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Original Research Article

Evaluation of fatty liver with grey scale 2D ultrasonography and ultrasound elastography and co-relation with lipid profile in adult patient in the state of Chhattisgarh attending Dr. Bhim Rao Ambedkar memorial hospital tertiary care centre Raipur

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ABSTRACT

Background: Several noninvasive imaging techniques have been introduced for the assessment of liver fibrosis. Among these techniques real-time Point shear wave elastography has become a promising imaging modality for the measurement of liver stiffness. The advantage of this technique is that the elasticity displayed using a B-mode image, also a quantitative estimation of liver stiffness is performed. The present study evaluates the fatty liver in patients above 18 years age with grey scale 2D ultrasonography and ultrasound elastography and also study the correlation with lipid profile in patients attending Dr B.R.A.M hospital tertiary care center Raipur, Chhattisgarh.
Methods: This was a hospital based observational study conducted in Department of Radio-diagnosis, Dr BRAM Hospital and Pt JNM Medical College, Raipur (C.G). A sample of 198 patient above 18-year age with fatty liver were taken. Grading and quantification of fatty liver was also done by Shear wave elastography. A *p*-value <0.05 was considered statistically significant.
Results: Mean age of study subjects was 48.47±15.21 years and 52.02% were female. 2D ultrasound technique diagnosed 75.25% grade-1 and 24.24% were in grade-II. Elastography technique diagnosed 57.58% with dysfunction (F1) liver stiffness, 28.28% fibrosis present (F2 or F3) and 13.64% normal. Increasing liver stiffness stages was significantly associated with increasing levels of serum VLDL (p=0.04).
Conclusions: Ultrasound used in conjunction with elastography has shown utility in diagnosing and follow up of fatty liver patients. Liver stiffness was significantly associated with increasing levels of serum VLDL.

Key words: Ultrasound, Elastography, Liver stiffness, Fatty liver, NAFLD

INTRODUCTION

Fatty liver, or hepatosteatosis, is characterized by accumulation of triglyceride within the cytoplasm of hepatocytes and fat accumulation in the liver exceeding 5%-10% by weight.[1,2] But when hepatosteatosis is present in patients with the absence of excessive alcohol consumption, it is termed non-alcoholic fatty liver disease, or NAFLD, and it is considered to be the hepatic manifestation of the metabolic syndrome, involving insulin resistance, visceral obesity, dyslipidemia, diabetes, hypertension, plus additional factors.[1,3-7] The prevalence of NAFLD in the general adult population has been estimated to range from 10% to 24% worldwide; and is as high as 57.5% to 74% in those who are obese.[8]

NAFLD encompasses from simple steatosis to inflammatory steatohepatitis (NASH). Of those who develop NASH, about 20% of patients develop cirrhosis in their lifetime.[9] Therefore, a diagnosis of NASH may result in a better therapeutic approach of the metabolic risk factors.[10] Presently, the available noninvasive markers for NAFLD lacked the specificity and sensitivity to distinguish NAFL from NASH and to determine the presence and grading of fatty liver.[10] Several noninvasive imaging techniques have been introduced for the assessment of liver fibrosis using ultrasound, CT, and MRI, and serum markers. Among them, ultrasound-based elastography has become a promising imaging modality for the measurement of liver stiffness. Elastography quantifies liver fibrosis by measuring the propagation velocity of ultrasound waves that pass through the liver.[11] There are several types of ultrasound elastography, the main ones used for the study of the liver being TE-Transient Elastography, 2D-SWE-Shear Wave Elastography and pSWE-Point Shear Wave Elastography.[11] Among these techniques real-time Point shear wave elastography is one of the new developed ultrasound-based techniques.[12] The technique has the advantage that the elasticity is displayed using a B-mode image, and at the same time, a quantitative estimation of liver stiffness (LS) can be performed in a certain region of interest (ROI), the results being expressed in kPa or m/s. Recently, many studies have been conducted on the application of p-SWE in patients with various liver diseases, and their validity has been confirmed. The present study evaluates the fatty liver in patients above 18 years age with grey scale 2D ultrasonography and ultrasound elastography and also study the correlation with lipid profile in patients attending Dr B.R.A.M hospital tertiary care center Raipur, Chhattisgarh.

METHODS

This was a hospital based observational, descriptive study conducted in Department of Radio-diagnosis, Dr BRAM Hospital and Pt JNM Medical College, Raipur. The study duration was January 2019 to December 2019. Patient above 18-year age referred from O.P.D. to department of radio-diagnosis for abdominal ultrasound and found to have fatty liver and willing to participate in study were taken as study population. Sample size for the study calculated using formula;

$$4pq/d^2$$

where P is Expected proportion i.e., 10% taken from study of Karla et al d is desired level of precision error (0.08) at 95% confidence interval the sample size came to 198.[13]

Exclusion criteria were; Patients below 18 years of age, diagnosed with diabetes mellitus, liver parenchymal disease and those not willing to participate were excluded from the sample size.

In this study grading of fatty liver was done using 2D grey scale ultrasonography. grading and quantification of fatty liver was also done by Shear wave elastography. For ultrasonography Samsung SA80 Ultrasound machine was used. Correlation of elastography quantification and 2D ultrasonography grades of fatty liver was done. Correlation of 2 D ultrasonography and elastography quantification fatty liver grading was done with lipid profile. A specially designed proforma was used to collect information on patients' demographics, pattern of presentation, previous history, medical comorbidity and grading and stiffness of fatty lever. The data collected were analyzed using statistical package for social sciences (SPSS) version 20. Data was presented in frequency and percentages. Continuous and categorical variables were analyzed by student T-test and chi-Square respectively. A p value <0.05 was considered statistically significant. Informed consent was taken from the patients or from care takers of all the study participants and ethical issues were considered

Method of ultrasonic elastography

Informed consent was obtained from each patient. All patient who underwent routine ultrasound scan were evaluated accordingly to the evaluation standards for ultrasonic elastography. Patients with fatty liver were divided into fatty grade I, grade II, grade III. Patients were placed in supine position and the 8th or 9th intercostal space will be selected as the scanning site. Appropriate depth of 10 cm will be selected, enhancement was adjusted. Yellow box was in central zone (not on extreme left or extreme right) and leaving 2cm from top and measure till 6-7cm depth (avoid left lobe as heart beatings can give wrong reading) with vascular branches avoided. Patient was asked to hold the breath, as soon as liver image was stable, took the reading by pressing SET, will take 8-10 readings if reading is stable. In profile window all readings are distributed in 25 to 75 percentiles. To know the exact stiffness (median value) of liver should be less than 30%. We removed all values less than 0.6 (as reliability measurement index value should be between 0.6 to 1.0, any value less than 0.6 should be removed in profile window) also removed all the values which are outside the percentile range. We need minimum 4 correct readings to know the right stiffness median value for the liver. Then with correct selected values in profile window when median goes below 30% the median value displayed was the stiffness value (in KPa) of the liver.

RESULTS

In present study the mean age of study subjects was 48.47±15.21 years (range 15-86 years). Maximum 23.74% were b/w 61-70 years of age group, followed by 23.23% from 31-40 years, 21.21% from 41-50 years, and 3.54% were from >70 years. Sex wise distribution of study subjects shows that 52.02% were female. The mean age of females was 52.56±13.94 years and for male it was 44.70±14.60 years. The (Figure 1) showed the fatty liver grading using 2D ultrasound technique, 75.25% were in

grade-1 and 24.24% were in grade-II and 0.51% was in grade-III.

Table 1: Age and Sex distribution of study subjects.

Parameters	N	%
Age (years)		
20-30	24	12.12
31-40	46	23.23
41-50	42	21.21
51-60	32	16.16
61-70	47	23.74
>70	7	3.54
Sex		
Female	95	47.98
Male	103	52.02

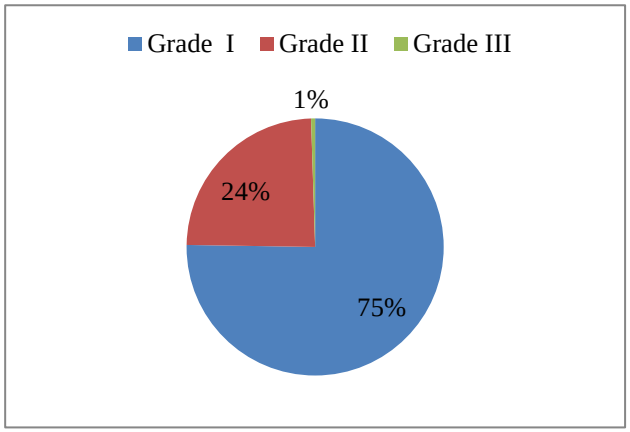

Figure 1: Fatty liver garding using 2D ultrasound technique (n=198).

The (Table 2) showed liver stiffness using elastography technique; the mean fat (Kpa) of total cases was 7.30. Maximum (57.58%) had dysfunction (F1) liver stiffness with mean fat (Kpa) of 6.5 followed by (28.28%) had Fibrosis present (F2 or F3) liver stiffness with mean fat (Kpa) of 9.71 and 1 (0.51%) had liver cirrhosis with mean fat (Kpa) of 22.9. (Table 3) showed the association between Liver stiffness on elastography and 2D ultrasound fatty liver grading. By using 2D ultrasound technique out of 198 study subjects 149 (75.25%) were in grade-1 and 48 (24.24%) were in grade-II and 1 was in grade-III. Of 149grade-I fatty liver cases diagnosed by 2D ultrasound 90 (60.4%) has dysfunction (F1) liver stiffness and 38 (25.5%) had fibrosis (F2 or F3) by using elastography technique. Whereas of 48 grade-II fatty liver cases diagnosed by 2D ultrasound 24 (50%) has dysfunction (F1) liver stiffness and 18 (37.5%) had fibrosis (F2 or F3) and 1 (2.1%) had liver cirrhosis (F4) by using elastography technique. Association b/w these two variables was statistically not significant (p=0.054). (Table 4) showed the distribution of patients showing normal and abnormal serum lipid profile and fatty liver grades. Serum cholesterol, triglycerides, HDL, VLDL and LDL levels were raised in 13.6%, 19.7%, 3.1%, 35.4 and 65.7% of patients respectively. (Table 5) showed the comparison between liver stiffness on elastography and Serum Lipid Profile. It was observed that increasing liver stiffness stages were not significantly associated with increasing levels of serum total cholesterol p=0.196), serum triglyceride (p=0.236), HDL (p=0.864) and LDL (p=0.216), whereas increasing liver stiffness stages was significantly associated with increasing levels of serum VLDL (p=0.04). (Table 6) showed the correlations between liver fat values and Serum lipid profile in study subjects as determined by Spearman correlation test. None of the components of serum lipid profile were significantly correlated with fatty liver value diagnosed by using elastography technique.

DISCUSSION

The present study with purpose to prospectively evaluate the application of ultrasonic elastography in quantitative assessment of fatty liver grading and correlating it with lipid profile of patient. In present study 198 study subjects were enrolled of them the mean age of study subjects was 48.47±15.21 years (range 15-86 years). Maximum 23.74% were b/w 61-70 years of age group, followed by 23.23% from 31-40 years. Sex wise distribution shows that 52.02% were female. The mean age of females was 52.56±13.94 years and for male it was 44.70±14.60 years. Similar study done by Gupta N et al 2019 on relationship between grey scale sonographic grades of fatty liver and shear wave elastographic values. They reported that among study subjects the mean age was 42.97±10.66), majority of them were females (56.25%).[14] In present study liver fat was estimated with 2D ultrasound technique also, about three-fourth were in grade-1 and one-fourth were in grade-II and 1 case was in grade-III. A similar study done by Mahaling D U et al 2013 reported that grade I NAFLD cases were 47.15%, grade II were 42.85% and grade III were 10%. The mean age of the patients was 49.14 years. Male to female ratio was 3:4.[15] Li et al also reported that using traditional sonography 30% were in grade-0, 30.67% were in fatty liver grade-I, 26% were in fatty liver grade-II and 13.33% were in fatty liver grade-III.[16] In present study liver stiffness was measured using elastography technique, the mean fat percent was 7.30. Maximum (57.58%) had dysfunction (F1) liver stiffness with mean fat (Kpa) of 6.5 followed by (28.28%) had Fibrosis present (F2 or F3) with mean fat (Kpa) of 9.71 and 1 (0.51%) had liver cirrhosis with mean fat (Kpa) of 22.9. Whereas 27 were normal with mean fat (Kpa) of 4.92. Gupta et al 2019 did an observational study on relationship between grey scale sonographic grades of fatty liver and shear wave elastographic values. They reported that the mean fat stiffness in (Kpa) was 5.07, in grade-I 6.84, in grade-II 9.43and in grade-III it was 11.96. They reported that with increasing mean liver stiffness with increasing grades of fatty liver.[14] Ghate et al did a similar study and reported that on objective assessment of liver parenchyma using shear wave elastography, the mean liver stiffness (shear modulus) in grade 1, grade 2 and grade 3 fatty liver was found out to be 6.84kPa, 9.43kPa and 11.96kPa respectively.[17]

Table 2: Liver stiffness on elastography technique.

Liver stiffness	Normal (<5.7 Kpa)	Dysfunction (F1) early fibrosis (<8 Kpa)	Fibrosis present (F2 or F3) (>8 Kpa)	Cirrhosis (F4) (>17 Kpa)	Total
N	27	114	56	1	198
%	13.64	57.58	28.28	0.51	100
Mean fat (Kpa)	4.92	6.5	9.71	22.9	7.3
Fat range (Kpa)	(3.3-5.6)	(5.7-7.9)	(8.1-14.1)	(22.9)	(3.3-22.9)

Table 3: Association between liver stiffness in elastography and 2D ultrasound fatty liver grading.

Liver stiffness on elastography	2D ultrasound fatty liver grading, N (%)			Total	P value
	Grade I	Grade II	Grade III		
Normal (F0)	21	5	1	27	0.054
	14.1	10.4	100.0	13.6	
Dysfunction (F1)	90	24	0	114	
	60.4	50.0	0.0	57.6	
Fibrosis present (F2 or F3)	38	18	0	56	
	25.5	37.5	0.0	28.3	
Cirrhosis (F4)	0	1	0	1	
	0.0	2.1	0.0	.5	
Total	149	48	1	198	
	100.0	100.0	100.0	100.0	

Table 4: Distribution of patients showing abnormal serum lipid profile and fatty liver grades.

Liver stiffness on elastography	Normal (F0)		Early Fibrosis (F1)		Fibrosis present (F2 or F3)		Cirrhosis F4		Total		Total (%)	
Sr. lipid profile	N	A	N	A	N	A	N	A	N	A	N	A
Sr. cholesterol	22	5	103	11	45	11	1	0	171	27	86.3	13.6
Sr. Triglyceride	20	7	98	16	41	15	0	1	159	39	80.3	19.7
Sr. HDL	27	0	108	6	56	0	1	0	192	6	96.9	3.1
Sr. VLDL	11	16	82	32	35	21	0	1	128	70	64.6	35.4
Sr. LDL	19	8	3	111	45	11	1	0	68	130	34.3	65.7

Table 5: Comparison between liver stiffness on elastography and serum lipid profile.

Liver stiffness on elastography	Normal (F0)		Dysfunction (F1) Early Fibrosis		Fibrosis present (F2 or F3)		Cirrhosis F4		P value
Sr. lipid profile	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
Sr. cholesterol	187.67	50.81	166.6	49.41	175.23	54.58	215	0	0.196
Sr. Triglyceride	176.81	98.4	149.67	102.02	143.89	77.61	286	0	0.236
Sr. HDL	39.93	6.57	41.86	14.28	40.59	10.42	42	0	0.864
Sr. VLDL	39.78	21.12	30.2	20.12	28.84	15.54	57	0	0.04
Sr. LDL	106.81	47.98	94.14	35.18	105.82	45.1	116	0	0.216

Table 6: Correlations between liver fat values and Serum lipid profile in study subjects as determined by Spearman correlation test.

Variables	Correlation Coefficient	P value	Interpretation
Sr. cholesterol	0.058	0.417	A weak (negative) linear relationship, statistically not significant
Sr. triglyceride	-0.002	0.978	A weak (negative) linear relationship, statistically not significant
Sr. HDL	-0.003	0.968	A weak (negative) linear relationship, statistically not significant
Sr. VLDL	-0.051	0.475	A very weak (negative) linear relationship, statistically not significant
Sr. LDL	0.108	0.130	A very weak uphill (positive) linear relationship, statistically not significant

Kamali et al (2019) also in a similar study of 77 individuals reported that (37.7%) were in grade-0, (9.1%) in grade-I, (20.8%) in grade-II, and (32.5%) in grade-III for fatty liver assessment using fibroscan.[18]

In present study shows that distribution of patients showing normal and abnormal serum lipid profile and fatty liver grades. Serum cholesterol, triglycerides, HDL, VLDL and LDL levels were raised in 13.6%, 19.7%, 3.1%, 35.4 and 65.7% of patients respectively. It was observed that increasing liver stiffness stages were not significantly associated with increasing levels of serum total cholesterol (p=0.196), serum triglyceride (p=0.236), HDL (p=0.864) and LDL (p=0.216), whereas increasing liver stiffness stages was significantly associated with increasing levels of serum VLDL (p=0.04). In present study Spearman correlation analysis shows that Sr cholesterol and Sr LDL were positively correlated whereas Sr Triglyceride, HDL and VLDL were negatively correlated. None of the components of serum lipid profile were significantly correlated with fatty liver value diagnosed by using elastography technique. Mahaling D U et al 2013) reported that Serum triglycerides, total cholesterol, LDL and VLDL levels were raised in 67.14%, 45.71% 34.28%, 25.71% of cases respectively. Low serum HDL levels in 62.85% of patients. They found that increasing grades of NAFLD were significantly associated with increasing values of total cholesterol (p=0.001), LDL (p=0.000) and VLDL p=0.003) and decreasing HDL (p=0.000).15 Macabuag-Oliva et al 2014 did a similar study and reported that an elevated LDL level (greater than 100 mg/dl) makes the likelihood of fatty liver and fibrosis greater.[19] Qazi Najeeb et al 2015 also observed that increasing grades of NAFLD were significantly associated with increasing levels of serumtotal cholesterol, triglycerides, LDL-C and decreasing HDL-Clevels, also serum ALT and AST were significantly increased.[20]

Limitations

The present study is a hospital-based study and this was limited to one tertiary care teaching hospital of the state. The more similar studies are needed in different settings and in different demographic profiles considering AST, ALT, Serum Platelet count, Serum albumin, blood glucose parameters.

CONCLUSION

Ultrasound used in conjunction with elastography has recently shown utility in diagnosing and follow up of fatty liver patients. In present study it was observed that increasing grades of fatty liver were not significantly associated with increasing levels of serum total cholesterol, serum triglycerides, low density lipoprotein, very low-density lipoprotein and decreasing high density lipoprotein. Correlations between liver fat stiffness scoring and serum lipid profile shows that serum VLDL was significantly correlated with fatty liver scoring diagnosed by point shear wave ultrasound elastography technique. Further studies on different locations with larger sample size are needed to establish the correlation b/w serum lipid profile and liver stiffness.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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