DIAGNOSTIC VALUE OF 2D-SWE IN THE TREATMENT PROCESS OF DIFFUSE LIVER DISEASE

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SUMMARY

Background: Two-dimensional shear wave elastography (2D-SWE) is a modern diagnostic method for evaluating liver fibrosis. It is non-invasive, performed in real-time, and results are available immediately. 2D-SWE is integrated into the diagnostic apparatus of ultrasound imaging and allows us to determine the overall distribution of fibrosis in the liver during the examination. Therefore, it is possible to use this technique during the treatment process in chronic liver disease to monitor fibrosis assessment.

Objective: Revealing the diagnostic capabilities of shear wave elastography in the process of treating diffuse liver disease.

Materials and Methods: The examination included 52 patients with chronic liver disease. Before and 24 weeks after the treatment, we performed an ultrasound examination of the abdominal, 2D-SWE, conducted several laboratory analyses, and compared the obtained results.

Results: At 24 weeks after treatment, liver stiffness values detected by 2D-SWE decreased from 17.51 kPa to 15.45 kPa ($p < 0.001$). Also, spleen length ($p<0.05$), ALT ($p < 0.001$), and AST ($p<0.01$) in blood serum were decreased. There was a statistically significant increase in hemoglobin ($p<0.001$) and serum albumin ($p<0.001$) levels. Platelet count increased ($p<0.001$).

Conclusion: 2D-SWE helps monitor liver fibrosis during the treatment period.

Keywords: liver fibrosis, liver cirrhosis, ultrasound, elastography, shear-wave elastography.

INTRODUCTION

There are approximately 75 million heavy drinkers in the world, 2 billion people suffer from being overweight, and more than 400 million people suffer from diabetes. However, the global prevalence of viral hepatitis is still high, and the cases of liver damage caused by drugs and toxic

substances are still increasing. All these mentioned again and again create a prerequisite for the development of liver diseases.[1] Using antiviral drugs can cure more than 95% of patients, but there is also a risk of reinfection. This is why the hepatitis C virus (HCV) continues to be a global public health problem.[2]

The introduction of antiviral treatment in modern medicine has reduced the progression of liver fibrosis to cirrhosis and its decompensation during viral hepatitis. Patient hospitalizations and mortality decreased as hepatocellular injury and the necessity of liver transplantation decreased. This led to a significant improvement in the quality of life of the infected patient.[3]

The ultimate goal of antiviral treatment is sustained virological response (SVR). Initially, liver inflammatory processes improve, followed by liver structure changes. Then, the liver's metabolic function improves, reducing cognitive disorders and portal hypertension manifestations.[4] The mentioned processes are more effective the earlier the disease is diagnosed and treated.

Formation of cirrhosis from liver fibrosis sometimes takes decades. The process is slow if there is HCV infection or NASH. Still, this process progresses rapidly in cases of biliary obstruction, immunosuppression developed after liver transplantation, or co-infection with human immunodeficiency virus (HIV).[5]

Accurate staging of liver cirrhosis and fibrosis is crucial, as treatment recommendations sometimes differ depending on the type of chronic liver disease (CLD).[6]

To detect liver fibrosis and evaluate its degrees in modern radiology, the newly introduced two-dimensional shear wave elastography (2D-SWE) is used (2D-SWE), which assesses the liver fibrosis stage in kilopascals in real-time by quantitative stiffness estimation.[7-8]

2D-SWE, as a non-invasive, safe, and simple procedure, has dramatically reduced the number of biopsies, especially for the routine evaluation of viral hepatitis.[4]

2D-SWE – This tool has allowed clinicians to conduct timely and effective treatment, stop the progression of fibrosis, and promote its reverse development process.[9] Furthermore, 2D-SWE can be used to monitor fibrosis during treatment to evaluate the effect of therapeutic agents.

MATERIAL AND METHODS

The study included 52 patients (39 men and 13 women) with chronic liver disease, ages 18 to 77. It was conducted at P. Todua Medical Center (#13 Tevdore Mgvdeli St., Tbilisi 0112) from 2019 to 2023. Patients underwent abdominal ultrasonography, 2D-SWE to measure liver stiffness, and certain laboratory tests before and 24 weeks after treatment.

The study aimed to evaluate the diagnostic value of 2D-SWE in treating chronic liver disease and to determine clinical-biochemical data after treatment.

We carried out a retrospective study. We collected and entered the following patient data into the database: age, gender, disease etiology, liver stiffness measured in Kpa, liver size, structural changes of the liver, portal vein diameter, splenic size, splenic vein diameter, data on the presence of ascites, direct bilirubin µmol/L, ALT U/L, AST U/L, GGT U/L, INR, number of platelets 10^9/L, hemoglobin g/dL, albumin g/L.

Exclusion criteria were insufficient clinical data, acute hepatitis, hepatocellular carcinoma, encephalopathy, portal vein thrombosis, kidney, heart, lung, and blood diseases. As well as radiotherapy or chemotherapy received by extrahepatic tumors.

We reviewed and compared liver 2D SWE results and clinical-biochemical data before and after the respective treatment.

Statistical analysis was performed using SPSS 23.0 software.

Experienced specialists performed instrumental examinations in our study in accordance with the appropriate protocol.

Abdominal ultrasound examination

Abdominal ultrasound examinations were performed using the Canon Aplio i800 ultrasound system (Canon Medical Systems, Tokyo, Japan) with a 3.5 MHz convex probe with the patient in the supine position. The patient was fasting and followed the doctor's instructions to take deep breaths and hold his breath. Liver lobes, a nodular liver surface, echogenicity, parenchymal structure, portal vein diameter, splenic size, and splenic vein diameter were assessed, and the presence of ascites was determined.

Shear wave elastography

2D SWE studies were performed using a Canon Aplio i800 ultrasound system (Canon Medical Systems, Tokyo, Japan) with a 3.5 MHz convex probe. The patient was required to fast. Liver stiffness (LS) measurements using 2D-SWE were performed via a proper intercostal scan. The patient was in the supine position, with the right arm maximally extended. LS was assessed by short-breath holding and neutral breathing. Measured elasticity values were expressed in kilopascals (kPa). Stiffness was determined as the median of several successful SWE measurements...

RESULTS AND ANALYSIS

The etiology of chronic liver disease in our study was as follows: HCV–34; HBV-7; HCV/HBV–5; alcoholic-4; HCV/alcoholic-1; biliary-1;

In patients with chronic liver disease, liver stiffness increases along with the decrease in the elasticity of the liver tissue and the increase in fibrosis. In our study, the average liver stiffness was 17.51 Kpa. Changes were also noted in all clinical and laboratory data (liver size, portal vein, spleen length, splenic vein diameter, direct bilirubin, ALT, AST, GGT, INR, platelet count, hemoglobin).

Abdominal ultrasound examination revealed mild hepatomegaly and structural changes in 10 patients. There were no signs of portal hypertension, splenomegaly, or ascites. The remaining 42 patients had varying degrees of structural changes in the liver, incorrect edge contour, rounding of corners, nodules, vascular deformation, hypertrophy of the caudal lobe with a decrease in the size of the right lobe, signs of portal hypertension, and splenomegaly. Ascites were detected in 28 patients.

Patients with chronic liver disease were treated with appropriate, both symptomatic and pathogenic, as well as antiviral medicines. Abdominal ultrasound, 2D SWE, and follow-up analyses were conducted again 24 weeks after treatment. The obtained results were compared with the data before treatment, revealing that liver stiffness (LSM values) decreased. (Figure 1 a,b; Figure 2 a,b).

a ***b***

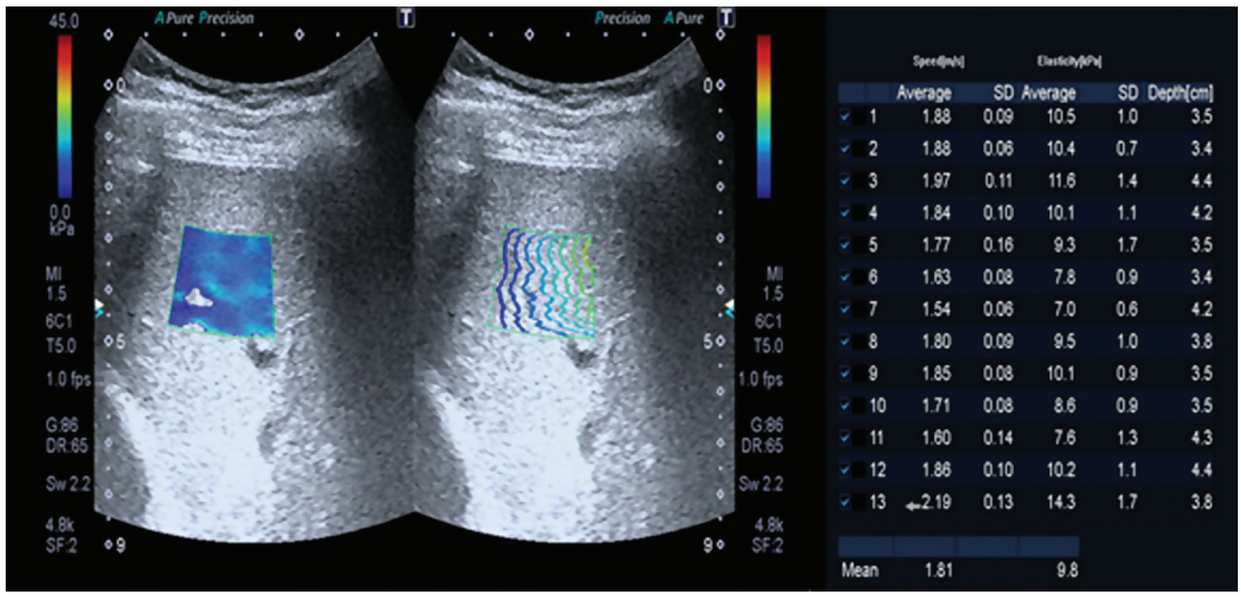

Figure 1. **Liver fibrosis of HCV etiology.**
Before starting treatment. a. Liver 2D SWE image during measurement of liver stiffness. b. In the calculation table, the liver stiffness is 9,8 Kpa.

a ***b***

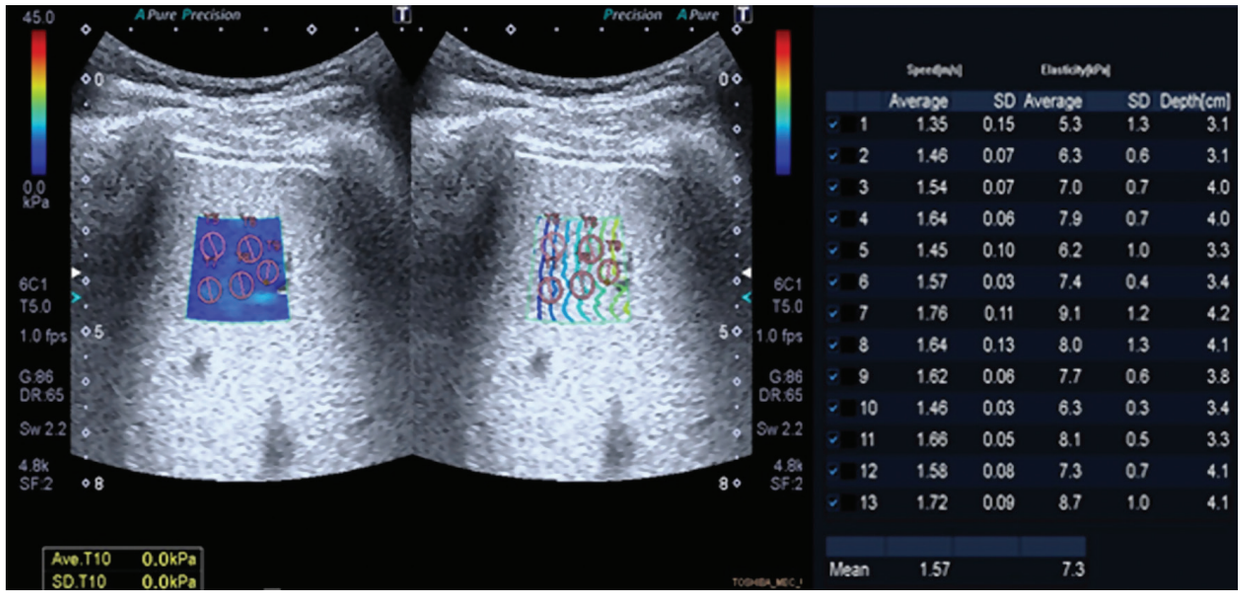

Figure 2. It shows the same patient 24 weeks after antiviral treatment. a. Liver 2D SWE image during measurement of liver stiffness. b. Calculation table: The liver stiffness is 7.3 Kpa.

During our study, at 24 weeks after treatment, mean LSM values decreased from 17.51 kPa to 15.45 kPa. LSM reduction was not associated with etiology, gender, or age. The condition of 44 patients improved after treatment, and the clinical-laboratory indicators improved; 5 patients did not have improvement, and the clinical and laboratory data were slightly changed; 3 patients had disease progression despite treatment. After the treatment, the diameter of the portal vein ($p = 0.42$) and the splenic vein ($p = 0.08$) were slightly changed. These changes were not statistically significant. The change in the spleen length was found to be statistically significant ($p < 0.05$). Significantly decreased blood serum ALT ($p < 0.001$) and AST ($p < 0.01$). There was also a

statistically significant increase in hemoglobin ($p < 0.001$) and serum albumin ($p < 0.001$) levels. Platelet count increased statistically substantial ($p < 0.001$). Statistically significant changes were not detected in the values of direct bilirubin ($p < 0.75$) and INR ($p < 0.43$) (Table N 1).

Table 1. *Bivariate analysis (T-test of independent variables)*

Feature	Mean	Mean difference	Standard deviation	P
Portal vein				
Before treatment	15.97	2.15	13.13	0.42
After treatment	13.81			
Spleen length				
Before treatment	156.71	1.26	4.24	<0.05
After treatment	155.44			
Splenic vein				
Before treatment	9.96	0.32	1.32	0.08
After treatment	9.63			
LSM				
Before treatment	17.51	2.05	2.22	<0.001
After treatment	15.45			
Direct bilirubin				
Before treatment	31.64	1.19	27.00	<0.75
After treatment	30.45			
ALT				
Before treatment	68.73	25.57	31.18	<0.001
After treatment	43.15			
AST				
Before treatment	105.31	50.14	113.25	<0.01
After treatment	55.16			
INR				
Before treatment	1.42	0.01	0.10	<0.43
After treatment	1.41			

Platelets				
Before treatment	181.79	23.59	20.90	<0.001
After treatment	205.38			
Hemoglobin				
Before treatment	11.96	0.41	0.65	<0.001
After treatment	12.38			
Albumin				
Before treatment	34.95	3.19	3.78	<0.001
After treatment	38.14			

DISCUSSION

During our study, liver fibrosis assessed by 2D SWE decreased after treatment, and mean liver stiffness decreased from 17.51 kPa to 15.45 kPa. ($p < 0.001$). These data are statistically reliable. Other studies confirm our study results.[10,11,12] Studies have shown that at the end of treatment, the liver stiffness assessed by 2D SWE decreases by several units compared to the initial stiffness. After 24 weeks, LSM rates continue to decrease, and at 36 weeks, LSM rates decrease further.11,13,14 According to the authors, the initial decrease in liver stiffness is caused by the improvement of inflammatory processes, and the subsequent decrease is related to the regression of fibrosis.11,12 During the study, it should be noted that regression of fibrosis after treatment was significantly higher in patients with LSM≥8.2 kPa than in the group of patients with LSM<8.2 kPa ($p<0.001$ and $p<0.001$).[12]

Our study shows that the reduction of liver fibrosis measured by 2D SWE after treatment was significantly associated with specific clinical-laboratory parameters.

At 24 weeks after treatment, serum ALT ($p < 0.001$) and AST ($p < 0.01$) decreased. Other authors obtained similar results.[15,13,14,12] A significant decrease in serum ALT after treatment should be associated with improving inflammatory processes.15,8 Our study found a statistically significant increase in serum albumin ($p < 0.001$) levels in a repeat analysis after 24 weeks of treatment. Other studies confirmed our results.[15,14] After 24 weeks of treatment, there was an increase in hemoglobin levels ($p < 0.001$) with statistical reliability. However, the opposite result was obtained by Suda et al., where the hemoglobin change was insignificant ($p = 0.47879$).[15] 24 weeks after treatment, our patient's platelet counts also increased statistically significantly ($p <0.001$). Regarding platelets, Kohla et al., in the study, state that, although platelet counts were not significantly different at 12 weeks of treatment, they increased significantly at 24 and 36 weeks. ($P <0.001$) (Kohla et al., 2020) According to the data of Yaraş et al., the number of platelets increased ($p < 0.05$) with statistical confidence 12 weeks after antiviral treatment.[14] These results contradict studies where platelet counts did not change significantly after antiviral treatment.[15] This can be explained by the fact that sometimes antiviral therapy worsens thrombocytopenia due to its side effects. Severe thrombocytopenia occurred in 6.1% to 41.1% of CHC patients receiving IFN-based therapy. However, after successful

IFN therapy and a certain period, the examination shows a significant increase in the number of platelets.[16] Statistically significant changes were not detected in the value of direct bilirubin ($p < 0.75$). Other authors found similar results[14,15] In our study, comparing the data before and after treatment at 24 weeks, no statistically changed data in INR values were revealed ($p<0.43$). A similar result was obtained in another study, where INR was measured in patients with chronic hepatitis B before starting antiviral therapy and at 24 and 48 weeks after treatment.[12] During the study, the portal and splenic vein diameter did not change statistically significantly after treatment. As for the length of the spleen, it decreased by an average of 12 mm. However, this change was statistically significant ($p<0.05$). Like our study, Olariu et al. revealed a positive relationship between the fibrosis degree and the spleen size one year after the end of therapy ($p < 0.001$). Moreover, the author reports that one year after treatment, patients with normal-sized spleens showed more improvement in the degree of fibrosis than patients with larger spleens.[10]

In our study, we could not correlate the regression of liver fibrosis after treatment with the patient's gender and age. However, Olariu et al., in their study, point out that better indicators of liver fibrosis regression in men are associated with the presence of such risk factors in women as childbirth, abortion, surgery, and blood transfusion. As for age, its correlation with changes in fibrosis after treatment was not observed in this study either.[10]

CONCLUSION

2D-SWE, a noninvasive and highly informative tool, can monitor liver fibrosis during treatment. Future studies on a more significant number of patients are desirable to expand the capabilities of 2D SWE.

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