Original Research Article

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Association of nonalcoholic fatty liver disease to early carotid atherosclerosis in a tertiary care center: A cross-sectional study

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ABSTRACT

Introduction: Nonalcoholic fatty liver disease (NAFLD) encompasses conditions ranging from simple hepatosteatosis to severe liver cirrhosis. It is strongly correlated with components of metabolic syndrome such as insulin resistance, dyslipidemia, and obesity. As NAFLD patients have higher cardiovascular risk, ultrasonography assessed carotid artery intima-media thickness (CIMT) provides a non-invasive measure of evaluating atherosclerosis.

Objective: To evaluate CIMT among NAFLD patients by using B-mode ultrasonography to assess NAFLD as an independent risk factor for atherosclerosis.

Methodology: This descriptive cross-sectional study was conducted among NAFLD patients aged 18–80 years undergoing ultrasound at Kathmandu Medical College. Patients with alcohol consumption >30g/day or other comorbidities such as chronic liver disease and cardiovascular disease were excluded. Calculated sample size was 196 and convenience sampling technique was used. CIMT and hepatic echogenicity were assessed by B-mode ultrasonography. Data were collected via a proforma, and descriptive statistics like frequency percentage, mean±SD was calculated to see the distribution and Analysis of variance (ANOVA) test was done to evaluate the difference in CIMT. Ethical clearance was obtained from the Institutional Review Committee of Kathmandu Medical College Teaching Hospital (Ref:199012024/07).

Results: Among 196 patients, 120 (61.2%) patients had Grade I fatty liver, 71 (36.2%) had Grade II fatty changes and 5 (2.6 %) had Grade III fatty liver respectively. The mean right and left CIMT were 0.65mm and 0.67mm respectively. CIMT increased significantly with the severity of fatty liver (p=0.001).

Conclusion: NAFLD is significantly associated with early carotid atherosclerosis, supporting its role as an independent cardiovascular risk factor.

Keywords: Atherosclerosis; Carotid artery intima-media thickness; Hepatosteatosis; Nonalcoholic fatty liver disease; Ultrasonography

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INTRODUCTION

Non-alcoholic fatty liver disease (NAFLD) involves fatty infiltration of the liver unrelated to alcohol consumption.[1] It encompasses a spectrum from simple hepatosteatosis to nonalcoholic steatohepatitis (NASH) and cirrhosis. NAFLD is now recognized as a part of the metabolic syndrome since it is linked to obesity, dyslipidemia, insulin resistance, and type 2 diabetes.[2] Patients with NAFLD are at risk of cardiovascular disease due to endothelial dysfunction and atherosclerosis.[3] It is closely associated with metabolic syndrome components such as obesity, dyslipidemia, and insulin resistance, all of which contribute to increased cardiovascular risk. [2,4-5] While liver biopsy remains the diagnostic gold standard

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for hepatosteatosis, ultrasound offers a non-invasive alternative for its detection.[5-6] Recent evidence suggests that cardiovascular disease, rather than liver-related complications, is the leading cause of mortality among patients with NAFLD.[2-3,5] This study evaluates NAFLD as an atherosclerotic risk factor by estimating CIMT using grayscale ultrasound to evaluate the associated with NAFLD to early carotid atherosclerosis and assess the cardiovascular risk[7]

METHODOLOGY

This descriptive cross-sectional study was conducted among non-alcoholic fatty liver disease (NAFLD) patients aged 18 to 80 years undergoing abdominal ultrasound at Kathmandu Medical College and Teaching Hospital (KMCTH), Sinamangal, Kathmandu, Nepal. Data were collected from patients who underwent ultrasound at the institute between 1st April 2024 and 30th September 2024. Patients consuming alcohol >30 g/day, aged <18 or >80 years, patients with a history of chronic liver disease or cardiovascular disease and patient under medications that are known to cause hepatic steatosis were excluded. Ethical approval was obtained from the Institutional Review committee of KMC (Reference number: 199012024/07).

A convenience sampling method was used, and the sample size was calculated using the formula:

$n = Z^2p(1-p)/e^2$
$= (1.96)^2 x (0.015) x (1-0.0.15)/ (0.05)^2$
$= 196$

Where,
n = required sample size
Z = 1.96 at 95% CI
p = prevalence from previous study (15%) [8]
e = margin of error (5%)

Data collection was done using a predesigned proforma. Data entry was performed in Microsoft Excel and analyzed in statistical package for social sciences, IBM SPSS Statistics for Windows version 26 (IBM Corp., Armonk, N.Y., USA).

CIMT was measured using high-resolution B-mode ultrasonography with a 7–12 MHz linear array transducer by consultant radiologist. Informed written and verbal consent was taken with the patient or patient party before starting the examination. The participants were examined in a supine position with the head turned slightly away from the side being scanned. Both right and left common carotid arteries (CCA) were evaluated.

The CIMT is defined as the distance between the leading edge of the first echogenic line (lumen–intima interface) and the leading edge of the second echogenic line (media–adventitia interface) on the far wall of the artery. Measurements were taken approximately 1 cm proximal to the carotid bulb, where the arterial wall appeared parallel and free from plaques or calcifications.

For each side, three measurements were taken, and the average value was used for analysis. The presence of focal plaque was excluded from the measurement sites. A CIMT value of >0.8 mm was considered indicative of increased intima-media thickness, suggestive of early atherosclerosis.

All measurements were performed by consultant radiologist using same ultrasound machine with standard imaging settings to minimize inter-observer variability.

Hepatic echogenicity was evaluated using a 3.5–5 MHz convex transducer after 6–8 hours of fasting. The diagnosis and grading of NAFLD were based on hepatic–renal contrast, parenchymal brightness, intrahepatic vessel visualization, diaphragm obscuration and posterior beam attenuation. NAFLD was graded as: Grade I (Mild): Slight, diffuse increase in liver parenchymal echogenicity with normal vessel and diaphragm visualization, Grade II (Moderate): Moderate increased in parenchymal echogenicity with partial vessel and diaphragm obscuration and Grade III (Severe): Marked increased in parenchymal echogenicity with poor visualization of vessels diaphragm obscuration and posterior beam attenuation. NAFLD diagnosis required exclusion of significant alcohol use (>30 g/day men, >20 g/day women) and other liver diseases. Grading was performed by a blinded consultant radiologist using same ultrasound machine with standard imaging settings to minimize bias.

RESULTS

Out of 196 patients enrolled in the study 53.1% were male and 46.9% were female (figure 1). More than two/third i.e., 120 (61.2%) patients had Grade I fatty liver followed by Grade II 71 (36.2%) and Grade III 5 (2.6 %, Figure 2). As per age distribution, proportionately higher number of cases 59 (30%) were from the age group 31-40 years (Table 1).

The mean carotid-intima media thickness (CIMT) on the right and left side were 0.65±0.17 mm and0.67 ±0.21 mm respectively. On both sides, there is an increase in mean

carotid-intimal medial thickness with increase in the severity of the fatty liver which is statistically significant (p-value =0.001, Table 2).

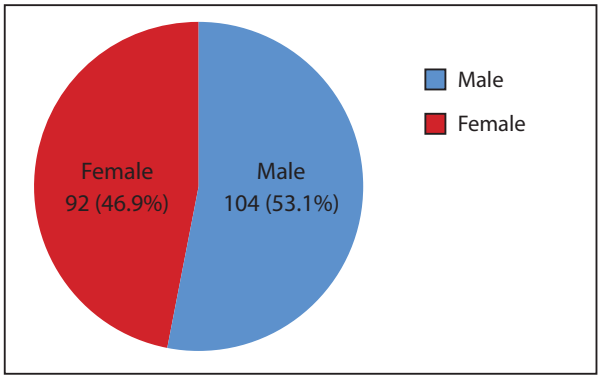

Figure 1: **Sex distribution of the patient.**

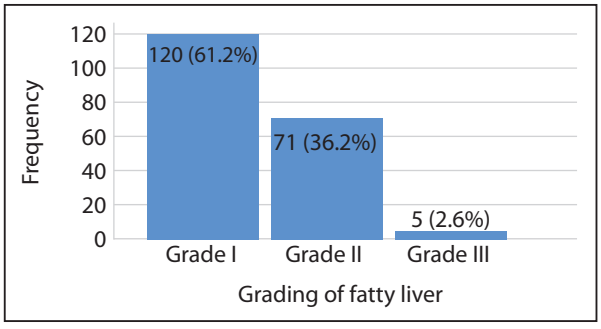

Figure 2: **Fatty liver grade distribution of the patient**

Table 1: **Distribution of grade of fatty liver according to age groups of the patients.**

Age Groups in years	NAFLD grade		
	Grade 1 n (%)	Grade II n (%)	Grade III n (%)
21-30	**16 (8.16)**	15(7.65)	2(1.02)
31-40	38 (19.38)	21 (10.7)	0
41-50	29 (14.7)	14 (7.14)	3 (1.53)
51-60	34 (17.34)	20 (10.2)	0
61-70	2 (1.02)	0	0
71-80	1(0.5)	1 (0.5)	0

DISCUSSION

This descriptive cross-sectional study demonstrates a significant association between the severity of nonalcoholic fatty liver disease (NAFLD) and carotid intima-media thickness (CIMT), indicating early atherosclerotic changes. Similar to findings by Vernon et al. and Targher et al., this study shows that increased grades of NAFLD are strongly correlated with elevated CIMT, a recognized marker of subclinical atherosclerosis.[1-2] Correspondingly, Völzke et al. and Chalasani et al. also reported an independent association between hepatic steatosis and carotid atherosclerotic plaques, supporting the present study's findings. [4,6]

Our results are consistent with Villanova et al., who demonstrated that endothelial dysfunction plays a central role in the heightened atherogenic risk among patients with NAFLD.[3] Furthermore, Polak et al. and Lorenz et al. established a substantial relationship between carotid atherosclerosis and coronary artery disease, while Bots et al. emphasized the predictive value of CIMT for cardiovascular risk assessment.[7-10] These studies, along with our findings, underscore that NAFLD itself can serve as a significant and independent risk factor for early atherosclerosis and cardiovascular disease, even in patients without traditional comorbidities.

The strength of this study lies in its exclusion criteria, which eliminated potential confounders such as alcohol consumption (>30 g/day), chronic liver disease, and existing cardiovascular conditions. This methodological rigor supports NAFLD's role as an independent variable influencing vascular health. Fracanzani et al. similarly observed a clear association between CIMT and NAFLD severity, further validating this relationship [11].

The pathophysiological link between NAFLD and atherosclerosis can be explained by mechanisms involving oxidative stress, systemic inflammation, and the release of pro-inflammatory cytokines, which contribute to endothelial injury and vascular remodeling. [10, 12-13]

Table 2: **Mean carotid-intima media thickness (CIMT) among different grades of fatty liver.**

Fatty liver grade	n (%)	Right CIMT (mm) Mean ±SD	p-valve	Left CIMT (mm) Mean ±SD	p-valve
Grade I	120 (61.3%)	0.59 ±0.14		0.61 ±0.16	
Grade II	71 (36.2%)	0.71 ±0.16	0.001*	0.75 ±0.25	0.001*
Grade III	5 (2.6%)	1.01 ±0.14		1.0 ±0.12	
Total	**196**	**0.65 ±0.17**		**0.67 ±0.21**	

p-value significant at <0.05, *=ANOVA test

Despite these findings, the cross-sectional nature of this study limits causal inference between NAFLD and atherosclerosis. Future longitudinal studies are warranted to explore temporal relationships and progression patterns using advanced imaging modalities.

The global prevalence of NAFLD continues to rise alongside obesity and metabolic syndrome. [1-2] Therefore, early detection and management are vital in reducing cardiovascular morbidity. Incorporating CIMT measurement into routine assessment of NAFLD patients may help identify those at increased cardiovascular risk and guide preventive interventions.

CONCLUSION

This study demonstrates a significant association between the severity of nonalcoholic fatty liver disease (NAFLD) and carotid intima-media thickness (CIMT), indicating that NAFLD contributes to early atherosclerotic changes independent of other conventional cardiovascular risk factors.

Early identification of vascular changes in NAFLD patients is of great clinical importance. Routine assessment of CIMT using non-invasive ultrasonography may serve as a valuable screening tool for detecting subclinical atherosclerosis, facilitating timely preventive and therapeutic interventions.

So, NAFLD should be recognized not only as a hepatic disorder but also as an independent cardiovascular risk factor. Incorporating vascular assessment such as CIMT measurement into the routine evaluation of NAFLD patients could improve early risk stratification and ultimately reduce cardiovascular morbidity and mortality.

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Conflict of Interest: None.

REFERENCES

1. Vernon G, Baranova A, Younossi ZM. Systematic review: the epidemiology and natural history of non-alcoholic fatty liver disease and non-alcoholic steatohepatitis in adults. Aliment Pharmacol Ther. 2011;34(3):274-85. [PubMed | Full Text | DOI]
2. Targher G. Non-alcoholic fatty liver disease, the metabolic syndrome and the risk of cardiovascular disease: the plot thickens. Diabet Med. 2007;24(1):1-6. [PubMed | Full Text | DOI]
3. Villanova N, Moscatiello S, Ramilli S, et al. Endothelial dysfunction and cardiovascular risk profile in nonalcoholic fatty liver disease. Hepatology. 2005;42(2):473-80. [PubMed | Full Text | DOI]
4. Volzke H, Robinson DM, Kleine V, et al. Hepatic steatosis is associated with an increased risk of carotid atherosclerosis. World J Gastroenterol. 2005;11(12):1848-53. [PubMed | Full Text | DOI]
5. Tuyama AC, Chang CY. Non-alcoholic fatty liver disease. J Diabetes. 2012;4(3):266-80. [PubMed | Full Text | DOI]
6. Chalasani N, Younossi Z, Lavine JE, et al. The diagnosis and management of non-alcoholic fatty liver disease: practice Guideline by the American Association for the Study of Liver Diseases, American College of Gastroenterology, and the American Gastroenterological Association. Hepatology. 2012;55(6):2005-23. [PubMed | Full Text | DOI]
7. Bots ML, Grobbee DE. Intima media thickness as a surrogate marker for generalised atherosclerosis. Cardiovasc Drugs Ther. 2002;16(4):341-51. [PubMed | Full Text | DOI]
8. Ashtari S, Pourhoseingholi MA, Zali MR. Non-alcohol fatty liver disease in Asia: Prevention and planning. World journal of hepatology. 2015 Jul 8;7(13):1788. [PubMed | Full Text | DOI]
9. Polak JF, Pencina MJ, Pencina KM, et al. Carotid-wall intima-media thickness and cardiovascular events. N Engl J Med. 2011;365(3):213-21. [PubMed | Full Text | DOI]
10. Lorenz MW, Markus HS, Bots ML, et al. Prediction of clinical cardiovascular events with carotid intima-media thickness: a systematic review and meta-analysis. Circulation. 2007;115(4):459-67. [PubMed | Full Text | DOI]
11. Fracanzani AL, Burdick L, Raselli S, et al. Carotid artery intima-media thickness in nonalcoholic fatty liver disease. Am J Med. 2008;121(1):72-8. [PubMed | Full Text | DOI]
12. Day CP, James OF. Steatohepatitis: a tale of two "hits"? Gastroenterology. 1998;114(4):842-5. [PubMed | Full Text | DOI]
13. Tilg H, Moschen AR. Evolution of inflammation in nonalcoholic fatty liver disease: the multiple parallel hits hypothesis. Hepatology. 2010;52(5):1836-46. [PubMed | Full Text | DOI]