Comparison of Shear-Wave Elastography and Biopsy in the Evaluation of Liver Masses

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Abstract: Background: Liver cancer is the 6th most occurrence disease around the world with a rating of 749,700 in the year 2008. The maximum number of liver cancers 75-90 % among the people were diagnosed with hepatocellular carcinomas (HCC) where HCC is a malignant tumor effect the liver parenchymal cell. Share waves elastography (SWE) is a technique used for the evaluation of liver masses in all aspects however SWE showed high sensitivity, specificity and predictivity of masses. Whereas the liver biopsy is still considered to be the gold standard. Objective: To compare Biopsy and shear-wave elastography findings in the differentiation of liver masses. Methodology: The study was cross-Sectional. 133 patients were included in the study, 84 patients (mean age:42.9762 years; all females) underwent SWE and 40 (mean age:42.8750 years; male:14 and female:26) patients underwent both technique SWE and biopsy. The study was conducted at Shaukat Khanum Memorial cancer hospital & Research center and General hospital. The duration of the study was 9 months. The sampling Technique was Convenient sampling. All the individuals having liver fibrosis were included while Liver transplant patients were excluded. Toshiba i-800 US machine (Shear Wave Elastography software) was used in the study and hospital protocols were followed. Data were analyzed by SPSS version 23. Results: out of 84 participants who underwent SWE, 50 participants showed masses and 34 had negative results. participants who underwent both SWE and biopsy (no:40) showed masses in 27 participants when they underwent SWE and 33 after diagnosis of biopsy. Sensitivity, specificity, positive predictive value and negative predictive value of shear wave elastography were 100 %, 53.85%, 81.82%, 100% respectively. Conclusion: Shear wave elastography was found to have magnificent diagnostic achievement in assessing liver fibrosis with liver disease. The SWE has got high sensitivity but not specificity. However, liver biopsy is still considered to be the gold standard.

Keywords: Shear wave elastography, liver masses, cirrhosis, Transient elastography, and liver biopsy.

INTRODUCTION

Liver cancer is the 6th most occurrence disease around the world with rating 749,700 in the year of 2008. The maximum number of liver cancers 75-90 % among the people was diagnosed hepatocellular carcinomas (HCC) where HCC is malignant tumor effect the liver parenchymal cell.(1) In the other article is shown the prevalence of liver cancer in 1997 was 8/100000 per year in Pakistan (2). In the continental of Europe especially France and Italy a study been discovered that HCV genotype 1 b is the main cause of liver cancer among the people in Europe, therefore within 15 years the rate of liver cancer is increased from 919 in 1979 to 1764 in 1994. Between 1979 and 1994, the death rates were increased in UK per 100 000, from 2.39 to 3.56 in male, and 1.08 to 2.22 in female. (3) The liver is located in the right upper quadrant, and middle epigastric region of the abdominal cavity, the liver is consider the largest organ in the body according to Snell anatomy. (4) However Stephanie Rayan had classified the liver into two lobes, eight segments, right and left lobe which is split by middle hepatic vein, right hepatic vein separated the right lobe into anterior and posterior segments, left hepatic vein split the liver into medial and lateral fragment, portal vein split the liver into superior and inferior segments where left and right branches of portal veins goose superiorly and Inferiorly in the mid of each segment. (5) Recently the ultrasound machine is widely used around the world, It is inexpensive procedures that can be easily preform on different organs in the human body, without using radiation which is not harmful to body, and therefore ultrasound machine is a good option in diagnostic of the different lesions seen in the abdominal. (6) Years ago the patients used to suffer a lot from the old procdures of lesions, however when a new technique had been discovered which called biopsy it made all procdures

easy for the surgen and patients more comfortable.(7)ultrasound guided biopsy is defined as a medical technique that used to diagnose different types of masses by the help of ultrasound machine and give a final result for the lesions rather it is benign or malignant.(8) matesties is said to be the common lesion that occur in the liver, in previous study shows that the core needle biopsy (CNB) accuracy was high 93.7%.(9) needle biopsy of liver had been the gold stander for long time, however there is some complictions can be accured after biopsy is done like severe pain and bleeding, whereas a new and latest techinque was described, which is elestography ultrasound where can be detect the stiffness of liver non invasily.(10)ultrasound elastography, and also called sonoelastography, is more utilized in detecting and discover of diffuse liver masses,elastography has the ablitiy to identify between adavnce and early stage of liver fibrosis, evaluation of liver cirrhosis, evaluation between liver fibrosis like HCV and HBV in pateints, and other reliable evaluation just like distinguishing non-alcoholic steatohepatitis from simple steatosis in non-alcoholic fatty liver disease patients, and prognostic evaluation of liver disease is autoimmune liver disease moreover elastogrphy has shown better evaluation in detecting portal hypertension which is very useful in the clinical.(11) In the beginner, imaging-based elastography techniques have been published to measure stiffness and other mechanical tissues noninvasively rather it is research and clinical indications. However, these modalities cannot measure stiffness directly; but they assess stiffness indirectly. By measuring the velocity of shear waves propagating in the tissue of interest. The basic concept is that the speed shear waves is related to the stiffness of the tissue. Shear waves propagate faster in hard tissues; however, it gooses slower in soft tissues.(12) the elastography technique is considered to be a sort of remote palpation that gives measurement and show of bio-mechanical properties related with the velocity restoring forces in the tissues that been act against shear deformation.(11)

There are a lot of masses can be occur in the liver ranging from bengin and malignant. Different management planes are adopted accordingly. The recognitum of these masses with the help of established sonographic criteria will be helpful in the early detection of different masses in the liver, however a new imaging modility been discovered, it is able to detect masses without using biopsy.

MATERIALS AND METHODs

In this cross-sectional study 133 patients were conveniently enrolled after signing informed consent from all of them, 84 patients (mean age:42.9762 years; all females) were underwent for SWE, however only 40 (mean age:42.8750 years; male:14 and female:26) patients underwent for both technique SWE and biopsy. The study conducted at Shaukat Khanum Memorial cancer hospital & Research center and General hospital. The duration of the study was 9 months. All the individuals having liver fibrosis and performed Elastography and biopsy were included while Liver transplant patients were excluded. Toshiba i-800 US machine (Shear Wave Elastography software) was used in the study. The rules and regulations set by the ethical committee of university of Lahore were followed while conducting the research and the rights of the research participants were respected. Data was collected on data collection sheets according to the variables of the questionnaire that includes: History/ complaints/ clinical diagnosis, age etc.

Data analysis: SPSS version 23 was used for data analysis. Quantitative variables (mention quantitative variables) were presented with mean±SD and qualitative variables (mention qualitative variables) was presented with frequency and percentage. A cross tubulation method was construed to calculate the diagnostic accuracy parameters (sensitivity, Specificity, Positive predictive value, Negative Predictive value and diagnostic accuracy).

Elastography Protocol: Departmental protocol was followed. Tow approach used to be done for the patients longitudinal and transverse views, the liver measurement used to be taken on longitudinal view. The parenchyma of liver should be evaluated for focal diffuse abnormalities. If needed, the echogenicity of the liver should be compared with the right kidney. In addition, those following should be imaged. Both lobe of liver right and left lobe, caudate lobe, and pleural space. The hepatic vessels, including the inferior vena cava (IVC), hepatic veins, portal vein and its branches left and right. The surface of the liver may be imaged with a high-frequency transducer to evaluate possible surface nodularity in patients at risk for cirrhosis. Doppler should be used for vascular examinations, to document blood flow characteristics and the blood flow direction.

RESULTS

In this study 133 patients were voluntarily enrolled with mean age 42.97 SD±12.36 (min: 6, max: 77). Out of the total participants 84 individuals were selected to undergo to shear wave elastography. But the masses were seen in only 50 patients as seen in figure 1 and the rest of 34 were declared normal by the share wave elastography. Out of 50 patients, the mass was located in 15 patients (30%) in the left side, whereas in 35 patients (70%) were located in the right side as seen in figure 2. Out of 50 patients, the size 15(30%), in the left side, while the size was 35(70%) in the right side of the liver as seen in figure 3 and 4. Out of 40 patients, 33 (82.5%) patients showed positive results, whereas in 7 patients (17.5%) showed negative results. The sensitivity, Specificity, positive predictive value and negative predictive value were calculated with the help of two by two contingency table which is shown in table 1. Sensitivity for shear wave elastography is 100 % and specificity is 53.85% respectively. Positive predictive value for shear wave elastography is 81.82% and negative predictive value 100%.

DISCUSSION

Liver cancer considered to be the 2nd most common cancerous over the world whereas 700000 deaths were counted annually. Hepatocellular carcinoma (HCC) and intrahepatic Cholangiocarcinoma (iCCA) are prevalent types of liver cancer, both occurring in cirrhotic liver in contrast to adolescence—hepatoblastoma and fibrolamellar carcinoma—both occurring in a non-cirrhotic liver.(14) Current studies revealed that liver cancer remarkably appears in males more than females with high frequencies in age ranged from 45-60 years. In the last two decades, the prevalence and mortality of liver cancer have been found to be increasing, perhaps this due to increase of surrounding of risk factors.(15) Many risk factors are playing significance role in occurring of liver cancer including: liver infections like hepatitis, aflatoxin, diabetes, alcohol consumption, smoking, alcohol consumption, obesity and exposure to some detergents and chemical agents.(16) In the past ten years, elastography, particularly transient elastography (TE), has been exceedingly used to assess liver fibrosis and cirrhosis and portal hypertension-related complications in patients with chronic liver disease. In addition, TE has been shown to be a useful predictor of HCC in (chronic hepatitis) CHB patients.(17) Lately, Kim et al, reported that TE can identify the so-called subclinical cirrhosis of CHB patients with non-clinical cirrhosis but an increased risk of HCC.(18) In addition, shear wave dispersion slope has better diagnostic performance than liver in detecting allograft damage Stiffness value (area under receiver operating characteristics). Relationship curve between shear wave dispersion slope and liver stiffness, 0.86 vs Respectively 0.75;.(19) The liver stiffness value should be taken into consideration the frequency of the transducer used to obtain the measured value. The influence of the sensor on the measurement may related to the relationship between viscoelasticity tissue and transducer frequency, and broadband characteristics generated by mechanical excitation Ultrasonic radiation force through SWE mode.(20) on the other hand some studies showed limitations for shear wave elastography which showed some effect on the image some of these limitations is 2D-SWE spatial resolution decreases with transducer frequency; US absorption rate increases with the increase of transducer frequency In-depth analysis decreases as the frequency of the transducer increase. note that large bandwidth is an important parameter because higher frequencies decay faster and average, The frequency of the transducer changes with depth. The frame rate itself is related to the depth of analysis and area of frequency of the transduce.(21) Despite of progress in non-invasive tools (NIT) in diagnosis but liver biopsy still considered as golden standard for liver biopsy evaluation masses. The importance of the liver biopsy is that it can accurately evaluate patterns of histological lesion that associate with hepatocytes injury and fibrosis.(22) It also can provide important diagnostic information about necrotizing inflammation (disease activity) and blood lipid levels Fatty degeneration.(23) However, there are some limitations for liver biopsy procedures like, (cost, pain, increased morbidity and mortality), Error or patient rejection. There is a slight dispute about suitability the replacement of liver biopsy with SWE in detecting masses and accurately determining the fibrosis in the liver.(22) Shereen M., et al The researchers assumes that the sensitivity, specificity and predictivity of the liver biopsy is relatively low as compared with SWE.(24) The biggest argument in favor of other imaging techniques over liver biopsy is that there are some drawbacks accompany the biopsy process such as bleeding, mortality and it may be relatively more expensive than others. Despite the credibility of some of these arguments, a liver biopsy remains the gold standard for diagnosis masse, Despite the credibility of some of these arguments, liver biopsy remains the best reference for detecting lumps as some studies report that the mortality rate ranges from 0.03 to 1% only while bleeding reaches 0.06% of cases. These values can be relatively slight.(25),(26) liver biopsy shows high sensitivity, specificity and predictivity after diagnosis of masses when it is compared to other imaging modalities.(27) Jeong Rye Kim et conducted meta-analysis study include 10 of the 12 competent studies provide knowledge on the diagnostic accuracy of shear wave elastography for severe liver fibrosis (≥F2). The overall sensitivity of shear wave elastography for predicting main liver fibrosis (≥F2) is 81% (95% CI: 71-88), and the overall specificity is 91% (95% CI: 83-96). 3). The diagnostic odds ratio was 44 (95% CI: 15-126), and the AUC was found to be 0.91 (95% CI: 0.88-0.93) from the HSROC curve.(28) another study was conducted for Shashi B. Paul in 2017 for both hepatitis CHB and CHC were compered by shear wave elastography and transient elastography in the liver which showed high sensitivity, specificity, positive predictive value and negative predictive value ranged between (98.7 and 97.9%).(29)

This study conducted to compare SWE with liver biopsy through measuring of sensitivity, specificity, positive and negative predictive values of both. 133 patients were conveniently enrolled in the study from **Shaukat Khanum Memorial cancer hospital & Research center and General hospital**. the patients suffering from masses in their liver and diagnosed by SWE or SWE with biopsy have been included however, liver transplant patients were excluded. the elastography departmental protocol was followed as standard procedure in diagnosis of masses in the liver.

The duration of research took approximately 12 months. Toshiba i-800 US machine with Shear Wave Elastography software was used for diagnosis. the data of the research was collected from questionnaire given to patients involved personal information: gender, age, complaints and history. imaging and biopsy data were recorded too. out of 133 participates, 84 with mean age 42.97 SD±12.36 were diagnosed by SWE technique only (group a) and 40 with mean age 42.875 SD±16.9648 were administrated to SWE technique followed by biopsy procedure (group b). the both procedures performed to investigate presence, location, size and echogenicity of masses. The mass location was left in 15 patients and 3 patients at group a and b respectively, while 50 and 35 patients underwent mass at right lobe in group a and b respectively. 33 and 8 patients have normal size in both groups respectively however 51 and 32 have abnormal size respectively. Echogenicity explained as the ability of tissues to reflect sound waves it can identify the masses by color coding and compression.(30) our result showed Echogenicity of masses either it is hyperechoic or hypoechoic. 79 and 30 patients showed hyperechoic masses whilst 5 and 10 patients were hypoechoic at both groups A and B respectively. In group A. the majority of patients manifested positivity in their diagnosis (50 patients), the rest (34 patients) had negative results. on second group the patients were diagnosed by both SWE and biopsy sequentially. SWE showed positivity in 27 patients and 13 were negative however after administrating to biopsy 33 patients were positive while 7 patients were negative. SWE could not find the masses of some diagnosed participates whereas liver biopsy had detected those masses of particular participates. Although the maximum participants were correctly detected by both techniques. So, in present study the sensitivity, specificity and predictivity of SWE exhibit significantly high and accurate outcome in which make this technique magnificent for identification of masses.

CONCLUSION

Shear wave elastography was found to have magnificent diagnostic achievement in assessing of liver fibrosis with liver disease. The SWE is sensitive but is not specific However liver biopsy still considered to be gold standard.

Declaration

Ethical approval

The rules and regulations set by the ethical committee of the University of Lahore were followed while conducting the research and the rights of the research participants were respected.
- Written informed consent attached was taken from all the participants.
- All information and data collection were kept confidential.
- Participants were remained anonymous throughout the study.
- The subjects were informed that there are no disadvantages or risks on the procedure of the study.
- They were also be informed that they will be free to withdraw at any time during the process of the study.
- Data was kept in under key and lock while keeping keys in hand. In laptop, it was kept under a password.

Consent of publication

The authors declare that the consent of publication is available on demands.

Availability of supporting data

The authors declare that the data supporting the findings of this study available within the article.

Competing interest

The authors declare that they have no competing interests.

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RECOMMENDATION

Liver stiffness measurement by using SWE should be performed through the right intercostal space in supine position, with arm extension and hold of breathing to avoid any blur in the image during the scan however the patients should keep fasting for at least 4 hours pre scan for better image. The topic should be given more importance in future studies by increasing the number of participants and period of study

Table-1: cross tabulation of share wave elastography and biopsy for the liver masses.

Biopsy results * SWE results Cross tabulation				
Count				
SWE results		Biopsy results		
		Positive	Negative	Total
	Positive	27(81.8%)	6(18.2%)	33(100%)
	Negative	0(0.0%)	7(100%)	7(100%)
Total		27(67.5%)	13(32.5%)	40(100%)

Out of 40 patients who underwent SWE, 27 (67.5%) patients showed positive results, whereas in 13 patients (32.5%) showed negative results. However, when they underwent biopsy, 33 (82.5%) patients showed positive results, whereas in 7 patients (17.5%) showed negative results.
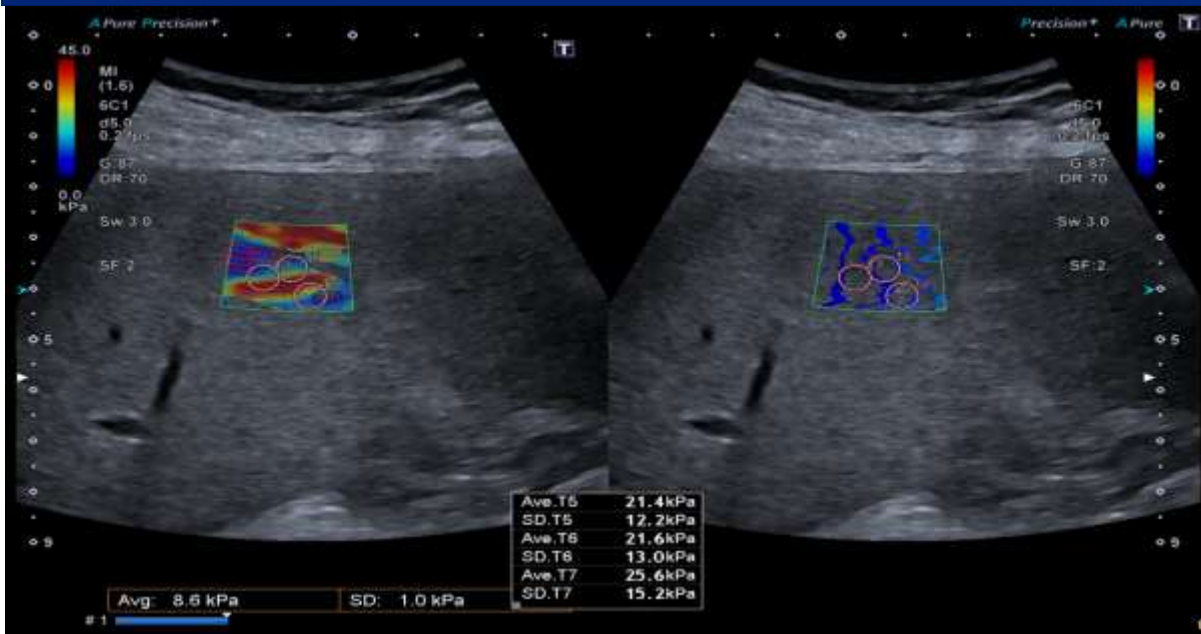
Figures

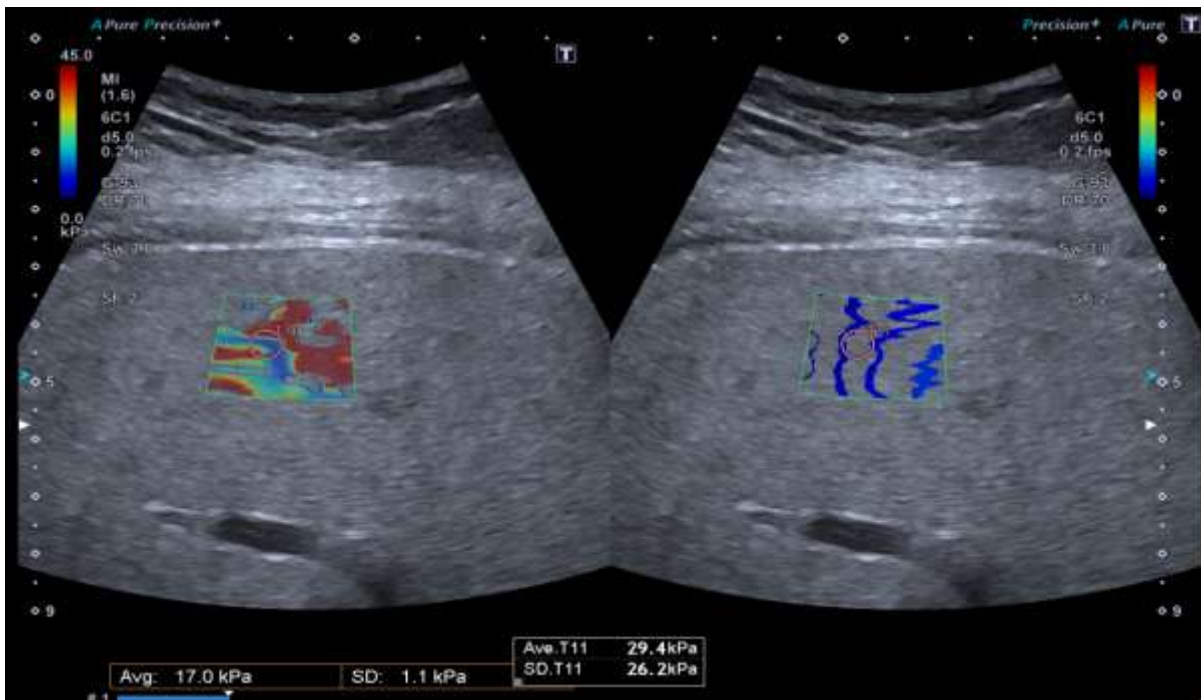*figure 1: Shear wave elastography shows liver fibrosis stage 3.*

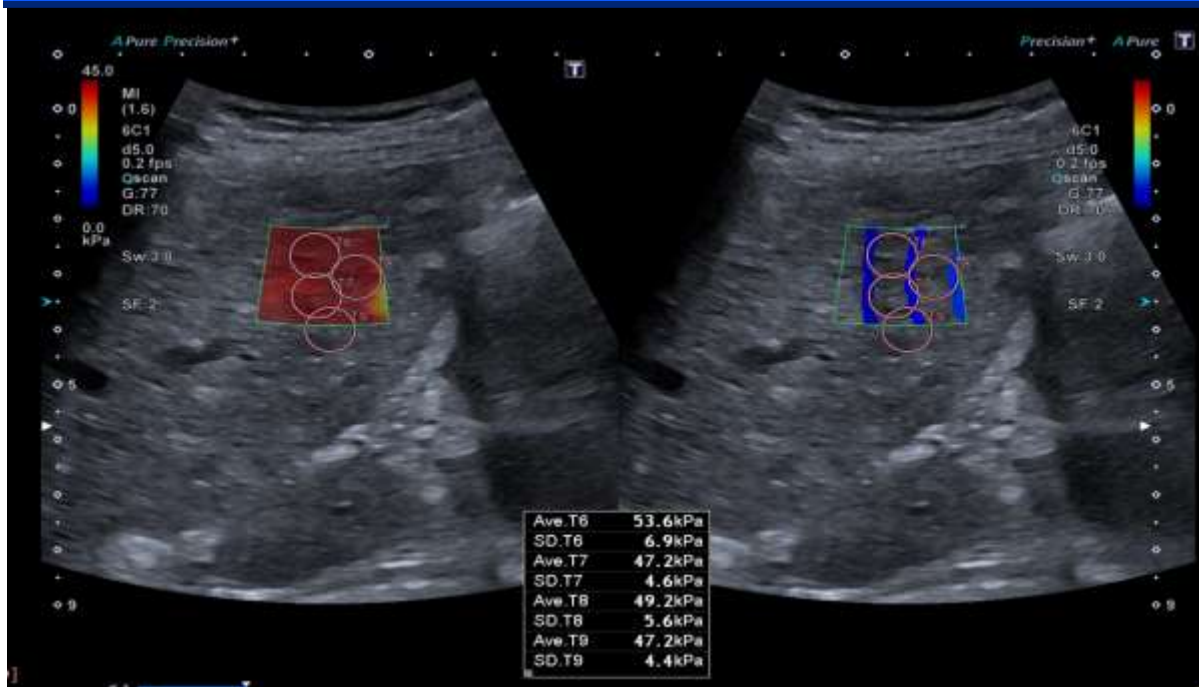*figure 2: Shear wave elastography shows liver fibrosis stage 4*

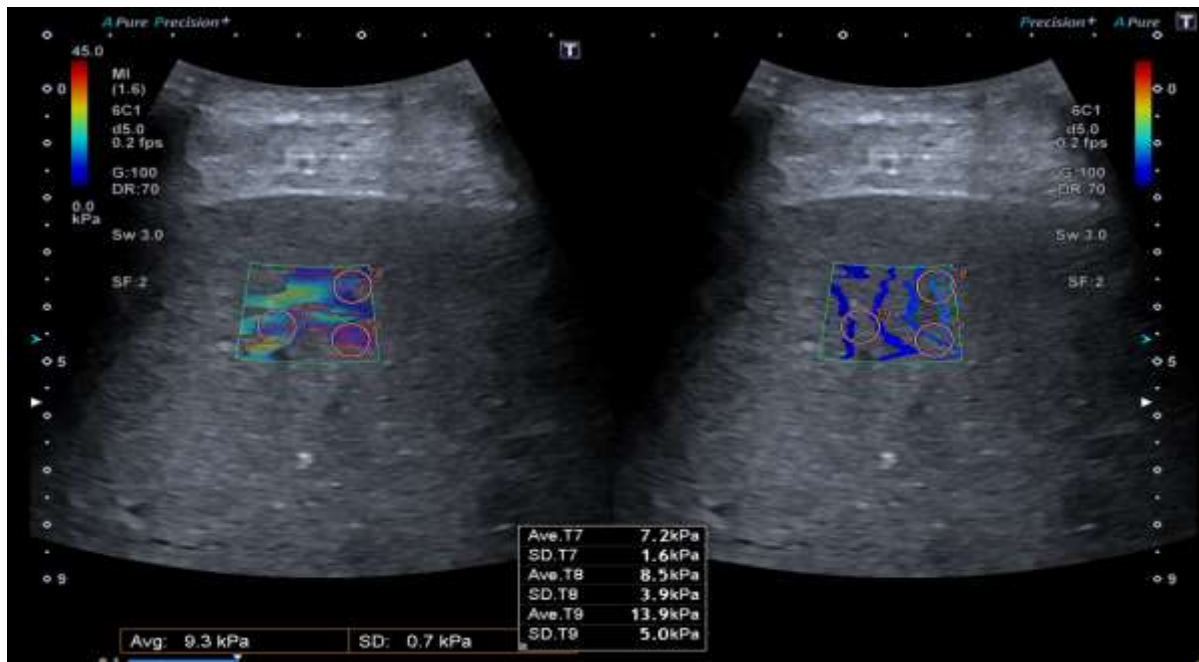*figure 3: Shear-wave elastography shows liver fibrosis stage 4.*

Figure 4: Shear-wave elastography shows liver fibrosis stage 0/1.

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