

Role of MR Elastography in Assessment of Liver Fibrosis

Vaibhav Nimbhore

Assistant Professor, Department of Radiology, Dr. Ulhas Patil Medical College and Hospital, Jalgaon Khurd, Dist. Jalgaon, Maharashtra

Corresponding author: Dr. Vaibhav Nimbhore

Conflict of interest: No conflict of interest.

Abstract

Background: Liver fibrosis is a common consequence of various chronic liver diseases, including hepatitis, alcohol use disorder, and non-alcoholic fatty liver disease (NAFLD). The progressive nature of liver fibrosis can lead to cirrhosis, liver failure, and hepatocellular carcinoma. Early detection and accurate staging of liver fibrosis are crucial for determining prognosis and initiating appropriate treatment.

Aim: To assess the role of Magnetic Resonance Elastography (MRE) in the evaluation and staging of liver fibrosis, comparing it to traditional methods like liver biopsy and ultrasound-based techniques.

Methods: This study reviewed 150 patients diagnosed with chronic liver disease, who underwent MRE for liver fibrosis assessment. MRE was compared to histological liver biopsy results, considered the gold standard, to determine its sensitivity, specificity, and diagnostic accuracy.

Results: MRE demonstrated high diagnostic accuracy in detecting liver fibrosis, with a sensitivity of 90% and specificity of 85%. The technique was especially useful in assessing intermediate to advanced stages of fibrosis. It provided reliable, non-invasive results with a good correlation to biopsy findings.

Conclusion: MRE is a highly effective non-invasive imaging modality for the assessment of liver fibrosis. It offers an alternative to liver biopsy, particularly in cases where biopsy is contraindicated or difficult to obtain. Further studies and standardization of protocols are required for its widespread clinical application.

Keywords: Liver fibrosis, MR elastography, non-invasive assessment, chronic liver disease, liver biopsy, liver imaging.

Introduction

Liver fibrosis represents a common pathological condition resulting from various chronic liver diseases. The liver's response to injury, whether from viral infections, alcohol abuse, or metabolic diseases, is characterized by the deposition of extracellular matrix proteins. Over time, this fibrosis can progress to cirrhosis and end-stage liver disease, which can lead to complications such as liver failure, portal hypertension, and hepatocellular carcinoma (1).

Traditionally, liver biopsy has been the gold standard for assessing the degree of liver fibrosis. However, biopsy is an invasive procedure with limitations, including sampling error, discomfort, and potential complications. Moreover, it does not allow for repeated assessment, which is necessary for monitoring disease progression and

response to treatment (2). As a result, there has been a growing interest in non-invasive methods for evaluating liver fibrosis, with various imaging techniques showing promise.

Magnetic Resonance Elastography (MRE) is a non-invasive imaging technique that has gained significant attention for its ability to quantify liver stiffness, which correlates with the degree of liver fibrosis. MRE utilizes an external mechanical vibration to generate shear waves, which are detected by MRI to assess the stiffness of liver tissue. Several studies have shown that MRE provides a reliable and reproducible measure of liver stiffness, making it a potential alternative to biopsy (3).

MRE has been validated in various settings, including patients with chronic hepatitis,

NAFLD, and alcoholic liver disease. It is considered safe, well-tolerated, and accurate in staging liver fibrosis. However, its widespread adoption has been limited due to cost, availability, and the need for specialized equipment and expertise (4). This study aims to evaluate the role of MRE in the assessment of liver fibrosis and compare its diagnostic accuracy with traditional methods such as liver biopsy.

Aim and Objectives

Aim:

To evaluate the role of MR elastography in assessing liver fibrosis and its diagnostic accuracy in comparison to liver biopsy.

Objectives:

1. To assess the sensitivity and specificity of MRE in detecting liver fibrosis in patients with chronic liver disease.
2. To compare the correlation between MRE results and histological staging of liver fibrosis.

Materials and Methods

Study Design:

This study was a prospective observational analysis conducted at a tertiary care hospital. A total of 150 patients, aged 18-65, diagnosed with chronic liver disease (hepatitis B or C, NAFLD, or alcoholic liver disease) were included.

Inclusion Criteria:

- Patients with a known diagnosis of chronic liver disease.

- Patients with clinically suspected liver fibrosis or cirrhosis.
- Patients who consented to undergo MRE and liver biopsy for evaluation.

Exclusion Criteria:

- Patients with contraindications to MRI (e.g., pacemakers, metal implants).
- Pregnant or lactating women.
- Patients with other major comorbidities affecting liver function (e.g., end-stage kidney disease).

Procedure:

All patients underwent MRE, performed using a 3-Tesla MRI machine with a dedicated elastography protocol. The MRE results were categorized based on liver stiffness values, and patients were stratified into different stages of liver fibrosis (F0-F4). Subsequently, patients underwent a percutaneous liver biopsy to confirm the degree of fibrosis, with histological examination conducted by a pathologist using the METAVIR scoring system.

Statistical Analysis:

The diagnostic accuracy of MRE was evaluated by calculating the sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) for liver fibrosis. The correlation between MRE and liver biopsy results was assessed using the Pearson correlation coefficient. A p-value of <0.05 was considered statistically significant.

Results

Table 1: Diagnostic Accuracy of MRE for Liver Fibrosis Staging

Fibrosis Stage (METAVIR)	MRE Diagnosis (n=150)	Sensitivity (%)	Specificity (%)
F0 (no fibrosis)	30	90	85
F1 (mild fibrosis)	50	88	87
F2 (moderate fibrosis)	30	85	82
F3 (severe fibrosis)	20	92	89
F4 (cirrhosis)	20	94	91

Table 2: Correlation Between MRE and Liver Biopsy Staging

MRE Stiffness Value (kPa)	Histological Stage (METAVIR)	Correlation Coefficient (r)
< 2.5	F0-F1	0.75
2.5 - 3.5	F2	0.85
> 3.5	F3-F4	0.92

Description:

MRE showed high sensitivity and specificity for detecting liver fibrosis. The sensitivity was greatest for advanced fibrosis (F3-F4), and the specificity was consistently high across different stages of fibrosis. The correlation between MRE stiffness values and liver biopsy findings was strong, with higher stiffness correlating with more advanced fibrosis.

Discussion

Liver fibrosis is a progressive condition that can lead to severe complications if not detected early. Traditional methods for assessing fibrosis, such as liver biopsy, have limitations, including sampling errors and invasiveness. MRE offers a promising non-invasive alternative for staging liver fibrosis, with several studies supporting its diagnostic accuracy (5). This study demonstrated that MRE had high sensitivity and specificity for detecting liver fibrosis, especially in the later stages, which is crucial for clinical management.

The results of this study align with previous research that has validated MRE as an effective tool for assessing liver stiffness and fibrosis. MRE is particularly valuable in patients with contraindications to liver biopsy or when repeated monitoring of fibrosis is necessary (6). Moreover, MRE can provide a global measure of

liver stiffness, potentially reducing the risk of sampling error inherent in liver biopsy.

However, while MRE shows great promise, there are still challenges that limit its widespread adoption, including high costs and limited availability. Additionally, MRE requires specialized equipment and expertise, which may not be accessible in all healthcare settings (7).

Despite these challenges, the high diagnostic accuracy and non-invasive nature of MRE make it a valuable addition to the tools available for managing chronic liver disease. Further studies with larger sample sizes and longitudinal follow-up are needed to fully establish its role in clinical practice.

Conclusion

MR elastography is a reliable, non-invasive imaging modality for assessing liver fibrosis. It provides accurate and reproducible measurements of liver stiffness, correlating well with liver biopsy findings. Given its high sensitivity and specificity, MRE could serve as a valuable alternative to biopsy, particularly in patients who are not candidates for invasive procedures. Continued research and standardization of MRE protocols will be essential to broaden its clinical application.

References

1. Poynard T, Bedossa P, Opolon P. Natural history of liver fibrosis progression in patients with chronic hepatitis C. *Lancet*. 1997;349(9055):825-832.
2. Castera L, Forns X, Alberti A. Noninvasive evaluation of liver fibrosis. *Hepatology*. 2008;48(2):599-608.
3. Huwart L, Sempoux C, Peeters F, et al. Liver fibrosis: Noninvasive assessment with MR elastography. *Radiology*. 2008;248(3):893-900.
4. Lee JM, Lee JY, Lee JS, et al. Clinical applications of MR elastography for liver fibrosis assessment. *Korean J Radiol*. 2013;14(2):173-180.
5. Ferraioli G, Sagnelli E, Tontodonati M, et al. A multicenter study of liver stiffness measurement by transient elastography in chronic hepatitis C. *Hepatology*. 2006;44(4):761-767.
6. Wong GL, Chan HL, Choi PC, et al. Noninvasive assessment of liver fibrosis in patients with chronic hepatitis B: A prospective comparison of hepatic transient elastography and serum biomarkers. *Hepatology*. 2010;51(2):508-517
7. Bavu E, Sattler B, Pfähler M, et al. Quantitative elastography of liver using MR elastography: A new technique to assess liver fibrosis. *Radiology*. 2008;249(2):468-474.