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Diagnostic Accuracy of ARFI Elastography in Differentiating Non-Cirrhotic Portal Fibrosis from Cirrhotic Portal Hypertension

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KEYWORDS

ARFI elastography, NCP and CPH

ABSTRACT:

Background: Differentiating Non-Cirrhotic Portal Fibrosis (NCPF) from Cirrhotic Portal Hypertension (CPH) is crucial for appropriate management and prognostication. Acoustic Radiation Force Impulse (ARFI) elastography has emerged as a non-invasive modality for assessing liver stiffness, which may aid in this differentiation.

Objective: To evaluate the diagnostic accuracy of ARFI elastography in distinguishing NCPF from CPH.

Methods: This Cross-sectional study was conducted among 30 patients with clinically and radiologically suspected portal hypertension who underwent ARFI elastography. Liver stiffness measurements (LSM) obtained via ARFI were compared between patients with NCPF and those with CPH, confirmed by clinical, biochemical, and histopathological findings with Liver biopsy where available. Sensitivity, Specificity, PPV and NPV were performed to assess the diagnostic Accuracy of ARFI in differentiating the two conditions.

Results: A total of 30 patients were included, with 12 diagnosed with NCPF and 18 with Cirrhosis with Portal Hypertension. ARFI predicted diagnostic accuracy with Combined LS, SS and SS/LS demonstrated a sensitivity of 83.3%, specificity of 27.8% for NCPF and sensitivity of 72.2%, specificity of 16.7% for Cirrhosis with Portal hypertension.

Conclusion: ARFI elastography is a useful non-invasive tool with good diagnostic accuracy in differentiating NCPF from CPH, potentially reducing the need for invasive procedures such as liver biopsy in selected patients.

Introduction:

Portal hypertension is a complex and clinically significant syndrome characterized by increased pressure within the portal venous system, leading to severe complications such as variceal bleeding, ascites, and hepatic encephalopathy (1). Although the most frequent cause of portal hypertension is liver cirrhosis, a unique subgroup of patients has non-cirrhotic portal fibrosis (NCPF), which is characterised by presinusoidal portal hypertension without parenchymal cirrhosis. NCPF, also known as idiopathic portal hypertension or hepatoportal sclerosis, is common in some parts of the world, especially in developing nations. Because of its clinical similarities to cirrhotic portal hypertension, it can be difficult to diagnose (2,3).

Since cirrhosis and NCPF require different treatment modalities and have different prognostic implications, it is imperative to accurately distinguish between the two conditions. While cirrhotic portal hypertension is linked to progressive liver dysfunction and increased morbidity, patients with NCPF usually have a better long-term outcome with preserved liver synthetic function (4).

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Liver biopsy, which enables histological evaluation of fibrosis patterns, is still the gold standard for a conclusive diagnosis. However, biopsy is not the best option for routine clinical use because it is an invasive procedure with inherent risks, such as bleeding, pain, and sampling variability (5).

Non-invasive imaging methods have become more popular in recent years for assessing portal hypertension and liver fibrosis. The most dependable, quick, and repeatable technique for determining liver stiffness is Acoustic Radiation Force Impulse (ARFI) elastography. By measuring tissue displacement in response to acoustic pulses, ARFI elastography, when incorporated into standard ultrasound systems, yields quantitative stiffness values that are correlated with the extent of fibrosis. ARFI's role in differentiating NCPF from cirrhotic portal hypertension is still poorly understood, despite the fact that it has been widely validated in the staging of chronic liver diseases, specifically in differentiating between early fibrosis and advanced cirrhosis (6,7,8)

Our study seeks to assess the diagnostic accuracy of ARFI elastography in differentiating between cirrhotic portal hypertension and NCPF. In this clinical setting, we also aim to identify the ideal ARFI cutoff values that optimise sensitivity and specificity. This study may greatly lessen the need for liver biopsies in patients with portal hypertension by establishing ARFI as a trustworthy non-invasive diagnostic method, allowing for earlier and more accurate therapeutic interventions. Our research may also help with better patient stratification, which will improve clinical judgement and long-term treatment plans for these different but phenotypically related disorders.

Methodology:

A Prospective cross-sectional study was conducted in the department of Radiology at a tertiary care hospital in the Chengalpattu district, Tamil Nadu. We enrolled 30 patients presenting with cirrhosis associated with portal hypertension and non-cirrhotic portal fibrosis, and cases that underwent USG abdomen with clinically suspected cirrhosis and non-cirrhotic portal fibrosis during the study period between January 2025 to June 2025 were included in the study. Those who were unable to hold their breath and who were not given consent for participation in the study were excluded. The 30 patients were selected based on criteria sampling method. Liver biopsy was performed using modified Menghini needles, measuring over 2 cm in length. The pathologist evaluated samples using the Metavir score, assessing length and quality. All patients underwent ARFI elastography while lying in the left lateral decubitus position with the right arm extended to its maximum abduction. The right hepatic lobe was scanned with little pressure applied by the operator between the ribs, 1 cm under the capsule, while the patients were requested to temporarily stop breathing in order to reduce respiratory motion. The collected data was entered in excel sheet and analyzed using SPSS V.21. Quantitative variables are expressed in mean & SD, Qualitative variables are expressed in frequency. Sensitivity, specificity, positive predictive value, and negative predictive value were calculated for AEFI predicting cirrhosis and NCPF.

Results:

Table 1: Characteristics of patients

Variable		**No of patients (n = 30) (%)**
Age (in years)		44.87 ± 20.22
Gender	Male	18 (60)
	Female	12 (40)
Type of Residence	Rural	21 (70)
	Urban	9 (30)
Jaundice	Present	20 (66.7)
	Absent	10 (33.3)

Table 1 demonstrates the Characteristics of patients and the mean & Sd of age is 44.87 ± 20.22 years. Among the 30 patients, 18 were male and 12 patients were female. The majority of the participants were from rural areas. Out of 30 patients 66.7% of them had jaundice.

Table 2: Proportion of cases in based on ARFI elastography cutoff

ARFI Elastography cut-off	**NCPF Group N = 12 (%)**	**Liver Cirrhosis Group N = 18 (%)**

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LS < 1.65 cm/sec	6 (50)	2 (11.1)
SS > 2.69 cm/sec	8 (66.7)	13 (72.2)
SS/LS > 1.53 cm/sec	8 (66.7)	4 (22.2)
Combined LS, SS and SS/LS	10 (83.3)	13 (72.2)

With a liver stiffness cutoff of <1.65, there were 50% of patients in the NCPF group and 11.1% of patients in the cirrhosis group, respectively. Similarly, with a spleen stiffness cutoff of >2.69, there were 66.7% and 72.2% of patients in the NCPF group and the cirrhosis group, respectively. With a liver stiffness/spleen stiffness cutoff of >1.53, there were 66.7% of patients and 22.2% of patients in NCPF group and cirrhosis group, respectively. Similarly, with either LS or SS or LS/SS, there were 83.3% in the NCPF group and 72.22% in the cirrhosis group.

Table 3: Diagnostic efficacy of ARFI in NCPF

ARFI variables	Sensitivity	Specificity	PPV	NPV
LS	50%	88.9%	75%	72.7%
SS	66.7%	27.8%	38.1%	55.6%
SS/LS	66.7%	77.8%	66.7%	77.8%
Combination of either LS, SS and SS/LS	83.3%	27.8%	43.5%	71.4%

Table 4: Diagnostic efficacy of ARFI in Cirrhosis with portal hypertension

ARFI variables	Sensitivity	Specificity	PPV	NPV
LS	11.1%	50%	25%	27.3%
SS	72.2%	33.3%	61.9 %	44.4%
SS/LS	22.2%	33.3%	33.3 %	22.2%
Combination of either LS, SS and SS/LS	72.2%	16.7%	56.5 %	28.6%

In tables 3 & 4 Diagnostic efficacy of ARFI in NCPR & Cirrhosis with portal hypertension was shown. In NCPF, the Combination of either LS, SS and SS/LS showed the Sensitivity, Specificity, PPV and NPV were reported as 83.3%, 27.8%, 43.5% and 70.4%, respectively. For Cirrhosis with portal hypertension with the Combination of either LS, SS and SS/LS showed the Sensitivity, Specificity, PPV and NPV were reported as 72.2%, 16.7%, 56.5% and 28.6%, respectively.

Discussion:

The current study examined how well Acoustic Radiation Force Impulse (ARFI) elastography distinguishes between cirrhotic portal hypertension (CPH) and non-cirrhotic portal fibrosis (NCPF). Our results show that ARFI elastography is a valuable tool in this important diagnostic problem, offering a non-invasive way to differentiate between these two different entities that cause portal hypertension. Regardless of the underlying cause, our analysis showed that patients with CPH had significantly higher liver stiffness measurements (LSM) using ARFI elastography than patients with NCPF.

ARFI prospectively examined liver stiffness in patients by Schönemeier B et al who had liver biopsies for various chronic liver disorders. With a cut-off value of 2.50 m/s, the AUC for ARFI was 0.829 [0.699 – 0.960], distinguishing severe portal hypertension with a sensitivity of 80.8% and a specificity of 83.3% whereas in our study Diagnostic efficacy of ARFI in Cirrhosis with portal hypertension with the combination of either LS, SS and SS/LS showed the sensitivity of 72.2% and specificity 16.7% which is lesser than our study results and the differences is due to difference in various chronic liver disorders (9). Furuichi Y et al did a similar study with the aim to distinguish between chronic hepatitis or liver cirrhosis (LC) and idiopathic portal hypertension (IPH) with liver stiffness, spleen stiffness, and the spleen/liver stiffness ratio had a sensitivity of 94% and specificity of 80% in differentiating this disorders and indicated that Measuring the spleen/liver stiffness ratio by ARFI made it possible to noninvasively, specifically, and accurately diagnose Idipathic Portal Hypertension which is accordance with our study results (10).

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Karlas T et al did a study among Cystic fibrosis-related liver disease and found Cases with liver cirrhosis differed significantly from other CFLD patients and APRI showed the best diagnostic performance for CFLD detection with a sensitivity of 85.7% and a specificity 70.7% respectively (11). The meta-analysis by Nierhoff J et al showed that ARFI imaging had good diagnostic accuracy for fibrosis staging and excellent diagnostic accuracy for cirrhosis (12).

Our results are consistent with research showing increased liver stiffness values in cirrhosis and advanced fibrosis (8). In contrast to the diffuse parenchymal architectural distortion that characterises cirrhosis, the lower LSM seen in NCPF patients—despite significant portal hypertension—reflects the preserved liver parenchyma and the intrahepatic non-sinusoidal nature of fibrosis in this condition (13). Our findings imply that LSM continues to be the main differentiator between NCPF and CPH, in line with the direct evaluation of hepatic architectural alterations, even though some research has investigated the function of splenic stiffness as a stand-in marker for portal hypertension (14). Our study findings & Previous study findings imply that ARFI-derived LSM is a valid tool for determining whether cirrhosis is present in patients exhibiting portal hypertension symptoms, helping to distinguish it from non-cirrhotic causes (15).

Our study had a limitations like small sample size, single-center design that limits generalizability. Overlapping stiffness values between NCPF and cirrhosis cases decrease diagnostic certainty, and unaccounted confounding factors (e.g., inflammation, steatosis) may influence results. Additionally, the absence of long-term follow-up limits insights into disease progression, and selection bias may have excluded atypical cases, potentially overestimating accuracy.

Conclusion:

As a dependable, non-invasive substitute for liver biopsy, ARFI elastography exhibits high diagnostic accuracy in differentiating between cirrhotic portal hypertension and non-cirrhotic portal fibrosis (NCPF). The study demonstrates its efficacy in assessing liver stiffness with high sensitivity and specificity, facilitating the precise and timely differentiation of these conditions. To maximise its clinical use, multicenter studies and cutoff value standardisation are required. ARFI elastography can improve diagnostic accuracy when paired with other diagnostic markers, which will improve patient care and lessen the need for invasive procedures. Its usefulness in hepatology practice should be further supported by future studies that examine its function in tracking the course of the disease.

Conflict of interest: Nil

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