Journal of Biomedical and Pharmaceutical Research
Available Online at www.jbpr.in
CODEN: - JBPRAU (Source: - American Chemical Society)
NLM (National Library of Medicine): ID: (101671502)
Index Copernicus Value 2018: 88.52
Volume 8, Issue 5: September-October: 2019, 148-152
ISSN (Online): 2279-0594
ISSN (Print): 2589-8752
Research Article

Ultrasound Evaluation of Fatty Liver and Its Correlation with BMI and Diabetes Mellitus

Kada Venkata Ramana

Associate Professor, Department of Radiodiagnosis, Konaseema Institute of Medical Sciences, Amalapuram

Article Info: Received 02 June 2019; Accepted 15 August. 2019
Address for Correspondence: Kada Venkata Ramana
Conflict of interest statement: No conflict of interest

Abstract:

Background: Fatty liver is increasingly recognized as a common hepatic manifestation of metabolic dysfunction and is closely associated with obesity and diabetes mellitus. Ultrasonography is a widely available and non-invasive tool for its detection.

Aim: To evaluate fatty liver by ultrasound and correlate its presence and severity with body mass index (BMI) and diabetes mellitus.

Methods: This prospective observational study was conducted at KIMS, Amalapuram, from November 2018 to May 2019. A total of 115 adult participants underwent abdominal ultrasonography. Fatty liver was diagnosed based on increased hepatic echogenicity and graded as mild, moderate, or severe. BMI was calculated using standard formulae, and diabetic status was recorded from clinical history and laboratory data. Statistical analysis was performed using chi-square test and independent sample t-test, with $P < 0.05$ considered significant.

Results: Fatty liver was detected in 61 (53.0%) participants. Mild fatty liver was the most common grade (29.6%), followed by moderate (17.4%) and severe (6.1%). Fatty liver showed a significant association with BMI category ($\chi^2 = 24.87$, $P < 0.001$) and diabetes mellitus ($\chi^2 = 11.53$, $P = 0.001$). Mean BMI was significantly higher among participants with fatty liver.

Conclusion: Ultrasound-detected fatty liver was significantly associated with increasing BMI and diabetes mellitus.

Keywords: Fatty liver; Ultrasonography; Body mass index; Diabetes mellitus; Hepatic steatosis

Introduction:

Non-alcoholic fatty liver disease (NAFLD) has emerged as one of the most common hepatic manifestations of metabolic dysfunction and is increasingly encountered in routine radiology practice. Ultrasonography is widely used for evaluating fatty liver because it is non-invasive, inexpensive, readily available, and suitable for grading hepatic steatosis in clinical settings [1, 2]. Earlier evidence has shown that ultrasound-detected fatty liver is closely associated with obesity, higher body mass index (BMI), insulin resistance, and type 2 diabetes mellitus, indicating that hepatic steatosis is not merely a liver finding but part of a broader metabolic disorder [3]. As BMI increases, the prevalence and severity of fatty liver also tend to rise, while diabetes further amplifies the metabolic burden and risk of progression [1-3]. Hence, studying fatty liver by ultrasound along with BMI and diabetic status may help identify high-risk individuals early. The aim of the present study was to evaluate fatty liver by ultrasound and correlate its presence and severity with BMI and diabetes mellitus.

Methods:

This prospective observational study was conducted in the department of Radiodiagnosis in collaboration with the departments of General Medicine and Biochemistry at KIMS, Amalapuram, from November 2018 to May 2019. The study included adult patients attending outpatient and inpatient services who were referred for abdominal ultrasonography and were willing to participate in the study. The objective was to evaluate fatty liver on ultrasonography and correlate the sonographic findings with BMI and diabetic status. Patients aged 18 years and above of either sex were considered eligible. Individuals with significant alcohol intake, known chronic liver disease, viral hepatitis, hepatotoxic drug use, pregnancy, hepatic malignancy, severe systemic illness, or incomplete clinical and laboratory data were excluded to avoid confounding factors that could influence hepatic echogenicity. After obtaining informed consent, demographic details, relevant clinical history, height, weight, and diabetic status were recorded in a predesigned proforma.

A detailed clinical assessment was performed in all enrolled participants. BMI was calculated using the standard formula: weight in kilograms divided by height in meters squared (kg/m^2). Based on BMI values, patients were categorized into standard nutritional groups for analysis. Diabetic status was determined from prior medical records, ongoing treatment history, fasting blood glucose values, and physician diagnosis. All participants underwent transabdominal ultrasonography using a standard real-time ultrasound machine with a curvilinear probe of appropriate frequency. Liver echotexture was assessed by an experienced radiologist. Fatty liver was diagnosed sonographically on the basis of increased hepatic echogenicity relative to the renal cortex, blurring of vascular margins, and posterior beam attenuation. Fatty liver was graded as mild, moderate, or severe according to standard sonographic criteria. When necessary, associated findings such as hepatomegaly and poor visualization of the diaphragm were also noted. Care was taken to maintain uniformity in image acquisition and interpretation.

The collected data were entered into Microsoft Excel and analyzed using SPSS software. Continuous variables such as age and BMI were expressed as mean ± standard deviation, while categorical variables such as sex, fatty liver grade, and diabetic status were presented as frequencies and percentages. The prevalence of fatty liver on ultrasound was calculated for the overall study population and across BMI and diabetes categories. The association between fatty liver and categorical variables was assessed using the chi-square test or Fisher's exact test wherever applicable. Comparison of mean BMI between groups with and without fatty liver was performed using the independent sample t-test. Correlation between severity of fatty liver and BMI was also examined. $P<0.05$ was considered statistically significant.

Results:

Total 115 study participants were evaluated. The age of the study population ranged from 21 to 68 years, with a mean age of 44.8 ± 11.2 years. Males constituted 62 (53.9%). On ultrasonography, fatty liver was detected in 61 (53.0%), while 54 (47.0%) had no sonographic evidence of fatty liver. Among the fatty liver cases, mild fatty liver was the most common grade, seen in 34 (29.6%), followed by moderate (20; 17.4%) and severe fatty liver (7; 6.1%). The mean BMI of the study population was 26.1 ± 4.3 kg/m^2. A significantly higher proportion of fatty liver was observed among overweight and obese individuals compared to those with normal BMI ($\chi^2 = 24.87$, $P < 0.001$). Similarly, diabetes mellitus showed a strong association with fatty liver; 35 of 49 diabetics (71.4%) had fatty liver compared to 26 of 66 non-diabetics (39.4%), and this difference was statistically significant ($\chi^2 = 11.53$, $P = 0.001$). Mean BMI was significantly higher in participants with fatty liver (28.2 ± 3.8 kg/m^2) compared with those without fatty liver (23.7 ± 3.2 kg/m^2), ($t = 6.88$, $P < 0.001$). Increasing severity of fatty liver also showed a progressive rise in mean BMI, indicating a positive clinical correlation between adiposity and sonographic grade of hepatic steatosis.

Table 1: Distribution of the study participants according to ultrasound findings (n = 115)		
Ultrasound finding	**Number**	**%**
No fatty liver	54	47
Mild fatty liver	34	29.6
Moderate fatty liver	20	17.4
Severe fatty liver	7	6.1
Total	115	100

Table 2: Association between BMI and fatty liver findings			
BMI	**Fatty liver; n (%)**		**Total**
	Present	**Absent**	
Normal (<25)	12 (23.5)	39 (76.5)	51
Overweight (25–29.9)	28 (71.8)	11 (28.2)	39
Obese (≥30)	21 (84.0)	4 (16.0)	25
Total	61 (53.0)	54 (47.0)	115
Statistical analysis	$\chi^2 = 24.87$, df = 2, $P < 0.001$		

Table 3: Association of diabetes mellitus with fatty liver on ultrasound			
Diabetic status	**Fatty liver; n (%)**		**Total**
	Present	**Absent**	
Diabetic	35 (71.4)	14 (28.6)	49
Non-diabetic	26 (39.4)	40 (60.6)	66
Total	61 (53.0)	54 (47.0)	115
Statistical analysis	$\chi^2 = 11.53$, df = 1, $P = 0.001$		

Discussion:

The present study demonstrated that more than half of the participants had ultrasound-detected fatty liver, with mild steatosis being the commonest grade. This pattern is clinically plausible because ultrasonography generally identifies a large pool of asymptomatic or minimally symptomatic individuals at an earlier stage, while severe fatty infiltration represents a smaller subset. Ultrasonography remains a practical first-line imaging tool for evaluating hepatic steatosis in routine hospital settings because it is non-invasive, inexpensive, repeatable, and widely available, particularly in resource-constrained environments. Earlier literature has also shown that ultrasound-based prevalence estimates of NAFLD are substantial in adult populations. Amarapurkar et al. reported a population prevalence of 18.9% based on ultrasound, highlighting that fatty liver is not uncommon even outside specialty clinics [4]. Yki-Järvinen emphasized that NAFLD is strongly linked to metabolic dysfunction and that imaging, especially ultrasound, is widely used in everyday practice for diagnosis [5]. Thus, the relatively high frequency of fatty liver observed in the present study is consistent with the increasing burden of metabolic disease and the ability of sonography to detect hepatic steatosis in routine clinical referrals [4, 5].

A major finding of the present study was the strong association between fatty liver and increasing BMI. The proportion of fatty liver rose progressively from normal-weight individuals to overweight and obese participants, and mean BMI was significantly higher among those with fatty liver. This agrees with the established pathophysiological role of adiposity in hepatic triglyceride accumulation. Excess body weight promotes insulin resistance, increased free fatty acid flux to the liver, altered adipokine balance, and hepatic lipid deposition, which together contribute to steatosis. Several studies support this relationship; Petrović et al. identified obesity and metabolic syndrome as important risk factors for ultrasound-diagnosed NAFLD [6]. Yi et al. reported increased prevalence and risk of NAFLD in overweight and obese patients with type 2 diabetes mellitus, reinforcing the combined effect of excess body weight and metabolic abnormalities [7]. George et al. also observed that NAFLD patients attending tertiary centers were typically obese and insulin resistant, with a mean BMI in the obese range [8]. The present findings therefore strengthen the concept that BMI is not merely a demographic variable but a key clinical correlate of sonographic fatty liver severity. The rise in BMI across fatty liver grades in our study further suggests a dose-response relationship, wherein worsening adiposity is accompanied by more pronounced hepatic echogenic changes [6 – 8].

Another important observation in the present study was the significantly higher prevalence of fatty liver among diabetic participants compared with non-diabetics. This is expected because NAFLD and diabetes are closely interconnected manifestations of metabolic dysfunction. Insulin resistance plays a central role in both disorders, and diabetes accelerates hepatic fat accumulation, oxidative stress, and progression from simple steatosis to more advanced liver injury. Afolabi et al. showed a clear relationship between glycaemic status and ultrasound-diagnosed NAFLD in patients with type 2 diabetes mellitus, indicating that poorer metabolic control is associated with a greater burden of fatty liver [9]. Alsabaani et al. likewise found NAFLD to be a common association among patients with type 2 diabetes and reported increasing BMI as a significant contributing factor [10]. Kim et al. further described NAFLD as a sentinel marker of cardiometabolic risk, including in non-obese subjects, underlining that diabetes and fatty liver share broad systemic implications rather than being isolated conditions [11]. In the present study, the higher frequency of fatty liver among diabetics supports the view that diabetes screening and liver imaging should complement each other in high-risk patients. From a radiodiagnostic standpoint, ultrasound serves as a useful bridge between metabolic screening and early detection of hepatic involvement, especially where advanced modalities such as MRI proton density fat fraction or elastography may not be routinely feasible [10, 11].

The findings of the present study have practical implications for both radiology and general clinical care. First, they suggest that patients with elevated BMI and diabetes constitute an enriched high-risk group in whom fatty liver can be detected effectively by routine abdominal ultrasound. Second, because most cases in our study were mild or moderate, sonographic screening may help identify individuals at a stage when lifestyle intervention, weight reduction, and glycaemic optimization can still alter disease trajectory. These findings align with the literature indicating that NAFLD is tightly integrated with obesity, insulin resistance, and type 2 diabetes rather than being an isolated liver disorder [5, 7, 10]. At the same time, the study should be interpreted in light of a few limitations. Ultrasound, though practical, is operator-dependent and less sensitive for very mild steatosis than histology or advanced imaging. BMI also does not capture central adiposity as accurately as waist circumference or visceral fat measures. In addition, the study design demonstrated association rather than causation. Nevertheless, the strength of the present work lies in its prospective hospital-based design and its focus on easily measurable clinical variables that can be translated directly into practice. Overall, the study supports the role of ultrasonography as a valuable screening modality for fatty liver and confirms that both increased BMI and diabetes are important correlates of hepatic steatosis in routine tertiary care settings [6, 8, 11].

Conclusion:

Ultrasound proved to be a practical and effective imaging modality for detecting fatty liver in the present study. More than half of the participants showed sonographic evidence of fatty liver, with mild steatosis being the predominant grade. A significant association was observed between fatty liver and increasing BMI, and diabetic individuals had a markedly higher prevalence compared with non-diabetics. These findings indicate that obesity and diabetes are important correlates of hepatic steatosis. Routine ultrasonographic screening in individuals with elevated BMI and diabetes may facilitate early identification of fatty liver and timely intervention. The hospital-based sample and lack of histopathological confirmation were limitations.

References

1. Afolabi BI, Ibitoye BO, Ikem RT, Omisore AD, Idowu BM, Soyoye DO. The Relationship Between Glycaemic Control and Non-Alcoholic Fatty Liver Disease in Nigerian Type 2 Diabetic Patients. J Natl Med Assoc. 2018; 110(3): 256 – 64.
2. Liu M, Wang J, Zeng J, Cao X, He Y. Association of NAFLD With Diabetes and the Impact of BMI Changes: A 5-Year Cohort Study Based on 18,507 Elderly. J Clin Endocrinol Metab. 2017; 102(4): 1309 – 16.
3. Yki-Järvinen H. Diagnosis of non-alcoholic fatty liver disease (NAFLD). Diabetologia. 2016; 59(6): 1104 – 11.
4. Amarapurkar D, Kamani P, Patel N, Gupte P, et al. Prevalence of non-alcoholic fatty liver disease: population based study. Ann Hepatol. 2007; 6(3): 161 – 3.
5. Yki-Järvinen H. Diagnosis of non-alcoholic fatty liver disease (NAFLD). Diabetologia. 2016; 59(6): 1104 – 11.
6. Petrović G, Bjelaković G, Benedeto-Stojanov D, Nagorni A, Brzački V, Marković-Živković B. Obesity and metabolic syndrome as risk factors for the development of non-alcoholic fatty liver disease as diagnosed by ultrasound. Vojnosanit Pregl. 2016; 73(10): 910 – 20.
7. Yi M, Chen RP, Yang R, Chen H. Increased prevalence and risk of non-alcoholic fatty liver disease in overweight and obese patients with Type 2 diabetes in South China. Diabet Med. 2017; 34(4): 505 – 13.
8. George ES, Roberts SK, Nicoll AJ, Reddy A, Paris T, Itsiopoulos C, Tierney AC. Non-alcoholic fatty liver disease patients attending two metropolitan hospitals in Melbourne, Australia: high risk status and low prevalence. Intern Med J. 2018; 48(11): 1369 – 76.
9. Afolabi BI, Ibitoye BO, Ikem RT, Omisore AD, Idowu BM, Soyoye DO. The Relationship Between Glycaemic Control and Non-Alcoholic Fatty Liver Disease in Nigerian Type 2 Diabetic Patients. J Natl Med Assoc. 2018; 110(3): 256 – 64.
10. Alsabaani AA, Mahfouz AA, Awadalla NJ, Musa MJ, Al Humayed SM. Non-Alcoholic Fatty Liver Disease among Type-2 Diabetes Mellitus Patients in Abha City, South Western Saudi Arabia. Int J Environ Res Public Health. 2018; 15(11): 2521.
11. Kim SS, Cho HJ, Kim HJ, Kang DR, et al. Nonalcoholic fatty liver disease as a sentinel marker for the development of diabetes mellitus in non-obese subjects. Dig Liver Dis. 2018; 50(4): 370 – 7.