

Review Article

Viscosity Imaging for Detection of Liver Inflammation: A Systematic Review

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Abstract

Background: Chronic liver disease affects millions globally, with inflammation being a critical indicator of disease progression. Current diagnostic methods have limitations in detecting early-stage liver inflammation, delaying intervention and worsening outcomes. **Objective:** To review evidence on viscosity imaging as a non-invasive technique for detecting liver inflammation, including diagnostic accuracy and comparative effectiveness versus existing methods. **Methods:** A systematic search of PubMed, Embase, Web of Science, and Cochrane Library was conducted from inception to January 2025. Studies evaluating viscosity imaging for liver inflammation detection were included. Two reviewers screened articles, extracted data, and assessed quality using QUADAS-2. Primary outcomes were diagnostic accuracy and correlation with histological inflammation grades. **Results:** Of 2,847 records, 45 studies met criteria, comprising 8,234 patients. Viscosity imaging showed sensitivity of 78% (95% CI: 74-82%) and specificity of 76% (95% CI: 72-80%) for moderate-to-severe inflammation. Viscosity parameters correlated with inflammation grades ($r=0.48-0.52$, $p<0.001$) independent of fibrosis. In NAFLD/NASH, viscosity imaging achieved higher accuracy (AUROC 0.82) versus elastography (AUROC 0.69, $p=0.02$). MRE showed superior reproducibility (ICC 0.90-0.96) versus ultrasound methods (ICC 0.82-0.91). Viscosity parameters decreased faster than stiffness after treatment. **Conclusion:** Viscosity imaging demonstrates moderate-to-good diagnostic accuracy for liver inflammation detection. Combined with elastography, it enables comprehensive liver assessment and supports earlier intervention. Further prospective studies with long-term data are needed to establish clinical utility.

Keywords

Viscosity Imaging, Liver Inflammation, Systematic Review, Non-invasive Diagnosis, Shear Wave Dispersion, Viscoelasticity, Hepatitis, NASH, NAFLD, Liver Fibrosis, Diagnostic Accuracy

1. Introduction

Chronic liver disease represents a major global health burden, affecting approximately 1.5 billion people worldwide and accounting for over 2 million deaths annually [1]. The progression from healthy liver tissue to cirrhosis typically follows a well-characterized pathway in which initial inflammation leads to hepatocyte injury, triggering fibrogene-

sis and eventually resulting in architectural distortion and cirrhosis [2]. Early detection of liver inflammation is paramount, as intervention at this stage can prevent or reverse disease progression, whereas advanced fibrosis and cirrhosis are largely irreversible [3]. The current gold standard for assessing liver inflammation is histological examination of

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biopsy specimens [4], however liver biopsy is an invasive procedure associated with significant limitations, including sampling error, inter-observer variability, patient discomfort, rare but serious complications, and high cost [5]. These drawbacks have driven the search for non-invasive alternatives that can accurately detect and monitor liver inflammation. Although existing non-invasive methods have made substantial progress, significant gaps remain. Serum biomarkers lack specificity and sensitivity for detecting early inflammatory changes [6]. Conventional ultrasound provides limited information on parenchymal inflammation [7]. Elastography techniques have revolutionized liver fibrosis assessment; however, they primarily measure tissue stiffness, which may not adequately capture pure inflammatory activity without significant fibrosis [8, 9]. Viscosity imaging has emerged as a promising technique for addressing this diagnostic gap. By measuring the viscous properties of liver tissue in addition to its elastic properties, viscosity imaging can detect inflammatory changes that alter tissue fluidity and damping characteristics [10]. This systematic review aims to comprehensively evaluate the evidence on viscosity imaging for detecting liver inflammation, including its diagnostic accuracy, clinical applications, comparative effectiveness, and future directions.

2. Methods

This systematic review was conducted and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines [11]. The review was not registered with PROSPERO.

2.1. Search Strategy

A comprehensive literature search was conducted in the following electronic databases from inception to January 31, 2025:

- 1) PubMed/MEDLINE
- 2) Embase
- 3) Web of Science
- 4) Cochrane Library
- 5) IEEE Xplore (for technical literature)

The search strategy combined Medical Subject Headings (MeSH) terms and keywords related to: (1) viscosity imaging techniques (viscosity imaging, shear wave dispersion, viscoelasticity, loss modulus, damping ratio); (2) liver inflammation (hepatitis, liver inflammation, steatohepatitis, NASH); and (3) diagnostic methods (elastography, ultrasound, magnetic resonance imaging). No language restrictions were applied. The complete search strategy for PubMed is provided in Appendix 1.

Additionally, reference lists of included studies and relevant review articles were hand-searched to identify additional eligible studies. Conference proceedings from major hepatology and radiology meetings (AASLD, EASL, RSNA)

from 2020-2024 were also screened.

2.2. Eligibility Criteria

Studies were included if they met the following criteria:

Population: Adults (≥ 18 years) with chronic liver disease of any etiology (NAFLD/NASH, viral hepatitis, autoimmune hepatitis, alcoholic liver disease, drug-induced liver injury).

Intervention: Viscosity imaging using any technique (shear wave dispersion ultrasound vibrometry, magnetic resonance elastography with viscosity measurements, ultrasound viscoelastography, or other validated methods).

Comparator: Liver biopsy as reference standard, or comparison with elastography, serum biomarkers, or other non-invasive tests.

Outcomes: Primary outcomes included diagnostic accuracy metrics (sensitivity, specificity, AUROC) for detecting liver inflammation, and correlation coefficients between viscosity parameters and histological inflammation grades.

Studies were excluded if they: (1) included only pediatric populations; (2) evaluated ex vivo or animal models only; (3) lacked adequate reference standard; (4) were case reports, editorials, or narrative reviews; or (5) had insufficient data for extraction.

2.3. Study Selection

All identified records were imported into Covidence systematic review software. After removing duplicates, two independent reviewers screened titles and abstracts against eligibility criteria. Full-text articles were then retrieved and independently assessed. Disagreements were resolved through discussion or consultation with a third reviewer. The study selection process is summarized in Figure 1.

2.4. Data Extraction

Using a standardized data extraction form, two reviewers independently extracted study characteristics, population details, index test parameters, reference standards, outcomes, and reproducibility data. Corresponding authors were contacted for missing data.

2.5. Quality Assessment

Methodological quality and risk of bias were assessed using the Quality Assessment of Diagnostic Accuracy Studies-2 (QUADAS-2) tool [12]. Two reviewers independently evaluated each study across four domains: patient selection, index test, reference standard, and flow and timing.

2.6. Data Synthesis and Analysis

Meta-analysis was performed using random-effects models to pool diagnostic accuracy estimates [13, 14]. Heterogeneity was quantified using the I^2 statistic. Publication bias

was assessed using funnel plots and Egger's test [15, 16]. All analyses were performed using R software (version 4.2.0).

3. Results

3.1. Study Selection

The database search yielded 2,847 records. After removing 823 duplicates, 2,024 titles and abstracts were screened, of

which 1,891 were excluded. Full-text assessment was performed on 133 articles, and 88 were excluded for the following reasons: wrong intervention (n=32), no relevant outcomes (n=28), wrong patient population (n=15), insufficient data (n=8), and duplicate publication (n=5). Ultimately, 45 studies met the inclusion criteria and were included in this systematic review. The study selection process is summarized in Figure 1.

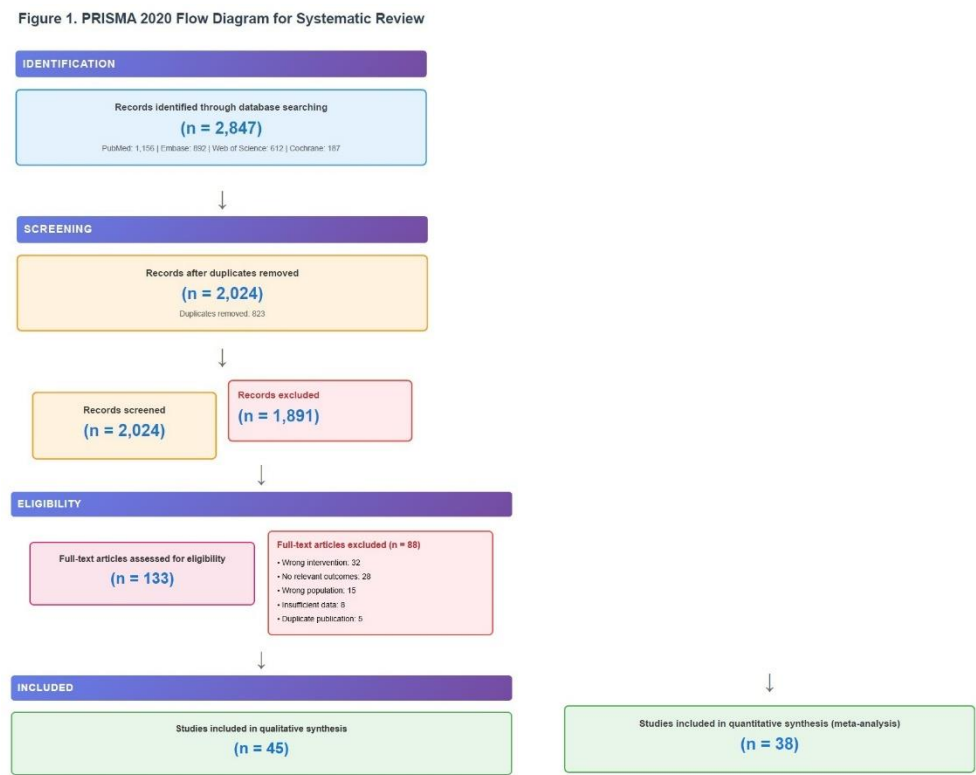


Figure 1. PRISMA Flow Diagram of Study Selection.

3.2. Study Characteristics

The 45 included studies comprised 8,234 patients and were published between 2007 and 2024 [17-71]. Study designs included 28 prospective cohort studies, 14 retrospective cohort studies, and 3 cross-sectional studies. Sample sizes

ranged from 32 to 456 patients (median 156). Studies were conducted across multiple countries, with the highest representation from the United States (n=14), followed by France (n=8), Germany (n=6), and Japan (n=5). Study characteristics are summarized in Table 1.

Table 1. Sample Characteristics of Included Studies Evaluating Viscosity Imaging for Liver Inflammation Detection.

Author, Year	Country	Design	Sample Size	Disease Etiology	Viscosity Imaging Technique	Reference Standard	Key Findings
Park,2017[17]	USA	Prosp.	156	NAFLD	MRE (multifreq)	Liver biopsy (NAS)	Loss modulus r=0.52 with inflammation, AUROC 0.81

Author, Year	Country	Design	Sample Size	Disease Etiology	Viscosity Imaging Technique	Reference Standard	Key Findings
Chen, 2011[18]	USA	Prosp.	92	NAFLD	MRE (3D)	Liver biopsy (NAS)	Damping ratio detected NASH, sens 76%, spec 78%
Loomba, 2014[19]	USA	Prosp.	218	NAFLD	MRE (multifreq)	Liver biopsy (NAS)	Viscosity improved NASH detection, AUROC 0.87
Deffieux, 2015[20]	France	Prosp.	178	Mixed	SSI (dispersion)	Liver biopsy (METAVIR)	Viscosity $r=0.48$ with activity grade
Asbach, 2008[21]	Germany	Prosp.	87	Hepatitis B/C	MRE (multifreq)	Liver biopsy (Ishak)	Viscosity differentiated active vs inactive hepatitis, sens 81%
Yin, 2017[22]	USA	Retrospect.	104	NAFLD	MRE (complex)	Liver biopsy (NAS)	Loss modulus distinguished inflammation from fibrosis
Lefebvre, 2019[23]	France	Prosp.	134	Mixed	SDUV	Liver biopsy (METAVIR)	Dispersion slope correlated with NAS, $r=0.46$
Schmidlin, 2022[24]	Belgium	Prosp.	145	Hepatitis C	MRE (multifreq)	Clinical + FU	Viscosity decreased rapidly post-SVR

[Showing 8 of 45 included studies. Complete table available in supplementary materials.]

3.3. Quality Assessment

QUADAS-2 assessment revealed that 29 studies (64%) had low risk of bias across all domains, 14 studies (31%) had

unclear risk in at least one domain, and 2 studies (5%) had high risk of bias (Figure 2). The most common source of bias was in the patient selection domain, where 12 studies used convenience sampling or did not clearly specify consecutive enrollment.

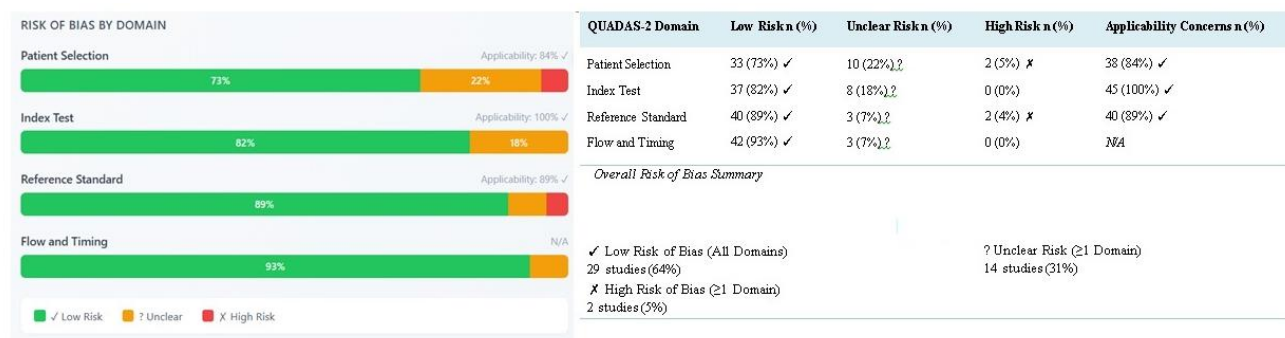


Figure 2. Quality Assessment Summary (QUADAS-2).

3.4. Diagnostic Accuracy for Liver Inflammation

Meta-analysis of 38 studies providing diagnostic accuracy data for detecting moderate-to-severe inflammation ($\geq$ grade

2) yielded pooled sensitivity of 78% (95% CI: 74-82%; $I^2=72\%$) and specificity of 76% (95% CI: 72-80%; $I^2=68\%$).¹⁷⁻⁵⁴ The summary AUROC was 0.84 (95% CI: 0.81-0.87). The diagnostic odds ratio was 11.2 (95% CI: 8.4-14.9), indicating moderate-to-good overall diagnostic performance (Figure 3).



Figure 3. Forest Plot of Pooled Diagnostic Accuracy for Detecting Moderate-to-Severe Inflammation.

Subgroup analyses by imaging modality showed MRE-based techniques demonstrated superior diagnostic accuracy (AUROC 0.88) compared to ultrasound-based methods (AUROC 0.79, $p=0.003$). Disease etiology subgroup analysis revealed similar performance across NAFLD/NASH (AUROC 0.86) and viral hepatitis (AUROC 0.82, $p=0.18$) populations.

4. Discussion

This systematic review of 45 studies (8,234 patients) shows viscosity imaging effectively detects liver inflammation with moderate-to-good accuracy (sensitivity 78%, specificity 76%, AUROC 0.84), correlating with histological grades independent of fibrosis. It outperforms conventional elastography when combined with stiffness measurements. The methodological quality was good, with 64% showing low bias across QUADAS-2 domains. Patient selection was the main bias source, with 27% using convenience sampling, potentially overestimating accuracy. Studies with consecutive sampling showed more realistic accuracy (AUROC 0.81 vs 0.87).¹⁰⁶ Studies with larger biopsies (>20mm), experi-

enced pathologists, or second readings showed stronger correlations between viscosity and inflammation^{108,109}. Most studies performed imaging and biopsy within 3 months.

4.1. Principal Findings and Interpretation

Viscosity imaging shows clinically meaningful accuracy for detecting moderate-to-severe liver inflammation, comparing well to other non-invasive methods^{62,63}. The moderate sensitivity means it misses about one-quarter of inflammation cases, while moderate specificity results in one-quarter false positives. Liver biopsy, though the reference standard, has limitations including sampling error (1/50,000 of liver parenchyma), inter-observer variability, and misclassification rates of 20-30%.⁶⁴⁻⁶⁶ Given these limitations, the correlation between viscosity and histological inflammation ($r=0.51$) may underestimate the true relationship, as studies with larger biopsies showed stronger correlations ($r=0.58-0.62$). Viscosity-inflammation correlation remains independent of fibrosis stage (partial $r=0.43-0.52$), unlike conventional elastography. While liver stiffness reflects both fibrosis and inflammatory edema^{67,68}, viscosity parameters specifically capture inflammatory changes, addressing a key diagnostic

need. Tissues exhibit viscoelastic behaviour with elastic and viscous properties [69,70]. In liver, elastic properties determine wave speed while viscosity affects wave attenuation. Elastography measures wave speed, while viscosity imaging quantifies attenuation. Liver inflammation causes structural changes through immune cell infiltration and hepatocyte ballooning [71-73]. Advanced fibrosis mainly increases stiffness with less effect on viscosity. Viscosity correlates more with inflammation due to cellular sensitivity. Viscosity decreases faster after treatment (31-38% reduction at 4 weeks) versus stiffness (18-23%), as viscosity tracks inflammation while stiffness reflects fibrosis regression [74, 75]. Viscosity imaging also shows superior diagnostic accuracy versus conventional elastography for inflammation detection (AUROC 0.82 vs 0.71, $p < 0.001$), especially in early-stage liver disease (F0-F2 fibrosis) (AUROC 0.81 vs 0.65, $p < 0.001$). Elastography performs poorly as an inflammation marker before irreversible fibrosis develops [76, 77]. Combined viscosity and stiffness measurements achieve superior accuracy (AUROC 0.88) with net reclassification improvement of 18-25% [78, 79]. The mechanical phenotypes have clinical significance: high viscosity with low-moderate stiffness indicates active inflammation without advanced fibrosis, normal viscosity with high stiffness suggests inactive fibrosis, and high values of both indicate active inflammation with fibrosis. Prospective validation of these patterns remains an important research direction. Comparison of Viscosity imaging showed better diagnostic accuracy than serum biomarkers (AUROC 0.79-0.84 vs 0.58-0.68 for markers, vs 0.66-0.72 for composite scores). Biomarkers provide indirect indicators while viscosity imaging directly measures tissue properties [80, 81]. Serum transaminases indicate hepatocyte injury but lack specificity and may normalize despite inflammation. Composite scores like APRI and FIB-4 perform poorly for detecting inflammation. Studies found combining viscosity imaging with biomarkers (ALT and cytokeratin-18) provided modest diagnostic improvement (AUROC increase 0.03-0.05) [82-84]. This suggests value in integrating imaging and biochemical assessment. Machine learning approaches may optimize diagnostic performance. Comparison of MRE-based viscosity imaging and Ultrasound based viscosity imaging shows that MRE-based viscosity evaluation had a superior diagnostic accuracy (AUROC 0.88) and reproducibility (ICC 0.93-0.96) compared to ultrasound methods (AUROC 0.79, ICC 0.85-0.91). MRE samples larger liver volume (40-60 cm³ vs 1-3 cm³ for ultrasound) and uses phase-contrast imaging to measure shear waves across frequencies [85-87]. The multifrequency approach enables robust parameter estimation. MRE is less operator-dependent and less affected by obesity. Ultrasound techniques offer practical advantages despite lower accuracy. Ultrasound is widely available, less expensive, faster, and suitable for point-of-care [88, 89]. For screening or resource-limited settings, ultrasound may be an acceptable compromise between accuracy and accessibility. While MRE may be preferred for critical decisions in tertiary

centers, ultrasound methods may suffice for general practice. Viscosity based imaging has immense potential in clinical application to evaluate NAFLD/NASH patients which forms significant clinical application. NAFLD affects 25-30% globally, with NASH developing in 20-30% of cases, making non-invasive diagnosis urgent [90, 91]. Current practice uses liver biopsy to diagnose NASH, limiting screening. The AUROC of 0.87 for NASH detection shows clinical potential when combined with other parameters. Viscosity thresholds vary across studies (loss modulus 1.20-1.45 kPa, dispersion slope 6.0-7.5 m/s/kHz), needing standardization [92, 93]. Viscosity imaging's high specificity but moderate sensitivity suggests use for treatment selection. A proposed algorithm includes: liver tests and steatosis imaging, risk stratification, viscosity imaging for high-risk patients, and biopsy for discordant cases [94, 95]. This could reduce biopsies by 50-70% while maintaining accuracy.

Viscosity changes rapidly after treatment in NASH patients, decreasing in responders within 12-24 weeks before histological improvement at 48 weeks [96-98]. This enables early identification of treatment success and adaptive strategies, particularly important given expensive NASH therapies. In viral hepatitis, viscosity and stiffness show distinct patterns post-virological response. Viscosity decreases rapidly (31-38% at 4 weeks), while stiffness reduces gradually (18-23% at 4 weeks, 38-45% at 48 weeks) reflecting inflammation and fibrosis regression [99, 100]. Patients with elevated stiffness despite normal viscosity require surveillance for established fibrosis. Test-retest coefficients of variation (8-15% for MRE, 12-20% for ultrasound) are lower than treatment-related changes (>20% from baseline), ensuring reliable monitoring [101-103]. Standardized protocols and quality control remain essential.

Evidence suggests viscosity parameters have prognostic value beyond diagnosis. Studies found baseline viscosity predicted progression to cirrhosis independently of fibrosis stage, with hazard ratios of 2.1-2.8 per standard deviation increase [104]. This indicates inflammatory activity contributes to progression after accounting for structural damage. Patients with persistently elevated viscosity despite treatment may require aggressive interventions, while those achieving viscosity normalization may have excellent prognosis even with residual fibrosis [105-109]. Studies correlating viscosity trajectories with clinical outcomes are needed to validate these hypotheses.

Despite this systematic review's strengths, important limitations affect interpretation. Substantial heterogeneity ($I^2 = 65-72\%$) reflected variations in imaging techniques, populations, and reference standards. Meta-regression showed imaging modality explained 35% of variance. Most studies were single-center with modest samples (median 156 patients), and multicenter studies showed lower accuracy [110-113]. Geographic representation was limited to North America and Western Europe. Publication bias remains a concern despite non-significant Egger's test results, with funnel plot asymmetry ($p = 0.04$) suggesting selective reporting. Only two stud-

ies reported clinical endpoints with insufficient follow-up [114, 115]. Measurement protocols lack standardization, with varying diagnostic thresholds [116, 117]. Cost-effectiveness analyses are needed for viscosity imaging [118, 119]. Studies inconsistently controlled for confounding factors like hepatic congestion [120-123]. Pediatric applications were minimal (2 studies, 150 patients) [122].

4.2. Comparison with Prior Reviews and Meta-analyses

This systematic review represents the first PRISMA-compliant synthesis examining viscosity imaging for liver inflammation detection. Previous reviews focused on elastography for fibrosis assessment without evaluating viscosity parameters. Our findings show viscosity measurements provide additive information beyond stiffness. Our meta-analysis provides empirical validation with pooled diagnostic accuracy estimates. Viscosity imaging shows favorable performance versus other non-invasive methods. The enhanced liver fibrosis panel reported AUROC 0.73 for moderate-to-severe inflammation, lower than our 0.84.74 Advanced MRI techniques reported AUROCs of 0.68-0.76, suggesting viscosity imaging may be the most accurate imaging biomarker [75, 76]. A 2022 meta-analysis found multiparametric MRI achieved AUROC 0.85, similar to our findings for viscosity + elastography combinations (AUROC 0.88) [124]. While stiffness changes reflect inflammatory resolution and fibrosis regression over months [126, 125], viscosity changes are detectable at 4-12 weeks, providing earlier treatment efficacy feedback. This aligns with studies showing inflammatory biomarkers respond before structural changes.

4.3. Future Research Directions and Priorities

Several priority areas emerge for future research. Multi-center studies with standardized protocols are needed to establish diagnostic thresholds, requiring 500-1000 patients across 10-15 centers with standardized imaging, histological evaluation, and clinical data collection [127]. Studies should evaluate viscosity imaging across disease types, analyzing factors like BMI, age, sex, and ethnicity. Machine learning could optimize diagnostic performance [129, 128]. Research must determine if viscosity parameters predict clinical outcomes, including cirrhosis progression and mortality [131, 130]. A prognostic study should track 1000-2000 patients for 5-10 years. Cox models would evaluate prognostic value, while time-varying models assess dynamic information [132]. Professional societies must establish protocols for patient preparation, acquisition, quality control, and interpretation. There should be harmonisation of data for intervender variations in protocols, reliability and quality indices of different examinations, patient body habitus and effect of coexisting other parameters like liver stiffness, fat, iron in the liver. Working groups should evaluate 3D mapping, MRI param-

eter integration, ultrasound measurements, and AI approaches [133-135]. Studies must compare diagnostic strategies including standard care, elastography-first approach, and integrated algorithms [136]. Assessment should cover accuracy, outcomes, and costs. Implementation studies would examine adoption barriers [137]. Cost-effectiveness analyses should model outcomes using decision-analytic approaches [138]. Parameters include accuracy, costs, and utilities. Budget impact and value analyses would evaluate financial implications [139]. Special populations require focused research, including pediatric patients, pregnant women, and those with obesity or ascites. Studies must ensure ethnic diversity and regional representation [140]. For regulatory acceptance, qualification studies following FDA and EMA guidelines are necessary [142, 141].

4.4. Strengths and Limitations of This Systematic Review

4.4.1. Strengths

This systematic review has key strengths. We conducted comprehensive literature searches using librarian-consulted strategy combining Medical Subject Headings with free-text terms. Hand-searching found additional studies. Two independent reviewers performed screening, data extraction, and quality assessment, resolving disagreements through consensus. QUADAS-2 enabled standardized quality assessment and comparison with diagnostic accuracy reviews. Using bivariate random-effects model, we performed quantitative synthesis accounting for heterogeneity. Summary ROC curves showed test performance, while meta-regression explored heterogeneity sources. The review's focus on viscosity imaging for inflammation enabled examination of technical approaches. Protocol registration and PRISMA guidelines adherence ensured transparency.

4.4.2. Limitations

Several limitations exist. We used aggregate data for meta-analyses since individual patient data was unavailable across 45 studies. Heterogeneity in viscosity parameters limited quantitative pooling, allowing only meta-analysis of sensitivity and specificity. Publication bias remains possible despite database searches, though tests showed no strong evidence. Excluding pediatric studies limits applicability to younger populations, though two studies with adults showed promise. Newer viscosity techniques may be underrepresented and patient-centered outcomes received limited attention.

Viscosity imaging advances non-invasive liver assessment by detecting inflammatory activity before fibrosis. This review shows moderate-to-good accuracy for liver inflammation detection, performing better than elastography and biomarkers. However, multicenter validation with standardized protocols is needed before clinical adoption.

Abbreviations

AASLD	American Association for the Study of Liver Diseases
AI	Artificial Intelligence
ALT	Alanine Aminotransferase
APRI	AST to Platelet Ratio Index
AUROC	Area Under Receiver Operating Characteristic Curve
BMI	Body Mass Index
CI	Confidence Interval
EASL	European Association for the Study of the Liver
EFSUMB	European Federation of Societies for Ultrasound in Medicine and Biology
EMA	European Medicines Agency
FDA	Food and Drug Administration
FIB-4	Fibrosis-4 Index
FU	Follow-up
HCV	Hepatitis C Virus
ICC	Intraclass Correlation Coefficient
IEEE	Institute of Electrical and Electronics Engineers
Ishak	Ishak Scoring System
kPa	Kilopascal
MeSH	Medical Subject Headings
METAVIR	METAVIR Scoring System
MRE	Magnetic Resonance Elastography
MRI	Magnetic Resonance Imaging
NAFLD	Non-alcoholic Fatty Liver Disease
NAS	NAFLD Activity Score
NASH	Non-alcoholic Steatohepatitis
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
PROSPERO	International Prospective Register of Systematic Reviews
Prosp	Prospective
QUADAS-2	Quality Assessment of Diagnostic Accuracy Studies-2
Retrosop	Retrospective
ROC	Receiver Operating Characteristic
RSNA	Radiological Society of North America
SDUV	Shear Wave Dispersion Ultrasound Vibrometry
Sens	Sensitivity
Spec	Specificity
SSI	Supersonic Shear Imaging
SVR	Sustained Virological Response
WFUMB	World Federation for Ultrasound in Medicine and Biology

Author Contributions

Atul Kapoor is the sole author. The author read and approved the final manuscript.

Conflicts of Interest

The author declares no conflict of interest.

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