Original article

Comparison of Ultrasound and Computed Tomography Findings in Non Alcoholic Fatty Liver Disease in Obese and Non-Obese Patients

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ABSTRACT

Background: Non-alcoholic fatty liver disease (NAFLD) is a type of chronic liver disease. It affects 6-35% globally and is related to obesity, requiring the patients to undergo hepatic transplant eventually.

Objective: To compare ultrasound and computed tomography findings in non-alcoholic fatty liver disease in obese and non-obese patients.

Methods: A cross sectional prospective analytical study was conducted at DHQ Hospital Narowal**.** 270 patients of both genders with ages 13 and 95 years, that were referred from surgical or medical outdoor for abdominal ultrasound were included in the study, who had a fatty liver on ultrasound and were non-alcoholics as per their clinical record. Patients having history of alcohol intake or any sonographic evidence of hepatic inflammation, cirrhosis or focal defect were excluded. The variables of age, height, weight, gender and BMI were recorded. Patients were categorized in two groups obese and non-obese on basis of BMI. Grading of fatty liver on ultrasound and computed tomography was done based on American Gastroenterologist Association criteria and was noted down on a predesigned data collection sheet. Quantitative data like age, and laterality was presented by mean and standard deviation. Spearman's correlation tests were applied to evaluate the relation of imaging scores with BMI.

Results: Out of 270 patients of NAFLD, 55.9% were females and 44.10% were males while 74.44% subjects were obese 25.55% were non obese. The correlation between USG and CT findings was significant(r = 0.761 for non-obese and 0.868 for obese patients). Among obese cases of NAFLD grade I was the commonest, and lowest number of patients were of grade III. Among non-obese cases grade II was commonest.

Conclusion: There is a good correlation between the structural ultrasound criteria and CT criteria for diagnosis of nonalcoholic fatty liver disease. This disease is seen more commonly in obese individuals and is more common in females as compared to males.

Keywords:

NAFLD, Computed Tomography, Ultrasonography, BMI, Obesity

INTRODUCTION

Non-alcoholic fatty liver disease (NAFLD) is one of the most common causes of chronic liver disease requiring liver transplantation in Western countries. It has global incidence of 6-35% and affects 15 to 40% of people in Western nations whereas 9-40% of people in Asian countries.[1, 2] In United States 30% and in Pakistan 18% of general population is affected.[3,4]

NAFLD is a chronic liver disease(CLD) caused by an accumulation of fat droplets in the hepatocytes that exceeds 5% in the absence of clinically substantial alcohol use, viral infection or any other particular cause of liver disease.[5,6] Obesity, metabolic syndrome, dyslipidemia, insulin resistance (IR), and type 2 diabetes mellitus (T2DM) are all linked to NAFLD.[7]

Obesity is a well-reported and independent risk factor for NAFLD.[8] It is a chronic condition defined by a body mass index (BMI) of greater than 30 kg/m2.[9] BMI is used for determining obesity based on individual heights and weights.[10] Recent research reveals that the Asian population's regional anthropometric measures are BMI 22.5—24.9 kg/m^2 for overweight and 25 kg/m^2 for obesity, lower than the global population's. NAFLD being more common among obese people.[11,12] It has prevalence of 80% obese patients as compared to just 16% in non-obese. It is projected to become a very common illness in United States, affecting approximately 35% of the adult population in industrialized countries.[9,13,14,15]

Several imaging modalities can identify NAFLD, each with its own set of benefits and drawbacks, the non-invasive ones being Ultrasound (USG), computed

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tomography (CT), and magnetic resonance imaging (MRI).[4] Ultrasound may only offer a subjective assessment, while CT and MRI can provide a more objective assessment.[16] The gold standard for diagnosing and quantifying liver fat is a liver biopsy, but its usage is limited due to its invasiveness with sampling mistakes and bleeding problems.

With a reported sensitivity of 84.8 percent and specificity of 93.6 percent, ultrasound has been recommended as a reliable and accurate imaging method for identifying moderate-severe fatty liver disease (FLD) due to its safety, ease of use, low cost, and lack of radiation.[17] Primary drawbacks are limited sensitivity for mild steatosis, operator dependence and patient variables such as obesity.

For mild hepatic steatosis, CT has a high specificity but a low sensitivity with major downside being radiation exposure, but can detect and quantify moderate to severe steatosis.[18] New methods, such as dual energy CT, have the potential to increase CT's sensitivity.[19]

Many investigators have discussed the sonographic findings and computed tomographic characteristics of NAFLD separately, but few have presented a direct comparison of ultrasound and CT images in the same patients. A good association will avoid unwanted radiation to the patient. This study further purposes to see if the comparison of findings between both modalities is the same or different in obese and non-obese individuals.

METHODS

A cross sectional prospective analytical study was conducted at DHQ Hospital Narowal, which is a 300-bedded secondary healthcare facility. 270 patients of both genders with ages 13 and 95 years, that were referred from surgical or medical outdoor for abdominal ultrasound were included in the study, who had a fatty liver on ultrasound and were non-alcoholics as per their clinical record. Patients having history of alcohol intake or any sonographic evidence of hepatic inflammation, cirrhosis or focal defect were excluded.

The variables of age, height, weight, gender and BMI were recorded.

With the patient in shallow suspended inspiration, multiple conventional B-mode images of the liver were obtained using a 3.5MHZ curvilinear probe of GE Logic P7 machine in the transverse and longitudinal planes by a single imaging technologist, to avoid inter-observer discordance. The liver parenchyma, liver vessels, relative echogenicity of the liver to the kidney and interface between the liver and diaphragm were obtained on images. These images were subsequently reviewed by consultant radiologist having more than 10 years of experience, for grading of fatty infiltration of liver. The criterion of American Gastroenterology Association was used to grade FLD:

- Grade 0- normal echogenicity. Liver appears equal to or slightly echogenic than right renal parenchyma.
- Grade I – Mild diffuse increase in echogenicity. Liver appears bright compared to the cortex of the kidney and normal picturing of diaphragm and intrahepatic vessel borders.
- Grade II - Moderate diffuse increase in echogenicity. Slightly diminished visualization of the intrahepatic vessels and diaphragm.
- Grade III - Noticeable increase in echogenicity. Poor or no visualization of intrahepatic vessels and diaphragm and poor penetration of the posterior segment of the right lobe of the liver

Unenhanced CT Abdomen (80-140 kV, 100-300 mAs, 5mm section thickness) of the same patient was then scheduled and performed by the technologist using Hitachi 256-slice CT machine in supine position. To calculate CT Hounsefield Unit (HU)Number (CTHFN) of liver, attenuation values were measured using random selection of regions of interest (ROIs) ranging from 50 to 100 mm^2 while taking care to exclude regions of non-uniform parenchymal attenuation, including hepatic vessels and biliary structures. The ROIs circles were placed when maximum part of both hepatic lobes were visible in a slice. There were two ROIs placed in the right liver lobe anterioposteriorly, one ROI in the left lobe of liver and one in the spleen. The images were reviewed and graded by same level consultant radiologist, using Grade 0 as <20HU difference in between spleen and average of liver; Grade I as 20-40HU difference; Grade II as 40-60 difference and Grade III >60HU difference, as per American Gastroenterologists Association criterion.

Based upon BMI patients were categorized in two groups obese and non-obese keeping in view Asian ethnicity where BMI $\geq$ 25 was taken as obese and <25 as non-obese. Grading of fatty liver on ultrasound and CT scan were noted down on a predesigned data collection sheet. The ultrasound scores for each patient were then be averaged and compared with the CT findings.

Quantitative data like age, and laterality was presented by mean and standard deviation. Spearman's

correlation tests were applied to evaluate the relation of imaging scores with BMI.

RESULTS

The mean age of the patients was 50.04 years with standard deviation (SD) of 16.09 years, minimum age 14 and maximum age 95 years. Out of total 270, 74.4% (n=201) patients were obese and 25.5% (n=69) patients were non-obese. 41.48% (n=112) females were obese out of the total 55.9% (n=151) while 32.96% (n=89) of males were obese out of the total 44.1% (n=119). In this study the correlation between USG and CT findings for NAFLD was significant (r=0.868 and r = 0.761 with p- value 0.000 <0.05) for obese and non-obese cases respectively. 16.9% (n=36) of the patients categorized as obese had grade III FLD on both USG and CT, as shown in case I. (Table 1)(Figure 1 & 2) While 21.73% (n=15) of the patients categorized as non-obese had grade III FLD. (Table 2) Spearman's test represented a significant correlation between FLD grading and BMI of the patients. (Table 3 & 4)

Table-1: Ultrasound and CT Grading Cross tabulation for obese cases

		CT Grading			
		I	II	III	Total
USG Grading	0	1(0.49%)	0(0.00%)	0(0.00%)	1(0.49%)
	I	73(36.31%)	4(1.99%)	0(0.00%)	77(38.30%)
	II	13(6.46%)	59(29.35%)	2(0.99%)	74(36.81%)
	III	0(0.00%)	15(7.46%)	34(16.91%)	49(24.37%)
Total		87(43.28%)	78(38.80%)	36(17.91%)	201(100%)

Table-2: Ultrasound and CT Grading Cross tabulation for non-obese cases

		CT Grading				
		0	I	II	III	Total
USG Grading	I	4(5.79%)	16(23.18%)	1(1.44%)	1(1.44%)	22(31.88%)
	II	1(1.44%)	6(8.69%)	16(23.18%)	6(8.69%)	29(42.02%)
	III	0(0.00%)	0(0.00%)	3(4.34%)	15(21.73%)	18(26.08%)
Total		5(7.24%)	22(31.88%)	20(28.98%)	22(31.88%)	69(100.00%)

Table-3: Spearman's Correlations for obese cases

		Ultrasound grading	CT grading
Ultrasound grading	Correlation coefficient		0.868
	Sig.(2_tailed)	.	.000
	N	201	201

Table-4: Spearman's correlation for non-obese cases

		Ultrasound grading	CT grading
Ultrasound grading	Correlation coefficient		0.761
	Sig.(2_tailed)	.	.000
	N	69	69

ULTRASOUND and CT IMAGES

Case I

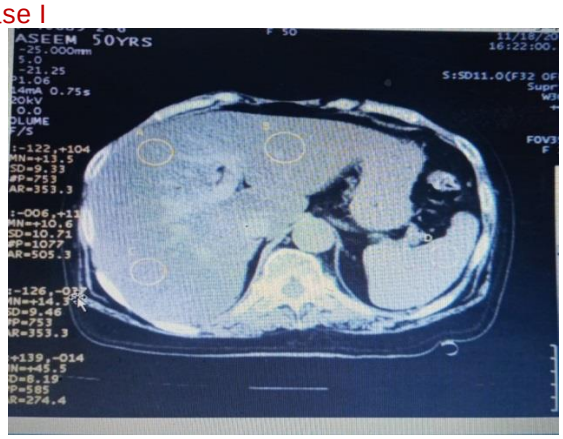

Figure 1: Grade III fatty liver on CT scan CTHFN liver =14 CTHFN=45

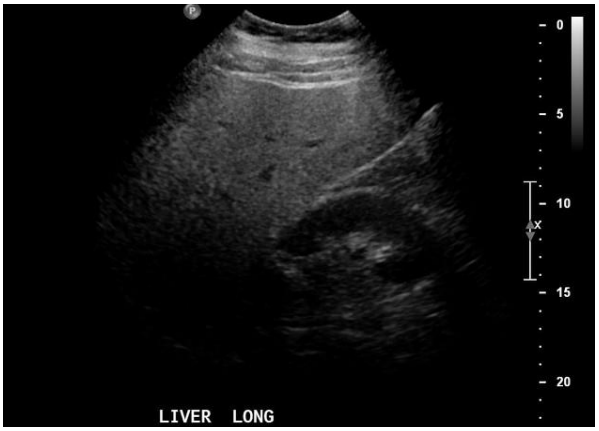

Figure 2: grade III fatty liver on ultrasound significantly increased echogenicity of the liver compared to the right kidney, a lack of visualization of intrahepatic vessel walls, and markedly decreased reflectivity of the hemidiaphragm.

DISCUSSION

NAFLD is closely linked to obesity and metabolic syndrome. It is estimated to affect anywhere from 25% of the general population to well over 50% of diabetics and has emerged as the most frequent cause of chronic hepatitis globally, posing a serious public health threat. As a result of a lifestyle centered on poor eating habits and sedentarism, its incidence is rapidly expanding at the same rate as T2DM and obesity.[6,20]

This study was designed to compare ultrasound and computed tomography findings in NAFLD in obese and non-obese cases. Data was collected from 270 patients of NAFLD keeping in view the inclusion and exclusion criteria. Out of 270 patients of NAFLD 74.44% were obese and 25.55% were non obese. Molina and coworkers support this finding of NAFLD being more common in obese individuals as they concluded that NAFLD is particularly common in overweight-obese persons.[21] Similarly a study by Milić and colleagues found that owing to a rise in the incidence of obesity, NAFLD is fast becoming the most prevalent cause of chronic liver disease.[22] Another study by Abangah and co-researchers support our study as they reported 72.3 percent of patients were overweight or obese in their study. They concluded that body mass index and triglycerides are the most important variables in determining the degree of fatty liver disease and the grade of ultrasonography in individuals with NAFLD.[23] Another study by Liu and associates supports this study as they concluded that NAFLD has astonishingly high prevalence rate in over weight and obese adults.[24]

In this study out of 270 patients of NAFLD 55.90% were females and 44.10% were males. Among 151(55.90%) females 112(41.48%) were obese and 39(14.44%) were non obese. A study by Mahaling and coworkers supports these findings, NAFLD being more common in females than males.[25] Abangah and associates, in contrast oppose our study as they found NAFLD being more prevalent in males as compared to females.[23]This may be attributed to more percentage of male patients in their study(65.7%) compared to ours (44.1%). Another study by Liu and coworkers' study also contradicts this study in terms of gender predilection, possibly due to the same increased male patients (59.0%) in their study compared to this one.[24]

In our study we found that the correlation between USG and CT findings for NAFLD was significant (r=0.868 and r = 0.761 with p- value 0.000 <0.05) for obese and non-obese cases respectively. A study by Yousef and colleagues favors our study as they found good correlation between ultrasound and CT Hounsfield numbers, they discovered significant p (0.05) values of CTHFN for all grades of FLD.[4] In contrast Needleman and associates oppose our study as they concluded that sonographic grading of disease severity was considerably less precise 63% overall and that sonography can only differentiate between two aberrant sonographic patterns.[26] Our study in contrast showed a good correlation between grades of fatty liver on CT and ultrasound.

CONCLUSION

There is a good correlation between the structural ultrasound criteria and CT criteria for diagnosis of nonalcoholic fatty liver disease. This disease is seen more commonly in obese individuals and is more common in females as compared to males.

Limitations

The limitation to our study is that it was carried out in local population.

Recommendations

Widespread data from different ethnic backgrounds needs to be studied for further confirmation of the findings.

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