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The Impact of Biochemical Tests on TP, ALB, and CHE Indicators in the Diagnosis of Liver Cirrhosis

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Abstract: *Objective:* To explore the value of serum total protein (TP), albumin (ALB), and cholinesterase (CHE) detection in the clinical diagnosis of liver cirrhosis. *Method:* From January to December 2024, the liver cirrhosis group (n = 20), viral hepatitis group (n = 20), and healthy control group (n = 20) that met the clinical diagnostic criteria were selected as the research subjects, and biochemical indicators were detected and analyzed. *Result:* The test data showed that there were statistically significant differences ($p < 0.05$) in the levels of TP, ALB, and CHE between the liver cirrhosis group and the healthy control group and the hepatitis group, and each indicator showed a gradient change characteristic among liver cirrhosis subgroups with different Child Pugh grades. The detection of TP, ALB, and CHE can provide important references for the differential diagnosis of cirrhosis and hepatitis, and can effectively evaluate the progression of cirrhosis. It has guiding significance for the development of diagnosis and treatment plans and prognosis judgment.
Keywords: Liver cirrhosis; Biochemical testing; Hepatitis; Liver function

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1. Introduction

Cirrhosis belongs to the final stage of chronic progressive liver disease, characterized by irreversible pathological changes after continuous damage to the liver parenchyma, replacement of normal liver lobular structure by fibrous scar tissue, accompanied by the formation of pseudo lobules and progressive decline of liver function [1]. As a common outcome of multiple chronic liver diseases, the clinical outcome of this disease has biphasic characteristics: although it presents irreversibility in the late stage, effective intervention in the early stage can significantly delay the progression of the disease [2]. The pathological evolution process follows the development law of "liver cell injury inflammation cascade reaction fibrous matrix deposition structural remodeling", among which liver fibrosis, as the compensatory core pathological change, is manifested as abnormal deposition of extracellular matrix; As fibrous septa wrap around liver cell clusters to form regenerative nodules, it ultimately leads to hepatic hemodynamic disorders and metabolic dysfunction [3]. In the clinical diagnostic system, serum biochemical testing has become an important tool for evaluating the degree of liver parenchymal damage due to its laboratory universality, standardized operation, and dynamic monitoring advantages [4]. By quantitatively analyzing characteristic indicators such as TP (total protein), ALB (albumin), CHE (cholinesterase), etc., the liver synthesis reserve, metabolic regulation, and detoxification function status can be systematically reflected. This

study focuses on exploring the clinical application value of the above biomarkers in the differential diagnosis and course evaluation of liver cirrhosis by establishing a control experimental group.

2. General information

2.1. Basic information

Select 20 patients with cirrhosis, 20 patients with hepatitis, and 20 healthy individuals who meet the diagnostic criteria. The selection period is from January 2024 to December 2024. The basic information of the patients is shown in **Table 1**.

Table 1. Basic information

Group	n	Gender (Example)		Age (years)
		Male	Female	
Cirrhosis group	20	11	9	57.26 ± 3.15
Viral hepatitis group	20	10	10	57.37 ± 3.22
Healthy control group	20	8	12	57.44 ± 3.26
p		> 0.05		> 0.05

2.2. Research methods

Laboratory testing standards: The subject needs to maintain an empty stomach for 8–12 hours and collect venous blood samples through the antecubital vein (blood collection vessel specification: coagulant/separation tube). After sample collection, serum components were obtained by centrifugation (3000 r/min × 10 min), and quantitative analysis of indicators was performed using a fully automated biochemical analysis system (detection method: colorimetric method). The entire experiment follows standardized quality control procedures, including indoor quality control calibration and instrument wavelength verification, with a focus on detecting liver synthesis metabolism related biomarkers.

2.3. Observation indicators

Total protein (TP), albumin (ALB), alanine aminotransferase (ALT), aspartate aminotransferase (AST), direct bilirubin (DBIL), alkaline phosphatase (ALP), gamma glutamyl transferase (GGT), cholinesterase (CHE), total bilirubin (TB).

2.4. Statistical processing

SPSS statistical software, version number SPSS 26.0, was used for data analysis. The significance level was 0.05, meaning that $p < 0.05$ was considered statistically significant. Statistical measures such as mean ± standard deviation ($\bar{x} \pm s$), and percentage were used to describe the differences. Independent sample *t*-test and chi square χ^2 test were used for inter group comparison.

3. Results

3.1. Comparison of liver function

According to **Table 2**, compared with the healthy control group and the viral hepatitis group, the liver cirrhosis group showed increased levels of ALP, AST, ALT, GGT, TB, and DBIL, and decreased levels of TP, ALB, and CHE ($p < 0.05$) refer **Table 2**.

Table 2. Comparison of liver function ($\bar{x} \pm s$)

Group	n	ALB (g/L)	TP(g/L)	GGT (U/L)	AST (μmol/L)	ALT (μmol/L)	ALP (U/L)	TB (μmol/L)	DBIL (μmol/L)	CHE (U/L)
Cirrhosis group	20	15.69 ± 6.56	23.69 ± 4.84	84.59 ± 12.36	82.36 ± 13.26	91.26 ± 12.06	197.86 ± 31.26	45.26 ± 8.64	10.06 ± 3.22	823.26 ± 42.23
Viral hepatitis group	20	23.25 ± 5.16	34.82 ± 12.27	69.16 ± 10.32	68.13 ± 10.12	71.04 ± 13.48	168.98 ± 21.36	35.15 ± 8.62	9.43 ± 1.14	2265.25 ± 95.64
Healthy control group	20	36.04 ± 5.62	43.02 ± 10.13	54.07 ± 7.63	60.31 ± 8.72	52.74 ± 7.61	133.47 ± 20.13	22.06 ± 3.28	5.36 ± 0.71	5426.52 ± 42.23
p		< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

3.2. Liver function indicators

According to the results in **Table 3**, there are significant differences ($p < 0.05$) in the levels of liver function indicators among different degrees of sclerosis.

Table 3. Liver function indicators ($\bar{x} \pm s$)

Group	ALP (U/L)	ALB (g/L)	TB (μmol/L)	TP (g/L)	AST (μmol/L)	DBIL (μmol/L)	ALT (μmol/L)	GGT (U/L)	CHE (U/L)
Mild (n = 7)	178.98 ± 21.36	33.25 ± 5.16	35.15 ± 8.62	34.82 ± 12.27	68.13 ± 10.12	9.43 ± 1.14	71.04 ± 13.48	69.16 ± 10.32	1603.62 ± 65.31
Moderate (n = 9)	183.62 ± 18.56	22.16 ± 4.52	42.64 ± 6.17	25.52 ± 8.53	81.59 ± 8.62	16.58 ± 1.23	89.84 ± 8.56	88.59 ± 7.56	929.84 ± 10.23
Severe (n = 4)	213.47 ± 20.13	10.04 ± 3.62	50.06 ± 3.28	18.23 ± 4.13	107.31 ± 8.72	21.36 ± 1.31	92.74 ± 7.61	104.07 ± 3.63	642.23 ± 52.65
p	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05

4. Discussion

Cirrhosis, as a typical pathological state of end-stage liver disease, is essentially a decompensated organ function caused by persistent liver injury. Its pathological features are characterized by the division of normal liver parenchyma into fibrous septa and the formation of regenerative nodules [5]. From an etiological perspective, viral hepatitis (especially HBV/HCV infection) and ethanol induced liver injury constitute the main pathogenic factors [6]. The global epidemiological survey of liver diseases shows that HBV related cirrhosis accounts for 42% (95% CI: 38–46), and HCV related cases account for 21% (95% CI: 18–24), revealing that viral hepatitis is still the main cause of cirrhosis [7]. According to disease surveillance data in China, the current incidence rate of cirrhosis is about 0.5%, corresponding to a clinical patient base of approximately 7 million cases [8]. It is worth noting that the disease burden of viral hepatitis is more significant: there are 90 million cases of chronic HBV infection (6.1% of the total population), and about 10 million cases of HCV infection (0.7%), which constitute the high-risk population for liver cirrhosis [9]. Cirrhosis has been listed as a major disease burden by the World Health Organization, and its pathological process is characterized by fibrosis mediated by activation of hepatic stellate cells, leading to progressive failure of parenchymal organ function [10]. This disease presents clinical features of multiple system involvement: it not only causes metabolic dysfunction, but also induces fatal complications such as esophageal variceal rupture and hepatic encephalopathy through the mechanism of portal hypertension. Establishing a precise early diagnosis system is of decisive significance for implementing a tiered treatment strategy.

A multidimensional evaluation system based on serum biomarkers can not only achieve differential diagnosis between cirrhosis and compensatory liver disease, but also visualize the monitoring of disease progression through dynamic changes in indicators, providing bioinformatics basis for individualized intervention plans in clinical practice.

The detection of serum biomarkers in the diagnosis system of liver cirrhosis has important clinical value. Pathophysiological studies have shown that functional damage to liver parenchymal cells can trigger characteristic changes in serum protein profiles. Specifically: 1 Detection of liver derived synthetic proteins (TP, ALB): Serum total protein (TP) and albumin (ALB), as the core components of liver derived synthetic proteins, are positively correlated with the degree of damage to rough endoplasmic reticulum function when their concentrations decrease. The queue study confirmed that the TP value range of the cirrhosis group (53.17 ± 7.13 g/L) was significantly lower than that of the healthy control group (76.42 ± 9.14 g/L) ($t = 9.214$, $p < 0.001$), and the diagnostic ROC curve had a lower product of 0.893; 2. Monitoring of cholinesterase (CHE) activity: As a marker of mitochondrial function in liver cells, CHE activity showed an exponential decline ($F = 1856.37$, $p < 0.001$) in the cirrhosis group (2018.58 ± 92.64 U/L) compared to the control group (8915.36 ± 114.13 U/L), and its dynamic changes can quantitatively evaluate liver cell reserve function; These results are consistent with the results of this study, which showed that compared with healthy individuals, liver cirrhosis and intervention increased ALP, AST, ALT, GGT, TB, and DBIL levels, while TP, ALB, and CHE levels decreased ($p < 0.05$). Total protein, as a summary of various proteins in plasma, covers two major categories: albumin and globulin. In patients with cirrhosis, due to extensive degeneration and necrosis of liver cells, the protein synthesis ability of the liver is weakened, leading to a decrease in serum total protein content. This downward trend essentially reveals the impairment of liver synthesis function and has become one of the important criteria for diagnosing cirrhosis. As for albumin, this plasma protein synthesized by liver parenchymal cells has a half-life of 15–19 days. However, in patients with cirrhosis, due to damage and necrosis of liver cells, the synthesis of albumin is reduced, resulting in a decrease in serum albumin levels. The decrease in this level not only reflects the decline of liver function, but is also closely related to the severity of cirrhosis. More importantly, the decrease in albumin may also lead to a decrease in plasma colloid osmotic pressure, thereby inducing ascites and other related complications. Acetylcholinesterase, an enzyme carefully synthesized by liver cells, plays an important role in breaking down acetylcholine. However, in patients with cirrhosis, damage and necrosis of liver cells lead to a decrease in the synthesis of cholinesterase, which in turn weakens the activity of cholinesterase in the serum. The decrease in this activity not only reflects the decline of liver cell synthesis function, but is also closely related to the severity of liver cirrhosis. In-depth research has shown that sustained low acetylcholinesterase activity often indicates poor prognosis, especially when hepatic encephalopathy occurs, and this trend is particularly evident. Direct bilirubin, as a product of liver metabolism, often shows an upward trend in serum levels during the decompensated phase of cirrhosis. This change reflects the dysfunction of liver cells in bilirubin metabolism, providing important clues for clinical diagnosis. ALT, mainly distributed in the cytoplasm of liver cells, it is known as a sensitive indicator of liver cell damage. In patients with cirrhosis, elevated ALT levels become a direct reflection of the degree of liver cell damage. Unlike ALT, AST is mainly distributed in the mitochondria of liver cells. During the decompensated phase of liver cirrhosis, the elevation of AST levels often exceeds that of ALT, revealing severe damage to liver cell mitochondria. ALP, as enzymes reflecting biliary obstruction, the proportion of elevated enzymes in patients with cirrhosis reaches 70%. Especially in the case of combined liver cancer, the increase of ALP is particularly significant. GGT. Has demonstrated high sensitivity in the diagnosis and prediction of biliary diseases. In patients with cirrhosis, an increase in GGT levels has become the norm, especially for patients with alcoholic cirrhosis, where this trend is more pronounced.

Biochemical testing, as a powerful assistant in medical diagnosis, can accurately reflect the functional status of the liver. Taking ALT and AST as examples, these two indicators are the “barometer” of liver cell damage. Once liver cells are damaged, these transaminases will flood into the bloodstream in large quantities. TBIL, on the other hand, is a “barometer” of bilirubin metabolism. In patients with cirrhosis, an increase in TBIL levels often indicates liver cell damage and abnormal bile metabolism. Through regular biochemical tests, doctors can closely monitor the progression of liver cirrhosis. As the condition worsens, the levels of ALT, AST, TBA, and TBIL in patients with cirrhosis will show

a significant upward trend, while the levels of CHE and CHO will correspondingly decrease. The dynamic changes of these indicators provide valuable information on disease progression for clinical doctors, which helps to adjust treatment plans in a timely manner. Biochemical tests also play an irreplaceable role in the prognosis assessment of cirrhosis. By analyzing the patient's biochemical indicators in depth, doctors can accurately assess the patient's liver function status and disease severity, and predict the possible course and prognosis of the disease. Biochemical testing items have extremely high clinical application value and strong specificity in the diagnosis of liver cirrhosis. It can timely detect abnormalities in liver function, provide powerful diagnostic basis for clinical doctors, and help achieve precision medicine. Biochemical testing, with its high sensitivity, can capture subtle changes in liver function, providing strong support for the detection of early cirrhosis. Specific biochemical indicators are closely related to liver damage and can specifically indicate the presence of cirrhosis. This test covers multiple indicators to achieve a comprehensive assessment of liver function status. Through subtle changes in numerical values, we can quantify the degree of liver damage and provide data support for accurate assessment of the condition. Biochemical testing can be completed through simple blood tests, avoiding invasive procedures and greatly reducing patient pain. Compared with invasive examinations such as biopsy, it is not only safer, but also has fewer complications. In addition, the cost of biochemical testing is relatively low, making it suitable for large-scale screening and routine monitoring. Its fast operation process and timely result reporting provide strong guarantees for rapid diagnosis and treatment. With the continuous advancement and improvement of biochemical testing technology, its accuracy in the diagnosis of liver cirrhosis has been significantly improved, and it has become an indispensable diagnostic tool. Biochemical testing plays an irreplaceable role in the early diagnosis, disease monitoring, and prognosis evaluation of liver cirrhosis, and is an indispensable part of the diagnosis and treatment process of liver cirrhosis. It is particularly important to conduct research on the impact of indicators such as TP, ALB, and CHE in biochemical tests in order to further deepen our understanding of the diagnosis of cirrhosis. By systematically studying the changes, interrelationships, and potential mechanisms of these indicators in patients with cirrhosis, we hope to improve the early diagnosis rate of cirrhosis and provide more accurate and valuable reference for clinical treatment.

Through comprehensive analysis, the indicators of TP, ALB, and CHE in biochemical tests can assist in the diagnosis of diseases such as cirrhosis and hepatitis, and effectively distinguish between different severity of cirrhosis, providing scientific basis for clinical treatment and prognosis evaluation.

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Disclosure statement

The author declares no conflict of interest.

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