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ASSESSMENT OF HEPATIC FIBROSIS USING SHEAR WAVE ELASTOGRAPHY AND ITS CORRELATION WITH SEROLOGICAL FIBROSIS MARKERS IN CHRONIC LIVER DISEASE: A CROSS-SECTIONAL STUDY

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Abstract
Background: The worldwide occurrence of diseases in the liver is very common. The assessment of hepatic fibrosis degree is very useful for staging and managing pathology. SMPs, TEs, and SHREs are being used by more chronic hepatitis patients to assess liver fibrosis non-invasively.
Aim: SWE's involvement in hepatic fibrosis evaluation and connection with blood indicators was examined in CLD patients.
Materials and Methods: A total of 84 adults with chronic liver disease were included in the study. Liver transient elastography was performed utilizing the Sound Touch Elastography (TEC) feature on the MINDRAY DC-80 USG system. This study used serological fibrosis indicators (apri), FIB-4, and King's Score (derived from laboratory data) as stiffness indices. Using Spearman, we correlated SWE with fibrosis markers.
Results: The average was 46.44 men and 69.05% women. Alcoholism (39.29%) and non-alcoholic fatty liver disease (NAFLD) (35.71%) caused most liver damage. The average value of liver stiffness was 11.44 ± 3.28 kPa. 42.86% of patients had cirrhosis while 33.33% experienced advanced fibrosis as per SWE. SWE utilized.
Conclusion: SWE is a trustworthy non-invasive method for evaluating fibrosis in the liver of individuals suffering from chronic liver disease.

KEYWORDS: CLD; Hepatic fibrosis; Shear wave elastography; APRI; FIB-4; King's Score.

INTRODUCTION

For a journal abstract/introduction section limited to **~200 words**, you can condense it as follows:
CLD is a major global health concern. Cirrhosis, portal hypertension, decompensation, and hepatocellular malignancy are caused by hepatic fibrosis. When the liver is damaged by diseases like alcohol, progressive fibrosis occurs.[1-6] The increasing prevalence of obesity, diabetes mellitus and harmful use of alcohol in India are largely responsible for the increasing burden of CLD. [4-9] Accurate assessment of hepatic fibrosis is important to assess disease stage, prognostication, treatment decision.
When it comes to evaluating fibrosis, a liver biopsy is the way to go. Due to its invasive nature, potential for sample variability, discomfort for patients, and risks of consequences, liver biopsies are not often performed.[7-10] Serological fibrosis markers are popular despite their disadvantages because to their non-invasiveness, simplicity of use, and cheap cost. Among the most prominent are King's Score, Fibrosis-4 index, and APRI. SWE is a USG-based method that offers quantitative assessment of liver stiffness and has several advantages. Nowadays, evaluating the liver is seen as a trustworthy way to measure fibrosis.[11-25]There is a scarcity of data correlating SWE with commonly used serological fibrosis markers in the Indian context. The study has been done with the motive of evaluation of hepatic Fibrosis among chronic liver Disease Patients using SWE and to determine its correlation.

MATERIALS AND METHODS

Design of study and procedures

A tertiary care teaching hospital's Department of Radiodiagnosis undertook 18-month analytical cross-sectional research from March 2024 to October 2025.

Study Population
Adults with chronic liver disease were eligible based on clinical, biochemical, and ultrasonographic results.

Inclusion Criteria
• Patients over 18.
•Patients with any cause of chronic liver disease.
• Patients giving written informed consent.

Exclusion Criteria
• Liver cancer patients.
• Pregnant women.
• Patients unable to perform adequate breath-hold during elastographic examination.

Sample Size
The division of war powers debate is an old debate which may be traced back to the very first genesis of the constitution. According to separation of powers, the Executive, Legislature, and Judiciary have distinct authorities to avoid overlap. The legislature produces legislation, the executive implements it, and the judiciary interprets it.

Study Procedure
Using the Sound Touch Elastography, the value was acquired on the MINDRAY DC-80 platform.
Calculation of Serological Fibrosis Indices
- APRI = "[(AST / Upper Limit of Normal AST) × 100] / Platelet Count (10^9/L)"
- FIB-4 = "[Age × AST] / [Platelet Count × √ALT]"
- King's Score was created using a validated algorithm that considers age, AST, INR, and platelet count.

Statistical Analysis
Data were entered into Microsoft Excel and analyzed using IBM SPSS Statistics version 27. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. Spearman's rank correlation coefficient was used to assess associations between SWE-derived liver stiffness and serological fibrosis markers. Group comparisons were performed using the Mann–Whitney U test and Kruskal–Wallis H test where appropriate. A p-value less than 0.05 was considered statistically significant.

RESULTS
The average age of the total number of participants was 46.44 8.48 years; Most patients (45.24%) were 41-50 years old, and 69.05% were male. Alcohol-related and non-alcohol fatty liver disease caused most liver damage. Most complained of weariness (77.38%). Jaundice affected 48%.

Table 1. Clinical and demographic baseline characteristics of study participants (n = 84).

Variable	**n (%)**
Gender	
Male	58 (69.05)
Female	26 (30.95)
Etiology	
Alcohol-related liver disease	33 (39.29)
NAFLD	30 (35.71)
HBV infection	13 (15.48)
HCV infection	5 (5.95)
Autoimmune hepatitis	3 (3.57)
Symptoms	
Fatigue	65 (77.38)
Jaundice	41 (48.81)
Abdominal distension	40 (47.62)
Pedal edema	34 (40.48)
Upper gastrointestinal bleed	10 (11.90)

Table 2. Laboratory parameters and fibrosis indices

Parameter	**Mean ± SD**
Serum bilirubin (mg/dL)	1.91 ± 0.43
AST (U/L)	54.43 ± 14.87
ALT (U/L)	43.20 ± 11.10
Serum albumin (g/dL)	3.36 ± 0.41
Platelet count (×10^9/L)	131.43 ± 38.85
APRI	1.79 ± 1.04

FIB-4	3.39 ± 1.97
King's Score	29.88 ± 21.86
SWE (kPa)	11.44 ± 3.28

Based on SWE values of the literature previously published, 42.86% patients had stiffness of cirrhosis (F4) and 33.33% with advanced fibrosis (F3). Fourteen percent of patients had significant fibrosis (F2) whereas nine percent had no fibrosis or mild fibrosis (F0- F1).

Table 3. Distribution of fibrosis stages based on SWE liver stiffness measurements

SWE Category (kPa)	Fibrosis Stage	n (%)
<7.0	F0–F1	8 (9.52)
7.0–9.4	F2	12 (14.29)
9.5–12.4	F3	28 (33.33)
≥12.5	F4	36 (42.86)

The autoimmune hepatitis patients had the highest mean SWE values (12.33 ± 4.04 kPa), while HCV-related liver disease patients had expansive values (12.20 ± 4.82 kPa). No important differences were found between aetiological groups; Kruskal-Wallis H = 3.

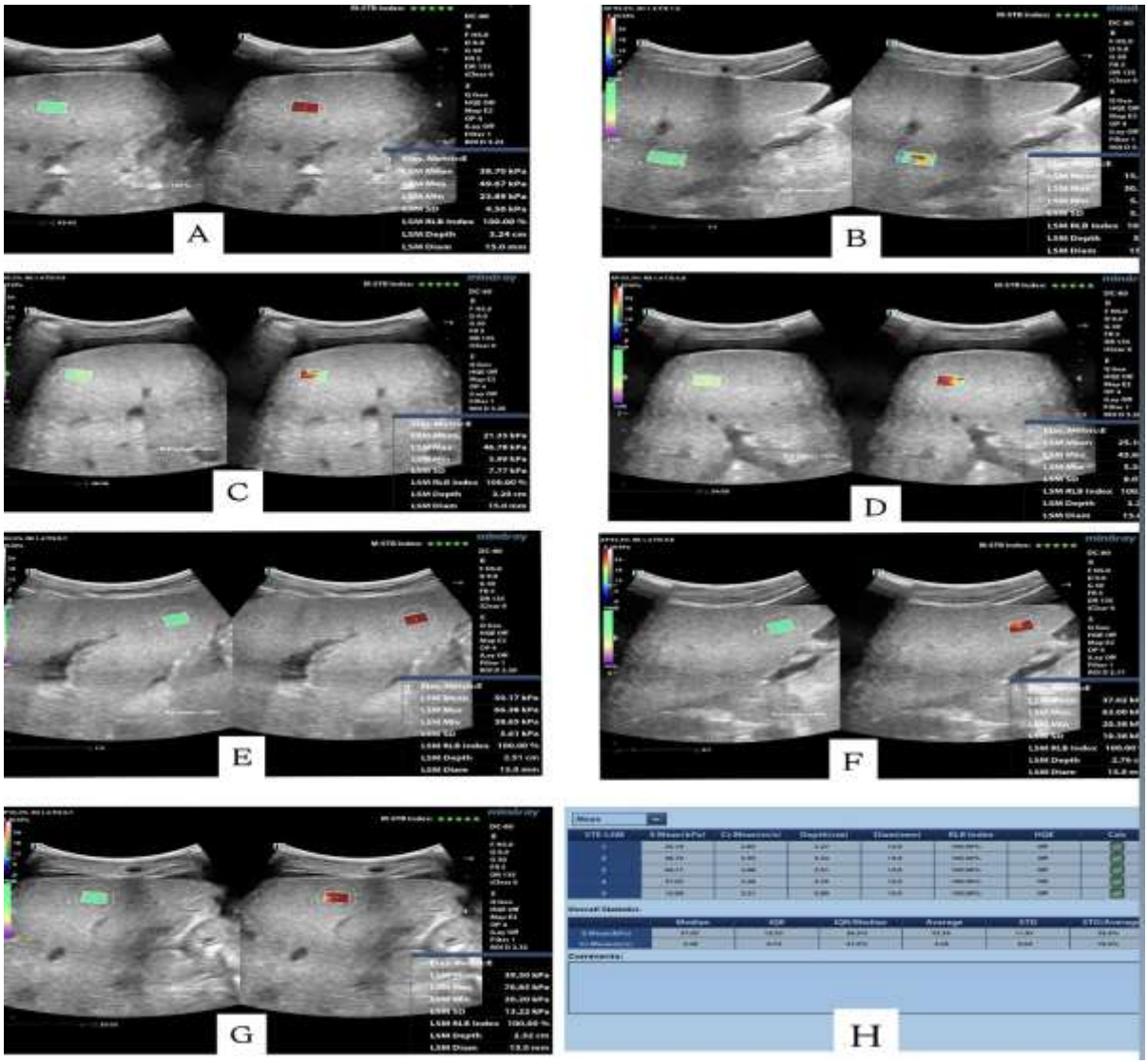

Figure 1. Examples of Shear Wave Elastography (SWE) images illustrating the assessment of liver stiffness in patients suffering from chronic liver disease. A–G: Grayscale ultrasound and color-coded elastograms of various regions of interest in the liver parenchyma, excluding the vessels and biliary ducts in the same. H: Summary of elastography measurement presenting values for E-Mean, median, interquartile range (IQR), standard deviation, depth, diameter, and reliability index. Source: Original images taken by the authors using MINDRAY DC-80 ultrasound machine with Sound Touch Elastography.

Table 4. Comparison of SWE values according to etiology

Etiology	n	Mean SWE (kPa)

Alcohol-related CLD	33	11.97 ± 3.17
NAFLD	30	11.10 ± 3.32
HBV	13	10.38 ± 2.81
HCV	5	12.20 ± 4.82
Autoimmune hepatitis	3	12.33 ± 4.04

Positive associations were found between SWE-derived liver stiffness and serological fibrosis markers and all other indicators. A substantial association was found between SWE and APRI ($\rho = 0.814$, $p < 0.001$), followed by King's Score ($\rho = 0.797$, $p < 0.001$). A moderate to significant connection ($\rho = 0.649$ $p < 0.0$) was found between SWE and FIB-4.

Table 5. Correlation of SWE with fibrosis markers and Doppler indices

Variable Pair	Spearman's ρ	p-value
SWE vs APRI	0.814	<0.001
SWE vs FIB-4	0.649	<0.001
SWE vs King's Score	0.797	<0.001
SWE vs Resistive Index	0.105	0.342
SWE vs Pulsatility Index	-0.149	0.176

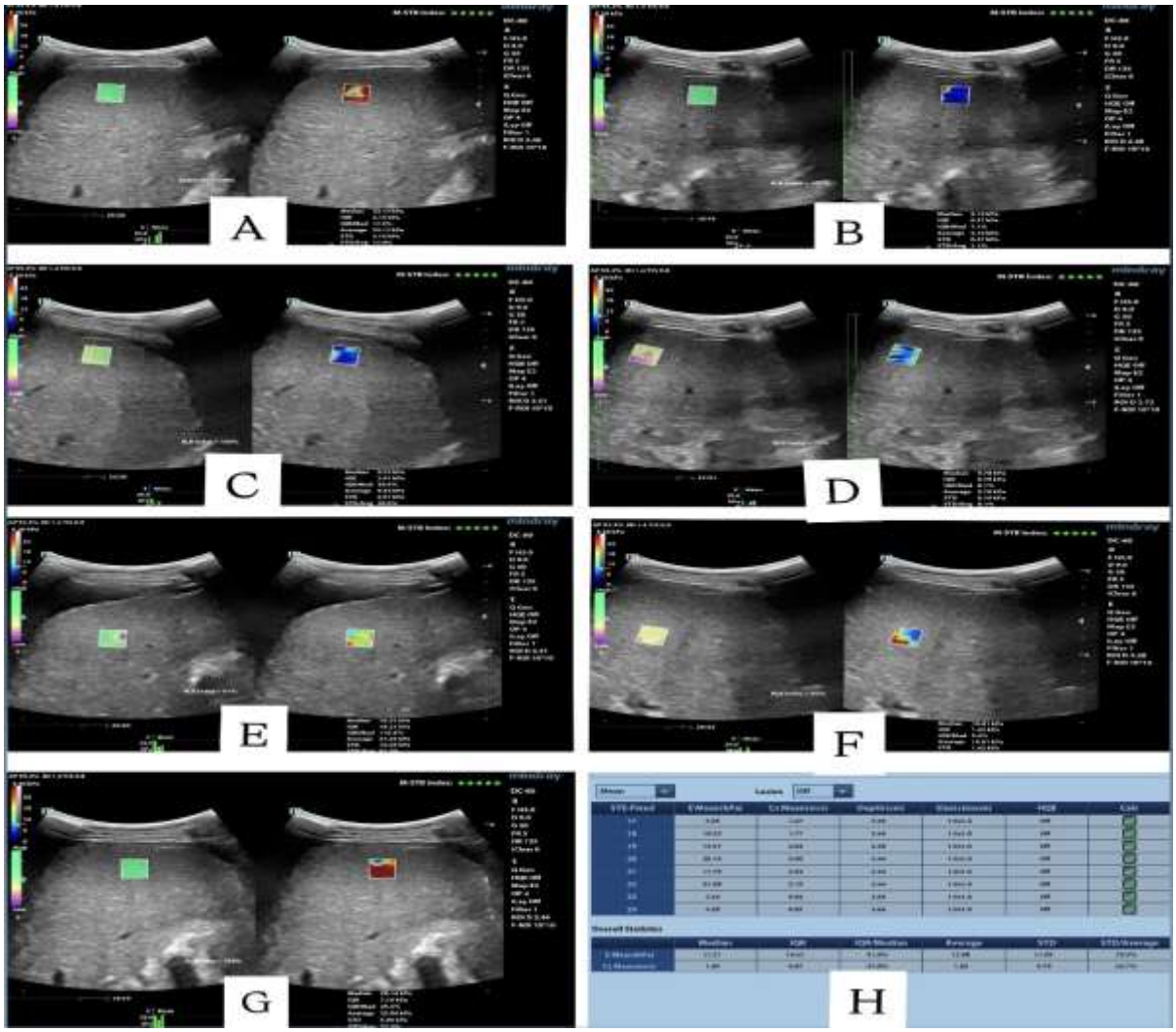

Figure 2. Liver SWE scans depicting the elastographic evaluation of liver fibrosis. A-G represent the gray scale images with color scale depiction of liver stiffness in kPa. H represents the statistical summary of the results obtained through the elastography technique, indicating the median, interquartile range, mean values, and measure of variability. Source: Original figures provided by the authors using MINDRAY DC-80 ultrasound machine with Sound Touch Elastography.

DISCUSSION

SWE was utilized to evaluate hepatic fibrosis in chronic liver disease patients and compared to serological markers. SWE-derived liver stiffness evaluations associated strongly with biochemical fibrosis markers, and advanced fibrosis and cirrhosis were common.

The average age of the study population was 46.44 ± 8.48 years, with most persons in their 40s and 50s. Males prevailed (69.05%). These results support Paul et al. and Shaji et al., who reported that liver disease's chronicity and men's greater risk of risk factors made fibrosis evaluation patients primarily middle-aged guys.[24-27]

Alcohol-related liver disease and NAFLD accounted for roughly three-fourths of patients in this research. This is congruent with modern epidemiology. Alcohol-related liver disease and NAFLD increase CLD burden globally and in Asia Pacific.[3–5] The main factors leading to liver disease include fatty liver, toxins and viral hepatitis.

Over 75% of patients in this research had advanced fibrosis and cirrhosis, according to SWE values. This shows that patients continue to present to tertiary care centres at a relatively late stage of disease. As per Song et al. and Wang et al., SWE can accurately identify advanced fibrosis and cirrhosis.[20,21] Mean liver stiffness was 11.44 3.28 kPa in this research. This value matches recent research on SWE for fibrosis staging in several chronic liver disease etiologies.[22,23]

SWE derived liver stiffness exhibited the strongest correlation with serological markers of fibrosis. APRI had the strongest connection to SWE ($\rho = 0.814$, $p < 0.001$), followed by King's Score ($\rho = 0.797$, $p < 0.001$) and FIB-4 ($\rho = 0.649$, $p < 0.001$). Yang et al and Zhuang et al demonstrated similar correlations between elastographic parameters and serum fibrosis parameters. This indicates that the two modalities are complementary in assessing fibrosis in a non-invasive way.[23,29] In relation to the slightly less correlation on FIB-4, we propose that the inclusion of age in the calculation likely introduces variance not necessarily due to fibrosis severity.

No significant differences in liver stiffness were observed across etiological categories. Although autoimmune hepatitis and HCV-related liver disease demonstrated numerically higher SWE values, the absence of statistical significance suggests that liver stiffness is primarily influenced by fibrosis severity rather than disease etiology. This finding supports the concept that hepatic fibrosis represents a common final pathway of chronic liver injury irrespective of the underlying cause.

Another important observation was the lack of significant correlation between SWE and Doppler-derived vascular indices. While Doppler ultrasonography remains useful for evaluating portal hypertension and vascular complications, these findings suggest that Doppler parameters may be less sensitive than elastography for direct assessment of fibrosis burden. Fu et al. found SWE to identify substantial fibrosis and cirrhosis with good sensitivity and specificity.[30] Large-scale evidence supports these conclusions. Herrmann et al. found two-dimensional SWE had good fibrosis staging diagnostic performance in an individual patient data meta-analysis.[13] These data demonstrate SWE's reliability, repeatability, and clinical value as a non-invasive hepatic fibrosis diagnostic technique.

CONCLUSION

Many individuals had extensive fibrosis or cirrhosis upon presentation, showing late-stage illness. SWE was reliable and non-invasive for measuring hepatic fibrosis in chronic liver disease patients. SWE correlated well with APRI, King's Score, and FIB-4, demonstrating high agreement between elastographic and serological fibrosis diagnostic techniques. These findings support the use of SWE as part of routine non-invasive fibrosis evaluation, particularly in combination with serological fibrosis markers for screening, staging, and clinical decision-making.

CLINICAL IMPLICATIONS

- For chronic liver disease hepatic fibrosis testing and staging, SWE is reliable and non-invasive.
- With SWE, APRI and FIB-4 may be cost-effective screening techniques for fibrosis confirmation and staging.
- Serological markers and SWE may minimize liver biopsies in certain individuals.
- The early identification of advanced fibrosis, via non-invasive means, could benefit risk stratification and clinical decision-making.

LIMITATIONS

- As this is a uni-centre study, smaller sample size is a fair communication of the result.
- USG strain elastography showed negative histopathological correlation with liver biopsy.
- A number of confounding factors which affect liver stiffness were not analysed independently.
- There was no follow-up, which led to an adverse prognostic outcome.

FUTURE PROSPECTS

- The present findings should be analysed via multicentric studies on larger and more diverse patient groups in future.
- Future studies must analyze the SWE findings in conjunction with the histopathological fibrosis.
- Monitoring your fibrosis progression as well as your treatment response plays a key role in longitudinal studies.
- Combining elastographic, biochemical, and clinical parameters with diagnostic algorithms may improve fibrosis evaluation.
- Increased availability of platform-specific cut-off values pertaining to Indian populations may enhance the clinical utility of SWE.
- Studies on SWE-based screening pathways must be done to assess their potential use in low-resource clinical environments. Cost-effectiveness studies

DECLARATIONS

Ethical Clearance

Institutional Ethics Committee approved the study before its implementation. Institutional standards and the Declaration of Helsinki principles guided the procedures. (IEC NO: 942/24)

Aware Authorization
Before enrolling anybody in the research, we made sure they gave us their written informed permission.
Sponsorship and Financial Assistance: None.
Authors' conflicts of interest: The writers of the study report having none relevant to their work.
All figures included in this manuscript are original images acquired during the present study by the authors using the MINDRAY DC-80 ultrasound platform with Sound Touch Elastography technology. No figures have been reproduced or adapted from previously published sources.

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