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Ultrasonographic Grading of Fatty Liver and Its Correlation with Liver Function Tests

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ABSTRACT:
Background: Fatty liver disease is one of the most common hepatic disorders worldwide and is closely associated with obesity, diabetes mellitus, dyslipidemia, and metabolic syndrome. Ultrasonography serves as a simple and non-invasive modality for detection and grading of fatty liver. Liver function tests help assess the extent of hepatocellular injury and hepatic dysfunction. **Aim:**To evaluate ultrasonographic grading of fatty liver and correlate it with liver function tests. **Materials and Methods:** This hospital-based observational cross-sectional study was conducted in the Department of Radiodiagnosis at Maharishi Markandeshwar Institute of Medical Sciences and Research over a period of 6 months. A total of 50 patients with ultrasonographic evidence of fatty liver were included in the study. Fatty liver was graded on ultrasonography into Grade I, Grade II, and Grade III. Liver function tests including serum ALT and AST levels were analyzed and correlated with ultrasonographic grades. Statistical analysis was performed using IBM SPSS Statistics and GraphPad Prism software. **Results:** The majority of patients belonged to the 51–60 years age group (36%), with male predominance (64%). Grade I fatty liver was the most common ultrasonographic finding (48%). Mean serum ALT and AST levels increased significantly with increasing grades of fatty liver. Abnormal liver function tests were more common in Grade II and Grade III fatty liver patients. The correlation between ultrasonographic grading and liver function tests was statistically significant ($p<0.05$). **Conclusion:** Ultrasonography is an effective tool for grading fatty liver and shows significant correlation with liver function test abnormalities. Combined radiological and biochemical assessment helps in early diagnosis and evaluation of disease severity.

INTRODUCTION:
Non-alcoholic fatty liver disease (NAFLD) has emerged as one of the most common chronic liver disorders worldwide and is increasingly recognized as a major public health concern. It is characterized by excessive accumulation of fat within hepatocytes in individuals who consume little or no alcohol. The disease spectrum

ranges from simple steatosis to non-alcoholic steatohepatitis (NASH), fibrosis, cirrhosis, and eventually hepatocellular carcinoma if left untreated [1]. Rapid urbanization, sedentary lifestyle, obesity, diabetes mellitus, dyslipidemia, and metabolic syndrome have contributed significantly to the increasing prevalence of fatty liver disease in both developed and developing countries [2]. In India, the burden of NAFLD has shown a steady rise due to changing dietary habits and increasing prevalence of obesity and type 2 diabetes mellitus [3].

Fatty liver disease is often asymptomatic in the early stages and is frequently detected incidentally during imaging studies or routine biochemical investigations. Since liver biopsy, the gold standard for diagnosis, is invasive and associated with complications, non-invasive imaging modalities play a crucial role in the evaluation of fatty liver [4]. Ultrasonography (USG) is considered the most widely used initial imaging technique because it is inexpensive, readily available, non-invasive, and free from ionizing radiation. Ultrasonography can detect hepatic steatosis by demonstrating increased echogenicity of the liver parenchyma compared to the renal cortex, vascular blurring, and posterior beam attenuation [5]. Based on these sonographic findings, fatty liver can be graded into mild (Grade I), moderate (Grade II), and severe (Grade III) steatosis [6].

Liver function tests (LFTs) are commonly employed biochemical investigations used to assess hepatic injury and functional status. Parameters such as serum alanine aminotransferase (ALT), aspartate aminotransferase (AST), alkaline phosphatase (ALP), bilirubin, and serum albumin may show abnormalities in patients with fatty liver disease [7]. Among these, elevated ALT and AST levels are frequently associated with hepatocellular injury and may correlate with the severity of hepatic steatosis [8]. However, many patients with ultrasonographic evidence of fatty liver may exhibit normal liver enzyme levels, making the relationship between ultrasonographic grading and liver function tests an area of ongoing research [9].

Correlation between ultrasonographic grading of fatty liver and liver function tests is important for understanding disease severity and progression. Establishing such a relationship may help clinicians identify patients at greater risk of hepatic dysfunction and metabolic complications without resorting to invasive procedures. Early diagnosis and grading of fatty liver through ultrasonography, along with assessment of biochemical parameters, can aid in timely intervention through lifestyle modification and medical management [10]. Therefore, the present study aims to evaluate ultrasonographic grading of fatty liver and correlate it with liver function test abnormalities in affected patients.

The present study aims to evaluate ultrasonographic grading of fatty liver and correlate it with liver function test abnormalities. The objectives are to assess the severity of hepatic steatosis using ultrasonography, analyze liver function parameters in affected patients, and determine the relationship between sonographic grades of fatty liver and biochemical liver dysfunction.

MATERIALS AND METHODS:

Study Design: Hospital-based observational cross-sectional study.
Study Population: Patients referred to the Department of Radiodiagnosis for ultrasonographic evaluation of abdomen and diagnosed with fatty liver were included in the study.
Sample Size:A total of 50 patients were included in the study.
Study Duration: The study was conducted over a period of 6 months.
Study Place: The study was carried out in the Department of Radiodiagnosis at Maharishi Markandeshwar Institute of Medical Sciences and Research.

Inclusion Criteria:

1. Patients aged more than 18 years.
2. Patients with ultrasonographic evidence of fatty liver.
3. Patients willing to participate in the study.
4. Patients who underwent liver function tests during the study period.

Exclusion Criteria:

1. Patients with history of significant alcohol consumption.
2. Patients with known chronic liver disease or cirrhosis.
3. Patients positive for hepatitis B or hepatitis C infection.
4. Patients with hepatic malignancy or focal liver lesions.

5. Pregnant women.
6. Patients unwilling to participate in the study.

Statistical Analysis: The collected data were entered into Microsoft Excel and analyzed using IBM SPSS Statistics and GraphPad Prism software. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. The unpaired t-test was used for comparison of continuous variables between independent groups. The Chi-square test or Fisher's exact test was applied for analysis of categorical variables as appropriate. A p-value of less than 0.05 was considered statistically significant.

RESULT:

Table 1: Distribution of Patients According to Age Group

Age Group (Years)	Number of Patients	Percentage (%)	p-value
<40	6	12%	0.032
41–50	10	20%	
51–60	18	36%	
61–70	12	24%	
>70	4	8%	
Total	**50**	**100%**	

Table 2: Gender Distribution of Study Population

Gender	Number of Patients	Percentage (%)	p-value
Male	32	64%	0.041
Female	18	36%	
Total	**50**	**100%**	

Table 3: Ultrasonographic Grading of Fatty Liver

Fatty Liver Grade	Number of Patients	Percentage (%)	p-value
Grade I	24	48%	<0.001
Grade II	18	36%	
Grade III	8	16%	
Total	**50**	**100%**	

Table 4: Correlation of Fatty Liver Grade with Serum ALT Levels

Fatty Liver Grade	Mean ALT (U/L) ± SD	p-value
Grade I	38.4 ± 8.6	<0.001
Grade II	56.8 ± 10.2	
Grade III	82.5 ± 14.7	

Table 5: Correlation of Fatty Liver Grade with Serum AST Levels

Fatty Liver Grade	Mean AST (U/L) ± SD	p-value
Grade I	34.2 ± 7.4	0.002
Grade II	49.6 ± 9.1	
Grade III	71.3 ± 12.5	

Table 6: Association of Fatty Liver Grade with Abnormal Liver Function Tests

Fatty Liver Grade	Normal LFT	Abnormal LFT	Total	p-value
Grade I	16	8	24	<0.001
Grade II	6	12	18	
Grade III	1	7	8	
Total	**23**	**27**	**50**	

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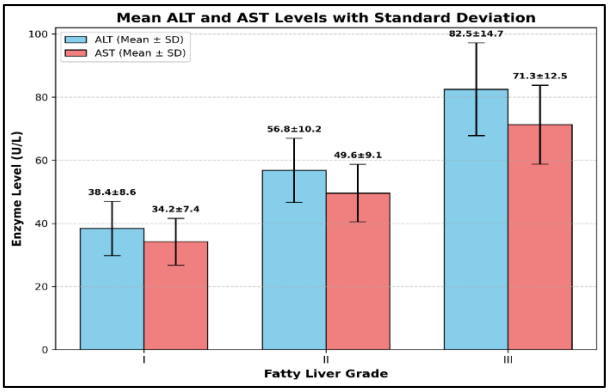

Figure: 1. ALT & AST Levels Across Fatty Liver Grades

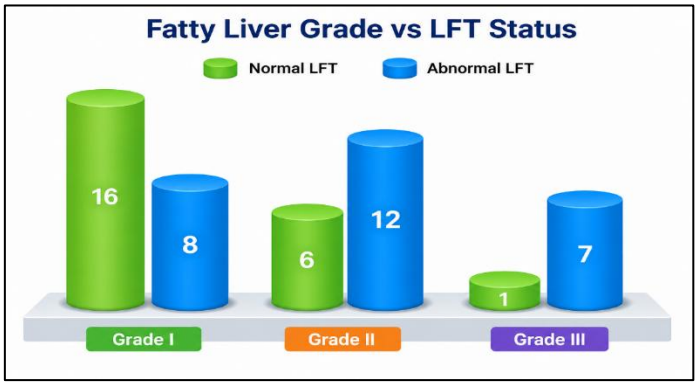

Figure: 2. Distribution of Normal and Abnormal LFT Across Fatty Liver Grades

The majority of patients belonged to the 51–60 years age group, accounting for 18 cases (36%), followed by 61–70 years with 12 patients (24%). Patients aged 41–50 years constituted 20% of the study population, while those below 40 years and above 70 years accounted for 12% and 8% respectively. The age distribution showed statistical significance (p=0.032).

Among the 50 study participants, males were predominant with 32 patients (64%), whereas females constituted 18 patients (36%). The gender distribution demonstrated a statistically significant male predominance (p=0.041).

Ultrasonographic grading revealed that Grade I fatty liver was the most common finding, observed in 24 patients (48%). Grade II fatty liver was seen in 18 patients (36%), while Grade III fatty liver was identified in 8 patients (16%). The distribution of fatty liver grades was statistically highly significant (p<0.001).

Mean serum ALT levels increased progressively with increasing ultrasonographic grade of fatty liver. Patients with Grade I fatty liver had a mean ALT level of 38.4 ± 8.6 U/L, whereas Grade II and Grade III fatty liver showed mean ALT levels of 56.8 ± 10.2 U/L and 82.5 ± 14.7 U/L respectively. This association between fatty liver grade and serum ALT levels was statistically highly significant (p<0.001).

A progressive rise in mean serum AST levels was observed with increasing severity of fatty liver on ultrasonography. Grade I fatty liver patients showed a mean AST level of 34.2 ± 7.4 U/L, while Grade II and Grade III fatty liver patients had mean AST levels of 49.6 ± 9.1 U/L and 71.3 ± 12.5 U/L respectively. The correlation between ultrasonographic grading and AST levels was statistically significant (p=0.002).

Abnormal liver function tests were more commonly associated with higher grades of fatty liver. Among Grade I fatty liver patients, 8 out of 24 cases showed abnormal LFT findings, whereas abnormal LFTs were present in 12 out of 18 Grade II patients and 7 out of 8 Grade III patients. The association between fatty liver grade and abnormal liver function tests was statistically highly significant (p<0.001).

DISCUSSION:

In the present study, the majority of patients belonged to the 51–60 years age group (36%), followed by 61–70 years (24%), indicating that fatty liver disease was more prevalent in middle-aged and elderly individuals. Similar findings were reported by Mohan et al., who observed the highest prevalence of non-alcoholic fatty liver disease among individuals in the fifth and sixth decades of life due to increasing metabolic risk factors with advancing age [11]. Singh et al. also demonstrated that hepatic steatosis was significantly associated with age-related metabolic disturbances such as obesity, insulin resistance, and dyslipidemia [12]. The statistically significant age distribution in the present study supports the concept that advancing age contributes to progression of hepatic fat accumulation and liver dysfunction.

The present study demonstrated male predominance, with males accounting for 64% of the study population. Comparable findings were observed in the study conducted by Das et al., where males constituted nearly two-thirds of patients with fatty liver disease [13]. The higher prevalence among males may be attributed to lifestyle-related factors, dietary habits, central obesity, and increased metabolic syndrome prevalence. However, some authors have suggested that postmenopausal women also carry significant risk due to hormonal alterations affecting lipid metabolism [14]. Nevertheless, our findings remain consistent with most Indian studies showing greater prevalence among males.

Ultrasonographic grading in the present study revealed that Grade I fatty liver was the most common pattern (48%), followed by Grade II (36%) and Grade III (16%). Similar observations were made by Saverymuttu et al., who reported mild fatty infiltration as the predominant ultrasonographic finding in patients with hepatic steatosis [15]. Webb et al. also noted that most patients undergoing abdominal ultrasonography present during the early stage of fatty infiltration, making Grade I fatty liver the commonest presentation [16]. The predominance of lower-grade fatty liver in our study may indicate increasing awareness and earlier diagnosis through routine health evaluations and imaging investigations.

In the current study, serum ALT levels showed a progressive increase with increasing ultrasonographic grade of fatty liver, with Grade III fatty liver demonstrating the highest mean ALT values. Similar findings were reported by Fracanzani et al., who observed significantly elevated ALT levels in patients with advanced steatosis and steatohepatitis [17]. Elevated ALT reflects hepatocellular injury caused by lipid accumulation, oxidative stress, and inflammatory changes within hepatocytes. Persico et al. similarly demonstrated that serum ALT serves as an important biochemical marker correlating with severity of hepatic steatosis detected on imaging studies [18]. The statistically significant relationship observed in the present study highlights the usefulness of ALT as a supportive marker in assessing disease severity.

The present study also demonstrated a significant increase in serum AST levels with worsening ultrasonographic grade of fatty liver. Grade III fatty liver patients exhibited markedly elevated AST levels compared to Grade I patients. Similar findings were documented by Kirovski et al., who reported significant elevation of AST levels in moderate and severe hepatic steatosis [19]. Increased AST levels are believed to reflect progressive hepatocellular damage and mitochondrial dysfunction associated with advanced fatty liver disease. Although ALT is considered more liver-specific, rising AST levels may indicate progression toward fibrosis and advanced liver injury [20]. The significant correlation observed in our study further supports the role of liver enzymes in predicting disease severity.

Abnormal liver function tests were found to be more frequent among patients with higher grades of fatty liver in the present study. Most Grade III fatty liver patients demonstrated abnormal biochemical parameters compared to Grade I patients. Similar observations were reported by Marchesini et al., who found that worsening ultrasonographic severity of fatty liver was associated with progressively abnormal liver function profiles [11]. Elevated liver enzymes in higher grades of steatosis may result from ongoing inflammation, hepatocyte injury, and oxidative stress. Our findings reinforce the importance of combining ultrasonographic grading with liver function tests for early recognition of patients at risk of disease progression and hepatic complications.

CONCLUSION:

The present study concludes that ultrasonography is an effective, non-invasive, and reliable modality for detecting and grading fatty liver disease. Grade I fatty liver was the most common ultrasonographic finding among the study population, with higher prevalence observed in middle-aged and elderly individuals. A significant correlation was observed between ultrasonographic grades of fatty liver and liver function test abnormalities, particularly elevated

serum ALT and AST levels. Increasing severity of fatty liver on ultrasonography was associated with progressively deranged liver function parameters, indicating worsening hepatocellular injury. The study also demonstrated that abnormal liver function tests were more frequently associated with moderate and severe grades of hepatic steatosis. Therefore, ultrasonographic grading combined with liver function tests can serve as an important diagnostic and prognostic approach in the evaluation of fatty liver disease. Early detection through routine imaging and biochemical assessment may help initiate timely lifestyle modification and therapeutic interventions, thereby reducing the risk of progression to advanced liver disease and related complications.

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