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Exploring the Clinical Value of Combined Detection of Blood Lipids, Blood Glucose, and Liver Function in Non-alcoholic Fatty Liver Disease

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Abstract: *Objective:* To study the clinical value of combined detection of blood lipids, blood glucose, and liver function in non-alcoholic fatty liver disease. *Methods:* 105 patients with non-alcoholic fatty liver disease treated in our hospital from May 2022 to July 2024 were selected as the research subjects. All patients underwent a B-ultrasound examination. According to the severity of the disease, they were divided into group A (mild, $n = 35$), group B (moderate, $n = 44$), and group C (severe, $n = 26$). Another 30 healthy residents who came to the hospital for physical examination during the same period were selected as group D. The differences in blood lipids, blood glucose, and liver function indicators between groups were compared. *Results:* The triglyceride (TG), total cholesterol (TC), and low-density lipoprotein cholesterol (LDL) levels in groups A, B, and C were higher than those in group D, while the high-density lipoprotein cholesterol (HDL) level was lower ($P < 0.05$). The fasting plasma glucose (FPG) levels in groups B and C were higher than those in group D ($P < 0.05$). The TG, LDL, and FPG levels in groups B and C were higher than those in group A ($P < 0.05$). The TC level in group C was higher than that in group A, while the HDL level was lower ($P < 0.05$). The TC and FPG levels in group C were higher than those in group B ($P < 0.05$). The total bilirubin (TBil), aspartate aminotransferase (AST), and alanine aminotransferase (ALT) levels in groups A, B, and C were higher than those in group D ($P < 0.05$). The TBil and ALT levels in groups B and C were higher than those in group A ($P < 0.05$). The AST level in group C was higher than that in group A ($P < 0.05$). The AST and ALT levels in group C were higher than those in group B ($P < 0.05$). *Conclusion:* Patients with non-alcoholic fatty liver disease have disordered glucose and lipid metabolism. Blood lipids, blood glucose, and liver function are closely related to the severity of the disease. Strengthening exercise and dietary intervention early on can help control the progression of simple fatty liver disease and reduce the risk of severe liver diseases such as steatohepatitis and cirrhosis.

Keywords: Non-alcoholic fatty liver disease; Blood lipids; Blood glucose; Liver function

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1. Introduction

Fatty liver disease refers to a condition where there is an excessive accumulation of fat in liver cells due to various factors such as overnutrition, drug-induced factors, and long-term excessive alcohol consumption. Based on the etiology, it can be classified into four major categories: alcoholic liver disease, non-alcoholic fatty liver disease (NAFLD), special types of fatty liver disease, and acute fatty liver disease [1]. Among them, NAFLD is the most common type of fatty liver disease, characterized by fatty degeneration of liver cells caused by factors other than alcohol and other known liver-damaging agents. Initially, it manifests as a simple fatty liver with a high cure rate and good prognosis. However, if not treated on time, it may progress to non-alcoholic steatohepatitis and related liver cirrhosis, which can lead to liver failure and affect the patient's quality of life [2,3]. Therefore, early detection, diagnosis, and active intervention are crucial for controlling the progression of the disease. Biochemical index detection refers to the measurement of biochemical substance levels in human samples using biological and chemical methods. It has advantages such as comprehensiveness, accuracy, non-invasiveness, and good reproducibility, and has been widely used in the diagnosis of liver diseases [4,5]. In this study, 105 patients with NAFLD from May 2022 to July 2024 in the hospital were selected to investigate the clinical value of combined detection of blood lipids, blood glucose, and liver function in NAFLD. The results are summarized below.

2. Subjects and methods

2.1. General information

A total of 105 patients with NAFLD from May 2022 to July 2024 in the hospital were selected as the study subjects. Inclusion criteria were: (1) meeting the diagnostic criteria in the "Diagnostic Criteria for Non-alcoholic Fatty Liver Disease" [6]; (2) normal communication ability; (3) complete clinical data. Exclusion criteria were: (1) special types of fatty liver disease; (2) alcoholic fatty liver disease; (3) acute fatty liver disease; (4) comorbid blood system diseases; (5) comorbid mental and consciousness dysfunction. All patients underwent B-ultrasound examination and were divided into group A (mild, $n = 35$), group B (moderate, $n = 44$), and group C (severe, $n = 26$) based on the severity of their condition. Additionally, 30 healthy residents who underwent physical examination in our hospital during the same period were selected as group D. Group A consisted of 19 males and 16 females, aged between 45 and 68 years old with a mean age of (59.40 ± 4.55) years old, and a body mass index (BMI) ranging from 20 to 27 kg/m^2 with a mean BMI of (23.82 ± 1.62) kg/m^2. B-ultrasound showed no significant increase in liver size, clear ductal structure, and enhanced internal echoes. Group B consisted of 23 males and 21 females, aged between 46 and 69 years old with a mean age of (58.97 ± 4.63) years old, and a BMI ranging from 20 to 27 kg/m^2 with a mean BMI of (24.02 ± 1.53) kg/m^2. B-ultrasound showed no significant increase in liver size, less clear ductal structure, and significantly enhanced internal echoes. Group C consisted of 14 males and 12 females, aged between 35 and 70 years old with a mean age of (43.57 ± 3.98) years old, and a BMI ranging from 20 to 27 kg/m^2 with a mean BMI of (23.98 ± 1.59) kg/m^2. B-ultrasound showed a significant increase in liver size, completely blurred ductal structure, and significantly enhanced internal echoes. Group D consisted of 16 males and 15 females, aged between 35 and 68 years old with a mean age of (42.96 ± 4.73) years old, and a BMI ranging from 20 to 27 kg/m^2 with a mean BMI of (24.08 ± 1.47) kg/m^2. There were no statistically significant differences in general information between the four groups ($P > 0.05$).

2.2. Methods

All participants were required to provide 5mL of fasting venous blood, which was then centrifuged at 3000 $r \cdot min^{-1}$ for 15 minutes to separate the serum. An automatic biochemical analyzer (Guangdong Medical Device Registration Certificate No. 20172221214; Model: BS-830; Mindray Medical International Co., Ltd.) was used to detect blood lipids, blood glucose, and liver function indicators. The blood lipid indicators included triglyceride (TG), total cholesterol (TC), high-density lipoprotein cholesterol (HDL), and low-density lipoprotein cholesterol (LDL). The blood glucose indicator was fasting plasma glucose (FPG). The liver function indicators included total bilirubin (TBil), aspartate aminotransferase (AST), and alanine aminotransferase (ALT).

2.3. Observation indicators

(1) Comparison of blood lipid and blood glucose levels: Compare the differences in blood lipids (TG, TC, HDL, LDL) and blood glucose (FPG) levels among the four groups.

(2) Comparison of liver function indicators: Compare the differences in liver function indicators (TBil, AST, ALT) among the four groups.

2.4. Statistical methods

Statistical analysis was performed using SPSS 25.0 software. Measurement data conforming to a normal distribution were expressed as mean ± standard deviation (SD), and an independent sample *t*-test was used. Enumeration data were expressed as rates, and a chi-square test was used. The test level was set at $\alpha = 0.05$.

3. Results

3.1. Comparison of blood lipid and blood glucose levels between the two groups

The levels of TG, TC, and LDL in Groups A, B, and C were higher than those in Group D, while HDL was lower ($P < 0.05$). The FPG levels in Groups B and C were higher than those in Group D ($P < 0.05$). The levels of TG, LDL, and FPG in Groups B and C were higher than those in Group A ($P < 0.05$). In Group C, TC was higher and HDL was lower than in Group A ($P < 0.05$). The levels of TC and FPG in Group C were higher than those in Group B ($P < 0.05$). See **Table 1** for details.

Table 1. Comparison of blood lipid and blood glucose levels between the two groups (mean ± SD, mmol/L)

Group	Number of cases	TG	TC	HDL	LDL	FPG
Group C	35	$2.29 \pm 1.05^{\#*}$	$6.01 \pm 1.36^{\#*\&}$	$1.01 \pm 0.24^{\#*}$	$4.16 \pm 0.62^{\#*}$	$6.97 \pm 0.82^{\#*\&}$
Group B	44	$2.23 \pm 0.96^{\#*}$	$5.36 \pm 1.05^{\#}$	$1.04 \pm 0.26^{\#}$	$4.07 \pm 0.71^{\#*}$	$6.16 \pm 0.69^{\#*}$
Group A	26	$1.65 \pm 0.95^{\#}$	$5.13 \pm 1.06^{\#}$	$1.14 \pm 0.22^{\#}$	$3.58 \pm 0.59^{\#}$	5.04 ± 0.63
Group D	30	1.13 ± 0.57	3.96 ± 0.87	1.53 ± 0.35	2.67 ± 0.57	4.83 ± 0.56
F value		3.813	5.015	5.123	6.825	5.107
P value		< 0.001	< 0.001	< 0.001	< 0.001	< 0.001

Note: Compared with Group D, $^{\#}P < 0.05$; compared with Group A, $^{*}P < 0.05$; compared with Group B, $^{\&}P < 0.05$.

3.2. Comparison of liver function indices between two groups

The levels of TBil, AST, and ALT in Groups A, B, and C were higher than those in Group D ($P < 0.05$); TBil and

ALT levels in Groups B and C were higher than those in Group A ($P < 0.05$); AST level in Group C was higher than that in Group A ($P < 0.05$); AST and ALT levels in Group C were higher than those in Group B ($P < 0.05$) (**Table 2**).

Table 2. Comparison of liver function indices between two groups (mean ± SD)

Group	Number of cases	TBil (μmol/L)	AST (U/L)	ALT (U/L)
Group C	35	$18.82 \pm 4.90^{\#*}$	$43.56 \pm 13.05^{\#*\&}$	$45.25 \pm 14.50^{\#*\&}$
Group B	44	$17.01 \pm 3.93^{\#*}$	$34.46 \pm 8.12^{\#}$	$36.82 \pm 10.12^{\#*}$
Group A	26	$14.42 \pm 2.54^{\#}$	$31.43 \pm 8.08^{\#}$	$32.34 \pm 6.48^{\#}$
Group D	30	10.92 ± 1.35	23.43 ± 3.39	15.37 ± 5.19
F-value		7.154	5.417	11.355
P value		< 0.001	< 0.001	< 0.001

Note: Compared with Group D, $^{\#}P < 0.05$; compared with Group A, $^{*}P < 0.05$; compared with Group B, $^{\&}P < 0.05$.

4. Discussion

Nonalcoholic fatty liver disease (NAFLD) is currently the most common type of chronic liver disease encountered in clinical practice. It includes two major categories: primary and secondary. Primary NAFLD is mainly caused by insulin resistance and genetic predisposition, while secondary NAFLD is primarily induced by special factors such as parenteral nutrition support, malnutrition, and industrial poisoning [7,8]. In the recent years, with the rapid socio-economic development and changing lifestyles and dietary structures, the prevalence of NAFLD has increased rapidly. As of 2023, the global prevalence is around 25%, and it is estimated to reach approximately 33.5% by 2030, making it one of the significant diseases threatening public health [9]. Most patients with NAFLD have no self-perceived symptoms or may experience nonspecific symptoms such as fatigue, indigestion, and localized pain. Some patients may exhibit symptoms associated with metabolic syndrome, such as overweight, visceral obesity, and elevated blood glucose levels [10,11]. Studies suggest that NAFLD is a manifestation of metabolic disorder syndrome in the liver. Metabolic disorders like obesity, hyperglycemia, and dyslipidemia are closely related to its onset and progression. By adjusting dietary habits and maintaining regular aerobic exercise, most patients with NAFLD can control their weight, blood glucose, and blood lipids, thereby promoting liver function recovery [12,13].

The data from this study shows that Groups A, B, and C had higher levels of TG, TC, and LDL than Group D, while their HDL levels were lower ($P < 0.05$). Groups B and C had higher FPG levels than Group D ($P < 0.05$), and groups B and C also had higher levels of TG, LDL, and FPG than Group A ($P < 0.05$). Group C had higher TC and lower HDL levels than Group A ($P < 0.05$), and Group C's TC and FPG levels were higher than those of Group B ($P < 0.05$). These findings suggest the presence of lipid and glucose metabolism disorders in non-alcoholic fatty liver disease, with blood glucose and lipid levels closely correlated to the severity of the patient's condition. The analysis of the reasons behind this shows that insulin can affect lipid metabolism by regulating glucose metabolism. Insulin resistance can lead to disordered glucose and lipid metabolism, preventing blood glucose from being converted into glycogen and increasing fatty degeneration of liver cells. Large amounts of fat accumulate in the liver, leading to liver function damage [14]. The liver is the body's primary metabolic organ, responsible for synthesizing, storing, converting, and decomposing glycogen and blood lipids [15]. A decline in liver metabolic function can lead to abnormal blood glucose and lipid levels. Therefore, liver function damage can

cause abnormalities in blood glucose and lipids, which can further damage liver function, creating a vicious cycle. This study also revealed that groups A, B, and C had higher levels of TBil, AST, and ALT than Group D ($P < 0.05$). Groups B and C had higher levels of TBil and ALT than Group A ($P < 0.05$), and Group C had higher AST levels than Group A ($P < 0.05$). Additionally, Group C's AST and ALT levels were higher than those of Group B ($P < 0.05$), indicating a close correlation between liver function indicators and the severity of non-alcoholic fatty liver disease. The analysis of the reasons for this shows that TBil includes direct and indirect bilirubin. Indirect bilirubin can be converted into direct bilirubin in liver cells and metabolized through the bile duct [16,17]]. When liver function is damaged, the liver cells' conversion function declines, leading to an increase in indirect bilirubin levels. Additionally, since the liver is connected to the bile duct, non-alcoholic fatty liver disease can damage the capillary bile duct to some extent, affecting direct bilirubin metabolism. Therefore, the more severe the non-alcoholic fatty liver disease is, the higher the TBil level will be [18,19]. AST is mainly present in the mitochondria of liver cells, while ALT is primarily found in the cytoplasm of liver cells. When liver cells are damaged, AST and ALT are released into the blood, leading to increased serum levels of AST and ALT [20].

5. Conclusion

In summary, patients with non-alcoholic fatty liver disease have disordered glucose and lipid metabolism, and their blood lipids, blood glucose, and liver function are closely related to the severity of their condition. Strengthening exercise and dietary interventions early on can help control the progression of simple fatty liver disease and reduce the risk of severe liver diseases such as steatohepatitis and cirrhosis.

Disclosure statement

The authors declare no conflict of interest.

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