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Comparing Fibroscan with MR Elastography in Staging of Fibrosis as Noninvasive Methods in Chronic Hepatitis B Patients

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ABSTRACT

Evaluating liver fibrosis in chronic hepatitis B (CHB) patients is crucial for guiding management and treatment decisions. Liver biopsy, while the gold standard, is invasive and associated with complications. Magnetic Resonance Elastography (MRE) and Transient Elastography (TE), commonly known as FibroScan, have emerged as non-invasive alternatives for liver stiffness measurement (LSM) in assessing fibrosis. This study compares the diagnostic accuracy and effectiveness of MRE and TE in staging liver fibrosis in CHB patients. In this cross-sectional study, 30 chronic hepatitis B (CHB) patients were recruited. Each patient underwent both MRE and TE and liver stiffness values were measured using predefined cut-offs. For TE, fibrosis stages were defined as: <7 kPa (F0), 7-10 kPa (F1), 10-13 kPa (F2), 13-16 kPa (F3) and >16 kPa (F4). MRE measurements categorized fibrosis as normal (<2.5 kPa) and advanced fibrosis or cirrhosis (>5.0 kPa). Spearman correlation analysis and Kappa statistics were used to assess the correlation and agreement between MRE and TE, respectively. TE results showed that 60% of patients had no significant fibrosis (F0), 30% had mild fibrosis (F1) and 6.7% had cirrhosis (F4). MRE classified 83.3% of patients as F0, with fewer patients at advanced fibrosis stages (3.3% each in F3 and F4). Spearman's correlation analysis revealed a strong correlation between TE and MRE scores (rho=0.692, p<0.001). However, only moderate agreement was found between TE and MRE (Kappa k=0.484, p<0.001), indicating some variability between the methods. MRE demonstrated superior accuracy in detecting early fibrosis and provided a more comprehensive liver stiffness assessment. MRE offers higher diagnostic accuracy and reliability in staging liver fibrosis compared to TE, particularly in identifying early and advanced fibrosis stages. However, both methods are valuable non-invasive tools for clinical decision-making in CHB patients. Given MRE's greater precision but higher resource requirements, the choice between these two methods may depend on the clinical setting, availability and patient characteristics.

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Key Words

Liver fibrosis, hepatitis B, non-invasive diagnostics, magnetic resonance elastography (MRE), transient elastography (TE), liver stiffness measurement (LSM), fibroscan

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INTRODUCTION

Liver fibrosis is a progressive pathological condition that arises from sustained liver injury, including chronic infections such as hepatitis B virus (HBV) infection. Fibrosis is marked by the excessive accumulation of extracellular matrix (ECM) proteins, especially collagen, which disrupts the normal architecture of the liver and impairs its function[1]. If fibrosis is not appropriately managed, it can progress to cirrhosis, a more severe liver condition characterized by irreversible scarring. Cirrhosis can lead to life-threatening complications such as portal hypertension, hepatic encephalopathy, variceal bleeding and ascites. Most notably, it significantly increases the risk of developing hepatocellular carcinoma (HCC), which is one of the leading causes of cancer-related deaths worldwide[2,3]. Chronic hepatitis B (CHB) is one of the major causes of liver fibrosis globally. According to the World Health Organization (WHO), an estimated 240 million people are chronically infected with HBV and around 887,000 people die annually from complications related to CHB, such as cirrhosis and HCC[4]. The burden of CHB is disproportionately higher in regions such as East Asia, sub-Saharan Africa, and parts of Eastern Europe, where the disease is endemic[5]. The progression of liver fibrosis in CHB patients varies depending on factors such as viral load, genotype and co-infections. However, without timely intervention, many patients are at risk of progressing to advanced liver disease. The global burden of liver fibrosis and cirrhosis represents a substantial challenge for healthcare systems, particularly in low- and middle-income countries[6]. In addition to the clinical burden, the financial costs associated with the management of CHB, liver fibrosis, and its complications are considerable. For instance, liver transplantation is often the only option for patients with end-stage liver disease, but the availability and cost of this procedure are prohibitive for many patients in high-prevalence regions[7].

Importance of Non-Invasive Diagnostics for Liver Fibrosis: Traditionally, liver biopsy has been regarded as the gold standard for diagnosing and staging liver fibrosis. A liver biopsy involves the extraction of a tissue sample from the liver, which is then evaluated histologically to determine the degree of fibrosis. However, this method is invasive, painful and associated with risks such as bleeding and infection. Moreover, the accuracy of biopsy results can be compromised by sampling variability due to the heterogeneous distribution of fibrosis within the liver, leading to misclassification of fibrosis stages in some cases[8]. In recent years, there has been a growing demand for non-invasive methods to assess liver fibrosis. These alternatives not only reduce patient discomfort but also provide more consistent results by assessing larger areas of the liver. Two of the most widely studied non-invasive techniques are Magnetic Resonance Elastography (MRE) and Transient Elastography (TE)[9]. These imaging modalities have revolutionized the diagnosis and management of liver fibrosis by offering a safer, quicker and more patient-friendly alternative to liver biopsy. MRE combines magnetic resonance imaging (MRI) with mechanical vibrations to produce quantitative maps of liver stiffness, providing a comprehensive assessment of liver fibrosis across the entire organ[10]. TE, commonly known as FibroScan, measures liver stiffness by tracking the speed of a shear wave generated by a vibrating transducer as it passes through the liver. While both methods have demonstrated high accuracy in detecting liver fibrosis, they also have distinct advantages and limitations that make them suitable for different clinical scenarios[11,12].

Chronic Hepatitis B and Fibrosis: A Clinical Challenge For CHB patients, early and accurate staging of liver fibrosis is crucial to inform treatment decisions and prevent the progression to cirrhosis or HCC. As liver fibrosis is a key predictor of disease progression in CHB, identifying the degree of fibrosis allows clinicians to decide whether to initiate antiviral therapy, which can halt or reverse fibrosis progression in many cases[13]. Moreover, regular monitoring of liver stiffness is essential to assess treatment efficacy and adjust therapeutic strategies accordingly. Recent advancements in non-invasive diagnostic methods, particularly MRE and TE, have provided clinicians with valuable tools for monitoring CHB patients without the need for repeated invasive biopsies. Studies suggest that MRE offers superior diagnostic accuracy in detecting early stages of fibrosis, especially in patients with complicating factors such as obesity or ascites, which can limit the accuracy of TE[14]. However, TE remains a widely accepted method due to its ease of use, quick results and lower cost compared to MRE[15].

Literature Review: MRE vs. TE in Detecting Liver Fibrosis: Several studies have compared the diagnostic accuracy and clinical utility of MRE and TE for staging liver fibrosis in CHB patients. In a study by Yoon *et al.*, MRE was found to have a higher sensitivity for detecting early fibrosis (F1) compared to TE, with an area under the receiver operating characteristic curve (AUROC) of 0.92 versus 0.85, respectively[16]. Additionally, MRE was less affected by factors such as patient body habitus or the presence of ascites, which can compromise TE measurements[17]. However, TE remains a valuable tool for fibrosis staging, particularly in resource-limited settings where MRE may not be available. A study by Castera *et al.* demonstrated that TE had a sensitivity of 83% and a specificity of 85% for detecting significant fibrosis (F2 and above), making it a reliable alternative to liver biopsy in many clinical

settings[18]. The choice between MRE and TE often depends on the clinical context, with MRE being favoured for its comprehensive liver assessment and TE preferred for its accessibility and ease of use.

Rationale for the Study: Given the high global burden of CHB and the importance of early fibrosis detection, there is a clear need to assess the utility of non-invasive diagnostic methods like MRE and TE. This study aims to compare the diagnostic accuracy and effectiveness of these two modalities in detecting and staging liver fibrosis in CHB patients. By evaluating the strengths and limitations of MRE and TE, the study seeks to provide guidance for clinicians on the optimal use of these non-invasive tools in routine practice.

Aims and Objectives: aim of the study is to compare the diagnostic accuracy of Magnetic Resonance Elastography (MRE) and Transient Elastography (TE) in staging liver fibrosis in chronic hepatitis B patients.

- To assess the correlation between liver stiffness measurements obtained from MRE and TE in CHB patients.
- To determine the sensitivity and specificity of MRE and TE for detecting significant fibrosis (F2 and above).
- To evaluate the feasibility of using MRE and TE as non-invasive alternatives to liver biopsy for fibrosis staging in CHB patients.

MATERIALS AND METHODS

Study Design: This study was a cross-sectional descriptive survey conducted to evaluate the effectiveness of Magnetic Resonance Elastography (MRE) and Transient Elastography (TE) for staging liver fibrosis in chronic hepatitis B (CHB) patients.

Study Setting and Duration: The study was conducted in the Department of Radiology at GSVM Medical College, Kanpur, Uttar Pradesh, between September 2023 and June 2024. All diagnostic tests, patient evaluations, and elastography measurements were performed at this location.

Study Population:

Inclusion Criteria:

- Patients diagnosed with chronic hepatitis B (CHB) and confirmed liver fibrosis.
- Age range: 19-59 years.
- Patients without clinical or imaging signs of decompensated cirrhosis.
- Patients who provided written informed consent for study participation, including willingness to undergo both MRE and TE.

Exclusion Criteria:

- Patients with decompensated liver disease or prior history of liver decompensation.
- Uncontrolled diabetes mellitus or other significant co-morbidities affecting liver function.
- Coinfection with Hepatitis C Virus (HCV) or HIV.
- Non-alcoholic steatohepatitis (NASH) or a history of significant alcohol use, defined as >21 units/week for men and >14 units/week for women as per National Institute on Alcohol Abuse and Alcoholism (NIAAA) guidelines.
- History of hepatotoxic drug intake, or conditions such as hepatic encephalopathy, variceal bleeding, ascites, thrombocytopenia (platelet count <60,000/μL), or an abnormal prothrombin time (INR >1.5).
- Contraindications to MRI, including claustrophobia, metallic foreign bodies and implanted medical devices (such as pacemakers).
- Pregnant women and patients who refused to provide consent for participation or specific study procedures.

Ethical Considerations: The study was conducted in full compliance with ethical guidelines and was approved by the institutional ethics committee of GSVM Medical College, Kanpur. Written informed consent was obtained from all participants after explaining the nature and purpose of the study. Confidentiality was ensured by assigning unique identification numbers to each patient and all data were stored securely to maintain privacy. Given the potential social stigma associated with CHB, extra precautions were taken to ensure that no patient information was disclosed. The study adhered to ICMR guidelines on research involving human participants and no vulnerable groups were included in this study.

Sample Size Calculation: A total of 30 patients were enrolled in the study based on the availability of eligible participants at the study site during the defined period. The sample size was calculated using a power analysis designed to detect a moderate correlation (Spearman's rho $\geq$0.5) between MRE and TE with 80% power and a significance level of $p<0.05$.

Data Collection: Comprehensive clinical history and demographic data were collected from each patient. This included age, sex, disease duration and treatment history, as well as relevant medical records such as laboratory findings, viral load and liver function tests (LFTs). Laboratory investigations included HBsAg, HBeAg, prothrombin time/international normalized ratio (PT/INR) and liver function tests to assess hepatic function. An abdominal ultrasound was performed on all patients to evaluate for cirrhosis, portal hypertension and ascites. Patients were subjected to both MRE and TE within one month of each other to ensure consistency in staging fibrosis.

Magnetic Resonance Elastography (MRE): MRE was performed using a 3 Tesla (3T) Siemens Healthineers MR scanner. Shear waves at a frequency of 60 Hz were generated by an active driver, with a passive driver placed on the patient's upper abdomen in the 5th intercostal space, lateral to the mid-clavicular line. The passive driver was secured using an elastic belt for firm contact with the body, ensuring uniform wave propagation.

The MRE Protocol Consisted of Two Sequences:

- T2 HASTE (half-Fourier acquisition single-shot turbo spin echo) coronal and axial images.
- T1 VIBE (volumetric interpolated breath-hold examination) DIXON axial images, both in-phase and opposed-phase).

Elastograms were automatically processed and liver stiffness measurements (LSMs) were generated through weighted arithmetic means from the regions of interest (ROIs) drawn on the elastograms. Liver stiffness values were classified as follows:

- <2.5 kPa: normal liver tissue.
- 2.5-3.0 kPa: normal or inflammatory liver tissue.
- 3.0-3.5 kPa: Stage 1-2 fibrosis.
- 3.5-4.0 kPa: Stage 2-3 fibrosis.
- 4.0-5.0 kPa: Stage 3-4 fibrosis.
- >5.0 kPa: advanced fibrosis or cirrhosis.

Transient Elastography (TE): TE, also known as FibroScan, was performed using the Echosens Vibration-Controlled Transient Elastography (VCTE) device. A 5 MHz ultrasound transducer attached to a vibrating base was used to generate shear waves through the liver tissue. Liver stiffness was calculated using the formula $E=3pV^2$, where is the tissue density and V is the velocity of the shear wave. Measurements were considered reliable if:

- A minimum of 10 valid readings were recorded.
- The success rate was ≥60%.
- The interquartile range/median ratio (IQR/M) was ≤30%.

Liver stiffness values measured by TE were categorized as:

- <7 kPa: F0 (no fibrosis).
- 7–10 kPa: F1 (mild fibrosis).
- 10–13 kPa: F2 (moderate fibrosis).
- 13–16 kPa: F3 (severe fibrosis).
- >16 kPa: F4 (cirrhosis).

Patients were instructed to fast for at least three hours before the TE procedure to ensure accurate readings. All measurements were performed by an experienced operator and any unreliable or incomplete measurements were excluded from the analysis.

Statistical Analysis: The data were analysed using SPSS software (version 26.0). Descriptive statistics, including mean and standard deviation, were calculated for continuous variables, while categorical data were expressed as frequencies and percentages.

- Spearman's correlation analysis was used to assess the relationship between MRE and TE liver stiffness measurements.
- Kappa statistics were applied to evaluate the agreement between MRE and TE in staging liver fibrosis.
- P-values of less than 0.05 were considered statistically significant. The analysis aimed to compare the diagnostic accuracy of MRE and TE, emphasizing their potential as non-invasive alternatives to liver biopsy in CHB patients.

RESULTS AND DISCUSSIONS

The study included a total of 30 patients diagnosed with chronic hepatitis B (CHB). The majority of participants (46.7%) were aged between 26 and 30 years, with a mean age of 29.23±6.07 years. Of these participants, 60% were male and 40% were female, as detailed in (Table 1). The primary aim of the study was to assess the diagnostic accuracy of Magnetic Resonance Elastography (MRE) and Transient Elastography (TE) for staging liver fibrosis in this patient cohort.

Fibrosis Staging by Transient Elastography (TE) and Magnetic Resonance Elastography (MRE): The fibrosis stages of all patients were assessed using both TE and MRE. Transient Elastography results indicated that:

- 60% of patients were classified as F0 (no significant fibrosis),
- 30% were classified as F1 (mild fibrosis),
- 6.7% of patients were identified as having F4 (cirrhosis), reflecting advanced fibrosis.

In Contrast, MRE Identified:

- 83.3% of patients as F0 (no significant fibrosis),
- A smaller percentage (3.3% each) in advanced fibrosis stages (Fig. 3), indicating fewer cases of severe fibrosis compared to TE.

These findings are detailed in (Table 2), which highlights the distribution of fibrosis stages between the two methods. MRE consistently identified more patients in the early stages of fibrosis (F0), whereas TE showed a higher proportion of patients with more advanced fibrosis (Fig. 1).

Viral Load and Clinical Characteristics: Regarding viral load, 30% of patients had a viral load of ≤1000 copies/mL, indicating a low viral load, while 30% of patients had been diagnosed with CHB for ≤1 year. Additionally, 66.7% of patients were not receiving any

antiviral treatment at the time of the study, as illustrated in (Table 3), which presents detailed clinical and demographic characteristics.

Comparing Diagnostic Accuracy of MRE and TE: A key finding of the study was the superior diagnostic accuracy of MRE, particularly in detecting early-stage fibrosis. MRE classified 83.3% of patients as F0, compared to 60% by TE, demonstrating MRE's higher sensitivity in identifying patients without significant fibrosis. This can be attributed to MRE's ability to assess a larger volume of liver tissue and produce three-dimensional stiffness maps, which minimize sampling errors, as shown in (Fig. 1). TE, on the other hand, measures liver stiffness in a localized area, which can increase the risk of missing early-stage fibrosis, especially in patients with unevenly distributed fibrosis. The distinction between MRE and TE in identifying early fibrosis has important clinical implications, as early detection can significantly influence management and treatment outcomes for CHB patients. Moreover, the lower percentage of patients classified as F4 (advanced fibrosis) by MRE suggests that TE might overestimate fibrosis in certain patients, possibly due to technical limitations such as difficulty in wave propagation in patients with high BMI or significant ascites, as demonstrated.

Statistical Analysis and Agreement Between MRE and TE: A Spearman's correlation analysis was performed to evaluate the relationship between MRE and TE scores and a significant correlation (rho=0.692, $p<0.001$) was observed between the two methods. Despite this strong correlation, a Kappa statistic was applied to assess the agreement between fibrosis stages classified by both methods. The Kappa value ($k=0.484$, $p<0.001$) indicated moderate agreement between MRE and TE. This moderate agreement is crucial in clinical practice, as it underscores the fact that MRE and TE, while providing valuable insights into fibrosis staging, may not classify stages identically. MRE's ability to offer a comprehensive liver assessment provides an advantage in terms of diagnostic accuracy and precision, particularly for early-stage fibrosis. TE, however, may underestimate or overestimate fibrosis due to the limitations of its technique, which is more prone to error in certain patient populations, such as those with obesity or ascites. The chi-square test comparing fibrosis staging between MRE and TE yielded a chi-square value of 64.29 ($p<0.001$), reinforcing the statistical significance of the differences observed between the two methods in fibrosis staging. The moderate agreement between MRE and TE suggests that, while both are valuable non-invasive tools, they are not interchangeable. MRE, due to its higher accuracy, should be preferred in clinical settings where accurate staging is critical, whereas TE remains a viable option for rapid assessments, especially in resource-limited settings. The results of this study highlight the clinical relevance of choosing the appropriate diagnostic tool for assessing liver fibrosis in CHB patients. MRE demonstrated higher diagnostic accuracy in staging early fibrosis and showed greater reliability in detecting advanced fibrosis compared to TE. The moderate agreement between the two methods (Kappa=0.484) suggests that MRE provides a more comprehensive evaluation of liver stiffness, making it the preferred non-invasive method for diagnosing fibrosis in CHB patients with complicating factors, such as obesity and ascites.

The accurate assessment of liver fibrosis is critical in managing chronic hepatitis B (CHB) patients due to its implications for prognosis and therapeutic decision-making. Traditionally, liver biopsy has been considered the gold standard for diagnosing liver fibrosis., however, the invasiveness and associated risks have made non-invasive alternatives such as Magnetic Resonance Elastography (MRE) and Transient Elastography (TE) increasingly attractive[1,2].In this study, MRE demonstrated higher diagnostic accuracy compared to TE, particularly in detecting early-stage fibrosis (F0), with MRE classifying 83.3% of patients as F0 compared to 60% by TE. The improved accuracy of MRE can be attributed to its ability to assess a larger tissue volume, which reduces the impact of sampling variability often encountered in TE[3].

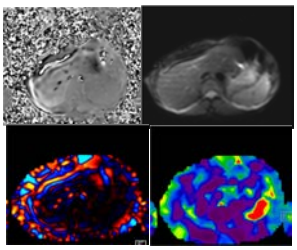

Fig. 1: Showing Raw Images Acquired by MRE Algorithm, Phase Image(A), Magnitude Image(B) and Postprocessed Elasograms, wave Image(C) and Colour Map(D)

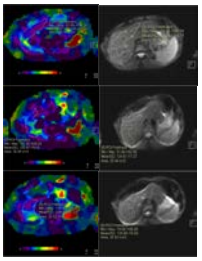

Fig. 2: Showing LSM Measurements in a Patient with Chronic Hepatitis B on 95% Confidence Map Slices (A,C,E,G) Using Free Hand ROIs and Confirming that ROIs Placed on the Liver on Magnitude Images (B,D,F,H)

Table 1: Demographic Characteristics of Chronic Hepatitis B Patients

Parameter	Number (n=30)	Percentage(%)
Age		
18-25 years	7	23.3%
26-30 years	14	46.7%
31-45 years	8	26.7%
46-50 years	1	3.3%
Mean±SD	29.23±6.07	
Sex		
Male	18	60.0%
Female	12	40.0%

Table 2: Clinical Characteristics of Chronic Hepatitis B Patients

Fibrosis Stage by TE			Fibrosis Stage by MRE	Viral Load (copies/mL)				
F0	18	60.0%	F0	25	83.3%	0–1000	9	30.0%
F1	9	30.0%	F1	3	10.0%	1000–10,000	8	26.7%
F2	1	3.3%	F2	0	0.0%	10,000–100,000	5	16.7%
F3	0	0.0%	F3	1	3.3%	>100,000	8	26.7%
F4	2	6.7%	F4	1	3.3%			
Treatment Status				Duration of Disease				
Not on Treatment	20	66.7%	≤1 year	9	30.0%			
On Treatment	10	33.3%	>1 year – 5 years	16	53.3%			
			>5 years	5	16.7%			

Table 3: Association and Agreement Between TE and MRE in Detecting Fibrosis Staging

TE Stage	MRE Stage F0 (%)	MRE Stage F1 (%)	MRE Stage F2 (%)	MRE Stage F3 (%)	MRE Stage F4 (%)
F0	25 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
F1	0 (0.0%)	3 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
F2	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
F3	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (100.0%)	0 (0.0%)
F4	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (100.0%)

MRE generates three-dimensional liver stiffness maps, allowing for a more comprehensive evaluation of fibrosis, while TE relies on shear wave propagation through a smaller portion of the liver, increasing the risk of underestimating early fibrosis in patients with heterogeneous liver tissue[4]. This ability of MRE to capture fibrosis over a larger area likely account for the detection of a higher proportion of patients without significant fibrosis (F0) compared to TE. Previous studies have similarly highlighted the advantages of MRE over TE. For example, Singh[5]. found that MRE exhibited higher sensitivity and specificity for detecting early-stage and advanced fibrosis, particularly in patients with complicating factors such as obesity or ascites[5]. These findings are consistent with the results of our study, where MRE was more effective at detecting fibrosis across the spectrum of disease stages. In contrast, TE is more prone to inaccuracies in patients with high BMI or ascites, both of which attenuate the shear waves generated during TE[6].

Clinical Implications: The findings of this study have significant clinical implications, particularly in settings where liver biopsy is either unavailable or not feasible due to resource limitations or patient preferences. MRE's superior diagnostic accuracy makes it the preferred method for staging fibrosis in CHB patients, especially in tertiary care centers where advanced imaging technologies are accessible. Its ability to detect early-stage fibrosis (F0 and F1) is critical for initiating timely antiviral therapy, which can halt or reverse fibrosis progression in CHB patients[7]. Furthermore, the moderate agreement between MRE and TE (Kappa k=0.484, p<0.001) suggests that while both methods can be used in clinical practice, TE may be better suited for screening and monitoring in primary care settings where access to MRE may be limited. In resource-constrained regions, TE's quick and operator-independent results make it a valuable tool for identifying patients who require further evaluation[8]. However, MRE should be considered in patients with complicating factors such as obesity or ascites, where TE may yield less reliable results. The moderate agreement between MRE and TE also underscores the need for clinicians to consider both methods' limitations when interpreting liver stiffness measurements. In practice, combining these two modalities in specific clinical settings may enhance diagnostic accuracy and optimize patient outcomes, particularly in regions with a high burden of CHB[9]. As liver biopsy becomes increasingly less desirable due to its risks, MRE and TE offer safer and effective alternatives, making them essential tools in the global effort to reduce liver disease morbidity and mortality[10].

Limitations and Future Research: This study has some limitations that must be considered when interpreting the results. The sample size of 30 patients limits the generalizability of the findings, particularly to populations outside of the geographic region where the study was conducted. Additionally, all patients were enrolled from a single tertiary care center, which may not be representative of patients with CHB in other settings, such as those seen in primary care or rural health centers. Future research should focus on

conducting multi-center studies with larger and more diverse patient populations to validate the findings of this study. Specifically, longitudinal studies could assess how changes in liver stiffness over time, as measured by MRE and TE, correlate with disease progression and the effectiveness of antiviral therapies. Another important avenue for future research is the development of diagnostic algorithms that combine non-invasive imaging methods with serum biomarkers to enhance the accuracy of fibrosis staging[11]. Furthermore, MRE's availability is currently limited to specialized centers due to its high cost and the need for advanced MRI equipment. Research into making MRE more cost-effective and accessible could significantly expand its use, particularly in low-and middle-income countries where the burden of CHB is highest[12]. Future studies should also explore the cost-benefit analysis of incorporating MRE into routine care for CHB patients, compared to the more widely available TE.

Comparisons with Existing Literature: The results of this study are consistent with existing literature that highlights the superior diagnostic accuracy of MRE over TE in detecting liver fibrosis. For instance, a meta-analysis by Singh[5] found that MRE had a higher area under the receiver operating characteristic curve (AUROC) for detecting significant fibrosis, advanced fibrosis and cirrhosis compared to TE[13]. Similarly, Yoon[8] demonstrated that MRE provided a more reliable assessment of liver stiffness in patients with high BMI or ascites, conditions known to affect the accuracy of TE[14]. However, some studies have reported discrepancies in the accuracy of MRE and TE, which may be due to differences in patient populations, equipment, or study methodologies. For example, Degos[15]. found that TE was more effective at detecting cirrhosis in non-viral liver diseases such as alcoholic liver disease or non-alcoholic fatty liver disease (NAFLD)[15]. The variability in elastography results across different liver diseases highlights the need for disease-specific diagnostic criteria when using MRE or TE for fibrosis staging. Differences in the equipment used for MRE and TE, as well as operator expertise, may also contribute to variability in study results, further emphasizing the need for standardized protocols[16].

Conceptualization within Global Guidelines: The findings of this study align with the recommendations of the American Association for the Study of Liver Diseases (AASLD) and the European Association for the Study of the Liver (EASL), both of which advocate for the use of non-invasive methods like MRE and TE in the evaluation of liver fibrosis[17]. According to the AASLD, non-invasive methods should be used to stage liver fibrosis in patients with chronic viral hepatitis before deciding on the initiation of antiviral therapy[18]. The EASL guidelines similarly recommend that non-invasive elastography methods be used for monitoring disease progression in patients undergoing treatment for CHB[19]. The findings of this study reinforce the importance of these guidelines by demonstrating the superior accuracy of MRE, particularly for early-stage fibrosis, and suggesting that both MRE and TE are valuable tools for staging fibrosis in clinical practice. However, MRE's role in early detection and TE's applicability in resource-limited settings should guide clinicians in choosing the appropriate modality based on the clinical context.

CONCLUSION

This study underscores the superior diagnostic accuracy and comprehensive assessment capabilities of Magnetic Resonance Elastography (MRE) compared to Transient Elastography (TE) in staging liver fibrosis in chronic hepatitis B (CHB) patients. MRE demonstrated higher precision, particularly in the early and advanced stages of fibrosis, due to its ability to assess liver stiffness over a larger tissue volume, reducing the impact of sampling errors commonly associated with other methods. While both MRE and TE serve as reliable non-invasive options, MRE's detailed liver stiffness mapping provides a more valuable tool for hepatologists, particularly in clinical settings requiring high diagnostic accuracy.

Clinical Recommendations: Based on these findings, MRE should be considered the first-line non-invasive tool for fibrosis staging in patients with chronic hepatitis B, especially in settings where advanced imaging facilities are available. MRE's ability to detect early-stage fibrosis is critical for guiding timely interventions and treatment decisions, making it a crucial asset in managing CHB. However, TE remains a valuable screening tool, particularly in primary care and resource-limited settings where quick assessments are necessary. Together, MRE and TE can be integrated into routine clinical practice to enhance early detection and improve long-term patient outcomes.

Next Steps for Research: Further research is needed to refine the diagnostic algorithms for liver fibrosis. Future studies should explore multi center trials to validate these findings across diverse populations, as well as longitudinal studies that follow CHB patients over time to evaluate how changes in liver stiffness measurements reflect disease progression and treatment response. Additionally, developing a combined diagnostic approach that integrates MRE, TE, and serum biomarkers could enhance the accuracy of fibrosis staging and provide a more holistic view of liver

health. Collaborative research efforts are essential to optimize these diagnostic tools, reduce healthcare disparities and address the global burden of liver fibrosis. Innovations in personalized medicine and cost-effective imaging technologies will also play a key role in improving access to non-invasive diagnostics worldwide.

REFERENCES

1. Huwart, L., F. Peeters, R. Sinkus, L. Annet and N. Salameh *et al.,* 2006. Liver fibrosis: Non-invasive assessment with MR elastography. NMR Biomed., 19: 173-179.
2. Bataller, R. and D.A. Brenner, 2005. Liver fibrosis. J. Clin. Invest., 115: 209-218.
3. Roth, G.A., D. Abate, K.H. Abate, S.M. Abay and C. Abbafati et al., 2018. Global, regional and national age-sex-specific mortality for 282 causes of death in 195 countries and territories, 1980–2017: A systematic analysis for the Global Burden of Disease Study 2017. The Lancet, 392: 1736-1788.
4. Sarin, S.K., M. Kumar, G.K. Lau, Z. Abbas and H.L.Y. Chan et al., 2016. Asian-Pacific clinical practice guidelines on the management of hepatitis B: A 2015 update. Hepatology Int., 10: 1-98.
5. Singh, S., S.K. Venkatesh, Z. Wang, F.H. Miller and U. Motosugi et al., 2015. Diagnostic Performance of Magnetic Resonance Elastography in Staging Liver Fibrosis: A Systematic Review and Meta-analysis of Individual Participant Data. Clin. Gastroenterol. Hepatology, 13: 440-451.
6. Marcellin, P., D.K. Wong, W. Sievert, P. Buggisch, J. Petersen and R. Flisiak, *et al.,* 2007. Hepatitis B virus (HBV) genotype and response to adefovir dipivoxil: results from a 5-year multicenter study. J Hepatol., 46: 172-179.
7. Bravo, A.A., S.G. Sheth and S. Chopra, 2001. Liver Biopsy. New Engl. J. Med., 344: 495-500.
8. Yoon, J.H., J.M. Lee and M.H. Yu, *et al.,* 2013. Quantitative assessment of hepatic fibrosis in chronic hepatitis B patients: Comparison of magnetic resonance elastography and transient elastography. Korean J Radiol., 14: 79-86.
9. Hepotal, J., 2015. EASL-ALEH Clinical Practice Guidelines. Non-invasive tests for evaluation of liver disease severity and prognosis. J Hepatol., 63: 237-234.
10. Kim, D., W.R. Kim, J.A. Talwalkar, H.J. Kim and R.L. Ehman, 2013. Advanced Fibrosis in Nonalcoholic Fatty Liver Disease: Noninvasive Assessment with MR Elastography. Radiology, 268: 411-419.
11. Petta, S., V.D. Marco, C. Cammà, G. Butera, D. Cabibi and A. Craxì, 2009. Reliability of liver stiffness measurement in non-alcoholic fatty liver disease: The effects of body mass index. Aliment. Pharmacol. & Ther., 29: 297-305.
12. Terrault, N.A., A.S.F. Lok, B.J. McMahon, K. Chang and J.P. Hwang *et al.,* 2018. Update on prevention, diagnosis, and treatment of chronic hepatitis B. Hepatology, 67: 1560-1599.
13. Tapper, E.B. and R. Loomba, 2018. Noninvasive imaging biomarker assessment of liver fibrosis by elastography in NAFLD. Nat. Rev. Gastroenterol. and Hepatology, 15: 274-282.
14. Kim, S.U., G.H. Choi and W.K. Han, *et al.,* 2012. Magnetic resonance elastography for non-invasive assessment of liver fibrosis: Performance in chronic hepatitis B compared to transient elastography. Eur Radiol., 22:507-515.
15. Degos, F., P. Perez, B. Roche, A. Mahmoudi, J. Asselineau, H. Voitot and P. Bedossa, 2010. Diagnostic accuracy of FibroScan and comparison to liver fibrosis biomarkers in chronic viral hepatitis: A multicenter prospective study (the FIBROSTIC study). J. Hepatology, 53: 1013-1021.
16. Castera, L., X. Forns and A. Alberti, 2008. Non-invasive evaluation of liver fibrosis using transient elastography. J. Hepatology, 48: 835-847.
17. Friedman, S.L., 2008. Mechanisms of Hepatic Fibrogenesis. Gastroenterology, 134: 1655-1669.
18. Castera, L. and M. Pinzani, 2010. Non-invasive assessment of liver fibrosis: Are we ready? The Lancet, 375: 1419-1420.
19. Yin, M., J.A. Talwalkar, K.J. Glaser, A. Manduca and R.C. Grimm *et al.,* 2007. Assessment of Hepatic Fibrosis With Magnetic Resonance Elastography. Clin. Gastroenterol. Hepatology, 5: 1207-1213.