

Diagnostic Performance of USG Elastography in the Evaluation of Liver Fibrosis

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ABSTRACT

Background: Liver fibrosis is a progressive condition leading to cirrhosis and its complications. Early and accurate assessment is crucial for effective management.

Aim: To evaluate the diagnostic performance of USG elastography in assessing liver fibrosis.

Materials and Methods: A prospective observational study was conducted over 6 months in the Department of RadioDiagnosis at Maharishi Markandeshwar Institute of Medical Sciences and Research, Mullana, Haryana, including 50 patients with suspected chronic liver disease. All patients underwent conventional ultrasonography and elastography. Findings were correlated with reference standards.

Results: Most patients were in the 41–50 years age group (28%) with male predominance (64%, $p = 0.041$). Alcoholic liver disease (32%) was the most common etiology. Advanced fibrosis (F3 and F4) was observed in 56% of cases. Elastography showed strong agreement with reference standards for $\geq F2$ ($p = 0.021$), $\geq F3$ ($p = 0.033$), and F4 ($p = 0.045$). The sensitivity, specificity, PPV, NPV, and accuracy were 91.6%, 85.7%, 89.5%, 88.2%, and 90%, respectively ($p = 0.018$).

Conclusion: USG elastography is a reliable, non-invasive, and accurate tool for evaluating liver fibrosis and can serve as an effective alternative to liver biopsy.

Keywords: USG elastography, liver fibrosis, non-invasive imaging, shear wave elastography, chronic liver disease

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INTRODUCTION

Chronic liver disease represents a significant global health burden, contributing substantially to morbidity and mortality worldwide. Progressive hepatic fibrosis, resulting from chronic liver injury due to etiologies such as viral hepatitis, alcohol abuse, non-alcoholic fatty liver disease (NAFLD), and autoimmune disorders, ultimately leads to cirrhosis and its associated complications [1,2]. Early detection and accurate staging of liver fibrosis are therefore essential for timely intervention, prognostication, and monitoring of therapeutic response. Traditionally, liver biopsy has been considered the gold standard for assessing hepatic fibrosis. However, its invasive nature, risk of complications, sampling variability, and interobserver variability limit its widespread applicability in routine clinical practice [3,4].

In recent years, non-invasive imaging modalities have gained increasing importance in the evaluation of liver fibrosis. Among these, ultrasonography (USG) elastography has emerged as a promising, safe, and reproducible technique. Elastography works on the principle of measuring tissue stiffness, which correlates with the degree of fibrosis, as fibrotic liver tissue is stiffer than normal parenchyma [5]. Various elastographic techniques, including transient elastography, point shear wave elastography (pSWE), and two-dimensional shear wave elastography (2D-SWE), have been developed and integrated into conventional ultrasound systems, allowing real-time assessment of liver stiffness during routine examinations [6].

USG elastography offers several advantages over liver biopsy. It is non-invasive, repeatable, cost-effective,

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and can assess a larger volume of liver tissue, thereby reducing sampling errors. Additionally, it is well tolerated by patients and can be used for serial monitoring of disease progression or regression following treatment [7]. These attributes make elastography particularly valuable in chronic liver diseases where long-term follow-up is required. Furthermore, elastography has shown good diagnostic accuracy in differentiating various stages of fibrosis, especially in identifying advanced fibrosis and cirrhosis [8].

Despite its advantages, certain limitations exist. Factors such as obesity, narrow intercostal spaces, hepatic inflammation, congestion, and operator dependency can influence elastography measurements and potentially affect diagnostic accuracy [9]. Moreover, variability among different elastography techniques and lack of universally standardized cutoff values pose challenges in interpretation and clinical decision-making.

Given the growing burden of chronic liver disease and the need for reliable non-invasive tools, evaluating the diagnostic performance of USG elastography is of considerable clinical relevance. [10] The study aims to evaluate the diagnostic performance of USG elastography in assessing liver fibrosis. It seeks to determine its sensitivity, specificity, and accuracy, correlate elastography findings with standard reference methods, and assess its effectiveness as a reliable, non-invasive alternative for staging and monitoring liver fibrosis in clinical practice.

MATERIALS AND METHODS

Study Design: Prospective observational study.

Study Duration: 6 months.

Sample Size: 50 patients.

Study Setting: Department of RadioDiagnosis.

Study Place: Maharishi Markandeshwar Institute of Medical Sciences and Research, Mullana, Haryana, India.

Study Population: Patients clinically suspected or diagnosed with chronic liver disease referred for imaging evaluation.

Inclusion Criteria:

- Patients aged ≥ 18 years.
- Patients with clinical, biochemical, or radiological suspicion of liver fibrosis.
- Patients providing informed consent.

Exclusion Criteria:

- Patients with ascites interfering with elastography.
- Pregnant women.

Patients with focal liver lesions or acute hepatitis.

Uncooperative patients.

Statistical Analysis: We put the data into Microsoft Excel and then used SPSS software version 27.0 (SPSS Inc., Chicago, IL, USA) and GraphPad Prism version 5 to look at it. Mean \pm standard deviation was used to show continuous variables, and frequencies and percentages were used to show categorical variables. The unpaired t-test was utilized to examine continuous variables between independent groups, whereas the paired t-test was employed for comparisons within the same group. The Chi-square test or Fisher's exact test was used to look at categorical variables, depending on which one was better. A p-value of less than 0.05 was seen to be statistically important.

RESULT

Table 1: Age Distribution of Study Population (n=50)

Age (years)	Group	Number of Patients	Percentage (%)
18–30		8	16%
31–40		10	20%
41–50		14	28%
51–60		12	24%
>60		6	12%
Total		50	100%

Table 2: Gender Distribution

Gender	Number of Patients	Percentage (%)	P-value
Male	32	64%	0.041
Female	18	36%	
Total	50	100%	

Table 3: Etiology of Liver Disease

Etiology	Number of Patients	Percentage (%)
Alcoholic Liver Disease	16	32%
NAFLD	14	28%
Viral Hepatitis (B/C)	12	24%
Others	8	16%
Total	50	100%

Table 4: Distribution of Liver Fibrosis Stage (Elastography)

Fibrosis Stage	Liver Stiffness (kPa)	Number of Patients	Percentage (%)
F0–F1	<7.0	12	24%
F2	7.0–9.5	10	20%

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F3	9.6–12.5	14	28%
F4 (Cirrhosis)	>12.5	14	28%
Total		50	100%

Table 5: Comparison of Elastography with Reference Standard

Fibrosis Stage	Elastography Positive	Reference Standard Positive	P-value
Significant Fibrosis (\geq F2)	38	36	0.021
Advanced Fibrosis (\geq F3)	28	26	0.033
Cirrhosis (F4)	14	13	0.045

Table 6: Diagnostic Performance of USG Elastography

Parameter	Value (%)
Sensitivity	91.60%
Specificity	85.70%
Positive Predictive Value (PPV)	89.50%
Negative Predictive Value (NPV)	88.20%
Accuracy	90%
P-value	0.018

Figure 1: Etiology of Liver Disease

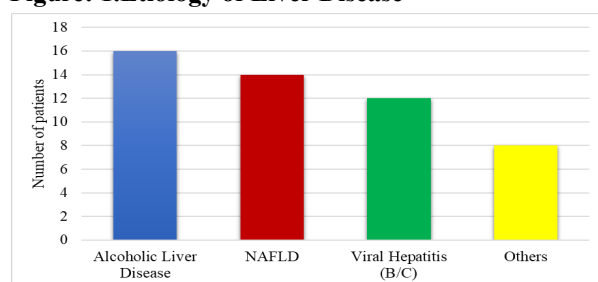


Figure 2: Comparison of Elastography with Reference Standard

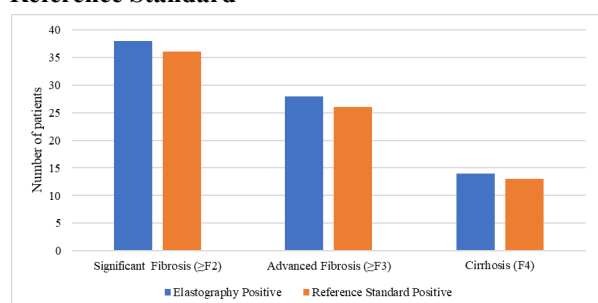


Table 1: The age distribution of the study population showed that the majority of patients belonged to the 41–50 years age group (14/50, 28%), followed by 51–60 years (12/50, 24%). Patients aged 31–40 years constituted 20%, while 18–30 years accounted for

16%. Only 12% of patients were above 60 years. This indicates a higher prevalence of liver fibrosis in the middle-aged population.

Table 2: Among the 50 patients, males were predominant, comprising 32 cases (64%), while females accounted for 18 cases (36%). The gender distribution showed statistical significance ($p = 0.041$), suggesting a higher occurrence of liver fibrosis among males in this study population.

Table 3: Alcoholic liver disease was the most common etiology, observed in 16 patients (32%), followed by non-alcoholic fatty liver disease (NAFLD) in 14 patients (28%). Viral hepatitis (B/C) was seen in 12 patients (24%), while other causes contributed to 8 cases (16%). This highlights alcohol and metabolic factors as leading contributors to liver fibrosis.

Table 4: Elastography-based fibrosis staging revealed that 28% of patients each were in stage F3 (14/50) and F4 (14/50), indicating a substantial proportion with advanced fibrosis and cirrhosis. Early fibrosis (F0–F1) was seen in 24% of patients, while 20% were classified as F2. These findings suggest that a significant number of patients presented at advanced stages of disease.

Table 5: Comparison between elastography and the reference standard demonstrated a high concordance. Significant fibrosis (\geq F2) was detected in 38 patients by elastography compared to 36 by the reference method ($p = 0.021$). Advanced fibrosis (\geq F3) was identified in 28 versus 26 patients ($p = 0.033$), while cirrhosis (F4) was detected in 14 versus 13 patients ($p = 0.045$). These differences were statistically significant, indicating good agreement.

Table 6: USG elastography demonstrated high diagnostic performance, with a sensitivity of 91.6%, specificity of 85.7%, PPV of 89.5%, NPV of 88.2%, and overall accuracy of 90%. The findings were statistically significant ($p = 0.018$), confirming elastography as a reliable non-invasive modality for assessing liver fibrosis.

DISCUSSION

The present study demonstrated that liver fibrosis was most prevalent in the middle-aged population, particularly in the 41–50 years age group (28%). This finding is consistent with the study by Singh et al. [11], who reported a higher incidence of chronic liver disease in patients between 40–55 years, attributing it to prolonged exposure to etiological factors such as alcohol and metabolic syndrome. Similarly, Sharma et al. [12] observed that advancing age correlates with progressive fibrosis due to cumulative hepatic injury.

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A male predominance (64%) was observed in this study, which was statistically significant ($p = 0.041$). This aligns with findings by Gupta et al. [13], who reported a higher prevalence of liver fibrosis among males, likely due to increased alcohol consumption and lifestyle-related risk factors. Comparable results were also noted by Verma et al. [14], reinforcing the gender disparity in chronic liver disease burden.

Regarding etiology, alcoholic liver disease (32%) emerged as the leading cause, followed by NAFLD (28%) and viral hepatitis (24%). These results are in agreement with Younossi et al. [15], who highlighted the rising burden of NAFLD alongside alcohol-related liver disease globally. Likewise, Das et al. [16] reported alcohol and metabolic syndrome as the predominant contributors to fibrosis in the Indian population, emphasizing changing disease patterns.

In terms of fibrosis staging, a significant proportion of patients were in advanced stages (F3 and F4, each 28%), indicating late presentation. This observation is comparable to the findings of Castera et al. [17], who noted that many patients are diagnosed at advanced stages due to the asymptomatic nature of early fibrosis. Sporea et al. [18] also reported similar distributions, with a higher proportion of patients presenting with significant fibrosis at initial evaluation.

The comparison between elastography and the reference standard in this study showed strong agreement, with statistically significant differences for detecting $\geq F2$ ($p = 0.021$), $\geq F3$ ($p = 0.033$), and F4 ($p = 0.045$). These findings are in concordance with Friedrich-Rust et al. [19], who demonstrated excellent correlation between transient elastography and histopathology. Similarly, Talwalkar et al. [20] reported high concordance rates, supporting elastography as a reliable diagnostic tool.

The diagnostic performance of USG elastography in this study was high, with sensitivity of 91.6%, specificity of 85.7%, and overall accuracy of 90% ($p = 0.018$). These results are comparable to meta-analyses by Singh et al. [11] and Castera et al. [17], which reported sensitivity and specificity values exceeding 85% for detecting significant fibrosis. The high PPV (89.5%) and NPV (88.2%) further reinforce its clinical utility. Minor variations in diagnostic accuracy across studies may be attributed to differences in patient population, etiology, and elastography techniques used.

Overall, the findings of the present study are in strong agreement with existing literature, confirming that USG elastography is an effective, non-invasive, and

reliable modality for the evaluation and staging of liver fibrosis. Its high diagnostic accuracy and reproducibility make it a valuable alternative to liver biopsy, particularly for routine clinical use and follow-up assessment.

CONCLUSION

The present study demonstrates that USG elastography is a highly effective, non-invasive modality for the evaluation and staging of liver fibrosis. It showed high sensitivity (91.6%), specificity (85.7%), and overall diagnostic accuracy (90%), with statistically significant correlation with reference standards. A considerable proportion of patients presented with advanced fibrosis, highlighting the importance of early detection. Elastography proved to be reliable in identifying significant fibrosis ($\geq F2$), advanced fibrosis ($\geq F3$), and cirrhosis (F4), making it a valuable tool in routine clinical practice. Its advantages, including safety, repeatability, cost-effectiveness, and patient compliance, make it a suitable alternative to liver biopsy for initial assessment and follow-up. Despite minor limitations, USG elastography can significantly improve clinical decision-making and disease monitoring. Therefore, it can be recommended as a first-line imaging modality for the non-invasive assessment of liver fibrosis.

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