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ORIGINAL RESEARCH

Liver stiffness quantification in patients with fatty liver using shear wave (2d) elastography

[1]Dr. Kashish Mahajan, [2]Dr. Anchal Gupta, [3]Dr. Ishween Kour, [4]Dr. Roopali Mangotra, [5]Dr. Kulbhushan Gupta

[1,3,4]Junior Resident, [2]Assistant Professor, [5]Professor and Head, Department of Radiodiagnosis, GMC, Jammu, Jammu & Kashmir, India

Corresponding author
Dr. Roopali Mangotra
Junior Resident, Department of Radiodiagnosis, GMC, Jammu, Jammu & Kashmir, India

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Abstract

Introduction: Inflammation & stiffness of the hepatic tissue, which leads to cirrhosis, portal hypertension, & ultimately hepatocellular cancer, is the main effect of fatty liver disease. Elastography & the fibrosis score have been investigated as non-invasive objective replacements for biopsy & other methods to reduce reliance on them. The aim of current study was to quantify liver fibrosis by using shear wave elastography in patients with fatty liver & also to determine the degree of stiffness & therefore the stage of liver fibrosis.

Material & methods: This hospital based prospective study was conducted Department of Radiodiagnosis, Govt. Superspeciality hospital, GMC Jammu during a period of 6 months. Total 50 participants underwent underwent 2D shear wave elastography & the values were compared with metavir scores. Statistical analysis was performed using Statistical Package for the Social Sciences (SPSS) statistics version 23.0.

Results: The mean age was 46.8±10.9 years including 26% females and 74 % males. The maximum (60%) subjects had fatty liver grade 1 and 4% had cirrhosis. The 44% subjects had metavir score of F0. The average SWE score of subjects was 7.14 ± 5.04 kPa.

Conclusion: Shear wave elastography in two dimensions performed well in terms of diagnosing liver stiffness.

Keywords: Elastography, Fatty Liver, Metavir, Shearwave, Stiffness

Introduction

Microvesicular or macrovesicular lipids (usually triglycerides) deposit & accumulate in hepatocytes, leading to hepatic steatosis, or fatty liver disease, which affects more than 5% of the liver's weight. Obesity, type 2 diabetes mellitus, hyperlipidemia, & other comorbidities that harm hepatocytes, such hepatitis C, are the main risk factors for the condition. Other risk factors include the use of pharmaceuticals & alcohol consumption. [1]

Chronic fatty liver disease patients experience lobular inflammation, & the condition can progress to hepatocyte ballooning & fibrosis. Hepatocellular carcinoma develops as the fibrosis worsens, followed by cirrhosis [2]. For figuring out the disease's stage & prognosis as well as for organising the treatment, a precise diagnosis of fibrosis & hepatic inflammatory activity is crucial. [3]

Transient elastography (TE), acoustic radiation force impulse imaging (ARFI), & magnetic resonance elastography are three recently discovered noninvasive techniques for assessing

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liver stiffness (LS). Real-time shear wave elastography (SWE), a more contemporary technique for LS measurement, has been created. [5]

SWE is a brand-new noninvasive technique that uses focused ultrasonic scanning (US) to apply local mechanical compression on soft tissue while collecting strain images that display tissue reactions.[6,7] Several studies indicate successful predictions of the severity of hepatic fibrosis. [8,9] SWE, in contrast to TE, simultaneously analyses tissue elasticity during a B-mode ultrasound examination, & elasticity values can be calculated using anatomical data. Moreover, SWE offers colour elastography, quantitative maps based on stiffness, allowing an evaluation of homogeneity. [4] It is possible to visualise the regional variability of liver stiffness & to choose or modify the size of the measuring area.

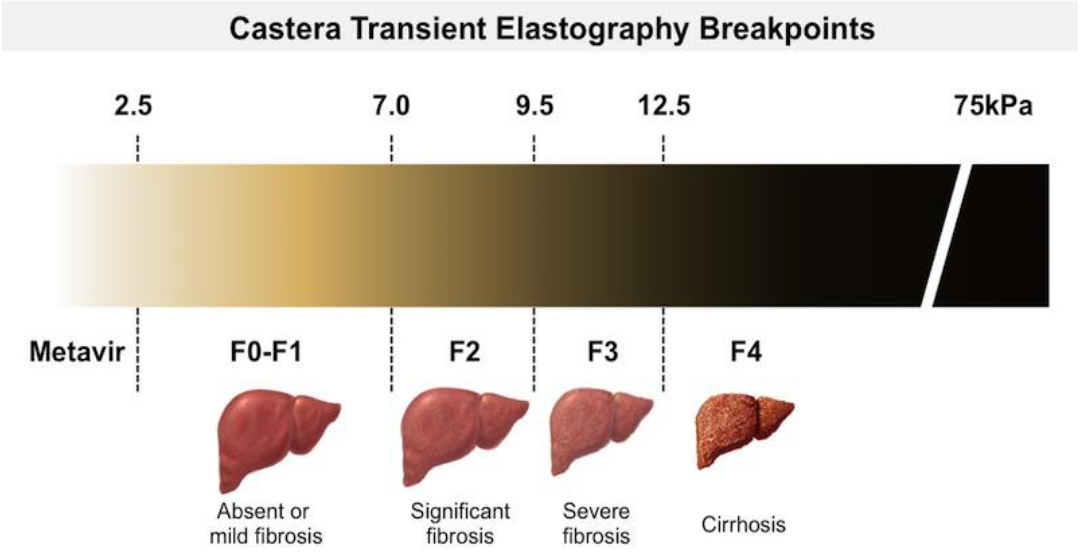
Hence the current research is done to quantify liver fibrosis by using shear wave elastography in patients with fatty liver & also to determine the degree of stiffness & therefore the stage of liver fibrosis.

Material & methods

This prospective study was conducted in Department of Radiodiagnosis, Govt. Superspeciality hospital, GMC Jammu during a period of 6 months. The plan was approved by the Institutional ethical Committee. The study included 50 fatty liver patients. Exclusion criteria included presence of hepatic encephalopathy grade 3 or grade 4, left-sided portal hypertension (this entity is due to pancreatic disease with normal liver). Patients with advanced cardiac, renal, or pulmonary disease were also excluded. All those subjected to fatty & had given written informed consent were included.

All patients were subjected to abdominal ultrasound examination, Doppler examination, & real-time Shear wave elastography using (esaote My Lab X9) at our Radiology Department. **The patients were classified according to metavir scoring system for liver fibrosis and classification of severity shown below:**

Severity	Fibrosis score	Description
Mild	F0	No fibrosis
	F1	Portal fibrosis without septa
Moderate	F2	Portal fibrosis with few septa
	F3	Numerous septa without cirrhosis
Severe	F4	Cirrhosis



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The Statistical Package for the Social Sciences (SPSS) statistics version 23.0 (IBM, Armonk, NY, USA) was used to conduct the statistical study. The mean & standard deviation were used to summarise continuous variables. Depending on the situation, the Student's t-test, Chi-square test, &ANOVA were applied. Patients exhibiting sonographic evidence of hepatic stiffness had their average values computed.

Results

The study involved 50 fatty liver patients. The age of this study group ranged from 29-74 years, mean age was 46.8±10.9 years. This study population consisted of 13 females (26%) & 37 males (74%) [Table 1]

Table 1: Shows the distribution of subjects according to age & gender

Variable		Mean±SD/ Frequency (%)
Age (in years)		46.8±10.9
Gender	Female	13 (26)
	Male	37 (74)

The division of patients according to fatty liver findings was done & it was found that that number of patients in grade 1 were 60 percent, in grade 2 were 26 percent, in grade 3 were 10 percent & the patients having cirrhosis were 4 percent only. (Table 2)

Table 2: Shows division of subjects according to grades of fatty liver

Fatty liver	Frequency	Percentage
Grade 1	30	60
Grade 2	13	26
Grade 3	5	10
Cirrhosis	2	4
Total	50	100

Real-times hear wave elastography findings revealed that majority of patients were in F0 i.e. 26 (52%) , 12 (24%) patients in F1 , 8 (16%) patients in F2 , 2 (4%) patients in F3 & 2 (4%) patients in F4 Metavir Score. (Table 3)

Table 3: Shows division of subjects according to elastography findings

Metavir Score	Frequency	Percentage
F0	22	44
F1	9	18
F2	11	22
F3	5	10
F4	3	6
Total	50	100

The mean SWE of different metavir score was calculated & the mean ± SD value of F0 was 4.44 ± 0.45, F1 was 6.01 ± 0.36, F2 was 8.21 ± 0.55, F3 was 9.52 ± 0.33, F4 was 22.5 ± 12.5 the total average value was 7.14 ± 5.04. (Table 4)

Table 4: Shows mean SWE findings in relation to metavir score

Metavir Score	SWE score (kPa) Mean ± SD
F0	4.44 ± 0.45
F1	6.01 ± 0.36
F2	8.21 ± 0.55
F3	9.52 ± 0.33

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F4	22.5 ± 12.5
Total	7.14 ± 5.04

With increase in fatty liver grading, the liver stiffness surge correspondingly (Table 5).

Table 5: Shows distribution of fatty liver grading with SWE liver stiffness (kPa)

Fatty Liver Grade	N	Mean	SD
Grade 1	30	4.88	.84
Grade 2	13	8.59	2.38
Grade 3	5	9.52	.34
Cirrhosis	2	25.80	15.84
Total	50	7.15	5.04

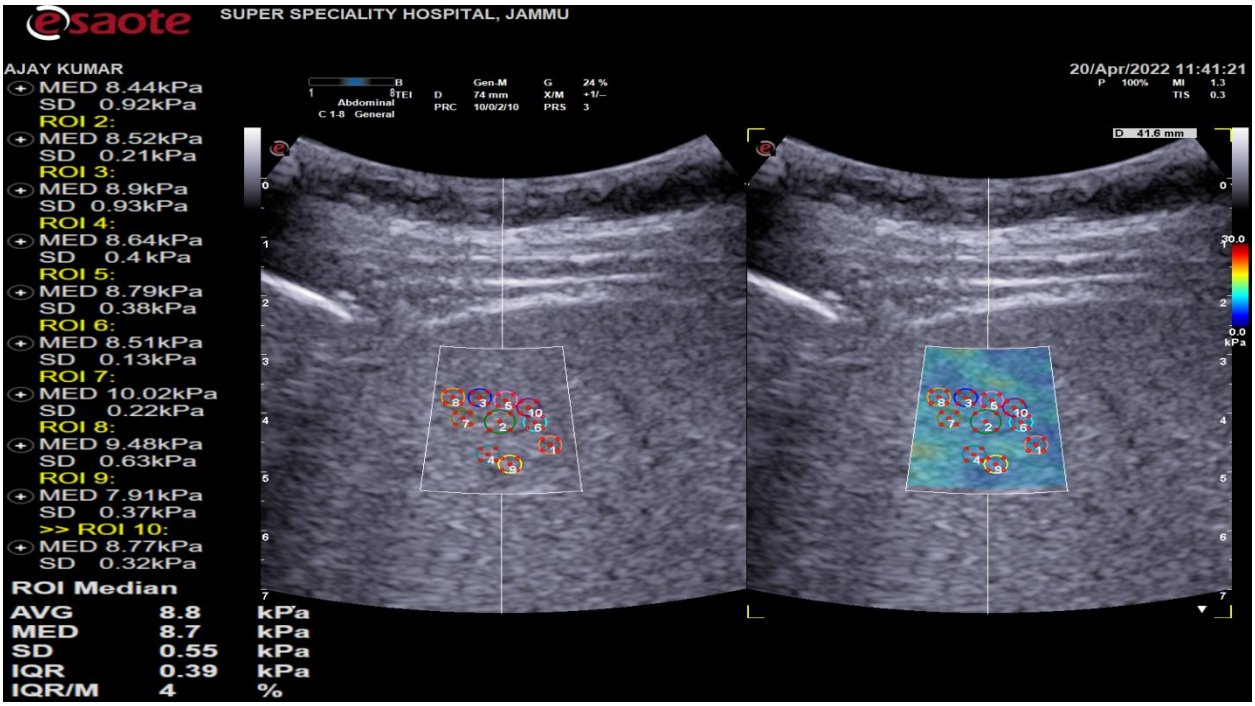

Figure 1: ultrasound examination of a liver with moderate steatosis, as characterized by increased echogenicity of the liver parenchyma and posterior attenuation of the ultrasound beam. The attenuation of the ultrasound beam decreases the definition of the hepatic vessels increased echogenicity of the liver parenchyma. 2D-SWE study showing stiffness of 8.8kPa, consistent with a METAVIR stage of F2. The elastography map is homogeneous and predominantly blue, indicating less stiffness.

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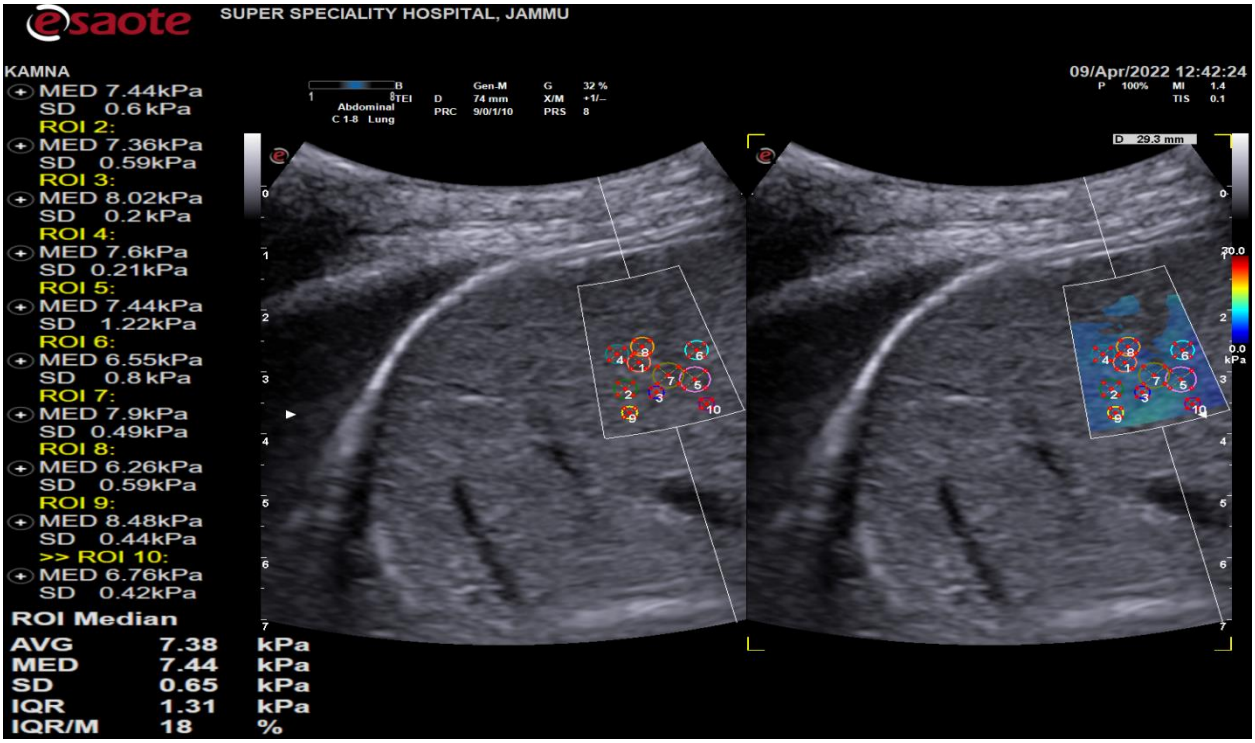

Figure 2: Ultrasound examination of a liver with mild steatosis, as characterized by the slightly increased echogenicity of the liver parenchyma. 2D-SWE study showing stiffness of 7.3kPa, consistent with a METAVIR stage of F2. The elastography map is homogeneous and predominantly blue, indicating less stiffness

Discussion

The present study was done among 50 patients of fatty liver to find out liver stiffness in fatty liver patients with the use of shear wave elastography. By measuring the speed at which ultrasound waves travel through the liver, a technique called elastography can quantify hepatic fibrosis. When the condition worsens, the liver tissue becomes stiffer & the ultrasound waves travel more quickly. The degree of stiffness & thus the stage of liver fibrosis can be calculated using the wave propagation velocity. There are various kinds of ultrasonic elastography, with TE, 2D-SWE, & pSWE being the most often employed varieties for studying the liver.[10]

The mean age of subjects found in this study was 46.8±10.9 years representing this as a disease of middle age, the number of male (74%) subjects were higher as compared to female (26%) showing the predominance of male. The results were similar to a research done by Vinyasa BN et al in 2022 where the male s were 66.9% of the total subjects involved in the study.[11]

The grading of fatty liver shows the maximum 60 percent of subject sin grade I infiltration & least 4 percent liver cirrhosis. In a study conducted by Vinyasa BN et al, 50 (32.5%) had no fatty infiltration of the liver, 51 (33.1%) had grade 1 fatty infiltration, 23 (14.9%) had grade II fatty infiltration, & 30 (19.5%) had grade III fatty infiltration, according to 2D USG grading of fatty infiltration of the liver.[11]

The average SWE reading was 7.14±5.04 in the current research work. In a study by Huang Z et al., similar comparable normal liver stiffness values were published [12]. In their investigation, the average SWE reading for 502 subjects without fatty liver infiltration was 5.10±1.02 kPa. According to Suh CH et al., typical elastography values vary from 2.6 to 6.2 kPa, while according to a study by Arda K et al., the right lobe of the liver's mean elasticity value is 4±2.2 kPa. [13,14]

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The severity of the fatty infiltration increased along with the liver stiffness in the current study. This result was in line with a study by Li YY et al., which demonstrated a correlation coefficient of 0.822 between an increase in liver stiffness & a progression of fatty liver.[15] This result, however, conflicts with a research by Yoneda M et al., which found that mild steatosis had less stiffness than a normal liver [16]. Many studies have studied the impact of steatosis & inflammation on the assessment of liver stiffness to evaluate fibrosis, with varying degrees of success. According to the majority of research, shear wave elastography & transient elastography [17-19] are not affected by steatosis or inflammation when assessing stifness.

In contrast to other forms of liver disease, the clinical value of hepatic stiffness in patients with fatty liver is less well understood. There is mounting evidence that stiffness, as opposed to simple steatosis or even NASH without fibrosis, has a significant impact on hepatic & extrahepatic mortality [20]. Therefore, it is crucial that individuals with fatty livers receive a swift diagnosis of stiffness. Also, it recognises individuals who should be under observation, such as endoscopic screening for gastric varices & hepatocellular carcinoma surveillance. [21]. Further research evaluating the efficacy of imaging modalities such as MR elastography & serum biomarkers such as the Enhanced Liver Fibrosis (ELF) panel, Fibrometer, FibroTest, & Hepascore in staging liver stiffness among patients with fatty liver is advised. The 2D SWE values were not matched to the stage of histologic liver fibrosis, which was a drawback of this investigation.

Conclusion

Two-dimensional shear wave elastography demonstrated strong diagnostic performance for identifying liver stiffness and had good agreement with the fatty liver grading in detecting the degree of stiffness; as a result, it may be utilised with confidence for non-invasive patient stiffness evaluation.

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