Med. J. Cairo Univ., Vol. 90, No. 6, September: 1583-1590, 2022
www.medicaljournalofcairouniversity.net

Is Shear Wave Elastography Effective for Characterization of Hepatic Focal Lesions?

ENGY S. ELKAYAL, M.D.*; ASHRAF T. YOUSSEF, M.D.*; ESSAM A. HASSAN, M.D.** and DUA` M. ABDOLLAH, M.D.*

The Departments of Radiodiagnosis and Tropical Medicine**, Faculty of Medicine, Fayoum University*

Abstract

Background: Shear wave elastography (SWE) is initially developed to investigate hepatic stiffness and measures soft tissue changes that is altered by specific pathological processes. Nowadays there is great need for a noninvasive method to differentiate benign & malignant hepatic focal lesions (FLLs) without dependency on invasive method as biopsy that cause pain bleeding & even death.

Aim of Study: Was to detect the diagnostic accuracy of shear wave elastography in the characterization of hepatic focal lesions.

Patients and Methods: This study included 138 patients presenting with hepatic focal lesion detected by abdominal ultrasound examination. The following data was recorded: The built-in ROI of the system ranging from dark blue indicating the lowest stiffness, to dark red indicating the highest stiffness.

The stiffness of adjacent liver parenchyma was also measured to obtain a direct reference for the SWE measurements of the lesion.

For each focal lesion and adjacent liver parenchyma, five measurements were performed. Median kPa was chosen as the representative value for both the lesion and the parenchyma.

Results: SWE acquisitions for the 138 patients (84 males 61% and 54 females 39% with age range between 25-85 years old were successfully evaluated,The sensitivity of 100% and a specificity of 80% at a cut-off value of 11.13 kPa. The positive predictive value of about (94.7%) and negative predictive value of about (100%) with total accuracy of about (95.7%). There is significant difference in stiffness between benign and malignant lesions with (p<0.001), The mean (±SD) stiffness value of malignant lesions was (22.53±9.33 kPa), and that of benign lesions was (9.36±2.48 kPa). The mean (±SD) stiffness of malignant lesions was significantly higher compared with that of benign lesions (p<0.0001). The mean (±SD) lesion to parenchyma ratio of malignant lesions was (2.53±1.31) with no significant difference from that of benign FLLs (1.86±0.62) as p-value is higher than 0.05 (p=0.174). The mean (±SD) of Hepatocellular carcinoma was the lowest in comparison to other sub-types of malignant lesions. Lymphoma showed the highest stiffness value. The mean (±SD) lesion to parenchymal stiffness of Hepatocellular carcinoma was (1.86±0.68) KPa, with no significant difference from that of benign focal lesions (1.86±0.62) as p-value is higher than 0.05 (p=0.280).

Conclusion: SWE provides information on hepatic FLLs and would help discriminate malignant from benign masses, especially for patients unsuitable for contrast-enhanced imaging. SWE can characterize hepatic focal lesions successfully based on the tissue elasticity values.

Key Words: *SWE – FLL – KPa.*

Introduction

EGYPT reports the highest prevalence worldwide of Hepatitis C virus which is a leading cause of death and morbidity **[1]**. According to Egypt Health Survey 2015, the percentage of population aged 1-59 years positive on HCV RNA test was 4.4%, and the percentage Positive on HCV antibody (chemiluminescence test) was 6.3% **[2]**. In Egypthepatocellular carcinoma (HCC) is the second most frequent cause of cancer and cancer mortality **[3]**.

According to WHO, 55-85% of population infected with HCVwill chronic hepatitis and one third of untreated patients, will have liver cirrhosis or hepatocellular carcinoma **[4]**.

Accurate detection and characterization of hepatic focal lesion is important for optimal patient management **[5]**.

Hepatocellular adenomas, focal nodular hyperplasia, hemangiomas and Cystsare the most commonly encountered benign lesions **[6]**. Metastases, Hepatocellular carcinomas and intrahepatic cholangiocarcinomas represent liver malignancies **[7]**.

Abbreviations:

SWE: Shear wave Elastography (SWE).
FLL : Focal liver lesion.
KPa : Unit's kilopascals.

Correspondence to: Dr. Engy S. Elkayal, The Department of Radiodiagnosis, Faculty of Medicine, Fayoum University

A lot of modalities are being used to reach anexact diagnosis. These include: Conventional and contrast enhanced ultrasound, Triphasic computed tomographyand Dynamic magnetic resonance imaging **[8]**.

Ultrasound is the first choice used for the detection and characterization of hepatic focal lesions due toits safety, availability and low cost. The sensitivity and specificity of B mode ultrasound is less than 70% for the detection and characterization of hepatic focal lesions. The use of ultrasound contrast agents, improves the sensitivity and specificity to 80 and 90% respectively **[9]**, however limitations are operator-dependent technique, high patient body weight and intestinal meteorism, and difficult visualization of the whole liver **[10]**.

Exposure to large dose of radiation is one of disadvantages of Triphasic CT and the nephrotoxic effect of the iodine contrast on patients with renal impairment **[11]**.

Dynamic MRI using different sequences and contrast material is the technique of choice in characterization of hepatic focal lesions which is free of ionizing radiation **[12]**, however long procedure time and need for the patient to hold breath for a long time and high cost are main drawbacks of Dynamic MRI **[13]**.

If there is still uncertainty of the diagnosis percutaneous biopsy is mandatory, however it is an invasive procedure causing pain, patient discomfort in 20-30% of procedures **[14]**. New techniques has been developed which maximize the accuracy of diagnosis and decreasing the rate of unnecessary biopsies **[15]**.

The recent implementation of elastography, has improved the study of organ stiffness and hepatic focal lesions. Elastographic software provides information on their features and aid to characterize them and predict their nature and behavior without contrast material **[16]**. Shear wave elastography is a promising application that can be used in clinical practice to estimates the mechanical tissues properties **[17]**.

Patients and Methods

This is a descriptive cross section study was done in ultrasound unit of Fayoum University Hospital approval of protocol from Fayoum university from January 2019 – June 2021. Ethical committee; fully informed written consent was taken from each patient after given an explanation of the procedures and the importance of the study.

This study used a LOGIQ S8 system with XD clear machine equipped with shear wave elastography software version and the C1-6-D probe.

This Study included 138 Patients (83 males and 55 females). The patient's age was ranging from (28 to 82) years with the mean age of 58.6± 14.1 years. The patients hadhepatic focal lesion were referred from tropical and internal medicine department.

The aim of this study:

The aim of this study was to detect the diagnostic accuracy of shear wave elastography in the characterization of hepatic focal lesions.

Inclusion criteria:

It included patients with hepatic focal lesion.

Exclusion criteria:

Incapable of appropriate breathing. Advanced liver cirrhosis. Massive bowel gases.

Shear wave elastography (SWE) acquisition:

Patients were examined in the supine position with the right arm elevated above the head to eliminate tissue motion from respiratory movements, the patients were asked to hold breathing,

After immobilization of the lesion to stabilize the SWE image without external compression, the image was frozen and saved.

The built-in ROI of the system ranging from dark blue indicating the lowest stiffness, to dark red indicating the highest stiffness.

The ROI was situated at the center hepatic focal lesion to ensure more quantification of stiffness. Appropriate adjustment of the size and position of the box. A smaller ROI was better chosen to ensure that most of the estimate included tissue within the lesion.

The stiffness of adjacent liver parenchyma was also measured to obtain a direct reference for the SWE measurements of the lesion.

For each focal lesion and adjacent liver parencyma, five measurements were performed. Median kPa was chosen as the representative value for both the lesion and the parenchyma.

Statistical analysis: For lesion characterization, the mean (±SD) was calculated for the median Pa values of the malignant and benign hepatic focal lesions to liver parenchyma ratio was calculated for each focal lesion. The Mann-Whitney test was

used to assess the difference between the groups of lesions, whereas a *p*-value of less than 0.05 was considered statistically significant. The diagnostic performance of SWE in discriminating between benign and malignant FLLs was assessed by using the receiver operating characteristic (ROC) curve analysis.

Results

Demographic data:

A total of 138 patient were successfully evaluated (83 males and 55 females). The patient's age was ranging from (28 to 82) years with the mean age of 58.6±14.1 years.

Type of lesions:

Lesions successfully evaluated by SWE were 6 cholangiocarcinoma (4.3%), 6 lymphoma (4.3%), 30 hemangiomas (21.7%), 60 HCCs (43.5%) and 36 metastases (26.2%) (Table 1).

Table (1): Distribution of studied patients according to type of tumor compared with CT & histopathology as gold standard.

Diagnoses	N	%
Benign lesions:		
Hemangiomas	30	21.7
Malignant lesions:	108	78.3
HCC	60	43.5
Metastasis	36	26.2
Lymphoma	6	4.3
Cholangiocarcinoma	6	4.3

SWE quantitative analysis:

For elasticity characterization of hepatic focal lesions, the median value of 5 consecutive measurements was used as a representative value for each lesion. The mean (±SD) stiffness of each pathologic group and the mean (±SD) parenchymal stiffness of those groups are demonstrated in (Table 2). We found that:

The 30 Hemangioma lesions were found to have a mean stiffness (9.36±2.48 kPa), minimum value of stiffness was (7.11 kPa), and maximum value was (12.85 kPa) found in atypical hemangioma. The mean parenchymal stiffness was (5.19± 1.24). The mean stiffness of the 60 HCCs (17.74± 3.22 kPa) with the minimum value of stiffness was (11.22 kPa) and the maximum value was (24.41 kPa) (Fig. 1).

The mean parenchymal stiffness was (10.05± 2.15). The mean stiffness of the 6 metastatic lesions was (35.89±12.55 kPa) with the minimum stiffness value was (18.28 kPa) and the maximum value was (29.28kPa) of pancreatic primaries. The mean parenchymal stiffness was (8.80±1.97). The 6-cholangiocarcinoma showed median stiffness value (43.29 kPa). The parenchymal stiffness was (9.36 KPa). The 6 lymphomas were found to have median stiffness value (47.46 kPa). The parenchymal stiffness was (7.62 kPa).

Comparison between Benign & Malignant lesions:

The mean (±SD) stiffness value of malignant lesions was (22.53±9.33 kPa), and that of benign lesions was (9.36±2.48 kPa). The mean (±SD) stiffness of malignant lesions was significantly higher compared with that of benign lesions ($p<0.0001$). The mean (±SD) lesion to parenchyma ratio of malignant lesions was (2.53±1.31) with no significant difference from that of benign FLLs (1.86± 0.62) as *p*-value is higher than 0.05 ($p=0.174$) (Table 3).

The mean (±SD) of Hepatocellular carcinoma was the lowest in comparison to other sub-types of malignant lesions (Fig. 2). Lymphoma showed the highest stiffness value. The mean (±SD) lesion to parenchymal stiffness of Hepatocellular carcinoma was (1.86±0.68) KPa, with no significant difference from that of benign focal lesions (1.86 ±0.62) as *p*-value is higher than 0.05 ($p=0.280$). (Table 4).

Diagnostic accuracy SWE in characterization of benign and malignant tumors:

The sensitivity of 100% and a specificity of 80% at a cut-off value of 11.13 kPa. The positive predictive value of about (94.7%) and negative predictive value of about (100%) with total accuracy of about (95.7%). (Table 5) (Fig. 3).

Table (2): Distributions of Stiffness Values of Malignant and Benign FLLs Measured by SWE (Fig. 1).

Lesion type	N	Minimum lesion stiffness (KPa)	Maximum lesion stiffness (KPa)	Mean lesion stiffness (±SD)	Mean parenchymal stiffness (±SD)
Hemangioma	30	7.11	12.85	9.36±2.48	8.31 (7.11-12.85)
HCC	60	11.22	24.41	17.74±3.22	17.83 (11.22 - 24.41)
Metastasis	36	18.28	29.28	22.91±4.52	21.21 (18.28-29.28)
CCC	6	43.29	43.29	43.29	43.29
Lymphoma	6	47.46	47.46	47.46	47.46

Table (3): Differences in Shear-wave parameters according to type of tumor Comparison between sub-types of malignant lesions.

Variable	All patients	Malignant	Benign	*p*-value#
	Mean ± SD			
Median lesion stiffness	19.67±9.96	22.53±9.33	9.36±2.48	<0.0001*
Median parenchymal stiffness	8.53±2.59	9.46±2.04	5.19±1.24	0.001*
Lesion/Parenchyma Ratio	2.39±1.22	2.53±1.31	1.86±0.62	0.174*

#Mann-Whitney U-test. *Significance.

Table (4): Differences in Shear-wave parameters according to sub-type of malignancy.

Variable	HCC	Metastasis	CCC	Lymphoma	*p*-value
	Mean ± SD				
Median lesion stiffness	17.74±3.22	22.91±4.52	43.29	47.46	0.001
Median parenchymal stiffness	10.05±2.15	8.80±1.97	9.36	7.62	0.012
Lesion/Parenchyma Ratio	1.86±0.68	2.69±0.67	4.63	6.23	0.280

Table (5): Diagnostic accuracy of Shear-wave parameters compared to final diagnosis in differentiating malignant from benign.

	AUC	*p*-value	Cut-off point	Sensitivity	Specificity	PPV	NPV	Total accuracy
Median lesion stiffness	0.989	0.001	11.13	100.0	80.0	94.7	100.0	95.7
Median parenchymal stiffness	0.956	0.002	5.61	94.4	80.0	94.4	79.8	91.3
Lesion/Parenchyma Ratio	0.711	0.157	1.56	88.9	60.0	88.9	59.9	82.6

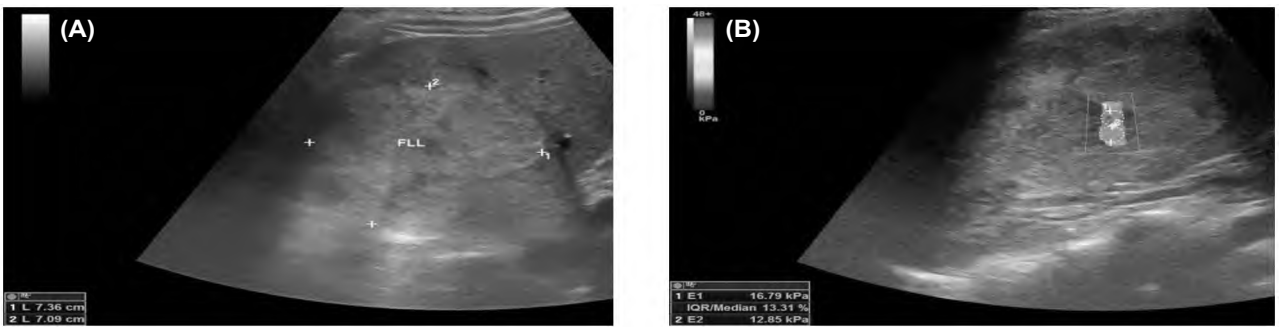

Fig. (1): Giant atypical hemangioma. A 33 years old female patient complaining of heavyness and discomfort in the upper right abdominal quaderent. (A) By conventional ultrasound: Liver is mildly enlarged with bright texture.A single large lobulated echogenic mass is detected in the right hepatic lobe measuting about (7 X 7.3 cm) with heterogenous texture and well defined margine. (B) Shear wave elastographyshowed heterogenous color within the color-coded shear wave box. The median lesion stiffness was 12.85 kPa, and the median parenchymal stiffneess was 4.43 kPa (Metavir score F0-Normal parenchyma).

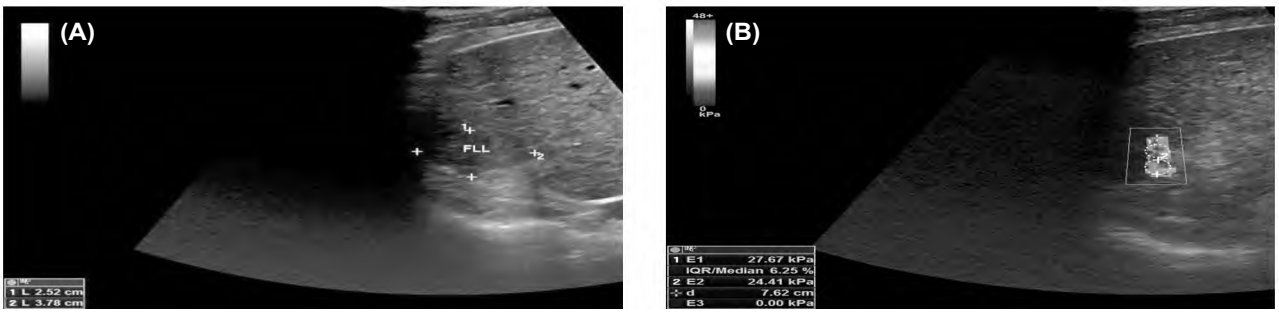

Fig. (2): Hepatocellular carcinoma: A 65 years old male patient with HCV positive and elvated AFP. (A) Conventional ultresound revealed enlarged liver with cirrhotic features. A well defined slightly hypoechoic right lobe focal lesion measuring about (3.7 x 2.5 cm.). (B) Shear wave elastography of the lesion showed heterogenous color within the color-coded shear wave box. It revealed that the median lesion stiffness was 24.41 kPa and the median parenchymal stiffness was 6.50 kPa (Metavir score F1 - mild liver fibrosis).

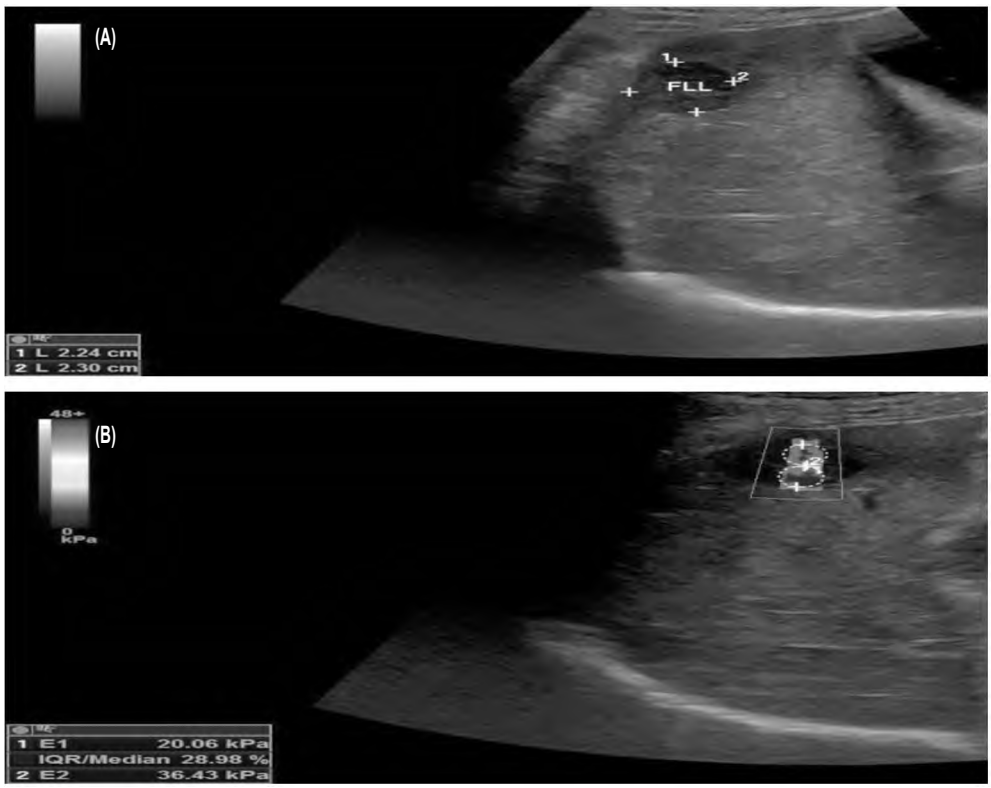

Fig. (3): Mtastatic lesion. A 67 years old male patient was complaining of jundice and progrssive loss of weight. He was suffering from cancer head of pancreas with lung metastasis. (A) By conventional ultrasound: Reavaled single hypoechoic focal lesion measuring about (2.2 x 2.3 cm). Shear wave elastography of the lesion showing heterogenous color within the color-coded shear wave box. The median lesion stiffness is 20.42 kPa and the median parenchymal stiffness was 9.91 kPa (Metavir score F3 - moderate to sever liver fibrosis).

Discussion

The accurate characterizationand the differential diagnosis between different types of hepatic focal lesions are important aims **[19]**. Elastography is an imaging method which estimates tissue elasticity.

Liver elastography is a non-invasive measure of fibrosis that is commonly used in clinical practice to assess liver stiffness in patients with chronic liver disease. Shear wave elastography is also used in the field of hepatology to diagnose clinically significant portal hypertension (CSPH) and high-risk esophageal varices (HRV), as well as to characterize FLLs and predict clinical outcomes in chronic liver disease **[20]**.

SWE could also be utilized to pinpoint the exact location at which FNAC is required in liver lesions **[21]**.

SWE measurements detect and quantify tissue stiffness in response to a mechanical force applied (compression or shear wave) **[21]**. The resulting shear waves are imaged with the same transducer at an ultra-fast imaging sequence in order to provide quantitative elasticity m aps **[22]**.

Shear wave elastography (SWE) is a novel technology involving the remote generation of transient mechanical forces into the tissue by a transducer. SWE is integrated into an ultrasound machine which provides real-time two-dimensional B-mode images to identify the area of interest **[23]**.

The aim of this study was to detect the diagnostic accuracy of shear wave elastography in the characterization of hepatic focal lesions.

Our descriptive cross section study conducted at Radiology department including138 patients known to have hepatic focal lesions, the mean patient age was 58.6±14.1 years. All lesions were subjected to 2-D ultrasound studies, which was followed by Shear wave elastography quantitative assessment of hepatic focal lesions stiffness, then compared with the Triphasic CT and pathological results. Cases had deep lesions (>5cm from the skin), and/or advanced liver cirrhosis were excluded.

In our study, we assessed the elasticity characterization of hepatic focal lesions. We found the mean (SD) stiffness of hemangiomas was (9.36± 2.48 kPa) which is lower than that reported by Guibal A et al, that was (13.8±5.5 kPa), Grgurevic I et al., (14.10±6.44 kPa) and Ronot M et al., (17.1±7 kPa). However, all studies observed that Hemangiomas have slightly elevated stiffness compared with the surrounding liver parenchyma (5.19±1.24 kPa). This elevation in stiffness was explained due to the presence of fibrous septae separating the blood-filled spaces **[24,23,25]**.

In the current study, The mean stiffness of Hepatocellular carcinomas (HCCs) was (17.74± 3.22 kPa) which is consistence with Ronot et al., who reported 19.6 kPa for one hepatocellular carcinoma, but is not consistence with Guibaal et al., Grgurevic et al., and Hee et al., As the measures reported by Guibal A et al., was slightly lower (14.86±10 KPa), and that reported by Grgurevic I et al., and Hee et al., were higher (29.57±11.67 KPa, 45.72±35.65 KPa respectively) **[23-26]**.

In our study, the mean stiffness of metastatic lesions was (22.91±4.52 kPa). Our measures were lower than the measures reported by Guibal A et al., (28.8±16 KPa), and Heet al., (67.43±43.39 KPa) **[24,26]**.

It is worth mentioning that Guibal et al., stated that stiffness of metastases varied depending on their primary tumor type. Metastases from adenocarcinomas of the gastrointestinal tract showed mean elasticity values of (21.8±14.6 kPa), while carcinoid metastases were stiffer (30.7±16.6 kPa). However, this difference was not statistically significant (p<0.1116) **[24]**.

In our study, we found that there is a significant difference in stiffness between benign and malignant groups (p<0.0001). The mean stiffness of benign lesions was (9.36±2.48 kPa)and that of malignant lesions was (22.53±9.33 kPa). This agrees with Guibal A et al., (p=0.01), Hee et al., (p=0.0001), and Grgurevic et al., (p<.001). But disagrees with Ronot M et al., who reported that there was no difference in mean stiffness between the benign and the malignant lesions (26.7±14 vs. 29.3±9.7 kPa, p=0.64) **[24,26,25]**.

In our study, HCCs showed significantly lower stiffness value compared with other hepatic malignant tumors such as CCC or metastasis, and lymphoma which contain more fibrosis (p=0.012). This agrees with most of the previous studies.

In our study, lymphoma showed higher stiffness value compared with other hepatic malignant tumors. This disagrees with Hee et al., which described lymphoma as the stiffest hepatic focal lesion **[26]**.

Our study showed that the mean (SD) lesion/ parenchyma ratio of malignant lesions (2.53±1.31 KPa) was not significantly different from that of benign FLLs (1.86±0.62 kPa), as p=0.174. This agrees with Hee et al., who reported that mean (SD) lesion-parenchyma ratio of hepatocellular carcinoma (3.76±4 KPa) was not significantly different from that of benign FLLs (3.7±3.77 kPa). p>0.05 **[26]**.

We agree with Hee, et al., that Hepatocellular carcinoma showed lower ratio than all of other malignant hepatic focal lesions and showed similar ratio value compared with benign hepatic focal lesions. Hepatocellular carcinoma was relatively soft compared with the background liver, when compared with other malignancy groups. This may be attributed to the liver cirrhosis background in most patients with Hepatocellular carcinoma. The lesion to parenchyma ratio may be especially of clinical value in hepatic fibrosis patient population **[26]**.

In our study, the area under the ROC curve of SWE for differentiating benign lesions from malignant tumors was 0.989, with a sensitivity of 100% and a specificity of 80% at a cut-off value of 11.13 kPa. The positive predictive value of about (94.7%) and negative predictive value of about (100%) with total accuracy of about (95.7%).

It is higher than what is described in Hee et al., and Grgurevic et al., 127 patients having 136 FLLs are included in the study Hee et al., The area under the ROC curve of SWE for differentiating benign lesions from malignant tumors was 0.793, with a sensitivity of 70.6% and a specificity of 82.4% at a cutoff value of 30.8 kPa **[23,26]**.

196 patients with 259 FLLs are included in the study Grgurevic et al., The best performing mean lesion stiffness cut-off to differentiate benign and malignant lesions was 23.2 kPa with sensitivity 83% (95% CI: 76-88), specificity 86% (95% CI: 77-92), positive predictive value (PPV) 91.5% and negative predictive value (NPV) 73% **[23]**.

Hence, Ronot M et al., believed that the different stiffness thresholds published in the literature for distinguishing malignant from benign tumors should be considered with great caution **[25]**.

The study had some limitations:

1- These results were obtained by thorough measurement which was time-consuming procedure and took up to 25-30min in some cases.

2- Poor intercostal windows and the patient's inability to hold their breath long enough to acquire a steady SWE acquisition.

Conclusion:

SWE, as an adjunct to conventional ultrasound, provides additional information for the characterization of focal liver lesions based on the tissue elasticity values.

References

1- Centers for Disease Control and Prevention (CDC): Progress toward prevention and control of hepatitis C virus infection-Egypt, 2001-2012. Atlanta, GA, US Department of Health and Human Services; CDC. MMWR, 61 (29): 545-549, 2012.

2- Ministry of Health and Population, El-Zanaty and Associates, Cairo, Egypt and The DHS Program, ICF International, Rockville, Maryland, USA. Egypt Health Issues Survey, 2015.

3- EL-ZAYADI A.R., BADRAN H.M., BARAKAT E.M., et al.: Hepatocellular carcinoma in Egypt: A single center study over a decade. World J. Gastroenterol., 11: 5193-5198, 2005.

4- World Health Organization (WHO): Hepatitis C Fact Sheet N°164. Geneva, Switzerland: World Health Organization. Available at: http://www.who. int/mediacentre/ factsheets/fs164/en/, 2015.

5- COGLEY J.R. and MILLER F.H.: MR imaging of benign focal liver lesions. Radiol. Clin. North Am., 52: 657-682, 2014.

6- NAULT J.C., BIOULAC-SAGE P. and ZUCMAN-ROSSI J.: Hepatocellular benign tumors-from molecular classification to personalized clinical care. Gastroenterology, 144: 888-902, 2013.

7- BASTATI N., FEIER D., WIBMER A., TRAUSSNIGG S., BALASSY C., TAMANDL D., EINSPIELER H., WRBA F., TRAUNER M., HEROLD C., et al.: Noninvasive differentiation of simple steatosis and steatohepatitis by using gadoxetic acid-enhanced MR imaging in patients with nonalcoholic fatty liver disease: A proof-of-concept study. Radiology, 271: 739-747, 2014.

8- PADIA S.A., BAKER M.E., SCHAEFFER C.J., REMER E.M., OBUCHOWSKI N.A., WINANS C. and HERTS B.R.: Safety and efficacy of sonographic-guided random real-time core needle biopsy of the liver. J. Clin. Ultrasound., 37: 138-143, 2009.

9- TRANQUART F., LE GOUGE A., CORREAS J.M. and LADAM MARCUS V.: Role of contrast-enhanced ultrasound in the blinded assessment of focal liver lesions in comparison with MDCT and CEMRI: Results from a multicentre clinical trial. EJC supplements. September, 6: 9-15, 2008.

10- CELLI N., GAIANI S., PISCAGLIA F., et al.: Characterization of liver lesions by real-time contrast-enhanced ultrasonography. Eur. J. Gastroenterol. Hepatol., 19: 3-14, 2007.

11- SGOURAKIS G., LANITIS S., KORONTZI M., KONTOVOUNISIOS C., ZACHARIOUDAKIS C., ARMOUTIDIS V., KARALIOTAS C., DEDEMADI G., LEPIDA N. and KARALIOTAS C.: Incidental findings in focused assessment with sonography for trauma in hemodynamically stable blunt trauma patients: Speaking about cost to benefit. J. Trauma, 71: E123-E127, 2011.

12- TAN C.H., LOW S.C. and THNG C.H.: APASL and AASLD Consensus Guidelines on Imaging Diagnosis of Hepatocellular Carcinoma: A Review. Int. J. Hepatol., 2011: 519783, 2011.

13- SEMELKA R.C. and HELMBERGER T.K.: Contrast agents for MR imaging of the liver. Radiology, 218: 27-38, 2001.

14- ATWELL T.D., SMITH R.L., HESLEY G.K., et al.: Incidence of bleeding after 15,181 percutaneous biopsies and the role of aspirin. AJR Am. J. Roentgenol., 194: 784-789, 2010.

15- WATANABE A., RAMALHO M., ALOBAIDY M., KIM H.J., VELLONI F.G. and SEMELKA R.C.: Magnetic resonance imaging of the cirrhotic liver: An update. World J. Hepatol., 7: 468-487, 2015.

16- Lawrence Pan and MS IV: New Jersey Medical School Radiology. Common CT Findings Secondary to Liver Tumors. Beth Israel Deaconess Medical Center September, 32: 1-27, 2006.

17- CLARA BENEDETTA CONTI, FEDERICA CAVALCOLI, MIRELLA FREQUELLI, DARIO CONTE and SARA MASSIRONI: Ultrasound elastographic techniques in focal liver lesions. World J. Gastroenterol., Mar. 22 (9): 2647-2656, 2016.

19- GALLOTTI A., D'ONOFRIO M., ROMANINI L., CANTISANI V. and POZZI MUCELLI R.: Acoustic Radiation Force Impulse (ARFI) ultrasound imaging of solid focal liver lesions. Eur. J. Radiol., 81: 451-455, 2012.

20- ANA-MARIA GHIUCHICI, IOAN SPOREA, MIRELA DAN NILA *, ROXANA S., IRLI, TUDOR MOGA, FELIX BENDE and ALINA POPESCU: Is There a Place for Elastography in the Diagnosis of Hepatocellular Carcinoma? Journal of Clinical Medicine, 10: 1710, 2021.

21- ASHU SINGLA, VISHWANATH T.T., M.D., DNB, SUDHA KIRAN DAS, DMRD, M.D.*, NAGARAJ MURTHY, M.D., VIKRAM PATIL, DNB, ANUPAMA C., DNB and VINAY RAJ, M.D.: Evaluation of Solid Focal Liver Lesions by Shear Wave Sonoelastography with FNAC Correlation. International Journal of Radiology and imaging Tchnology, Volume 6 Issue 2, 2020.

22- BERCOFF J., TANTER M. and FINK M.: Supersonic shear imaging: A new technique for soft tissue elasticity mapping. IEEE Transactions on Ultrasonics, Ferroelectrics, and Frequency Control., 51 (4): 396-409, 2004.

23- GRGUREVIC I., BOKUN T., SALKIC N.N., et al.: Liver elastography malignancy prediction score for noninvasive characterization of focal liver lesions. Liver Int. October, 00: 1-9, 2017.

24- GUIBAL A., BOULARAN C., BRUCE M., et al.: Evaluation of shear wave elastography for the characterisation of focal liver lesions on ultrasound. Eur. Radiol., 23: 1138-1149, 2013.

25- RONOT M., RENZO S.D., GREGOLI B., et al.: Characterization of fortuitously discovered focal liver lesions: Additional information provided by shearwave elastography. Eur. Radiol., 25: 346-358, 2015.

26- HEE SUN PARK, YOUNG JUN KIM, MI HYE YU, SUNG IL JUNG and HAE JEONG JEON: Shear Wave Elastography of Focal Liver Lesion. Intraobserver Reproducibility and Elasticity Characterization. ORIGINAL RESEARCH. Wolters Kluwer Health, 2015.

هل التصوير الإلستوجرافى بموجة القص فعال فى توصيف الآفات البؤرية الكبدية؟

تم تطوير التصوير الإلستوجرافى بموجة القص فى البداية للتحقيق فى تصلب الكبد وقياس تغيرات الأنسجة الرخوة التى يتم تغييرها بواسطة عمليات مرضية محددة. فى الوقت الحاضر، هناك حاجة كبيرة لطريقة غير جراحية للتمييز بين الآفات البؤرية الكبدية الحميدة والخبيثة دون الاعتماد على الطريقة الغازية مثل الخزعة التى تسبب الألم والنزيف وحتى الموت. الغرض من هذه الدراسة هو الكشف عن الدقة التشخيصية لتصوير المرونة بموجة القص فى توصيف الآفات البؤرية الكبدية.

كان الهدف من الدراسة هو الكشف عن الدقة التشخيصية لتصوير المرونة بموجة القص فى توصيف الآفات البؤرية الكبدية.

تضمنت هذه الدراسة ١٣٨ مريضاً يعانون من آفة بؤرية كبدى تم الكشف عنها بفحص البطن بالموجات فوق الصوتية. تم تسجيل البيانات التالية يتراوح العائد على الاستثمار الداخلى للنظام من اللون الأزرق الداكن الذى يشير إلى أدنى صلابة، إلى الأحمر الداكن الذى يشير إلى أعلى صلابة. تم قياس صلابة حمة الكبد المجاورة أيضاً للحصول على مرجع مباشر لقياسات للآفة.

لكل آفة بؤرية وحمة الكبد المجاورة، تم إجراء خمسة قياسات. تم اختيار متوسط كيلو باسكال كقيمة تمثيلية لكل من الآفة والحمة.

تم بنجاح تقييم التصوير الإلستوجرافى بموجة القص لـ ١٣٨ مريضاً (٨٤ ذكور ٦١٪ و ٥٤ إناث ٣٩٪ تتراوح أعمارهم بين ٢٥–٨٥ عاماً، حساسية ١٠٠٪ وخصوصية ٨٠٪ بقيمة قطع ١١.١٣ كيلو باسكال. بلغت القيمة التنبؤية الموجبة حوالى (٩٤.٧٪) والقيمة التنبؤية السلبية حوالى (١٠٠٪) وبدقة كلية حوالى (٩٥.٧٪) يوجد فرق معنوى فى الصلابة بين الآفات الحميدة والخبيثة مع (p<٠.٠٠١)، المتوسط كانت قيمة الصلابة (± SD) للآفات الخبيثة (٢٢.٥٣±٩.٣٣ كيلو باسكال)، أما الآفات الحميدة فكانت (٩.٣٦±٢.٤٨ كيلو باسكال) وكان متوسط صلابة الآفات الخبيثة (± SD) أعلى بكثير مقارنة مع الآفات الحميدة (p<٠.٠٠٠١) متوسط نسبة الآفة (± SD) إلى حمة الآفات الخبيثة كانت (٢.٥٣±١.٣١) مع عدم وجود فرق معنوى عن الـ FLLs الحميدة (١.٨٦±٠.٦٢) حيث أن قيمة p أعلى من ٠.٠٥ (p=0.174) كان متوسط (± SD) لسرطان الخلايا الكبدية هو الأدنى مقارنة بالأنواع الفرعية الأخرى من الآفات الخبيثة. أظهر سرطان الغدد الليمفاوية أعلى قيمة تصلب. كان متوسط (± SD) للصلابة المتنى لسرطان الخلايا الكبدية (١.٨٦±٠.٦٢)، مع عدم وجود فرق كبير عن الآفات البؤرية الحميدة (١.٨٦±٠.٦٢) حيث أن قيمة p أعلى من ٠.٠٥ (p=0.280).

الاستنتاجات : يوفر التصوير الإلستوجرافى بموجة القص مزيداً من المعلومات حول الآفات البؤرية الكبدية وسيساعد فى التمييز بين الأورام الخبيثة والكتل الحميدة، خاصة للمرضى غير المناسبين للتصوير المعزز بالتباين. يمكن أن تميز التصوير الإلستوجرافى بموجة القص الآفات البؤرية الكبدية بنجاح بناءً على قيم مرونة الأنسجة.