Low Hemoglobin Density as a Measure of Iron Status

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Abstract Iron deficiency anemia is the commonest cause of anemia in the developing countries. Iron status is the result of the balance between the rate of erythropoiesis and the amount of iron stored in the body. Various biochemical parameters have been used to assess iron status such as iron levels, transferrin, transferrin saturation and ferritin, and all of them may be influenced by acute phase response and are also expensive tests 1–4. In our situation where patients cannot afford exhaustive tests to document iron deficiency we utilized the LHD values as a predictor of iron status based on the formula provided by Urrechaga 5.

Keyword Iron deficiency anemia ·
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Introduction

Iron deficiency anemia is the commonest cause of anemia in the developing countries. Iron status is the result of the balance between the rate of erythropoiesis and the amount of iron stored in the body. Various biochemical parameters have been used to assess iron status such as iron levels, transferrin, transferrin saturation and ferritin, and all of them may be influenced by acute phase response and are

also expensive tests [1–4]. In our situation where patients cannot afford exhaustive tests to document iron deficiency we utilized the LHD values as a predictor of iron status based on the formula provided by Urrechaga [5].

Materials and Methods

We evaluated patients referred to the Haematology Out Patient Department for evaluation of anemia (Hemoglobin less than 11 gm%) over a period of 6 months from October 2009 to March 2010. Samples were run on the LH 750 (Beckman coulter) within 2 h of collection. Patients were considered to be iron deficient if the following criteria were fulfilled—serum iron less than 35 ug/dl, transferrin saturation less than 20 %, mean corpuscular volume (MCV) less than 70 fl and hemoglobin less than 11 gm%. Patients with an MCV more than 70 and anemia were analyzed as a separate group. A total of 136 patients on whom data was available were analyzed. We found that 80 patients had an MCV less than 70 fl and 56 patients had an MCV more than 70 fl. Ferritin levels were not monitored as it is an acute phase reactant and also added considerably to the cost. We analyzed this data and also derived the LHD% from the MCHC values using the formula described by Urrechaga.

$$\text{LHD\%} = 100\sqrt{1 - \left[1 / \left(1 + e^{1.8(30 - \text{MCHC})}\right)\right]}$$

Results

The 136 patients were divided into two groups based on MCV and analyzed. The data from these two groups is depicted in Table 1.

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Table 1 Comparison of iron status based on MCV

	Group 1 MCV less than 70	Group 2 MCV more than 70	<i>P</i> value
Number	80	56	
HB	8.0 (4.6–10.9)	8.3 (4.4–10.9)	0.7365
RBC	2.8 (2.56–6.0)	4.3 (1.32–4.9)	0.005
MCV	60.4 (49.3–69.9)	85.4 (75.6–116)	0.0001
MCH	18 (13.7–22.4)	28.4 (22.1–34.2)	0.0001
MCHC	30.2 (26–32.5)	32.3 (31.7–36.5)	0.0001
IRON	22.5 (5–96)	65.1 (35–208)	0.0001
Transferrin	313 (100–438)	198 (76–344)	0.0001
Transferrin%	6.2 (1.1–29.3)	37.2 (8.1–89.7)	0.0005
TIBC	419 (104–640)	260 (83–453)	0.0001
UIBC	397 (96–630)	195 (24–415)	0.0001
LHD%	58.7 (10.4–99.9)	5.3 (0.2–12.1)	0.0001

Table 2 Patients with anemia with MCV less than 70 and serum iron less than 35 ug/dl

	Group 3
Number	66
HB	7.7 (4.6–10.9)
RBC	4.2 (2.56–5.6)
MCV	59.9 (49.3–69.9)
MCH	17.7 (13.7–22.4)
MCHC	30.0 (26–32.5)
IRON	14.5 (5–33)
Transferrin	324 (100–442)
Transferrin%	3.4 (1.1–11)
TIBC	434 (104–640)
UIBC	421 (96–630)
LHD%	61.8 (10.4–99.9)

We found that patients with anemia with a mcv less than 70 and the LHD above 10 had low iron stores

Table 1 shows the results of patients with anemia with suspected iron deficiency using an MCV less than 70 fl as cut off. Group 1 with 80 patients with a MCV less than 70 had a mean iron of 22.5 ug/dl (range 5–96) and mean transferrin saturation of 6.2 % (range 1.1–29.3) and LHD% of 58.7 (range 10.4–99.9). Group 2 with 56 patients with a MCV greater than 70 fl had a mean iron of 28.4 ug/dl (range 22.1–34.2) and mean transferrin saturation of 37.2 % (range 8.1–89.7) and LHD% of 5.3 (range

0.2–12.1). Except the difference in hemoglobin values between these two groups, the difference in all other parameters was statistically significant.

We sub-analyzed the patients in group 1 and found that 66 patients had a total iron less than 35 ug/dl. The data on these patients is depicted in Table 2.

Conclusions

With this study we are suggesting that in the absence of iron profile in people with suspected iron deficiency anemia, the LHD% value which can be calculated from the instrument is a useful predictor of iron deficiency. The LHD% is derived from the MCHC measured in this instrument. Using the formula provided we noticed that statistically significant differences in iron stores were observed in patients with LHD above 10.4 and this predicted iron deficiency. This cut-off value differs from the 4 % cut-off reported by Urrechaga et al. In developing countries like India where iron deficiency is a significant problem among children and women, the cost of doing an iron profile with serum ferritin levels adds a cost of US\$ 20 with which the patient can complete the entire course of treatment. Hence deriving the LHD% from the instrument adds to information on iron status and can be easily incorporated into the report released from the instrument. This information will be extremely useful to the primary care physician in diagnosis and monitoring response to therapy in a fairly reasonable manner when the LHD% is above 10.4 %.

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