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ROLE OF SHEAR WAVE ELASTOGRAPHY IN ASSESSING LIVER FIBROSIS IN PATIENTS WITH HEPATIC DISEASES AND ITS CORRELATION WITH SEROLOGICAL INDICES.

Radio-Diagnosis

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ABSTRACT

Introduction: Liver fibrosis is a progressive disorder that, if diagnosed early and staged precisely, allows early clinical intervention that may hinder or slow down the progression to end-stage decompensated cirrhosis. Grading of hepatic fibrosis is essential not only for diagnosis but also for prognostic evaluation, planning appropriate therapy, and follow-up of patients with chronic hepatitis. Liver biopsy has been considered the gold standard for grading liver fibrosis. As liver biopsy is invasive and associated with complications, non-invasive serological techniques and Aminotransferase Platelet Ratio Index (APRI), King's Score, and FIB 4 scores have been spotlighted. **Aim:** To evaluate patients with liver diseases using ultrasonography. To perform shear wave elastography and derive cut-off for patients with liver diseases. To correlate ultrasound and shear wave elastography findings with serological indices in patients with liver disease. **Methods:** Shear wave elastography (SWE) was used to assess the liver stiffness. 2D ultrasound was performed to correlate with the findings of the SWE. Serological values were obtained, and serological indices were calculated and correlated with the SWE findings. **Results:** The study reveals that the younger group (< 45 years) has a higher proportion of liver fibrosis stages, while the older group (> 45 years) has a lower proportion in each stage. Advanced liver fibrosis (ALD) is most prevalent in advanced stages (92.9% in F4), indicating a severe progression. Hepatitis B and C peak at F3 and drop drastically in F4, while NAFLD is more common in the early stages (50.0% in F0-F1). Type of liver disease is statistically significantly associated with stages. Patients without complications were predominant in the early stages but decreased substantially in F4. Patients with complications show a substantial increase in advanced fibrosis stages, comprising 78.6% of F4 cases. Hematemesis is the most common complication, especially in advanced stages (30.0% in F3, 39.3% in F4). Increased echogenicity is more common in advanced stages, rising from 65.0% in F0-F1 to 96.4% in F4. Significant changes in liver size and stiffness with advancing fibrosis are less pronounced. All APRI, FIB 4 and King's scores demonstrate strong correlations with fibrosis progression, making them valuable for assessing liver fibrosis severity and monitoring disease advancement. The SWE test has high AUC values, indicating strong discriminatory power when comparing stages (F0-F1) against F2, F3, and F4. It also demonstrates high accuracy in differentiating between minimal or no fibrosis (F0-F1) and advanced fibrosis (F3), with a sensitivity of 95% and a specificity of 90% at a cut-off value of ≥ 6.60. It also exhibits outstanding discriminatory ability in distinguishing between minimal or no fibrosis (F0-F1) and severe fibrosis/cirrhosis (F4), with a sensitivity of 96.4% and a specificity of 91.4% at a cut-off value of ≥7.50. SWE also shows good discriminatory performance in differentiating between moderate (F2) and advanced fibrosis (F3), with a sensitivity of 95% and a specificity of 77.6% at a cut-off value of ≥ 8.0. It also shows excellent accuracy in distinguishing between moderate fibrosis (F2) and severe fibrosis/cirrhosis (F4), with a sensitivity of 92.9% and a specificity of 79.8% at a cut-off value of ≥ 9.0. However, the diagnostic accuracy decreases when distinguishing between adjacent stages, such as F2 vs. F3 and F3 vs. F4, as indicated by lower AUC values and slightly lower sensitivity and specificity values. The test also has strong positive correlations with APRI and KING, suggesting that as liver size increases, all APRI, FIB 4, and King's scores tend to increase significantly. **Conclusion:** The study found significant associations between liver disease type, stages, complications, echogenicity, liver texture, liver size, stiffness, portal vein diameter, and spleen size. It also found strong correlations between liver elastography and size, APRI, King's and FIB 4 scores, and SWE, making them valuable tools for assessing liver fibrosis severity and monitoring disease advancement.

KEYWORDS

Chronic liver fibrosis, APRI, King's score & FIB-4, Serological markers, SWE.

INTRODUCTION

Chronic liver disease (CLD) is a major public health problem, causing significant morbidity and mortality around the world. The timely diagnosis and determination of the fibrosis stage is necessary for managing and treating patients with chronic liver disease.[1] In patients with chronic hepatitis, the progression of inflammatory reactions and necrosis of hepatocytes causes hepatic fibrosis. It leads to cirrhosis, which presents various clinical complications, including ascites, jaundice, or hepatocellular carcinoma[1]. Recently, non-invasive methods for measuring liver stiffness (LS), including transient elastography (TE), acoustic radiation force impulse imaging (ARFI), and magnetic resonance elastography (MRE), have been developed, and several studies report good results in their ability to predict the degree of hepatic fibrosis.[2,3] Real-time shear wave elastography (SWE), another method for measuring LS, has been developed.

Multidimensional SWE (e.g., 2D SWE and 3D SWE) is an adynamic elastographic technique in which focused ultrasound beams are transmitted continuously to tissue at different depths. As in TE and ElastPQ, the property is measured in shear wave speed. However, the region of interest (ROI) is fan-shaped and more significant than the ROI with other modalities. The shear wave speed measurements are displayed as a 2D map. Since very few structured studies have been conducted on the correlation of ultrasound and SWE with serum markers, this comparison must be explored further to establish facts. Hence, we conducted this study to evaluate the correlation between USG, shear wave elastography, and serological indices in patients with liver diseases.

MATERIALS AND METHODS

Source of Data

This hospital-based, prospective comparative study was conducted in the Department of Radiology at R.L. Jalappa Hospital and Research Centre attached to Sri Devaraj Urs Medical College, Tamaka, Kolar, over 18 months from September 2022 to February 2024. The study included patients with various diffuse hepatic diseases, such as alcoholic liver disease, non-alcoholic fatty liver disease, hepatitis B and hepatitis C infection.

Methodology

Inclusion Criteria

1. Patients diagnosed with alcoholic liver disease.
2. Patients with non-alcoholic fatty liver disease
3. Patients with deranged liver function tests.
4. Patients clinically and serologically diagnosed with liver diseases due to infective/ autoimmune/ drug-induced.

Exclusion Criteria

1. Pregnant patients.
2. Patients with insufficient breath holding or uncooperative.
3. Patients with moderate and gross ascites.
4. Patients diagnosed with liver tumours.

Informed written consent was obtained from every patient.

Sample size:

Bellamkonda S et al. reported the correlation coefficient (r) as 0.39. Assuming alpha error = 0.05 (95% Confidence Limit) and a power of 80%. The final required sample size was calculated to be 91.

$$n = \frac{\left(z_{1-\beta} + z_{1-\frac{\alpha}{2}}\right)^2}{\left(\frac{r^2}{1-r^2}\right)}$$

Where,

r : Correlation coefficient.

$Z_{1-\alpha/2}$: Desired confidence level

$1-\beta$: Power

Statistical Analysis:

The study encompassed both qualitative and quantitative variables. Qualitative variables were expressed as numbers (%), while quantitative variables were denoted by mean ± SD and Median (QR). The normality of the data was assessed via the Kolmogorov-Smirnov test. The Chi-square and Fisher exact test were utilised to explore associations between two independent qualitative variables. The significance of differences among ultrasound, clinical, and serological variables across SWE scores was assessed using the Nonparametric Kruskal Wallis test. Receiving Operating Characteristic (ROC) analysis was employed to ascertain the optimal SWE (Shear Wave Elastography) cut-off values for discriminating between various liver fibrosis stages based on SWE scores. Kendall's tau b correlation technique assessed relationships between ultrasound and serological variables. A confidence level of 95% was maintained for all statistical tests. SPSS 20 was employed for data analysis.

RESULTS:

Table 1 shows the distribution of age based on shear wave elastography stages.

Table 1 Age-wise Distribution.

Age	Distribution of age on basis of shear wave elastography stages				Total
	F0-F1	F2	F3	F4	
	N (%)	N (%)	N (%)	N (%)	
<45 years	14 (70.0%)	16 (69.6%)	12 (60.0%)	16 (57.1%)	58
>45 years	6 (30.0%)	7 (30.4%)	8 (40.0%)	12 (42.9%)	33
Total	20 (100.0%)	23 (100.0%)	20 (100.0%)	28 (100.0%)	91

Table 2 The table shows the distribution of complications by gender across different fibrosis stages (F0-F1, F2, F3, F4) based on the shear wave elastography stages. A chi-square test was applied (P- value 0.723). Males consistently represent a higher percentage in each stage (75.0% in F0-F1, 82.6% in F2, 85.0% in F3, and 85.7% in F4), indicating that males are more frequently affected across all stages. Females constitute a smaller proportion in each stage, highlighting a gender disparity in fibrosis severity. Gender is not significantly associated with the stages based on shear wave elastography.

Table 2 Gender-wise Distribution

	Stages on the basis of shear wave elastography stages				Total
Gender	F0-F1	F2	F3	F4	
	N (%)	N (%)	N (%)	N (%)	
Female	5 (25.0%)	4 (17.4%)	3 (15.0%)	4 (14.3%)	16
Male	15 (75.0%)	19 (82.6%)	17 (85.0%)	24 (85.7%)	75
Total	20 (100.0%)	23 (100.0%)	20 (100.0%)	28 (100.0%)	91

Table 3 Categories Fibrosis Stages (F0-F1, F2, F3, F4) According To Underlying Conditions

	Stages based on shear wave elastography stages				Total
Liver Disease	F0-F1	F2	F3	F4	
	N (%)	N (%)	N (%)	N (%)	
ALD	7 (35.0%)	12 (52.2%)	7 (35.0%)	26 (92.9%)	52
Hepatitis B	2 (10.0%)	4 (17.4%)	6 (30.0%)	0 (0.0%)	12
Hepatitis C	1 (5.0%)	0 (0.0%)	4 (20.0%)	1(3.6%)	6
NAFLD	10 (50.0%)	7 (30.4%)	3 (15.0%)	1 (3.6%)	21
Total	20 (100.0%)	23 (100.0%)	20 (100.0%)	28 (100.0%)	91

The table 3 categories fibrosis stages (F0-F1, F2, F3, F4) according to underlying conditions: Fisher Exact test (P Values < 0.05). ALD (Alcoholic Liver Disease), Hepatitis B, Hepatitis C, and NAFLD (Non-Alcoholic Fatty Liver Disease). ALD is most prevalent in advanced stages (92.9% in F4), indicating a severe progression. Hepatitis B shows significant presence in early and intermediate stages but none in F4. Hepatitis C peaks at F3 (20.0%) and drops drastically in F4 (3.6%). NAFLD is expected in early stages (50.0% in F0-F1), decreasing prevalence with advanced fibrosis. Type of liver disease is statistically significantly associated with stages based on shear wave elastography.

Table 4 Distribution Of Complications Based On Shear Wave Elastography

Complications	Stage of fibrosis based on shear wave elastography				Total
	F0-F1	F2	F3	F4	
Mild	2 (28.5%)	2 (25.0 %)	1 (10.0%)	2 (9.0 %)	7
Moderate	1 (14.2 %)	2 (25.0 %)	3 (30.0%)	5 (22.7%)	11
Severe	4 (57.1 %)	4 (50.0 %)	6 (60.0%)	15 (68.1%)	29
Total	7 (100.0%)	8 (100.0%)	10 (100.0%)	22 (100%)	47

Table 4 illustrates the distribution of fibrosis stages (F0-F1, F2, F3, F4) based on the presence of complications and the severity of complications in each stage

Table 5 Shows P values, sensitivity and specificity of cut-offs derived across various fibrosis stages based on shear wave elastography.

Test Result Variable(s)	AUC	P-Value	Asymptotic 95% Confidence Interval		Cut-off Value of SWE	Sensitivity	Specificity
			Lower Bound	Upper Bound			
(F0-F1) Vs F2	0.957	P<0.001	0.873	1.00	≥ 6.55	97%	95.5%
(F0-F1) Vs F 3	0.953	P<0.001	0.862	1.00	≥ 6.60	95%	90%
(F0-F1) Vs F4	0.993	P<0.001	0.976	1.00	≥ 7.50	96.4%	91.4%
F2 Vs F3	0.803	P<0.001	0.651	0.980	≥ 8.0	95%	77.6%
F2Vs F4	0.938	P<0.001	0.873	1.00	≥ 9.0	92.9%	79.8%
F3 Vs F4	0.898	P<0.001	0.790	1.00	≥ 9.15	89.3%	84.3%

Table 6 shows significant increases in APRI, KING's and FIB 4 scores across fibrosis stages (F0-F1, F2, F3, F4), with P-values < 0.001 for both measures.

SWE Stages	APRI	KING Score	FIB 4
F0-F1	0.45 (0.375-0.8)	7.1 (5.4-9.6)	0.70 (0.425-0.775)
F2	0.8 (0.7-1.1)	12.9 (12.1-14.1)	1.10 (0.90-1.30)
F3	0.95 (0.725-1.2)	13.5 (12.3-16.05)	1.56 (1.50-1.60)
F4	1.7 (1.425-1.875)	18 (16.825-18.85)	1.78 (1.67-1.90)
P - Value	P < 0.001	P < 0.001	P < 0.001

Based on the above results, the proposed cut-off for different stages of liver fibrosis

1. F0-F1 – **below 6.5 kPa**. – Suggestive of ordinary to mild disease/fibrosis
2. F2 – **> 6.5 kPa – 8 kPa** – Suggestive of moderate disease/fibrosis
3. F3 - **> 8 kPa – 9.15 kPa** – Suggestive of significant disease / advanced fibrosis
4. F4 - **> 9.15 kPa** – Suggestive of cirrhosis.

IMAGES:

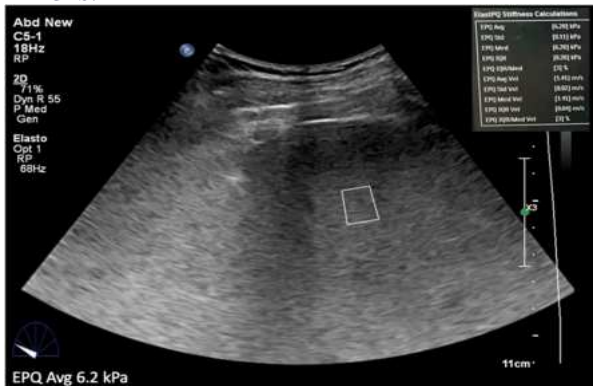

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Figure showing the case for routine check-ups. On ultrasound, the liver showed grade I fatty liver.

Median elastography values were 6.2 kPa, corresponding to the average value with APRI-0.45, FIB 4 - 0.91 – Suggestive of normal/mild fibrosis, i.e., stage FI disease.

DISCUSSION:

The management of chronic liver disease and its prognosis depends on the stage of fibrosis.[1] Although liver biopsies are commonly used for investigative purposes, the method also has several limitations, such as being invasive and costly. Also, it may bring about sampling errors and inter-and intra-observer variations when considering hepatic fibrosis. SWE is an innovative, non-invasive practice that evaluates liver fibrosis by assessing liver stiffness. Hence, these limitations of liver biopsy have encouraged research for non-invasive approaches for assessing liver fibrosis. SWE is an innovative practice grounded on shear waves and implemented using an investigative ultrasound method. Using B-mode ultrasound and shear wave elastography, this technique helps in more precise fibrosis staging.[2]

We evaluated the diagnostic performance of the APRI, King score and FIB-4 scores accompanying SWE in determining the stages of fibrosis (F0–F4). The main benefit of biochemical non-invasive scores (APRI, King score and FIB-4) in considering liver fibrosis is that they are generally available at a low cost and are very easy to perform. Though SWE measurement is not far and wide owing to the technical and practical field together with its unusual cost, on the other hand, its use is not widespread in low mid-income nations,[4,5] In contrast, APRI and FIB-4 scores are reliable for evaluating liver fibrosis. [5,6]

In the past few years, the number of liver biopsies has decreased because of the availability of non-invasive methods such as SWE and serum fibrosis indices for estimating liver fibrosis. Serum fibrosis indices such as APRI, FIB-4, and King's score are used for the non-invasive assessment of liver fibrosis.[4,7] A meta-analysis completed by Xiao et al.[7,8] indicated that serum fibrosis indices such as APRI, FIB-4, and King's score have moderate sensitivity and accuracy in identifying fibrosis.

Liver biopsy has been extensively regarded as the gold standard for assessing liver fibrosis. However, it has been nearly entirely replaced by non-invasive approaches that measure liver stiffness (LS), such as transient elastography (TE),[8] or biochemical markers and scoring systems.[8,9]. In the present study, two non-invasive techniques, SWE and serological findings, were evaluated for fibrosis grading in liver disease, and an agreement between SWE and serological findings (APRI, King's and FIB-4 scores) for the estimation of fibrosis grading in liver disease. A total of 91 patients were evaluated. The associations of the patient's characteristics at different stages of fibrosis were assessed using the chi-square test.

Nikolaos Papadopoulos *et al*. evaluated APRI/FIB-4 scores compared with TE-liver stiffness in detecting significant fibrosis or cirrhosis (F3 or F4). In that study, the authors retrospectively enrolled 575 patients with CHC who underwent TE-LS and found that both scores projected F4 patients adequately. This also shows that FIB-4 is a suitable evaluation for ruling out noncirrhotic patients.[10]

Another study was done by **Lun-Gen Lu *et al.*** in 2003 on the grading and staging of hepatic fibrosis and its correlation with non-invasive investigative considerations. That study aimed to examine the grades and stages of pathology and their relationship with hepatic fibrosis and non-invasive indicative factors. It was concluded that the categorising and staging of liver fibrosis are interconnected with serum markers, Doppler ultrasound, computed tomography (CT) scan and magnetic resonance imaging (MRI). The combinations of the above-stated non-invasive factors were recognised to be relatively sensitive and specific in determining liver fibrosis. The sensitivity, specificity and accuracy values were 80.36%, 86.67%, and 81.10%, respectively.[10]

Comparison Of Liver Stiffness Measured By SWE And Serum Fibrosis Indices

The results of the present study demonstrated moderate agreement, based on the correlation coefficient, between the SWE measurements and APRI, which was 0.541. The correlation coefficient between the SWE measurements and FIB-4 was 0.597, and between SWE and King's score was 0.576. All three serological indices, i.e. APRI, King's score and FIB4, strongly correlated with SWE.

Based on the Kendall Tau C correlation coefficient, Bellamkonda et al.'s study demonstrated moderate agreement between the SWE measurements and APRI, which was 0.46. In addition, there was moderate agreement based on the Kendall Tau C correlation coefficient between SWE measurements and FIB-4, which was 0.44. The SWE measurements and King's score showed a fair deal based on the Kendall Tau C correlation coefficient between SWE and FIB-4, which was 0.39.

Lee et al. and Lu et al. evaluated the correlation of SWE measurements and serum fibrosis indices (APRI and FIB-4) with HPE findings.[12,13] **Lee et al.** reported a significant positive correlation of ElastPQ, TE, and APRI with HPE findings.[12] **Lu et al.** concluded that liver stiffness (based on ElastPQ) demonstrated a significantly stronger correlation compared with fibrosis stages than APRI and FIB-4.[13]

Performance of SWE in the Estimation of Fibrosis In the present study, the diagnostic ability of SWE to differentiate the fibrosis stage was evaluated using AUC curve analysis. Patients were divided into a lack of significant fibrosis (F0–F1), significant-advanced fibrosis (F2–F3), and cirrhosis (F4). The ROC curves were plotted using stages (F0-F1) against F2, F3 and F4. The AUC was 0.957 for predicting a lack of significant fibrosis (F0-F1) over F2 using SWE measurements with optimum sensitivity and specificity of 100% and 95.5%. The AUC was 0.953 for predicting lack of significant fibrosis (F0-F1) over F3 using SWE measurements with optimum sensitivity and specificity of 95% and 90%.

The AUC was 0.993 for predicting a lack of significant fibrosis (F0-F1) over F4 using SWE measurements with optimum sensitivity and specificity of 96.4 % and 91.4%. The study demonstrates that SWE is effective in distinguishing between moderate (F2) and advanced fibrosis (F3), with a sensitivity of 95% and a specificity of 77.6% at a cut-off value of ≥8.0. It also shows excellent accuracy in distinguishing between moderate (F2) fibrosis and severe fibrosis/cirrhosis (F4), with a sensitivity of 92.9% and a specificity of 79.8% at a cut-off value of ≥9.0. SWE effectively differentiated advanced fibrosis (F3) from severe fibrosis/cirrhosis (F4), with a sensitivity of 89.3% and specificity of 84.3% at a cut-off value of ≥ 9.15.

Bellamkonda et al. demonstrated that the AUROC was 0.873 for the prediction of significant and advanced fibrosis (F2–F3) over a lack of significant fibrosis (F0–F1) using SWE measurements, and the cutoff value of the SWE measurements with optimum sensitivity and specificity was 7.07. The AUROC was 0.504 for the prediction of cirrhosis (F4) over significant-advanced fibrosis (F2–F3) using SWE measurements, and the cutoff value of SWE measurements with optimum sensitivity and specificity was 11.94. The present study showed better sensitivity and specificity than Bellamkonda et al.'s.[14]

Ferraioli et al. used the Fibro-Scan (TE) as the reference standard to evaluate the diagnostic performance of ElastPQ using the AUROC curve analysis. The cut-off values derived from the present study (e.g., 7.25 (mean) and 9.15, respectively, for significant fibrosis [≥F2] and cirrhosis [F4]) were comparable to those derived by **Ferraioli et al.**[15]

Ma et al. evaluated the reproducibility of ElastPQ technology in determining liver stiffness and also investigated the value of ElastPQ in liver fibrosis staging among chronic hepatitis B patients.[16] The cut-off value in the present study for the differentiation of cirrhosis (F4) and significantly advanced fibrosis F2 and F3 was ≥ 9.0 and ≥ 9.15. This was similar to the results obtained by **Ma et al.** (e.g., 9.0), and also, the sensitivity and specificity were high in the present study compared with that of **Ma et al**. [16]

In the present study, the liver texture is generally expected in the early

stages of fibrosis (F0-F1, F2). Still, as fibrosis progresses, the coarse texture becomes more prevalent, reaching 80.0% in F3 and 100.0% in F4, indicating a strong correlation between advanced fibrosis stages and coarse liver texture. There is a significant correlation between coarse echotexture, nodularity, surface irregularity and advanced fibrosis stages—normal echotexture declines from 35.0% in F0-F1 to 3.6% in F4.

Performance of ultrasound on liver size, spleen size, portal vein diameter and liver elastography across fibrosis stage Our study reveals that liver size decreases significantly with fibrosis progression, from 18.6 cm to 12.35 cm. Portal vein diameter increases from 12.6 mm to 14.6 mm, but this is not statistically significant. Liver stiffness increases from 6.1 Kpa to 21.1 Kpa, indicating a considerable increase. Spleen size slightly increases from 11.1 cm to 12.5 cm, but this is not statistically significant. The data suggests that liver elastography and size are crucial parameters in assessing fibrosis progression, while portal vein diameter and spleen size changes are less pronounced.

Performance of SWE in the Estimation of liver disease staging. The study found significant increases in APRI, KING and FIB 4 scores across fibrosis stages, indicating increased liver damage. The APRI score rose from 0.45 to 1.7, indicating liver damage, while the KING score increased from 7.1 to 18 and the FIB 4 score from 0.70 to 1.78, indicating worsening liver function. These scores are valuable for assessing liver fibrosis severity and monitoring disease progression.

Performance of SWE in the Estimation of liver size, portal vein (diameter), spleen (cm), evaluating APRI FIB 4 and King's score and estimation of fibrosis using shear wave elastography staging.
Our study found strong positive correlations between APRI, FIB4, and King's scores as the fibrosis stage increased. A moderate positive correlation was found with liver size, suggesting a modest association. No significant correlation was found with portal vein diameter. A weak positive correlation was found with liver elastography in kPa and spleen size. The present study found strong negative correlations between APRI, King's, and FIB 4 scores as liver size decreases and moderate positive correlations with portal vein diameter and spleen size. These findings suggest a moderate direct relationship between these parameters.

Our study found a weak positive correlation ($r=0.256$, $p<0.01$) between portal vein diameter and spleen size, suggesting a slight association. A moderate positive correlation between liver elastography values and APRI and KING scores was seen, and it increased both as liver elastography values increased. The study found a weak positive correlation between liver size and spleen size but a strong positive correlation between APRI and KING, indicating a significant association between these scoring systems for liver fibrosis assessment, and a strong positive correlation between FIB 4, and SWE, APRI, and KING Score.

A moderate positive correlation was seen between liver SWE values and APRI and King's scores. A weak positive correlation with liver size ($r=0.222$, $p=0.003$) indicates a slight association between spleen size and liver size. On significant and advanced fibrosis (F2–F3) over a lack of significant fibrosis (F0–F1) using SWE measurements, the cut-off value of the SWE measurements with optimum sensitivity and specificity was 7.07.

In the present study, we found different cut-off values for different fibrosis stages in different groups of fibrosis to distinguish their optimal cut-off values according to AUC and the diagnostic accuracies (sensitivity and specificity) of the Fibrosis index for predicting the performance of fibrosis accompanying ultrasound SWE elastography. The SWE has high AUC values for comparing stages (F0-F1) against F2, F3, and F4. For distinguishing between F0-F1 and F2, a cut-off value of ≥ 6.55 yields 97 % sensitivity and 95.5% specificity. SWE also demonstrates high accuracy in differentiating between minimal or no fibrosis (F0-F1) and advanced fibrosis (F3), with a sensitivity of 95% and a specificity of 90% at a cut-off value of ≥6.60. It also showed an outstanding discriminatory ability in differentiating between minimal or no fibrosis and severe fibrosis/cirrhosis (F4), with a sensitivity of 96.4% and a specificity of 91.4% at a cut-off value of ≥7.50. However, diagnostic accuracy decreased when distinguishing between adjacent stages, such as F2 vs. F3 and F3 vs. F4.

In a similar type of study, **Liaqat et al**. found different cutoff values for APRI and FIB-4 in different groups of fibrosis to distinguish their optimal cutoff values according to AUROC and the diagnostic accuracies (sensitivity and specificity) of APRI and FIB-4 (average AST level up-to 40 IU/L) for predicting the performance of APRI and FIB-4 accompanying ultrasound SW elastography.[17] **Yi-Hao Yen *et al.*** examined the optimum cut-off values of the two compound surrogates for envisaging cirrhosis by the AST level according to the AUROC analysis results differentiating cirrhotic (F4) from noncirrhotic (F0–F3).[22] They concluded that the ideal cut-off values of both APRI and FIB-4 to predict cirrhosis graded by AST levels could be more practicable compared to the single cut-off values offered in the preceding research paper.[18]

Conferring to former findings, APRI and FIB-4 were associated with the international normalised ratio, albumin level, and neuroinflammatory score.[13,14] Additionally, the positive correlations of APRI and FIB-4 with neuroinflammatory score also kept our theory that the use of APRI and FIB-4 causes a possibility of overrating the fibrosis stage due to the influence of neuroinflammatory activity on transaminases [12,14] and the indicative precision of FIB-4 foreseeing liver fibrosis was found to be equivalent to or superior to that of APRI.[14] The SWE is a readily available, repeatable, and cost-effective modality. It can be used as a non-invasive alternative to the biopsy for grading liver fibrosis and follow-up of chronic viral hepatitis patients. Biopsy is a gold standard and invasive test that can be reserved for specific clinical settings and baseline evaluation of fibrosis. SWE correlates more with APRI, King's Score, and FIB-4 markers for differentiating F0-F1 from clinically significant F2-F4 fibrosis. The serological indices can be combined with SWE for post-treatment follow-up of liver fibrosis patients, thus avoiding repeated biopsy.

CONCLUSION:

With advancing fibrosis, liver size and stiffness significantly change. Increased liver echogenicity with smooth echotexture suggests mild fibrosis, while coarse liver texture correlates with advanced fibrosis stages. Type of liver disease is significantly associated with fibrosis stages. Cases of alcoholic liver disease predominantly showed advanced stage of liver fibrosis. Meanwhile, the cases of NAFLD showed mild stages of fibrosis. These findings suggest liver echotexture and disease pathology significantly influence fibrosis stages, and elastography, along with 2D and color Doppler imaging, can serve as a crucial parameter in fibrosis progression assessment.

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