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ORIGINAL ARTICLE

Evaluation of Cutoff Values of RHE and MRV on Diagnosis for Iron Deficiency Anemia in Chinese Adults of Chengdu

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SUMMARY

Background: **Our aim was to evaluate the cutoff values of RHE and MRV as markers to diagnose IDA in healthy Han ethnic adults of Chengdu.**
Methods: **A total of 263 Han adults who needed bone marrow aspiration for diagnosis were enrolled according to the inclusive and exclusive criteria. The cutoff values of RHE and MRV were determined by receiver operating curves.**
Results: **According to statistical analysis, the cutoff values of RHE and MRV in male and female groups were 26.75 pg, 89.60 fL and 26.65 pg, 88.55 fL respectively. The areas under the curve (AUC) of RHE and MRV were 0.941, 0.939 and 0.925, 0.909 in male and female groups, respectively.**
Conclusions: **In our study, we explored the cutoff values of RHE and MRV to diagnose IDA in the Han ethnic population in Chengdu for the first time.**
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KEYWORDS

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INTRODUCTION

Iron deficiency anemia (IDA) is a common clinical anemia disease which can lead to developmental delays, perinatal complications, behavior disorders, and cognitive function [1,2], and early detection of IDA is essential to prevent various complications and for improving patient quality of life [3].
Compared with common laboratory parameters such as ferritin, hemoglobin, and reticulocytes. New laboratory indicators such as reticulocyte hemoglobin content (RHE) and mean reticulocyte volume (MRV) have been explored for the early diagnosis of IDA [4,5].
Our previous study has established male and female reference intervals for RHE and MRV based on a laboratory measurement system and local populations [6], which provide a certain basis for clinical diagnosis of IDA. However, the more important thing is to determine the

cutoff values for IDA diagnosis with RHE and MRV. Therefore, the purpose of this study is to determine the suitable cutoff values of RHE and MRV for the diagnosis of IDA.

MATERIALS AND METHODS

Subjects

All subjects were Han ethnicity adults (not younger than 18 years old) and collected from the Department of Hematology of Chengdu Fifth People's Hospital from September 2020 to November 2021. Two hundred and sixty-three patients who needed to undergo a bone marrow aspiration for diagnosis in the hematology department were enrolled. Exclusion criteria were: (1) subjects who had a blood transfusion, oral, or intravenous iron supplement within a month; (2) pregnant women; (3) patients who suffered from hemoglobinopathy, leukemia, myeloma, or myelodysplastic syndrome; (4) subjects who had a fever in the past week (CRP > 0.5 mg/dL), history of any malignancy. The 263 eligible subjects were divided into two groups according to Hb levels and bone marrow iron staining results: (1) The IDA group: bone marrow iron staining showed negative and the clinical diagnosis was IDA; (2) The control group: bone marrow iron staining showed positive.

Parameters measured

Hb, RHE, MRV were performed on a Mindray BC-6800; CRP was determined by the Hitachi 7180 automatic biochemical analyzer. During the study, internal quality control, and external quality assessment scheme (Clinical Test Center of Ministry of Health, China) of the study parameters were all controlled.

Statistical analysis

All hematological parameters in this study were analyzed by SPSS 19.0. Normally distributed quantitative variables were expressed as mean ± SD. Non-normally distributed quantitative variables were expressed as median (P25, P75). $p < 0.05$ indicated a significant difference.

RESULTS

Table 1 shows the comparison of RHE and MRV for different diagnostic groups.

Figure 1 shows the receiver operating characteristic (ROC) curve of RHE and MRV diagnosing for IDA.

Table 2 shows the optimal prognostic values of RHE and MRV for IDA according to ROC curves.

DISCUSSION

As can be observed in the Table 1, compared with the control group, the IDA group had significantly lower RHE and MRV. In the IDA group, the median and minimum values of RHE and MRV in the female group were both lower than those in the male group, indicating that women are more prone to small cell hypochromic anemia due to iron loss and deficiency [7]. Meanwhile, the parameters RHE and MRV were statistically different between the male and female groups in the IDA group, so gender should be taken into account in the evaluation of diagnostic efficiency.

Diagnostic efficiency of IDA diagnosed by RHE and MRV was presented in Figure 1 and Table 2. According to the ROC curves of RHE and MRV in different genders, we determined the cutoff values and area under curve (AUC) of RHE and MRV for diagnosing IDA in male and female groups. The cutoff values of RHE and MRV in female groups were lower than those in male groups. Our study showed that the best threshold for RHE in diagnosing IDA was 26.75 in male and 26.65 in female, both of them were slightly lower than the cutoff point of 27.2 pg selected by Jie Cai et al. [8]. Changes in the quality of life, regional diet, and ecological environment contribute to this difference. In some other studies, the cutoff value of RHE was 28 - 32.4 pg [9-12]. All of them were higher than our cutoff values of RHE which may be attributable to the difference of subjects and analytical method. The cutoff value of MRV for diagnosing IDA was also determined, which was a relatively interesting work, because almost no studies are available on determining the cutoff value of MRV for screening IDA. Therefore, determination of MRV cutoff threshold can provide a new way to diagnose IDA.

When evaluating the iron status of an individual, inexpensive, rapid, and non-invasive tests are generally chosen which could accurately reflect iron status. RHE and MRV are inexpensive and readily available assays and do not cause trauma or physical discomfort for a patient. Especially for the elderly and children, RHE and MRV can be used as a substitute for bone marrow iron stain in the diagnosis of IDA. So, a validation study based on the cutoff values of RHE and MRV in diagnosis of different etiologies of IDA is currently being undertaken by our group, especially for the further clinical application of MRV.

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Declaration of Interest:

The authors report no potential conflict of interests.

Table 1. Comparison of RHE and MRV for the different diagnostic groups.

Parameters	Gender	IDA Group (M = 79, F = 81)	Control Group (M = 50, F = 53)	p
		Median (P25, P75) (min - max)	Median (P25, P75) (min - max)	
RHE (pg)	Male	22.75 (19.97 - 26.00) (16.00 - 29.10)	28.80 (27.80 - 29.77) (26.00 - 31.80)	0.001
	Female	22.20 (20.35 - 25.30) (14.50 - 29.80)	27.96 (27.10 - 28.91) (25.10 - 30.68)	0.002
ANOVA		0.034	0.028	
MRV (fL)	Male	78.89 (70.60 - 88.00) (61.00 - 101.80)	96.95 (94.15 - 99.83) (88.60 - 106.30)	0.001
	Female	78.50 (71.00 - 88.45) (47.70 - 101.70)	95.50 (92.60 - 97.30) (86.56 - 104.10)	0.001
ANOVA		0.041	0.022	

M - male, F - female, significant p < 0.05.

Table 2. Optimal prognostic values of RHE and MRV for IDA according to ROC curves.

Parameters	Gender	Sensitivity %	Specificity %	Cutoff	ROC Area 95% CI
RHE (pg)	Male	82.1	94.2	26.75	0.941 (0.840 - 0.961)
	Female	84.0	94.9	26.65	0.939 (0.901 -0.977)
MRV (fL)	Male	79.4	93.6	89.60	0.925 (0.878 - 0.971)
	Female	80.2	94.3	88.55	0.909 (0.885 - 0.963)

95% CI indicates 95% confidence interval.

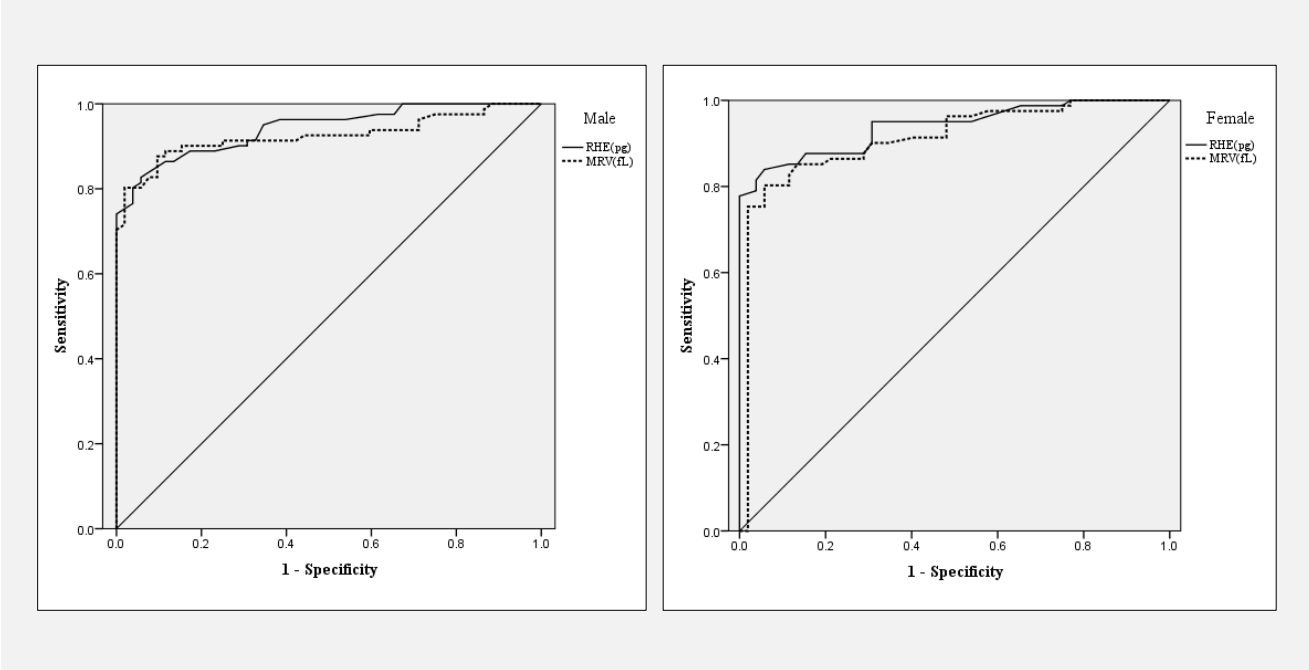

Figure 1. ROC curves of RHE and MRV diagnosing for IDA.

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