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Original Research Article

ACCURACY OF SHEAR WAVE ELASTOGRAPHY IN THE DIAGNOSIS OF HEPATIC FOCAL LESIONS

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Abstract: *This study aimed to evaluate the accuracy of Shear Wave Elastography (SWE) in diagnosing hepatic focal lesions using triphasic CT as the gold standard. The study was conducted prospectively at the Department of Radiology, Nishtar Medical Hospital, from January 2022 to January 2023. Patients with at least one hepatic focal lesion ranging from 1 to 5 cm in diameter were included in the study. All patients underwent SWE scanning and ultrasound examination. The segment of focal lesions was evaluated, and 5-8 measurements were taken for quantitative analysis of stiffness. In patients with multiple focal lesions, the pathology of all lesions was confirmed by MRI and CT, and the most accessible lesion was analyzed. The mean of all measurements was compared with the findings of triphasic CT and tumor markers to estimate SWE's accuracy, specificity, and sensitivity. The study was conducted on 100 patients, of which 85 were males and 17 were females. The mean stiffness in benign lesions was 10.4 ± 6.32 kPa, and in malignant lesions was 16.3 ± 9.24 kPa. This difference was statistically significant (P<.002). A cutoff value 13.25 was used to differentiate between malignant and benign lesions. The sensitivity, specificity, positive predictive value, negative predictive value, and accuracy of SWE were 78.05%, 71.43%, 88.9%, 52.3%, and 64.3%, respectively. The mean tissue stiffness in focal fatty infiltration was 12.7 ± 8.9 kPa, and in hemangioma lesions was 9.6 ± 4.3 kPa. The mean stiffness in HCC was 15.5 ± 7.1 kPa, in cholangiocarcinoma was 32.6 ± 8.26 kPa, and in metastatic lesions was 22.2 ± 0.5 kPa. In conclusion, SWE has a high sensitivity, specificity, and accuracy for differentiating malignant and benign hepatic focal lesions. The study shows that the stiffness of benign and malignant lesions differs significantly.*

Keywords: Shear Wave Elastography, CT Scan, Hepatic Malignancy, Ultrasound

Introduction

Liver tumors are the growth inside the liver. Liver tumors can be of several different types as the liver has many cell types. Liver tumors can be malignant or benign. They may present as abdominal pain, abdominal mass, jaundice, hepatomegaly, or any other liver dysfunction and can be discovered on imaging for purposes other than cancer (KOTNIS et al., 2021). Ultrasound (US) and computed tomography (CT) scans are usually the first-line imaging modalities for detecting focal and diffuse hepatic lesions. These techniques are helpful in the detection of complex liver masses (Corvino et al., 2019).

There is considerable evidence that any physiological or pathological process affects tissue elasticity more than any other parameter (Constantinescu and Saftoiu, 2019). Shear wave elastography (SWE) provides quantitative tissue stiffness analysis by estimating the shear wave's speed (Nakayama et al., 2021). SWE describes several parameters, including spatial heterogeneity of stiffness and quantitative estimate of lesion elasticity in meters/second or kilopascals. Moreover, it is guided by B-mode imaging using a high frame rate (Herrmann et al., 2018). Different studies have shown that B-mode imaging guidance in SWE provides reliable tissue stiffness estimates (Ferraioli et al., 2012; Moustafa et al., 2017). However, these studies are not conducted on local subjects; thus, in this study, we will evaluate the accuracy of SWE in diagnosing hepatic focal lesions using triphasic CT as the gold standard.

Methodology

The prospective study was conducted in the Department of Radiology, Nishtar Medical Hospital, from January 2022 to January 2023. Patients with at least 1 hepatic focal lesion ranging from 1 to 5 cm in diameter were included in the study. Patients with previously treated focal lesions and perihepatic ascites were excluded. Informed consent of the participants was taken. An ethical review committee of the hospital approved the study.

Detailed histories and results of laboratory examinations of all patients were recorded. Shear wave elastography and ultrasound were performed on all patients.

Patients were prone with the right arm above the head to improve intercostal access. Abdominopelvic ultrasonography was used to evaluate the liver size, outline, texture, echogenicity, and focal lesions. For SWE, patients were instructed to hold their breath for a few seconds. Segment of focal lesions was evaluated, and 5-8 measurements were taken for quantitative stiffness analysis. In patients with multiple focal lesions, the pathology of all lesions was confirmed by MRI and CT, and the most accessible lesion was analyzed. The mean of all measurements was taken and compared with findings of triphasic CT and tumor markers for estimating the accuracy, specificity, and sensitivity of SWE.

SPSS version 23.0 was used for data analysis. Qualitative was presented as mean ± standard deviation and compared using samples t-test. Quantitative data was presented as

frequency and percentage and compared using the chi-square test. P value < 0.05 was considered statistically significant.

Results

The study was conducted on 100 patients; 85 were males, and 17 were females. The mean age of the participants was 52.1 years. Malignant lesions were common in males aged 50-60 years. 41% of patients presented with abdominal distension, 36% with abdominal pain, and 13% with a loss of appetite, 6% with a loss of weight, and 4% with jaundice. The most significant laboratory findings in patients with malignant lesions were albumin (P=.013), SGOT (P=.006), SGPT (P=.002), hepatitis viral markers (P=.001), and alpha-feto proteins (P=.001). Patients underwent ultrasound, CT, and MRI. Malignancy was significantly associated with cirrhotic liver, ascites, and splenomegaly (P<.005).

Of 100 patients, 81 (81%) had malignant lesions (71 had HCC, 5 had cholangiocarcinoma, and 5 had metastasis. 19 (19%) patients had benign lesions (16 had hemangioma and 3 had focal fatty infiltration).

All patients underwent SWE scanning. Mean stiffness in benign lesions was 10.4 ± 6.32 kPa, and in malignant lesions was 16.3 ± 9.24 kPa; this difference was statistically significant (P<.002) (Table I). The cutoff value 13.25 was used to differentiate between malignant and benign lesions. Sensitivity, specificity, positive predictive value, negative predictive value, and accuracy of SWE were 78.05%, 71.43%, 88.9%, 52.3%, and 64.3%, respectively (Table II) (Figure). The mean tissue stiffness in focal fatty infiltration was 12.7± 8.9 kPa, and in hemangioma lesions was 9.6 ± 4.3 kPa. The mean stiffness in HCC was 15.5 ± 7.1 kPa, in cholangiocarcinoma was 32.6 ± 8.26 kPa, and in metastatic lesion was 22.2 ± 0.5 kPa.

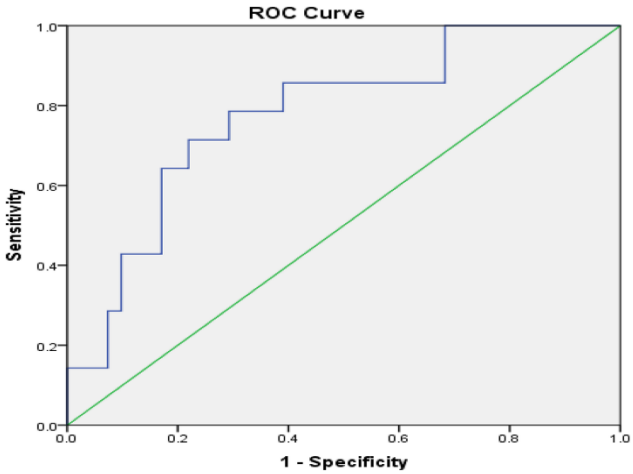

Figure I ROC (receiver operating characteristic) curve for SWE

Table I Stiffness values in malignant and benign lesions.

SWE criteria	Benign lesions	Malignant lesions	t-test	p-value
SWE mean	10.4 ± 6.32	16.3 ± 9.24	2.654	0.013
SWE standard	4.11 ± 2.34	6.1 ± 4.2	2.131	0.031
SWE median	10.31 ± 6.75	17.24 ± 8.26	3.321	0.001

Table II Diagnostic accuracy of SWE

Accuracy	Sensitivity	Specificity	PPV	NPV	Cutoff point	p-value	AUC
64.3%	78.05%	71.43%	88.9%	52.3 %	13.25	.002	.777

Discussion

It is essential to characterize hepatic hepatic lesions accurately and differentially diagnose various types to provide optimum treatment. In this study, we assessed the diagnostic accuracy of SWE in detecting hepatic focal lesions. Shear wave elastography was used for quantitative assessment of the stiffness of lesions and was compared with findings of a triphasic CT scan. In the current study, the mean stiffness in benign lesions was 10.4 ± 6.32 kPa, and in malignant lesions was 16.3 ± 9.24 kPa; this difference was statistically significant (P<.002). This was comparable to the findings of a previous study, which reported that the stiffness of benign lesions was 18.54 ± 13.6 kPa. That of malignant lesions was 26.8± 18.9 kPa, a statistically significant difference (P<.001) (Jesper et al., 2022). Another study also reported that the stiffness of malignant lesions was significantly higher than benign lesions (P<.0001) (Dong et al., 2023). However, some studies reported no difference in the stiffness values of both lesions (Alem et al., 2023; Dong et al., 2020).

In the current study, the mean stiffness of hemangioma lesions was 9.6 ± 4.3 kPa. A previous study reported that the mean stiffness of hemangioma was 13.4± 5.4 kPa, which is close to the findings of our study (RANIA et al., 2022). The higher stiffness was due to the separation of blood-filled spaces by fibrous septa; similar findings were reported in some other studies (Nagarajan, 2019). The current study had 3 focal fatty infiltrations with a mean stiffness of 12.7± 8.9 kPa. This was higher than the stiffness value reported by a previous study on stiffness of diffuse hepatic steatosis; it was reported that severe steatosis had a mean stiffness of 8.5 kPa (Chimoriya et al., 2020). This is due to the large sample size. In this study, the mean stiffness of hepatocellular carcinoma was 15.5 ± 7.1 kPa. A previous study reported a stiffness of 25 HCCs with a mean stiffness of 14.96 ± 11 kPa (Ruan et al., 2023). It was found that metastasis and cholangiocarcinoma have the highest stiffness values. SWE values for cholangiocarcinoma were 32.6 ± 8.26 kPa. This is close to the result of a previous study, which reported a mean stiffness value of 34.2 ± 7.4 kPa for cholangiocarcinoma; the stiffness of cholangiocarcinoma was attributed to their fibrous component (Dong et al., 2023). The difference in the stiffness of cholangiocarcinoma may be because of the small sample size in the current study. This study found 5 metastatic

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lesions with a a mean stiffness of 22.2 ± 0.5 kPa.Another study reported 54 metastases with 22..8 ± 15.6 stiffness values (Ruan et al., 2023). It was found that stiffness values are elevated because of different factors, including changes in cellular architecture, collagen deposit, and lymphatic and vascular permeability. This study has a few limitations. First, lesions < 5 cm were included, so we can't comment on the accuracy of SWE for larger lesions. Second, patients could not hold their breath, which affected SWE results. Lastly, a radiologist who did SWE scanning was not blinded to the findings of CT, which could bias the diagnosis.

Conclusion

SWE has high sensitivity, specificity, and accuracy for differentiating malignant and benign hepatic focal lesions. It shows that the stiffness of benign and malignant lesions differ significantly.

Declarations

Data Availability statement
All data generated or analyzed during the study are included in the manuscript.
Ethics approval and consent to participate
Approved by the department Concerned.
Consent for publication
Approved
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Not applicable

Conflict of interest

The authors declared absence of conflict of interest.

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