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ORIGINAL ARTICLE

The Clinical Application of RDW in Predicting the Severity of Liver Cirrhosis

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SUMMARY

Background: **This study aims to explore the clinical significance of RDW (Red Cell Distribution Width) in patients with liver cirrhosis.**
Methods: **For this retrospective analysis, a total of 355 patients with liver cirrhosis were collected and divided into three groups according to the Child-Pugh classification: Group A (132 cases), Group B (113 cases), and Group C (110 cases). Additionally, 88 healthy controls were included. Various indicators, including total bilirubin, albumin, ALT, serum creatinine, INR, AST, and RDW were detected to observe the changes in these indicators among different grades of liver cirrhosis and the characteristics of their ROC curves.**
Results: **In the liver cirrhosis group, the levels of total bilirubin (TB), ALT, AST, and RDW were significantly higher than those in the healthy control group ($p < 0.05$). ALT and RDW increased progressively from Child-Pugh A to C grades, with statistically significant differences between groups ($p < 0.05$). The area under the ROC curve for RDW was 0.773, with a sensitivity of 94.1% and a specificity of 76.2% for diagnosing liver cirrhosis. RDW's diagnostic efficacy was second only to ALT, comparable to AST, and higher than albumin, PLT, INR, and TB.**
Conclusions: **RDW is correlated with the degree of liver damage and closely related to the clinical grading of liver cirrhosis. Combining RDW with traditional liver cirrhosis indicators such as AST and ALT can help predict the prognosis of liver cirrhosis.**
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KEYWORDS

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INTRODUCTION

Red Cell Distribution Width (RDW) is a parameter that reflects the heterogeneity of red blood cell volume, expressed as the coefficient of variation of red blood cell size [1]. RDW test results are generally used together with MCV (Mean Corpuscular Volume) to diagnose anemia. Studies have reported associations between RDW and cardiovascular diseases [2], infections, and mortality prediction [3]. Recently, RDW has been found to be elevated in alcoholic liver disease and hepatitis B [4]. This study investigates the relationship between RDW and liver cirrhosis by selecting patients with liver

cirrhosis as subjects.

MATERIALS AND METHODS

A total of 355 patients with liver cirrhosis admitted to Shaoxing People's Hospital from October 2020 to February 2025 were selected, including 191 males and 164 females. According to the Child-Pugh classification, which quantitatively assesses liver reserve function, the patients were divided into three grades: A, B, and C, representing three different levels of liver damage severity (higher scores indicate worse liver function). Group A included 132 cases (71 males, 61 females), with an average age of 55.3 ± 13.2 years; Group B included 113 cases (62 males, 51 females), with an average age of 44.2 ± 12.5 years; Group C included 110 cases (58 males, 52 females), with an average age of 50.6 ± 13.7 years. Additionally, 88 healthy individuals (47 males, 41 females) with an average age of 44.5 ± 13.9 years were selected as the control group. The healthy individuals had no underlying diseases of the heart, kidneys, lungs, or other organs.

Venous blood was collected from the antecubital vein of all subjects, with EDTA anticoagulation and mixing. The Sysmex (Japan) fully automatic hematology analyzer and its matching reagents were used to complete the analysis within 30 minutes.

Five milliliters of fasting venous blood were drawn in the morning, left at room temperature for 20 minutes, and then centrifuged at 3,500 r/minute for 5 minutes. The Beckman Coulter Au5800 (USA) fully automatic biochemical analyzer and its matching reagents were used for analysis.

Three milliliters of fasting venous blood were drawn in the morning, and plasma was used for detection with the Sysmex (Japan) coagulation analyzer and its matching reagents. The same procedures were applied to the normal control group.

Data were processed using SPSS 17.0 software. Data are presented as mean ± standard deviation(s). Multiple group comparisons were performed using ANOVA. A p-value of less than 0.05 was considered statistically significant. The sensitivity, specificity, and diagnostic cutoff values of each indicator were represented by ROC curves.

RESULTS

Basic information of each group (Table 1).

ROC Curves of RDW, albumin, PLT, INR, AST, TB, and ALT (Figure 1).

Diagnostic efficacy of RDW, albumin, PLT, INR, AST, TB, and ALT for liver cirrhosis (Table 2).

DISCUSSION

Liver cirrhosis is a common chronic progressive liver disease characterized by diffuse liver damage caused by one or more etiologies acting over a long period or repeatedly [5]. In China, most cases are post-hepatitis cirrhosis. Pathologically, there is widespread hepatocyte necrosis, nodular regeneration of residual hepatocytes, proliferation of connective tissue, and formation of fibrous septa, leading to the destruction of hepatic lobule structure and the formation of false lobules. The liver gradually deforms and hardens, progressing to cirrhosis [6]. Although many clinical indicators change during the development of cirrhosis, there is currently no "gold standard" for diagnosing cirrhosis. Therefore, this study aims to explore indicators that may be associated with cirrhosis.

In this study, we found that RDW and ALT were significantly higher in patients with cirrhosis compared to the healthy control group and progressively increased from Child-Pugh A to C. This suggests that RDW, like ALT, is associated with the degree of liver damage and closely related to the grading of cirrhosis. Our analysis using ROC curves showed that the area under the curve (AUC) for RDW was 0.773, with a sensitivity of 94.1% and a specificity of 76.2% for diagnosing cirrhosis. RDW's diagnostic efficacy was second only to ALT, comparable to AST, and higher than albumin, PLT, INR, and TB. Since ALT and AST are the most powerful indicators for assessing liver damage and prognosis, RDW may also be associated with the severity of cirrhosis. Therefore, combining RDW with ALT and AST can help assess the severity and predict the prognosis of cirrhosis patients.

Compared to traditional indicators for diagnosing cirrhosis, RDW has the following advantages: 1) It is easy to obtain and cost-effective. RDW can be measured during a routine blood test, is inexpensive, and provides quick results. 2) RDW has a long half-life. The lifespan of red blood cells is approximately 130 days [7], compared to 4 days for platelets, 10 - 20 days for serum albumin [8,9], and the variable levels of creatinine that can change with treatment. Therefore, RDW is relatively stable.

The mechanism underlying the increase in RDW in cirrhosis patients is not yet clear. We speculate that it may be related to the following factors: 1) Tissue damage during cirrhosis is often accompanied by inflammation, and the relationship between RDW and inflammation has been reported in the literature [10]. 2) Cirrhosis patients often suffer from malnutrition, leading to insufficient absorption of hematopoietic nutrients (such as folic acid, vitamin B12, and iron), resulting in abnormal bone marrow hematopoiesis [11]. 3) Many cirrhosis patients have splenomegaly, which can lead to the destruction of red blood cells in the spleen, causing an increase in RDW [12]. 4) Many coagulation factors are synthesized in the liver. In cirrhosis patients, liver damage impairs the synthesis of coagulation factors. Additionally,

Table 1. Basic information of each group.

Item child / Pugh Grade	A (n = 132)	B (n = 113)	C (n = 110)	Healthy Control (n = 88)
Age (years)	55.3 ± 13.2	44.2 ± 12.5	50.6 ± 13.7	40.5 ± 13.9
Gender (male/female)	71/61	62/51	58/52	37/31
Total Bilirubin (TB, μmol/L) [a]	34.1 ± 2.9	35.5 ± 3.2	47.8 ± 7.3	12.3 ± 3.1
Albumin (g/L) [b]	38.1 ± 13.4	33.1 ± 10.3	29.1 ± 13.2	45.7 ± 12.1
ALT (U/L) [a, c]	197.2 ± 34.5	202.4 ± 39.9	379.1 ± 56.1	19.4 ± 10.1
Serum Creatinine (Cr, μmol/L) [d]	69.1 ± 23.1	75.3 ± 32.1	79.7 ± 23.1	68.2 ± 23.4
INR [a]	1.9 ± 0.7	2.0 ± 1.1	2.1 ± 1.3	1.6 ± 0.47
AST (U/L) [a]	191.4 ± 68.9	193.9 ± 78.8	231.3 ± 100.5	26.4 ± 6.2
PLT (x 10^9/L) [a]	100 ± 6	91 ± 20	85 ± 14	131 ± 39
RDW (%) [a, c]	13.3 ± 4.3	14.1 ± 2.1	15.5 ± 4.7	11.7 ± 3.1

[a] indicates that the values in Child-Pugh A, B, and C groups are significantly higher than those in the normal control group ($p < 0.05$). [b] indicates that the values in Child-Pugh A, B, and C groups are significantly lower than those in the normal control group ($p < 0.05$). [c] indicates that the values increase progressively from Child-Pugh A to C grades, with statistically significant differences between groups ($p < 0.05$). [d] indicates that there is no significant difference in serum creatinine (Cr) among the groups ($p > 0.05$).

Table 2. Diagnostic efficacy of RDW, albumin, PLT, INR, AST, TB, and ALT for liver cirrhosis.

Item	Cutoff value	Sensitivity (%)	Specificity (%)
RDW	15.1%	94.1%	76.2%
Albumin	31.4 g/L	51.3%	68.3%
PLT	109.2 x 10^9/L	55.1%	64.6%
INR	1.8	87.7%	44.3%
AST	173.2 U/L	96.1%	61.4%
TB	35.7 μmol/L	80.7%	68.9%
ALT	136.2 U/L	94.3%	72.3%

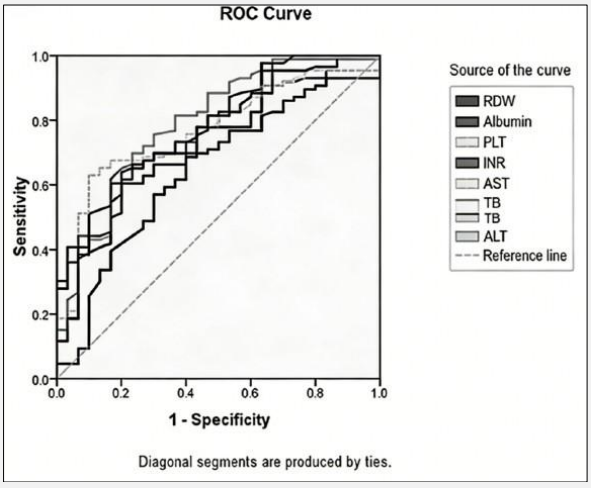

Figure 1. ROC Curves of RDW, albumin, PLT, INR, AST, TB, and ALT.

The areas under the ROC curves (AUC) for RDW, albumin, PLT, INR, AST, TB, and ALT are 0.773, 0.691, 0.706, 0.707, 0.767, 0.747, and 0.794, respectively.

obstruction of the portal vein return can lead to bleeding in cirrhosis patients, stimulating bone marrow hematopoiesis [13].

CONCLUSION

The study concludes that RDW is closely related to the severity of liver damage and the clinical grading of liver cirrhosis. Combining RDW with traditional indicators such as AST and ALT can help assess the severity and predict the prognosis of cirrhosis patients. Additionally, RDW has several advantages, including ease of measurement, low cost, and stability, making it a potentially valuable indicator for the clinical management of liver cirrhosis.

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Declaration of Interest:
All authors declare that they have no conflict.

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