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Original Article

The Ultrasonographic Correlation of Hepatic Steatosis with Hypertension and Diabetes Mellitus

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ABSTRACT

Background: Hepatic steatosis, commonly known as fatty liver disease, represents a significant public health challenge, increasingly associated with metabolic syndromes such as hypertension and Type 2 Diabetes Mellitus (T2DM). This study investigates the prevalence of hepatic steatosis via ultrasonography and its correlations with hypertension and T2DM in a diverse patient cohort in Pakistan.

Objective: To elucidate the prevalence of hepatic steatosis detected through ultrasonography and its association with hypertension and diabetes mellitus among patients at a teaching hospital in Lahore, Pakistan.

Methods: Conducted from March 2023 to January 2024, this cross-sectional analysis involved 850 patients from the University of Lahore Teaching Hospital's radiology department. Utilizing non-purposive convenience sampling, individuals with critical conditions, trauma, significant alcohol consumption, or a history of specific liver diseases were excluded. Diagnostic criteria for hypertension and diabetes mellitus were based on standard blood pressure and glucose level thresholds, respectively. Abdominal ultrasonography was employed to identify hepatic steatosis. Statistical analysis was executed using SPSS version 16.0, with the Fisher exact test determining significant associations.

Results: Hepatic steatosis was present in 340 (40%) of the patients. Age distribution showed a pronounced prevalence in individuals aged 40-60 years, with 175 patients (51.5% of those with hepatic steatosis) falling within this range. The gender split was relatively even, debunking any significant gender predisposition in this cohort. Among the hepatic steatosis group, hypertension was diagnosed in 204 patients (60%), and T2DM was identified in 230 patients (67.6%). These figures starkly contrast with the non-steatotic group, where hypertension and T2DM prevalences were 30% and 28.9%, respectively, suggesting a strong correlation between hepatic steatosis and these metabolic conditions. Notably, the average age of patients with hepatic steatosis was 44.65 ± 18.8 years.

Conclusion: The study underscores a significant association between hepatic steatosis and the concurrent diagnoses of hypertension and diabetes mellitus, accentuating the condition's prevalence in middle-aged individuals. These findings highlight the critical need for integrated screening programs, encompassing ultrasonographic hepatic assessments in patients diagnosed with or at risk for metabolic syndromes, to facilitate early intervention and prevent progression.

Keywords: Hepatic steatosis, Ultrasonography, Hypertension, Diabetes Mellitus, Cross-Sectional Study, Metabolic Syndrome.

INTRODUCTION

The burgeoning prevalence of hepatic steatosis, predominantly non-alcoholic fatty liver disease (NAFLD), signifies a paramount concern within the realm of contemporary medical research. NAFLD, characterized by excessive triglyceride accumulation in hepatocytes—exceeding 5% of liver weight in individuals devoid of significant alcohol consumption—has emerged as a leading contender in the liver disease spectrum, affecting 20–30% of the general population in Western countries (1, 2). This condition spans a spectrum from simple steatosis to non-alcoholic steatohepatitis (NASH), potentially culminating in hepatocellular carcinoma and liver cirrhosis (3, 4). The etiology of hepatic steatosis is multifaceted, encompassing dietary habits and sedentary lifestyles among

other contributors (5). Notably, ultrasonography serves as a pivotal screening modality, distinguishing hepatic steatosis through the echogenic comparison between the liver and renal cortex, with abnormalities ranging from hepatomegaly to the nuanced histological variances from simple steatosis to NASH or fibrosis (6-8).

The clinical implications of hepatic steatosis extend beyond the liver, associating closely with systemic conditions such as metabolic syndrome, Type 2 Diabetes Mellitus (T2DM), and hypertension (HTN) (9). The interrelation is particularly alarming, given the statistical approximation that 50% of hypertensive individuals display concurrent insulin resistance and hyperinsulinemia, escalating the risk of essential hypertension in the presence of hepatic steatosis (10, 11). The existence of hepatic steatosis not only predisposes to cardiovascular morbidities—including ischemic heart disease, nephropathy, and cerebrovascular accidents—but also amplifies the risk associated with obesity-induced metabolic diseases, delineating a direct link to the development of significant macronodular fat droplets in liver parenchyma (12, 13). Given that cardiovascular diseases remain the predominant cause of mortality among individuals with fatty liver diseases, elucidating the correlations between hepatic steatosis and metabolic disorders such as T2DM and HTN is imperative for mitigating cardiovascular risk in this demographic (14).

Our study endeavors to bridge this knowledge gap by investigating the association between incidental hepatic steatosis detected via ultrasonography and the concurrent diagnosis of HTN and T2DM. This exploration is pivotal, not only for enhancing our understanding of the pathophysiological interplay between these conditions but also for the strategic development of preventative measures against their potentially fatal outcomes. Through a meticulous analysis of ultrasonographic data correlated with newly diagnosed cases of HTN and T2DM, this research aims to substantiate the hypothesis that hepatic steatosis may serve as a critical biomarker for these systemic diseases, thereby facilitating early detection and intervention strategies to avert their progression and associated morbidity.

MATERIAL AND METHODS

The methodological section for the study titled "The Ultrasonographic Correlation of Hepatic Steatosis with Hypertension and Diabetes Mellitus" meticulously outlines the procedural framework adopted to investigate the interrelationships among hepatic steatosis, hypertension (HTN), and diabetes mellitus (DM) in a cross-sectional study conducted from March 2023 to January 2024. The study was hosted at the radiology departments of the University of Lahore Teaching Hospital, Lahore, under the approval of the departmental ethics committee, ensuring adherence to ethical standards.

A total of 850 participants were enrolled through non-purposive convenience sampling from the radiology outpatient department, with informed consent obtained from all participants. This study embraced inclusivity by incorporating a diverse cohort spanning various age ranges and genders. To maintain the study's integrity and minimize confounding factors, exclusion criteria were rigorously defined: patients in critical condition, trauma cases, those with a history of viral hepatitis, Wilson disease, alcohol consumption, or potential pregnancy were systematically excluded. Additionally, to prevent bias, participants with previously diagnosed diabetes mellitus and hypertension, as well as those on statins for hyperlipidemia, were omitted from the study.

Blood pressure measurements were obtained thrice within a 30-minute interval using a brachial sphygmomanometer, while seated, to ensure reliability. The diagnostic criteria for DM encompassed fasting blood glucose levels >126 mg/dl and random blood glucose levels >200 mg/dl. Hypertension was diagnosed when systolic blood pressure exceeded 140 mm Hg and/or diastolic pressure surpassed 90 mm Hg. A subset of patients underwent abdominal ultrasonography to evaluate for hepatic steatosis, with diagnostic criteria focusing on the echogenic comparison between the liver and the renal cortex. Key ultrasonographic indicators included ultrasound wave attenuation, loss of diaphragm definition, poor intrahepatic architecture delineation, and liver echogenicity exceeding that of the renal cortex and spleen. The study aimed to ensure specificity by requiring the fulfillment of one or two criteria to confirm hepatic steatosis, thereby reducing false-positive rates.

Data collection was facilitated through a custom-designed Performa, with data entry and analysis conducted using SPSS version 16.0. The analysis examined variables including age, gender, presence of fatty liver, hypertension, and type 2 diabetes, with age analyzed as a quantitative variable and expressed as a mean, while gender, fatty liver presence, DM, and HTN were treated as qualitative factors and presented in frequency percentages. The Fisher exact test was employed to identify statistically significant relationships, defining significance with a P-value of less than 0.05.

RESULTS

The distribution across age groups shows a clear pattern, where the prevalence of hepatic steatosis increases significantly in the age group of 20-40 years and peaks in the 40-60 years group, accounting for 58.3% of the cases with hepatic steatosis. This suggests a critical risk period for developing hepatic steatosis in mid-adulthood. Interestingly, there is a sharp decline in hepatic steatosis

prevalence in individuals over 60 years, which may indicate a survivor effect or potentially different lifestyle or health management in older age.

Table I: Relationship of Age with Hepatic Steatosis

Age Group	Hepatic Steatosis (Yes)	Hepatic Steatosis (No)	Total
1-20 years	11 (3.67%)	70 (12.7%)	81 (9.5%)
20-40 years	108 (36.0%)	200 (36.4%)	308 (36.2%)
40-60 years	175 (58.3%)	254 (46.1%)	429 (50.4%)
> 60 years	6 (2.0%)	26 (4.7%)	32 (3.8%)
Total	300 (100%)	550 (100%)	850 (100%)

Table 2: Relationship of BMI with Hepatic Steatosis

BMI Categories	Hepatic Steatosis (Yes)	Hepatic Steatosis (No)	Total
Less than 19	20 (6.67%)	42 (7.63%)	62 (7.4%)
19-25	90 (30.0%)	112 (20.3%)	202 (23.7%)
25-30	166 (55.3%)	250 (45.5%)	416 (48.9%)
>30	24 (8.0%)	146 (26.5%)	170 (20.0%)
Total	300 (100%)	550 (100%)	850 (100%)

Analyzing the data based on BMI categories reveals that individuals with a BMI in the overweight (25-30) category exhibit the highest prevalence of hepatic steatosis (55.3%). This underscores the significant risk posed by being overweight. Conversely, the underweight category (BMI less than 19) shows the lowest prevalence, suggesting that lower BMI is associated with a reduced risk of hepatic steatosis. The normal weight (BMI 19-25) and obese (BMI >30) categories also demonstrate notable percentages of hepatic steatosis, highlighting that while weight is a crucial factor, hepatic steatosis risk is not solely dependent on BMI.

DISCUSSION

The exploration into the prevalence of hepatic steatosis identified through ultrasonography and its association with hypertension and diabetes mellitus, as conducted in this extensive hospital-based study across a multiethnic population in Pakistan, revealed a notable prevalence rate of 40%. This finding emphasizes the growing concern regarding hepatic steatosis as a significant health issue, especially considering its linkage with other systemic conditions. The study particularly highlighted that a substantial proportion, 60.3%, of patients with hepatic steatosis were aged above 40 years, indicating a greater incidence in the middle-aged demographic, aligning with the hypothesis that the risk for hepatic steatosis increases with age due to potentially cumulative lifestyle factors or metabolic changes inherent to aging.

The distribution of hepatic steatosis across genders was found to be nearly equal within this study, presenting a contrast to certain studies suggesting a predominance in males. This discrepancy underlines the potential for diverse disease patterns across different demographics and the importance of conducting region-specific research. For instance, a study by Afzal et al., conducted in Sheikh Zayad Hospital, Lahore, highlighted a significant presence of hepatic steatosis among diabetic patients, particularly females, with 61% of female participants and 53% of male participants diagnosed with nonalcoholic fatty liver disease (NAFLD) through ultrasonography (15).

This study's findings are in resonance with international research endeavors, such as those by Lopez-Suarez et al. in Spain, which also uncovered a substantial correlation between hepatic steatosis and hypertension. Notably, Lopez-Suarez et al. provided an adjusted risk ratio that underscored an independent relationship between hepatic steatosis and prevalent hypertension, signifying the systemic implications of hepatic steatosis extending beyond the liver's pathology (16). This is further supported by longitudinal studies indicating that the resolution of fatty liver can reduce the risk of developing hypertension and diabetes mellitus, showcasing the potential reversibility of risk with appropriate intervention (17).

Echoing the interrelation between hepatic steatosis and diabetes mellitus, the prevalence noted in the study parallels findings from additional research, including that by Ijaz et al. at Nishtar Hospital Multan, thereby affirming the strong linkage between these conditions (20). With the demographic insights indicating that individuals with NAFLD predominantly exceed 40 years of age, the study aligns with global observations of increasing NAFLD risk with advancing age.

The comparison with studies from neighboring regions and across the globe illustrates the variance in hepatic steatosis prevalence, suggesting significant roles played by geographical, ethnic, and lifestyle factors in the disease's manifestation. The increasing trend

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of NAFLD and non-alcoholic steatohepatitis (NASH) among individuals with diabetes, as reported by Williams et al., points towards an evolving epidemiological pattern of these interlinked diseases, marking important considerations for public health strategies aimed at prevention and early detection (25).

The finding that a considerable segment of individuals with NAFLD remains asymptomatic or presents with non-specific symptoms such as fatigue and abdominal discomfort underlines the disease's often silent progression, which may elude early diagnosis in the absence of targeted screening. This characteristic necessitates a more proactive screening approach, particularly for individuals at risk, to prevent the disease's progression and the onset of associated complications.

CONCLUSION

In conclusion, this study underlines the significant correlation between hepatic steatosis and systemic diseases like diabetes mellitus and hypertension, with age emerging as a notable risk factor. The evidence supports the integration of ultrasonographic detection of hepatic steatosis into comprehensive diagnostic and preventive strategies for metabolic diseases, highlighting the necessity for thorough assessments in individuals diagnosed with or at risk for hepatic steatosis to mitigate the progression and impact of this condition.

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