosis on peripheral smears.[5,16,17] In a population which has a high prevalence of anemia, the evaluation of microcytic anemias and/or microcytosis is a common but expensive process.[18] For exact categorization of these diseases, a battery of investigations are required. In addition to complete blood counts, serum iron, serum ferritin, total iron binding capacity (TIBC), Hb electrophoresis is done for definitive diagnosis.[2,6,19] With the advent of automated analyzers, red blood cell (RBC) indices have emerged as low cost parameters for early detection of anemias.[7] However, in cases of microcytic anemias, RBC parameters show similar results i.e. low hemoglobin and MCV.[19]

RDW has emerged as a better RBC index to differentiate iron deficiency anemia from other causes of microcytosis especially thalassemia trait.[5] It is the first RBC index to become abnormal during the development of IDA.[4,10] RDW represents the coefficient of variation of RBC volume distribution and is an index of heterogeneity, the

equivalent of anisocytosis observed in peripheral smear.[2,10,20]

In present study, 79% cases had an abnormal RDW and in cases of iron deficiency anemia, 67 out of 79 cases had an abnormal RDW with sensitivity and specificity of 84.81% and 57.14%, respectively. The present study goes in favour of the previous studies done by Pandya et al, Aulakh et al and Nesa et al with sensitivity of 82.27%, 81% and 84.70%, respectively. Aulakh et al reported specificity of 53.40%. However, Nesa et al reported a specificity of 17.50%.[4,6,13] Raised RDW in iron deficiency anemia was also noted by Flynn et al, van Zeben et al and Choudhary et al who reported a sensitivity and specificity of 90% and 51%, 94% and 59% and 91.30% and 43.47% respectively.[2,5,18] RDW was found to be 100% sensitive by Santosh et al.[10] Limited specificity for iron deficiency anemia was seen in our study as was also observed in studies by Nesa et al, van Zeben et al, Aulakh et al and Flynn et al.[4-6,18] However, study done by Saroja et al have concluded a higher specificity of 75% and a sensitivity of 47%.[1]

Iron deficiency anemia shows raised RDW along with low MCV (microcytic heterogenous anemia) and thalassemia trait forms an important differential diagnosis but shows low MCV and normal RDW (microcytic homogenous anemia).[3,21]

Our study is in accord with a number of studies which suggest that increase in RDW is sensitive for iron deficiency. However, frequent occurrence of increased RDW in thalassemia and other conditions limits it specificity in the diagnosis of microcytic anemias. Further diagnostic investigations like bone marrow iron, serum ferritin, serum iron, serum total iron binding capacity, serum transferrin saturation and Hb studies are still necessary to make an appropriate diagnosis of the cause of microcytosis with precision.[5,6,18] But all these tests are either invasive or relatively expensive, time consuming and specialized techniques requiring sophisticated laboratories and therefore, can not be done routinely. Hence RDW, which all recent automated cell counters display can be used as a cheap, time efficient and reliable early indicator to distinguish between iron deficiency anemia and other causes of microcytosis.

CONCLUSION

Present study underlined the importance and role of RDW in diagnosis of iron deficiency anemia. In a scenario of high prevalence of anemia in our country and even higher costs of specialized tests, the need to adopt cost effective, accurate and efficient measures is required. RDW has a relatively high sensitivity in diagnosing iron deficiency anemia and therefore, can be used as a low cost initial investigation for distinguishing iron deficiency anemia from other causes of microcytic anemias. Patients can be put on iron therapy and followed up with RDW values. If these show no improvement, further investigations can be recommended. Thus, it is concluded that RDW, though not diagnostic, can be promoted as a sensitive screening test for iron deficiency anemia, thereby, reducing man power, time consumption and expenses.

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