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COMPARATIVE ANALYSIS OF SHEAR WAVE ELASTOGRAPHY, FIBROSCAN, AND LIVER BIOPSY IN THE ASSESSMENT OF LIVER FIBROSIS

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ABSTRACT

Background: Liver fibrosis results from chronic liver injury and can progress to cirrhosis or hepatocellular carcinoma if not properly diagnosed. Liver biopsy remains the gold standard for fibrosis assessment but has limitations such as invasiveness and sampling errors. Non-invasive techniques like Shear Wave Elastography (SWE) and FibroScan have emerged as viable alternatives. The objective of the study is to compare the accuracy of SWE and Fibro Scan against biopsy in assessing liver fibrosis. **Materials and Methods:** A prospective study of 150 patients was conducted, where liver stiffness measurements from SWE and FibroScan were correlated with biopsy results based on the METAVIR scoring system. Statistical analyses included Spearman's correlation, sensitivity, specificity, and receiver operating characteristic (ROC) curve analysis. **Results:** SWE exhibited a higher correlation with biopsy findings ($r = 0.82$, $p < 0.001$) than FibroScan ($r = 0.78$, $p < 0.001$). Both non-invasive methods correlated significantly with each other ($r = 0.80$, $p < 0.001$). SWE demonstrated superior diagnostic accuracy, with a sensitivity and specificity of 90% and 88% for significant fibrosis (F2-F4) compared to FibroScan's 85% and 83%. For cirrhosis (F4), SWE achieved a sensitivity of 93% and specificity of 90%, while FibroScan recorded 89% sensitivity and 85% specificity. **Conclusion:** SWE provided better results in obese patients and those with ascites, where FibroScan's accuracy was limited. While biopsy remains the definitive diagnostic tool, its limitations highlight the need for reliable non-invasive techniques. SWE's superior performance suggests its potential as a preferred alternative for liver fibrosis assessment. Standardizing SWE protocols and validating its use across diverse populations will enhance its clinical applicability.

Keywords: Shear Wave Elastography, FibroScan, Liver Biopsy, Liver Fibrosis, Non-Invasive Imaging

INTRODUCTION

Liver fibrosis is a progressive condition characterized by excessive extracellular matrix accumulation due to chronic liver injury. It results from various etiologies, including chronic viral hepatitis (HBV, HCV), non-alcoholic fatty liver disease (NAFLD), alcoholic liver disease, and autoimmune liver disorders [1,2,3,4]. If left untreated, fibrosis can lead to cirrhosis, liver failure, and hepatocellular carcinoma (HCC), significantly increasing morbidity and mortality rates worldwide. Accurate assessment of liver fibrosis is crucial for prognosis and management. Liver biopsy has long been considered the gold standard for fibrosis staging; however, it is invasive, associated with patient discomfort, and prone to sampling errors and interobserver variability. Due to these limitations, non-invasive imaging techniques such as transient elastography (FibroScan) and Shear Wave Elastography (SWE) have gained prominence in clinical practice [5,6,7,8]. FibroScan, a widely used method,

measures liver stiffness based on ultrasound-based transient elastography. While effective, its accuracy may be compromised in obese patients or individuals with ascites. SWE, an advanced ultrasound-based technique, allows real-time assessment of liver stiffness by measuring shear wave propagation velocity, providing more localized and detailed elasticity information. This study aims to compare the diagnostic performance of SWE and FibroScan with liver biopsy as the reference standard [9,10,11]. By evaluating their correlation with histological fibrosis staging, we seek to determine the reliability and clinical applicability of these non-invasive modalities. Our findings will contribute to the growing evidence supporting non-invasive techniques in routine liver fibrosis assessment, potentially reducing the need for invasive procedures while ensuring early and accurate diagnosis.

MATERIALS AND METHODS

Study Design and Population: This prospective study was conducted at the department of Radiodiagnosis, RKDF Medical College Hospital and Research Centre**,** Bhopal. A total of 150 patients with suspected liver fibrosis were enrolled based on clinical indications. Patients with acute hepatitis, hepatocellular carcinoma, or previous liver transplant were excluded.

Diagnostic Methods: **Liver Biopsy** All patients underwent ultrasound-guided percutaneous liver biopsy. Fibrosis staging was determined using the METAVIR scoring system. **FibroScan** Transient elastography (FibroScan, Echosens) was performed by a Radiologist. Measurements were taken in the right hepatic lobe with values recorded in kilopascals (kPa). A valid assessment required ten successful measurements with an interquartile range (IQR) of <30%. **Shear Wave Elastography (SWE)** SWE was conducted using an ultrasound system equipped with elastography software. SWE measurements were obtained in the same liver region assessed by FibroScan.

Statistical Analysis Correlations between SWE, FibroScan, and biopsy results were analyzed using Spearman's correlation coefficient. Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were calculated using biopsy as the reference standard. The diagnostic performance was assessed using receiver operating characteristic (ROC) curve analysis.

RESULTS

Patient Characteristics Out of 150 patients, 60% were male, and the mean age was 52 ± 10 years. The primary etiologies of liver disease included NAFLD (45%), chronic hepatitis B (30%), and chronic hepatitis C (25%).

Table 1: Baseline Characteristics of Patients

Characteristic	Value
Total Patients	150
Male (%)	60%
Mean Age (±SD)	52 ± 10 years
NAFLD (%)	45%
Chronic Hepatitis B (%)	30%
Chronic Hepatitis C (%)	25%

Correlation Between Diagnostic Modalities SWE demonstrated a strong correlation with biopsy results ($r = 0.82$, $p < 0.001$), slightly outperforming FibroScan ($r = 0.78$, $p < 0.001$). Both imaging techniques showed significant correlation with each other ($r = 0.80$, $p < 0.001$).

Table 2: Correlation Coefficients Between Diagnostic Modalities

Modality Comparison	Spearman Correlation (r)	p-value
SWE vs. Biopsy	0.82	<0.001
FibroScan vs. Biopsy	0.78	<0.001
SWE vs. FibroScan	0.80	<0.001

Diagnostic Performance Using biopsy as the reference, the sensitivity and specificity for detecting significant fibrosis (F2-F4) were:

Table 3: Diagnostic Performance of SWE and FibroScan for Significant Fibrosis (F2-F4)

Parameter	Sensitivity	Specificity	PPV	NPV
SWE	90%	88%	91%	87%
FibroScan	85%	83%	86%	82%

Table 4: Diagnostic Performance of SWE and FibroScan for Cirrhosis (F4)

Parameter	Sensitivity	Specificity	PPV	NPV
SWE	93%	90%	92%	89%
FibroScan	89%	85%	88%	84%

DISCUSSION

The findings of this study demonstrate that Shear Wave Elastography (SWE) provides superior diagnostic accuracy compared to FibroScan in assessing liver fibrosis, with a stronger correlation to histological biopsy results. The correlation coefficient for SWE ($r = 0.82$) was higher than for FibroScan ($r = 0.78$), indicating greater reliability in liver stiffness measurement. Additionally, SWE showed improved sensitivity and specificity for detecting significant fibrosis (F2-F4) and cirrhosis (F4), reinforcing its clinical applicability. A key advantage of SWE over FibroScan is its ability to provide more localized and real-time liver stiffness measurements. SWE was particularly effective in patients with obesity and ascites, where FibroScan often faces technical limitations.

This suggests that SWE could be a preferred alternative in patients with challenging anatomical conditions, enhancing diagnostic accuracy in diverse populations. Despite its advantages, SWE has certain limitations. Radiologist dependency and variability in measurement techniques could affect its reproducibility across different healthcare settings. Standardization of SWE protocols and training programs for operators could help address these concerns, ensuring consistency in clinical practice. Moreover, while non-invasive imaging techniques have shown strong correlations with biopsy results, liver biopsy remains essential in ambiguous cases and for detecting early-stage fibrosis [12,13,14]. Future research should focus on large-scale, multicenter studies to validate SWE's effectiveness across broader patient demographics and liver disease etiologies. Additionally, the cost-effectiveness and accessibility of SWE need to be further explored [15,16].

While SWE has shown superior diagnostic capabilities, its implementation may be challenging in resource-limited settings. Integrating SWE into routine practice should consider economic factors to ensure broader availability. Our study reinforces the clinical potential of SWE, suggesting that it could serve as a frontline tool for liver fibrosis assessment. However, further technological advancements and standardization efforts will be essential in optimizing its widespread clinical application. Overall, incorporating SWE into routine clinical practice could significantly improve the assessment and management of liver fibrosis. Future studies should aim to refine cutoff values for different fibrosis stages, ensuring enhanced diagnostic precision for various patient subgroups.

CONCLUSION:

SWE is a promising non-invasive tool for liver fibrosis assessment, demonstrating strong correlation with liver biopsy and superior accuracy compared to FibroScan. Given its real-time capabilities and improved diagnostic performance, SWE could be integrated into routine clinical practice to improve fibrosis staging and patient management.

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