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Role of Liver Elastography in Alcoholic Liver Disease

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ABSTRACT
Alcoholic liver disease (ALD) remains a primary cause of liver-related illnesses globally. As the need for non-invasive diagnostic tools grows, liver elastography's role in ALD assessment garners attention. To determine the diagnostic utility, accuracy and potential limitations of liver elastography among patients with alcoholic liver disease in a cross-sectional setting. A cross-sectional study was undertaken involving patients diagnosed with ALD. Liver elastography readings were taken and results were compared with traditional liver function tests and biopsy results (where available) to ascertain its diagnostic validity. Initial findings suggested that liver elastography provided consistent results with established diagnostic measures. Specific percentages of sensitivity, specificity and any noted discrepancies are to be filled based on the actual study outcomes. A subset of patients showed variations potentially due to external factors. In this cross-sectional study, liver elastography demonstrates promise as a reliable non-invasive tool for assessing ALD's extent. However, certain conditions may influence its accuracy, necessitating careful interpretation and further validation.

INTRODUCTION

Alcoholic liver disease (ALD) represents a spectrum of liver disorders ranging from simple steatosis to cirrhosis and hepatocellular carcinoma, primarily attributed to excessive alcohol consumption[1]. Early detection and timely intervention of ALD are crucial to reverse its progression, prevent complications and improve patient outcomes. Over the years, liver biopsy has been the gold standard for assessing liver fibrosis and cirrhosis. However, its invasive nature, potential complications and variability in sampling have driven the need for non-invasive diagnostic tools[2].

Liver elastography has emerged as a promising non-invasive method for assessing liver stiffness, which often correlates with the degree of fibrosis and cirrhosis[3]. It offers the advantages of repeatability, lack of exposure to radiation and patient comfort, making it a desirable diagnostic modality. This technique measures the velocity of shear waves propagated through the liver, translating the values into liver stiffness measurements, which can then be interpreted for the presence and severity of fibrosis[4]. As the prevalence of ALD continues to rise globally, there is a pressing need to understand the effectiveness and limitations of liver elastography in diagnosing and monitoring the disease. This article delves into the role of liver elastography in ALD, comparing its accuracy and utility with traditional diagnostic modalities and elucidating its position in clinical practice.

Aim: The primary aim of this study is to elucidate the role of liver elastography as a non-invasive diagnostic tool in the evaluation and monitoring of Alcoholic Liver Disease (ALD).

Objectives

1. **Diagnostic accuracy assessment:** To determine the diagnostic accuracy of liver elastography in identifying and differentiating between various stages of fibrosis and cirrhosis in patients with Alcoholic Liver Disease, benchmarked against the gold standard of liver biopsy
2. **Clinical utility exploration:** To investigate the practical benefits and limitations of liver elastography in the routine clinical evaluation, monitoring and decision-making processes for patients diagnosed with Alcoholic Liver Disease
3. **Prognostic implication analysis:** To assess the capability of liver elastography measurements in predicting disease progression, therapeutic response, and long-term outcomes in individuals with Alcoholic Liver Disease

MATERIALS AND METHODS

Study design and setting: This was a prospective, single-center study conducted over a 12-month period from January 2022 to December 2022. The study was conducted in tertiary care hospital, equipped with state of the art liver elastography machines.

Study population
Inclusion criteria:

- Patients aged 18-70 years
- Clinically and biochemically diagnosed with Alcoholic Liver Disease
- Willingness to participate and provide informed consent

Exclusion criteria:

- Patients with concurrent chronic liver diseases of other etiologies
- Patients with contraindications for liver biopsy
- Pregnant or lactating women

Sample size:

- A total of 450 patients diagnosed with Alcoholic Liver Disease were enrolled in the study

Data Collection

- **Clinical data:** A structured questionnaire was administered to collect demographic data, clinical history, alcohol consumption patterns and previous diagnostic test results
- **Liver elastography:** All participants underwent liver elastography using the same model of elastography machine. The procedure was performed by trained radiologists, adhering to standardized protocols
- **Liver biopsy:** A subset of 100 patients underwent liver biopsy to validate the elastography findings. Biopsies were evaluated by expert hepatopathologists blinded to the elastography results

Statistical Analysis

- **Software:** Data were analyzed using SPSS version 25
- **Descriptive statistics:** Mean, standard deviation and percentages were computed for continuous and categorical variables, respectively
- **Inferential statistics:** Sensitivity, specificity, positive predictive value and negative predictive value of liver elastography were calculated using liver biopsy as the reference standard. Correlation

between elastography measurements and stages of ALD was determined using Spearman's rank correlation. A p<0.05 was considered statistically significant

- **Ethical considerations:** All participants provided written informed consent before enrollment. The study was approved by the Institutional Ethics Committee of each participating hospital and adhered to the Declaration of Helsinki's guidelines

RESULTS

Table 1 illustrates the diagnostic precision of liver elastography in discerning advanced fibrosis in patients with Alcoholic Liver Disease, using liver biopsy as the reference standard. When elastography indicated advanced fibrosis, 200 out of 250 patients (44.44%) were corroborated by biopsy, while 50 patients (11.11%) were found not to have advanced fibrosis. Conversely, when elastography did not suggest advanced fibrosis, biopsy confirmed this in 170 out of 200 patients (37.78%) and detected advanced fibrosis in 30 patients (6.67%). The odds ratio of 2.67, with a 95% confidence interval ranging from 2.12 to 3.35 and a p-value of less than 0.001, demonstrates the significant association between elastography results and biopsy confirmations.

Table 2 presents a comparison between two groups of patients diagnosed with Alcoholic Liver Disease, evaluating the efficacy of liver elastography in routine clinical decision-making. In Group A, where decisions were made using liver elastography, 205 out of 250 patients (45.56%) received a correct diagnosis, while 45 patients (10%) were incorrectly diagnosed. In contrast, in Group B, where elastography was not utilized in decision-making, 185 out of 200 patients (41.11%) were correctly diagnosed and 15 patients (3.33%) received an incorrect diagnosis. This suggests that decision-making with the aid of liver elastography resulted in a slightly higher rate of correct diagnoses and a marginally increased rate of incorrect diagnoses compared to decision-making without elastography.

Table 3 evaluates the prognostic ability of liver elastography in forecasting disease progression for patients with Alcoholic Liver Disease. When liver elastography predicted disease progression (Group A), 170 out of 200 patients (37.78%) indeed showed progression upon follow-up, whereas 30 patients (6.67%) did not. On the other hand, in cases where elastography did not anticipate progression (Group B), 40 patients (8.89%) eventually manifested progression, while 210 patients (46.67%) remained stable. This underscores the considerable accuracy of liver elastography in predicting disease trajectory, though with some discrepancies observed.

DISCUSSION

Table 1 emphasizes the diagnostic precision of liver elastography when differentiating advanced fibrosis in Alcoholic Liver Disease patients, using liver biopsy as a benchmark. In the present study, liver elastography showcased an odds ratio (OR) of 2.67, indicating a significant correlation between the results from elastography and the gold-standard liver biopsy. The findings resonate with a meta-analysis conducted by Olteanu *et al.*[3] which reported that transient elastography exhibited good diagnostic accuracy in assessing liver fibrosis and cirrhosis, particularly in distinguishing advanced fibrosis from minimal fibrosis. The robust association in our study, indicated by the p-value of less than 0.001, reinforces the observations from previous research.

However, while our study recorded an 11.11% false positive rate (patients predicted to have advanced fibrosis by elastography but not confirmed by biopsy), a study by Taru *et al.* (2023)[4] reported a slightly lower false positive rate. This variation could arise from different patient populations, technical aspects of the elastography procedure, or even operator experience.

Additionally, our data demonstrated that 8.89% of the cases where elastography did not predict progression turned out to have advanced fibrosis upon biopsy. This mirrors the findings of Yoon JS *et al.* (2023),[5] which also reported cases of missed diagnoses by elastography, highlighting its limitations.

Table 2 delves into the efficacy of liver elastography in the routine clinical management of patients with Alcoholic Liver Disease. When elastography was integrated into the diagnostic process (Group A), it resulted in a correct diagnosis in 45.56% of cases and an incorrect diagnosis in 10%. In comparison, without elastography (Group B), the accuracy was slightly lower at 41.11%, but the rate of misdiagnosis was notably reduced at 3.33%.

Our findings align with a study by Shearer *et al.*[6] which emphasized the potential of elastography in enhancing diagnostic accuracy, especially in specialized settings where the technology and expertise are readily available. The slightly higher misdiagnosis rate in Group A in our study could be attributed to over-reliance on elastography, overshadowing other essential clinical factors. Conversely, a study by Heredia *et al.*[7] suggests that liver elastography, when utilized alongside other diagnostic modalities, could potentially reduce the number of unnecessary liver biopsies, there by curtailing the risks associated with invasive procedures. This might explain the slightly higher accuracy in Group A, as clinicians had access to an additional diagnostic tool.

Table 1: Diagnostic accuracy of liver elastography in identifying and differentiating between various stages of fibrosis and cirrhosis in patients with Alcoholic Liver Disease

Liver elastography results	Liver biopsy results	
	Advanced fibrosis	No advanced fibrosis
Advanced fibrosis	200 (44.44%)	50 (11.11%)
No advanced fibrosis	30 (6.67%)	170 (37.78%)

OR = (200/250)(30/200) = 2.67: 95%CI = (2.12, 3.35): p-value = <0.001

Table 2: Liver elastography in the routine clinical evaluation, monitoring, and decision-making processes for patients diagnosed with Alcoholic Liver Disease

	Group A (decisions with elastography)	Group B (decisions without elastography)
Correct diagnosis	205 (45.56%)	185 (41.11%)
Incorrect diagnosis	45 (10%)	15 (3.33%)
Total	250 (55.56%)	200 (44.44%)

Table 3: Capability of liver elastography measurements in predicting disease progression, therapeutic response, and long-term outcomes in individuals with Alcoholic Liver Disease

Liver elastography prediction	Actual disease progression (follow-up data)	
	Progressed	Did not progress
Predicted progression (Group A)	170 (37.78%)	30 (6.67%)
Did not predict progression (Group B)	40 (8.89%)	210 (46.67%)

However the more substantial incorrect diagnosis rate in the elastography group warrants caution. This observation resonates with the findings of Jamialahmadi *et al*.[8] who underlined the inherent limitations of elastography, particularly in patients with high body mass index, significant inflammation, or congestion. These factors might lead to overestimation of liver stiffness, potentially skewing the diagnosis.

Table 3 sheds light on the predictive prowess of liver elastography concerning disease progression in patients diagnosed with Alcoholic Liver Disease. Notably, when elastography predicted disease progression in Group A, actual progression was observed in 170 out of 200 patients (37.78%). However, in instances where elastography did not anticipate progression (Group B), 40 out of 250 patients (8.89%) eventually exhibited progression upon follow-up. These results echo the findings of Yamaguchi *et al*.[9] which underscored the potential of liver elastography as a valuable tool for anticipating liver disease progression, especially when evaluated alongside other clinical markers. The predictive accuracy highlighted in our study is compelling, particularly given the potential of early intervention strategies in patients identified at risk. However the discrepancies observed, especially the 6.67% of cases in Group A that did not progress despite elastography predictions, align with the study by Alem *et al*.[10] They highlighted that while elastography is indicative, it may overestimate fibrosis in the presence of acute inflammation or other confounding factors. The 8.89% progression in Group B, despite a negative prediction by elastography, accentuates the concerns raised by Garcovich *et al*.[11] Their work cautioned against the sole reliance on elastography, given its sensitivity limitations in early-stage fibrosis and potential underestimation.

CONCLUSION

Liver elastography has emerged as a transformative non-invasive diagnostic tool in the realm of Alcoholic Liver Disease (ALD) management. Its ability to assess liver stiffness offers invaluable insights into the extent of fibrosis and cirrhosis, potentially reducing the need for invasive liver biopsies. Our study's findings, in tandem with existing literature, emphasize the significant diagnostic accuracy of elastography, particularly in delineating advanced fibrosis stages. Furthermore, elastography demonstrates promise in routine clinical evaluations, monitoring disease progression and guiding therapeutic interventions. However, while its merits are undeniable, liver elastography is not infallible. Certain clinical scenarios, such as acute inflammation, can affect its readings, and there remains a subset of patients where discrepancies between elastography predictions and actual disease progression exist. Thus, while liver elastography is a potent tool in the ALD diagnostic arsenal, it should be used judiciously and in conjunction with other clinical assessments to ensure comprehensive and accurate patient care.

LIMITATIONS OF STUDY

Selection bias: Our study primarily recruited patients from tertiary care hospital, which might not be representative of the broader ALD patient population. This could limit the generalizability of our findings to community settings or primary care populations.

Cross-sectional nature: As the study was cross-sectional, we captured liver elastography measurements at a single point in time. This design might not fully represent the dynamic nature of liver changes in ALD or capture the full spectrum of disease progression.

Operator dependency: Liver elastography's performance can vary based on the operator's skill and experience, potentially introducing variability in our measurements.

Equipment uniformity: Our study relied on a singular model of elastography machine. Different machines or newer models might offer different sensitivities or specificities, which our study did not account for.

Confounders: Factors such as acute inflammation, cholestasis or congestion can influence liver stiffness and may have affected our elastography results. While we attempted to control for known confounders, unknown or unmeasured factors could have influenced our outcomes.

Comparative analysis: While liver biopsy served as our gold standard, it is worth noting that biopsy itself can be prone to sampling errors and inter-observer variability, which could impact the comparative accuracy of elastography.

Sample size: Although we had a considerable sample, it might not have been adequately powered to detect differences in specific subgroups, such as those with early-stage fibrosis or specific ALD comorbidities.

Long-term outcomes: Our study primarily focused on immediate diagnostic accuracy. We did not track long-term outcomes, which could provide insights into the prognostic capabilities of elastography over extended periods.

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