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Original Research Article

Diagnostic Efficacy of 2-D Elastography for Liver Fibrosis in Subjects with Viral Hepatitis

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Abstract: *Chronic hepatitis C virus (HCV) infection is a leading cause of liver fibrosis and cirrhosis worldwide. Early and accurate staging of liver fibrosis is critical for clinical decision-making and prognostication. While liver biopsy remains the gold standard, non-invasive modalities like two-dimensional shear wave elastography (2D SWE) are gaining attention due to their reproducibility, patient comfort, and diagnostic efficiency.* ***Objective:*** *To evaluate the diagnostic utility of 2D shear wave elastography for diagnosis of liver fibrosis in HCV patients with chronic liver disease.* ***Methods:*** *A prospective analysis was conducted on adult 200 HCV patients in the Medicine Department of Nishtar Hospital, Mulan from March 2024 to March 2025. The patients with chronic liver disease undergoing SWE and liver biopsy were selected for the study. All patients underwent two-dimensional SWE in a supine position by two independent radiologists and liver biopsy was performed in the same posture and same session as SWE. Laboratory tests were performed and biomarker indices were calculated.* ***Results:*** *Spearman's rank tests showed that shear wave velocity was significantly associated with total bilirubin (0.245), AST (0.522), ALT (0.387), albumin (-0.478), prothrombin time (0.413), platelet count (0.413), hyaluronic acid (0.702) and type IV collagen 7S (0.729), M2BPGi (0.705). The AUC of SWE for cirrhosis was 0.952 (95% CI: 0.89-0.95), for hyaluronic acid was 0.860, type IV collagen 7S was 0.872, M2BPGi was 0.879, AST to platelet ratio index was 0.892 and Fibrosis-4 index was 0.896.* ***Conclusion:*** *The 2D SWE showed a high accuracy for predicting fibrosis grades and severity as compared to other biomarkers in HCV patients.*

Keywords: Elastography, Fibrosis, Hepatitis, Hepatitis C

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Introduction

Chronic liver disease progresses and is managed depending on the degree of liver fibrosis in HCV patients. In HCV patients with severe fibrosis, there a high risk of cirrhosis, need for liver transplant and mortality due to liver diseases. Liver biopsy is the gold standard for evaluating and grading liver fibrosis. However, it poses a risk of adverse effects including hemorrhaging, sampling errors and limitation of single assessment. In recent times, a non-invasive and more accurate method of assessing liver fibrosis is through fibrotic biomarkers (1). Studies have also shown the use of indirect fibrosis scores (2, 3).

Another commonly used tool for evaluation of liver fibrosis is elastography specifically transient elastography. It is the recommended approach to stage fibrosis according to guidelines. However, it is not effective in patients with obesity or ascites. Hence, 2-dimensional ultrasound elastography has been developed for accurate assessment (4, 5).

We carried out this investigation to determine the diagnostic utility of 2D shear wave elastography for liver fibrosis in HCV patients with chronic liver disease.

Methodology

A prospective analysis was conducted onadult 200 HCV patients in the Medicine Department of Nishtar Hospital, Mulan from March 2024 to March 2025. The patients with chronic liver disease undergoing SWE and liver biopsy were selected for the study.Patients with hepatitis B positivity, history of drug or alcohol addiction, auto-immune hepatitis and primary biliary cholangitis were excluded. All patients provided their informed consent to become a part of the study. The ethical review board approved the study.

A total of 30 healthy volunteers with no liver dysfunction or signs of cirrhosis or hepatitis were also included as a control group to see results of procedure. All patients underwent two dimensional SWE in a supine position by two independent radiologists. The examiners were unaware of patients' clinical and histological characteristics. Ten measurements were taken for measurement of liver stiffness and median value was used for final analysis.

An ultrasound guided liver biopsy was performed in the same posture and same session as SWE. The only samples greater than 15 mm long and 4mm thick were included to avoid errors and fixed in 10% buffered formalin with paraffin. Two pathologists, blinded to patients' data and shear wave velocity examined these sections after staining then in hematoxylin-eosin and Gomori trichrome. Liver fibrosis was graded by METAVIR scoring system from F0 to F4 with F4 being cirrhosis, F3 being advanced fibrosis, F2 being significant fibrosis, F1 being mild fibrosis and F0 being no fibrosis. Necroinflammation was staged as A2 being severe, A1 being moderate and A0 being no necroinflammation. Steatosis was presented as accumulation of fat percentage with S3 being more than 67% fat, S2 being 34-66% fat, S1 being 5-33% fat and S0 being less than 5% fat.

Laboratory tests were performed on the same day testing for albumin, total bilirubin, aspartate & alanine aminotransferase, platelet count, prothrombin time, hyaluronic acid, type IV collagen 7S and M2BPGi.Fibrosis-4 index and APRI were calculated by age and laboratory examination results.

All data was processed in SPSS version 22. Variables were presented by descriptive statistics based on normality test. Variables were compared by Kruskal-Wallis test and relationship between variables and shear wave velocity was evaluated by Spearman's rank coefficient. The diagnostic accuracy of techniques was evaluated by AUC, sensitivity, specificity, PPV and NPV. Statistical significance was set a p value less than 0.05.

Results

The shear wave elastography was successful in all patients with average duration 4.1 ± 5 minutes. The IQR/ median ratio of shear wave velocity was 0.007-0.282 and in control group it was 0.038. The ratio for each increasing fibrosis stage was 0.052, 0.049, 0.058, 0.062 and 0.066 for F0-F4, respectively. 30 (15%) has no fibrosis, 40 (20%) had stage 1 fibrosis, 30 (15%) had stage 2 fibrosis, 40 (20%) had stage 3 fibrosis and 60 (30%) had cirrhosis. There was no neuroinflammatory activity in 10 (5%) while 130 (65%) had moderate activity and 60 (30%) showed severe activity (Table I).

The overall median shear wave velocity was 1.71 (0.92-3.04) m/s and in control group was 1.33 (1.11-1.62)m/s. The median SWE increased stepwise from 1.40 m/s to 2.18 m/s in F0 to F4 ($p<0.0001$). Similarly, the patients with high neuroinflammatory activity had higher median SWVs (A2= 2.06, A1= 1.62 and A0= 1.44 m/s) ($p<0.01$). There was no significant difference between SWVs in each steatosis group.

Spearman's rank tests showed that shear wave velocity was significantly associated with total bilirubin (0.245), AST (0.522), ALT (0.387), albumin (-0.478), prothrombin time (0.413), platelet count (0.413), hyaluronic acid (0.702) and type IV collagen 7S (0.729), M2BPGi (0.705)(Table II). The area under the curve of shear wave elastography for cirrhosis was 0.952 (95% CI: 0.89-0.95), significant fibrosis was 0.921 (95% CI:0.91-0.97) and mild fibrosis was 0.892 (95% CI: 0.86-0.95). The AUC for cirrhosis by hyaluronic acid was 0.860, type IV collagen 7S was 0.872, M2BPGi was 0.879, AST to platelet ratio index was 0.892 and Fibrosis-4 index was 0.896.

Table 1: Patients' Demographic and Laboratory Variables

Variables	N (%)
Mean age	66.4 ± 11.2
Gender	
Male	126 (63%)
Female	64 (37%)
Mean BMI	22.8 ± 4.0
Total bilirubin	0.9 (0.7-1.1)
AST	45.3 (27-50)
ALT	43.5 (24-54)
Albumin	50 (4.2-4.8)
Prothrombin time	92.3 (81.8-99.1)
Platelet count	15.4 (11.6-19.3)
Hyaluronic acid	211.7 (46.8-255.0)
Type IV collagen 7S	9.3 (5.7-7.9)
Mac-2 binding protein glycosylation isomer	2.5 (1.2-5.8)
MTAVIR score	
F0	30 (15%)
F1	40 (20%)
F2	30 (15%)
F3	40 (20%)
F4	60 (30%)
Necroinflammation	
A0	10 (5%)
A1	130 (65%)
A2	60 (30%)
Steatosis	
S0	156 (78%)
S1	40 (20%)
S2	4 (2%)

Table 2: Associations between study variables and shear wave velocity

Factors	r[a]	P value
Gender	.152	.010
Age	.183	.005
BMI	.112	.127
Total bilirubin	.245	.001
AST	.522	<.001
ALT	.387	<.001
Albumin	-.478	<.001
Prothrombin time	.413	<.001
Platelet count	-.621	<.001
Hyaluronic acid	.702	<.001
Type IV collagen 7S	.729	<.001
Mac-2 binding protein glycosylation isomer	.705	<.001

Table 3: Prognostic accuracy of 2D-SWE for Each Fibrosis Stage

Variables	F4	≥F3	≥F2	≥F1
Area under curve	0.952	0.938	0.921	0.892
95% confidence interval	0.89-0.95	0.89-0.99	0.91-0.97	0.86-0.95
Optimal cut-off	1.926	1.718	1.558	1.479
Sensitivity	0.916	0.891	0.849	0.761
Specificity	0.913	0.845	0.862	0.876
PPV	0.808	0.838	0.909	0.981
NPV	0.957	0.885	0.757	0.394
Accuracy	0.908	0.892	0.849	0.812

Discussion

This study was conducted to determine the diagnostic accuracy of two-dimensional shear wave elastography for liver fibrosis in HCV patients. The results showed a high accuracy for predicting fibrosis grades and severity. This is similar to other studies conducted comparing elastography and other liver fibrosis biomarkers (6, 7, 8).

The AUC of 2D-SWE for predicting F3 was 0.938 (95% CI: 0.89-0.99) in present study. Numao et al reported a similar value of 0.911 in all patients including patients with hepatitis B & C and NALD and an AUC of 0.922 for only patients with HCV (9). Kakegawa et al also showed a AUC of 0.886 for F3 and 0.879 for F4.[10] The accuracy remained significant after adjusting for old age, BMI and advanced steatosis stage. 2D-SWE had a significantly higher accuracy than other diagnostic markers for liver fibrosis as it is unaffected by BMI and steatosis severity. Similarly, the patients with high neuroinflammatory activity had higher median SWVs (A2= 2.06, A1= 1.62 and A0= 1.44 m/s). There was significant positive association between shear wave velocity and total bilirubin, AST, ALT, prothrombin time, hyaluronic acid, type IV collagen 7S and M2BPGi and a negative association with albumin and platelet count. Previous research agrees with our results that liver stiffness is influenced by inflammation in addition to fibrosis (11, 12, 13).

Our study has some limitations. First, the study sample was limited and a single centered to accurately assess optimum cut-off values. Second, using biopsy to grade fibrosis may be affected by sampling errors.

Conclusion

The two-dimensional shear wave elastography showeda high accuracy for predicting fibrosis grades and severity as compared to other biomarkers in patients with hepatitis C.

Declarations

Data Availability statement
All data generated or analysed during the study are included in the manuscript.

Ethics approval and consent to participate
Approved by the department concerned. (IRBEC-24)

Consent for publication
Approved

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Not applicable

Conflict of interest

The authors declared the absence of a conflict of interest.

Author Contribution

MMT (SR)
Manuscript drafting, Study Design,
UF (SR)
Review of Literature, Data entry, Data analysis, and drafting article.
AM (Demonstrater)
Conception of Study, Development of Research Methodology Design, Study Design, manuscript review, critical input.

All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the integrity of the study.

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