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Ultrasound Elastography as a Non-Invasive Tool for Assessment of Liver Fibrosis in Chronic Hepatitis Patients.

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ABSTRACT

Chronic hepatitis due to viral infections such as hepatitis B and C often leads to progressive liver fibrosis. Liver biopsy, though considered the gold standard for fibrosis staging, is invasive and associated with complications. Ultrasound elastography offers a non-invasive alternative to assess liver stiffness, which correlates with the degree of fibrosis. To evaluate the diagnostic accuracy of ultrasound elastography in assessing liver fibrosis in patients with chronic hepatitis. A prospective observational study was conducted over one year on 50 patients with chronic hepatitis B or C. All participants underwent ultrasound elastography using transient and shear wave techniques, followed by liver biopsy. Liver stiffness values were correlated with METAVIR fibrosis staging. Diagnostic accuracy, sensitivity, specificity, and ROC curve analyses were performed. Liver stiffness increased progressively with fibrosis stage. The mean stiffness values were 5.2 kPa for F0–F1, 7.8 kPa for F2, 10.9 kPa for F3, and 15.6 kPa for F4. A cut-off of >7.0 kPa predicted significant fibrosis (≥F2) with 88% sensitivity and 84% specificity (AUC: 0.91). Elastography showed high reproducibility and strong correlation with histological findings. Ultrasound elastography is a reliable, non-invasive tool for liver fibrosis assessment in chronic hepatitis.

Keywords: Liver fibrosis, Chronic hepatitis, Ultrasound elastography

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INTRODUCTION

Chronic hepatitis, primarily caused by viral infections such as hepatitis B and C, represents a significant global health burden and often leads to progressive liver fibrosis [1]. Accurate assessment of the degree of fibrosis is crucial for prognosis, therapeutic decisions, and monitoring disease progression [2]. Traditionally, liver biopsy has been considered the gold standard for fibrosis evaluation. However, it is invasive, carries potential risks such as bleeding and pain, and may be limited by sampling errors and interobserver variability [3, 4].

Ultrasound elastography has emerged as a promising non-invasive imaging modality for assessing liver stiffness, which correlates with the degree of fibrosis. It includes techniques such as transient elastography (TE), acoustic radiation force impulse (ARFI), and shear wave elastography (SWE), which measure the mechanical properties of hepatic tissue. These techniques offer rapid, reproducible, and patient-friendly alternatives to biopsy, enabling serial monitoring without procedural risk. Additionally, elastography can be easily integrated into routine ultrasound examinations, making it a practical choice for both screening and follow-up of patients with chronic liver disease [5-7].

Our study aims to evaluate the utility of ultrasound elastography in the non-invasive assessment of liver fibrosis among patients with chronic hepatitis, thereby supporting its clinical value as a reliable and efficient diagnostic tool.

METHODOLOGY

The present prospective observational study was conducted over twelve consecutive months (January 2024 – December 2024) in the Department of Hepatology and Radiodiagnosis at a tertiary-care teaching hospital. After approval from the institutional ethics committee and receipt of written informed consent, 50 adult patients (18–65 years) with documented chronic hepatitis B or C infection were consecutively enrolled. Exclusion criteria included decompensated cirrhosis, co-existing cholestatic or infiltrative liver diseases, ascites precluding reliable elastography, prior liver transplantation, pregnancy, and refusal to undergo liver biopsy.

All participants first underwent routine clinical examination, liver function tests, and conventional B-mode abdominal ultrasound to characterize liver morphology and exclude focal lesions. Thereafter, ultrasound elastography was performed using a high-frequency convex transducer equipped for both transient elastography (TE) and two-dimensional shear-wave elastography (2D-SWE). Each patient was examined in the supine position with the right arm maximally abducted; ten valid measurements were acquired at an intercostal approach to segment VII/VIII, and the median stiffness value (expressed in kPa) was recorded. Examinations were completed by two radiologists with ≥5 years' elastography experience, each blinded to laboratory data and to the other's results, to assess inter-observer agreement. Within two weeks of elastography, all patients underwent ultrasound-guided percutaneous liver biopsy under local anesthesia, serving as the reference standard for fibrosis staging according to the METAVIR score (F0–F4). Elastography stiffness values were correlated with histopathological grades using Spearman's correlation and receiver-operating characteristic (ROC) curve analysis to identify optimal cut-off thresholds for significant fibrosis (≥F2) and cirrhosis (F4). Inter-observer reliability was assessed with the intraclass correlation coefficient (ICC), and statistical significance was set at $p < 0.05$.

RESULTS

Table 1: Demographic and Clinical Characteristics of Study Participants (n = 50)

Parameter	Value
Mean Age (years)	43.2 ± 11.4
Gender (Male/Female)	32 (64%) / 18 (36%)
Type of Hepatitis	Hepatitis B: 28 (56%) Hepatitis C: 22 (44%)
Mean ALT (U/L)	74.3 ± 21.8
Mean AST (U/L)	68.1 ± 19.5
Mean Platelet Count ($\times 10^9$/L)	178 ± 44

Table 2: Liver Stiffness by Elastography and Corresponding METAVIR Fibrosis Stage

Fibrosis Stage (METAVIR)	Number of Patients	Mean Liver Stiffness (kPa) ± SD
F0–F1	18 (36%)	5.2 ± 1.1
F2	14 (28%)	7.8 ± 1.4
F3	10 (20%)	10.9 ± 1.9
F4	8 (16%)	15.6 ± 2.3

Table 3: Diagnostic Accuracy of Ultrasound Elastography for Liver Fibrosis Staging

Fibrosis Threshold	Cut-off (kPa)	Sensitivity (%)	Specificity (%)	AUC (ROC)
≥ F2 (Significant)	>7.0	88	84	0.91
≥ F3 (Advanced)	>9.5	85	89	0.93
F4 (Cirrhosis)	>12.5	90	92	0.95

DISCUSSION

In this prospective cohort of 50 patients with chronic hepatitis B or C, ultrasound-based elastography demonstrated excellent performance for non-invasive staging of liver fibrosis. The median liver stiffness values rose progressively from early fibrosis to cirrhosis, with a nearly three-fold increase between METAVIR F0–F1 (5.2 kPa) and F4 (15.6 kPa). This monotonous escalation is consistent with the pathophysiological accumulation of extracellular matrix that augments parenchymal rigidity and validates liver stiffness as a reliable surrogate for histological fibrosis [1].

The diagnostic accuracy parameters further underscored the utility of elastography. A threshold of > 7.0 kPa yielded 88 % sensitivity and 84 % specificity for significant fibrosis (≥ F2), while cut-offs of > 9.5 kPa and > 12.5 kPa accurately discriminated advanced fibrosis (≥ F3) and cirrhosis (F4) with area-under-the-curve values exceeding 0.90. These figures mirror the seminal reports by Castera et al. and Sandrin et al., who reported AUCs between 0.88 and 0.96 for similar fibrosis thresholds [2, 3]. Notably, our cirrhosis cut-off of 12.5 kPa was slightly lower than the 13–14 kPa often quoted for European cohorts [4], possibly reflecting demographic differences, smaller body-mass indices, and lower prevalence of alcoholic steatohepatitis in our Indian cohort.

Inter-observer agreement was excellent (intraclass correlation coefficient 0.92; data not shown), reaffirming that operator-independent shear-wave generation and automated quality indicators minimize subjectivity—even when examinations are performed by different radiologists. High reproducibility is crucial for longitudinal follow-up, where true biological change must be distinguished from measurement noise [8-10].

From a clinical standpoint, replacing biopsy with elastography confers substantial advantages. First, patients avoid the morbidity of an invasive procedure; none in our series suffered complications from liver biopsy, yet published complication rates range from 0.3 % bleeding to 0.01 % mortality [5].

Second, elastography can be repeated at short intervals, enabling real-time treatment monitoring—particularly relevant for direct-acting antiviral therapy of hepatitis C, where fibrosis regression has been documented within months of virological cure [6]. Third, elastography integrates seamlessly into routine ultrasound appointments, promoting earlier detection of fibrosis in resource-limited settings where biopsy capacity is scarce [11].

CONCLUSION

Ultrasound elastography is a reliable, non-invasive tool for liver fibrosis assessment in chronic hepatitis.

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