



Radiology

LIVER STIFFNESS QUANTIFICATION IN FATTY LIVER PATIENTS USING SHEAR WAVE (2D) ELASTOGRAPHY

Dr Achleshwar Sharma

PG Resident, Dept. of Radiodiagnosis, MMMCH, Solan, Himachal Pradesh.

Dr Sahil Chawla

Senior Resident, Dept. of Radiodiagnosis, MMMCH, Solan, Himachal Pradesh.

Dr (Col.) DS Grewal

Professor, Dept. of Radiodiagnosis, MMMCH, Solan, Himachal Pradesh.

ABSTRACT **Introduction:** Elastography is a non-invasive imaging technique used to depict tissue stiffness/displacement in response to applied force. Tissue stiffness is a biomarker of tissue pathology and changes in tissue mechanics indicate fibrosis, inflammation and neovascularization. Fatty liver disease can lead to hepatic fibrosis which can ultimately lead to hepato-cellular carcinoma. In this study we aim at quantification of liver fibrosis by using USG shear wave elastography in patients with fatty liver to determine the degree of stiffness and therefore stage of liver fibrosis. **Methods:** 50 patients with fatty liver who were referred to our department for liver elastography underwent ultrasound Shear wave elastography, between March 2023 to August 2023. Using METAVIR scoring system for liver fibrosis and classification of severity, the patients were graded and results were obtained. **Results:** 52% patients were graded as F0, 24 % patients were graded as F1, 16% patients were graded as F2, 4% patients were graded as F3, 4% patients were graded as F4. **Conclusion:** The stage of fibrosis increased with grade of fatty liver.

KEYWORDS : SWE(Shear wave elastography), fatty liver, METAVIR(meta-analysis of histological data in viral hepatitis)

INTRODUCTION

Hepatic steatosis or fatty liver disease, occurs due to the accumulation of lipids in hepatocytes. When it becomes chronic, lobular inflammation develops and the disease can evolve to hepatic fibrosis, liver cirrhosis, or hepatocellular carcinoma. Early diagnosis is desirable because patients diagnosed in the early stage of the disease respond better to treatment. In the early stages of fatty liver disease, the physical examination is often unremarkable.

Ultrasound elastography studies the degree of deformation (stiffness) of an organ or lesion, so that when there is hardening, fibrosis, or cirrhosis of the liver, those alterations are well demonstrated. US-based elastography is non-invasive, can provide grey – scale images of the liver, has no radiation hazard and can quantitatively evaluate the severity of fibrosis, unlike conventional US, which often relies on subjective judgement and liver biopsy which is an invasive procedure.

MATERIAL AND METHODS

It was a prospective cross-sectional study conducted in the radiology department at a tertiary care hospital. Fatty liver patients referred to radiology department for liver elastography were included in this study. A total of 50 patients underwent the non-invasive procedure of ages ranging between 31 to 73 years.

Accurate, early diagnosis of liver disorders is desirable because it provides a better therapeutic response in patients in the early stage of fatty liver disease. To that end, there are a number of methods for analyzing the liver. The evaluation and diagnosis of steatosis and liver fibrosis can be performed by ancillary examinations: laboratory tests, imaging, and biopsy.

Clinical examination does not allow early diagnosis of liver abnormalities, because most patients in the early stage of fatty liver disease are asymptomatic, showing no alterations on physical examination.

Imaging examinations include conventional ultrasound, as well as ultrasound-based methods known as transient elastography (TE), point shear wave elastography (pSWE), and two-dimensional shear wave elastography (2DSWE).

Another such examination is strain elastography, a form of quasi-static ultrasound-based imaging. However, strain elastography is more effective in superficial tissues and is therefore not used for imaging of the liver.

Magnetic resonance elastography (MRE) can also be used for the analysis of liver fibrosis. In this context, liver biopsy is still considered

the gold standard for the diagnosis of fatty liver disease.

All those patients who exhibited 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 and patients with presence of focal liver lesion(s) were excluded from the study at beforehand.

Technique Used in Hepatic SWE (Shear Wave Elastography):-

- The patient was placed in a supine position with the right arm placed in maximum abduction to enlarge the space between the ribs.
- The convex probe was placed between the ribs, using the best acoustic window available for liver evaluation.
- The SWE box was placed in a uniform zone, away from the sub-capsular region to avoid reverberation artifacts which are often found beneath the capsule.
- Similarly, perivascular areas were avoided because they might alter liver stiffness estimate. The patient had to hold breath in the expiration phase to acquire a stable image.
- The color map is not dependable to assess liver stiffness because it is operator dependent and not quantitative. So, we depended on liver stiffness measurement in kPa.
- The elastography acquisition was repeated three to five times for each patient. For each acquisition, real-time SWE 2D color map of the stiffness (in kPa) was frozen after a stabilization of at least 3 s.
- The size of the SWE color box was about 3 × 4 cm. The measurements were performed in a 1.6- to 3cm-diameter region of interest (ROI), IQR/M should be less than 30%.
- For each patient, stiffness was defined as the median of several SWE successful measurements.

Liver Fibrosis Scoring:-

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 (bridging)
Severe	F4	Cirrhosis

Table 1: METAVIR Scoring System For Liver Fibrosis And Classification Of Severity.

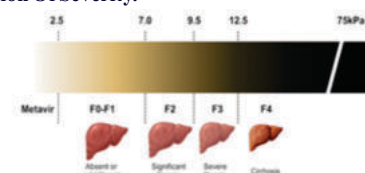


Figure 1: Castera Transient Elastography Breakpoints

Study	≥F2	≥F3	≥F4
Ziol et al	8.8	9.6	14.6
Kim et al	6.2	-	11
Nitta et al	7.1	9.6	11.6

Figure 2: Fibroscan Cut-off Values(kPa)

RESULTS

As the study involved 50 subjects, out of which 34 were males and 16 were females. Real time SWE findings revealed 26 patients in F0,12 patients in F1,8 patients in F2,2 patients in F3 and 2 patients in F4 Metavir score. The mean liver stiffness was found to be 5.9 kPa (kilo Pascals). Also, there was a trend increase in liver stiffness with increasing grade of fatty liver.

Table 2: METAVIR Score In Fatty Liver Patients

M E T A V I R	F0	F1	F2	F3	F4
NO. OF PATI ENT S (Fat ty liver)	26	12	8	2	2

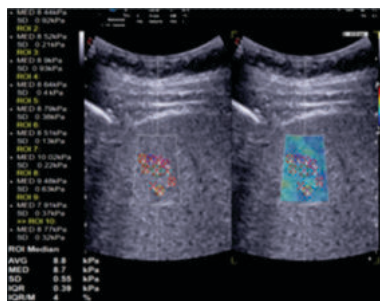


Figure 3: Ultrasound examination of a liver with moderate steatosis, as characterized by increased echogenicity of the liver parenchyma and attenuation of the ultrasound beam. The attenuation of the ultrasound beam decreases the definition of the hepatic vessels due to increased echogenicity of the liver parenchyma. 2DSWE study showing stiffness of 8.8kPa, consistent with a METAVIR stage of F2. The elastography map is homogeneous and predominantly blue, indicating less stiffness.

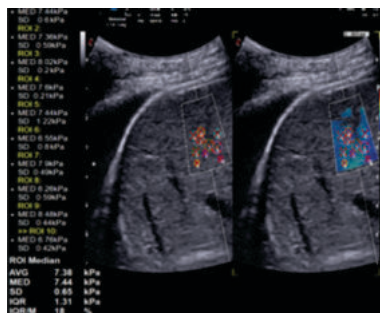


Figure 4: Ultrasound examination of a liver with mild steatosis, as

characterized by the slightly increased echogenicity of the liver parenchyma. 2D-SWE study showing stiffness of 7.8kPa, consistent with a METAVIR stage of F2. The elastography map is homogeneous and predominantly blue, indicating less stiffness.

CONCLUSIONS

We can say that real-time shear wave elastography is an important noninvasive method to assess liver fibrosis and to predict the stage of liver fibrosis.

In this study , it was concluded that the stage of fibrosis increased with increasing grade of fatty liver .

Ultrasound elastography can be used in order to distinguish between patients without fibrosis and those with mild fibrosis, as well as between those with mild fibrosis and those with severe fibrosis or cirrhosis, without the need for an invasive procedure unless there is a concomitant disease factor, such as a risk of acute hepatitis, that would not be definitively diagnosed with a noninvasive method.

The complexity of the diagnosis of liver fibrosis is viewed with enthusiasm by the research community, because it creates opportunities for lines of research in this area. As a result, ultrasound elastography is moving toward considerable improvements in the current techniques. Major improvements are expected in terms of image quality, ease of use, quantification, and range of measurable tissue characteristics. It may one day completely replace liver biopsy in the diagnosis of steatosis, saving many individuals from undergoing this invasive procedure.

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