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Shear Wave Elastography results of non-alcoholic fatty liver disease in diabetic patients

Non-alkolik yağlı karaciğer hastalığı bulunan diyabetik hastalarda Shear Wave Elastografi sonuçları

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Abstract

Aim: To evaluate liver stiffness degree in non-alcoholic fatty liver disease with type II diabetes mellitus patients via Shear Wave Elastography (SWV) measurement. SWV elastography values were compared to degree of hepatic steatosis, liver aminotransferases, lipid profile and body-mass index.

Methods: In this case-control study, 110 patients with non-alcoholic fatty liver disease, followed by a general internal medicine outpatient clinic (57 male 53 female mean age 50.17) and a control group of 50 healthy adults (26 males 24 females mean age 48.26) without liver disease and sonographically grade 0 steatosis were admitted to the study. Right lobe of the liver parenchyma in each person was evaluated for a total of ten measurements. Sonographic grade of the hepatic steatosis in patients, SWV values and laboratory values simultaneously received were compared.

Results: SWV average speed value is calculated to be 2.26±0.57 m/s in patient group; 1.71±0.34 m/s in the control group; 2.15±0.63 m/s in patients with grade I steatosis; 2.25±0.42 m/s in patients with grade II steatosis, 2.72±0.43 m/s in patients with grade III steatosis. SWV values indicate a statistically significant difference in patient and control groups ($p<0.01$). There wasn't a statistically significant difference of liver SWV values among the three grades of steatosis.

Conclusion: Acoustic radiation force impulse can be used to detect of decreased stiffness in liver (on average 2 and over SWV values) with increase of triglycerides, aspartate aminotransferase and alanin aminotransferaz in patients.

Keywords: Liver steatosis, Acoustic radiation force impulse, Tip II diabetes mellitus

Öz

Amaç: Non-alkolik yağlı karaciğer hastalığı bulunan Tip II diyabetes mellituslu hastalarda, Shear Wave Elastography (SWV) ile karaciğer sertliği derecesini değerlendirmek amaçlandı. SWV elastografi değerleri ile hepatik steatoz derecesi, karaciğer aminotransferazları, lipit profili ve vücut kitle indeksi karşılaştırıldı.

Gereç ve Yöntemler: Bu vaka-kontrol çalışmasında, dahiliye kliniğine başvuran non-alkolik yağlı karaciğer hastalığı olan 110 hasta, (57 erkek, 53 kadın, ortalama yaş 50,17) ve kontrol grubunda karaciğer hastalığı olmayan 50 sağlıklı yetişkin (26 erkek, 24 kadın), yaş ortalaması (48,26) çalışmaya alındı. Her bireyde karaciğer parankiminin sağ lobundan toplam on ölçüm için alındı. Hastalarda hepatik steatozun sonografik derecesi, SWV değerleri ve eş zamanlı alınan laboratuvar değerleri karşılaştırıldı.

Bulgular: SWV ortalama hız değeri hasta grubunda 2,26±0,5 m/sn) olarak hesaplandı; Kontrol grubunda 1,71±0,3 m/sn; Grade I steatozu olan hastalarda 2,15±0,6 m/sn; Grade II steatozlu hastalarda 2,25±0,4 m/sn, grade III steatozlu hastalarda 2,72±0,4 m/sn. SWV değerleri hasta ve kontrol gruplarında istatistiksel olarak anlamlı bir fark olduğunu göstermektedir ($p<0,01$). Her üç grade karaciğer steatozu ile SWV değerlerinin arasında, istatistiksel olarak anlamlı bir farkı yoktu.

Sonuç: Akustik radyasyon forse impuls, kanda trigliserit, aspartat transaminaz ve alanin transaminaz artışıyla birlikte, karaciğerdeki (ortalama SWV değerleri 2 ve üzerinde ise) doku sertliğinin artışının tespitinde kullanılabilir.

Anahtar kelimeler: Karaciğer steatozu, Akustik radyasyon forse impuls, Tip II diabetes mellitus

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Introduction

In developed countries, Non-alcoholic fatty liver disease (NAFLD) is the most common diffuse liver pathology and NAFLD is related to insulin resistance and the metabolic syndrome [1,2]. The disease occurs up to 80% of obese people [3]. Non-alcoholic steatohepatitis (NASH) is the most advanced form at the NAFLD and is a major cause of cirrhosis [4]. Usually, NAFLD is detected and followed by abnormal liver function tests. NAFLD usually associated with insulin resistance and metabolic syndrome [4]. A spectrum of disease activity is being considered to cover in NAFLD. NAFLD is a spectrum of disease; it begins with fat accumulation in the liver (hepatic steatosis) without disturbance of liver function. By varying mechanisms and insults, inflammation and fibrosis is added to the fat accumulation (steatohepatitis). As disease progresses, over a 10-year period and also up to 20% of patients with NASH may develop cirrhosis of the liver, and 10% will suffer death related to liver disease [5].

Materials and methods

After approval from the Institutional Ethics Committee, and gathering written inform consent from volunteers, 110 patients with NAFLD, followed by a general internal medicine outpatient clinic (57 male 53 female mean age 50.17) and a control group of 50 healthy adults (26 males 24 females mean age 48.26) without liver disease and sonographically grade 0 steatosis were admitted to the study. Anyone having any other liver diseases (chronic alcohol abuse, cholestatic chronic hepatitis, autoimmune chronic hepatitis, Wilson's disease, HBV, HCV infection, haemochromatosis) and using any liver treatment was excluded from the study. Volunteers selected were completely healthy. Radiological evaluation in the NAFLD and the control group was carried out between November 2015 and September 2016 prospectively.

B Mode Ultrasound (US) grading of diffuse hepatic steatosis on ultrasound has been used to communicate to the clinician about the extent of fatty changes in the liver. Increase in liver echogenicity without obscuring periportal and diaphragmatic contours is graded as grade I; increased hepatic echogenicity with obscuration of periportal echogenicity and without diaphragm affected is graded as grade II, increased hepatic echogenicity with imperceptible periportal echogenicity and obscuration of diaphragm is graded as grade III. Craniocaudal length of the liver was measured midclavicular line averages 10-12.5 cm. Any liver that had a craniocaudal length longer than 15.5 cm in the midclavicular line was considered enlarged.

Acoustic Radiation Force Impulse Imaging (ARFI) measurement

The patients and control subjects underwent an ARFI examination using a commercial scanner (Siemens Acuson S3000™ 4 MHz (6C1) probe, Siemens Medical Solutions USA, Inc., Mountain View, CA, USA), which was performed by an US physician with three months of experience in ARFI elastography. The patients were examined in the left lateral decubitus position with the right arm elevated above the head. Scanning was performed with minimal scanning pressure applied by the operator; the patients were asked to stop breathing to minimize motion. The operator positioned the probe over the following region of interest: right lobe of the liver parenchyma, away from motion and vessels, including at least two times every segment at a depth between 3.0 and 4.0 cm. Ten SWV measurements were made for each person. A median value was calculated for each patient. SWV average values were obtained in all patients. Tissue stiffness was quantitatively assessed via VTQ. VTQ's were measured by detection of acoustic push pulses and measuring SWV which in increases with increasing tissue stiffness. The presence of steatosis and ratings were determined by sonographic criteria.

Laboratory tests

SWV values and laboratory values simultaneously received were compared. Routine liver function tests were performed immediately and patients with increase aminotransferases (ALT and AST) > 5 times the upper limit of normal were excluded from the further examination. Lipid profile was examined for triglycerides, very low density lipoprotein (VLDL), low density lipoprotein (LDL), and total cholesterol. We calculated body mass index (BMI) of patients and control group.

Statistical analysis

Statistical analysis was performed using SPSS 14.0 software package (SPSS Inc, Chicago, IL, USA). Data were expressed as means ± standard deviation (SD) $p< 0.05$ was considered statistically significant. The normal distribution for each variable was examined via the Kolmogorov-Smirnov test. Spearman correlation was used to reveal one to one interrelationships between SWV values and other variables. Analysis of variance (ANOVA) and Student's t-test were used for continuous variables with normal distribution. Nonparametric tests (Mann–Whitney U test and Kruskal Wallis test) were used for variables that were not normally distributed in the studied population.

Results

SWV values average speed value is calculated to be 2.26 ± 0.5 m/s in patient group (Figure 1); 1.71 ± 0.3 m/s in the control group (Figure 2) (Table 1).

Table I: SWV values in patient and control groups

	N	SWV Mean	SD
Patient	110	2.26	0.5
Control	50	1.70	0.3

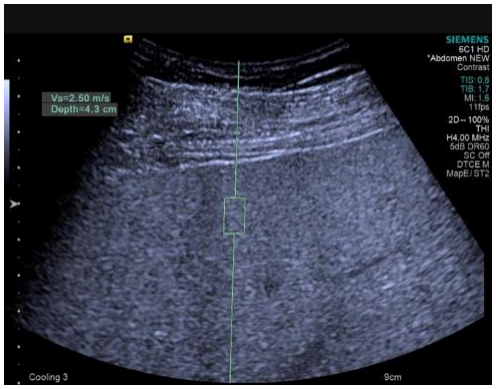

Figure 1: Image of liver stiffness measurement by ARFI in patients with hepatic steatosis (SWV: 2.50 m/s)

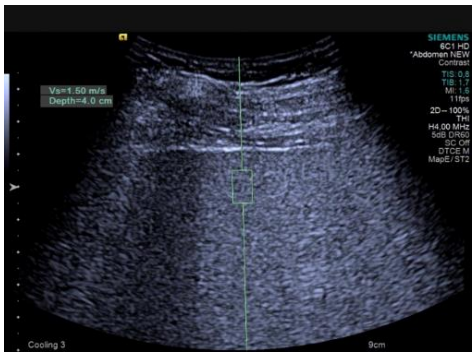

Figure 2: Image of liver stiffness measurement by ARFI in control group (SWV: 1.50 m/s)

SWV values average speed value is calculated 2.15 ± 0.6 m/s in patients with grade I steatosis; 2.25 ± 0.4 m/s in patients with grade II steatosis, 2.72 ± 0.4 m/s in patients with grade III steatosis (Table 2). SWV values indicate a statistically significant difference in patient and control groups ($p < 0.01$) (Table 3).

Table 2: Mean SMW values according to hepatic steatosis grades

Grade of liver steatosis	N	SWV Mean	Std. Deviation	Std. Error
I	43	2.15	0.6	0.06
II	54	2.25	0.4	0.08
III	13	2.72	0.4	0.12
Total	110	2.26	0.5	0.05

Table 3: SWV values in the degree grade of hepatic steatosis SWV values indicate a statistically significant difference in patient and control groups ($p < 0.01$)

SWV	Sum of Squares	df	Mean Square	F	p
Between Groups	3.492	2	1.746	5.968	0.003
Within Groups	31.304	107	0.293		
Total	34.796	109			

SWV values with statistically insignificant differences were detected between the degrees of hepatic steatosis grade. The triglyceride ($p < 0.01$), AST ($p < 0.01$), ALT ($p < 0.01$) show a significant difference between normal and pathological groups for SWV mean values. Liver craniocaudal length with increased triglycerides ($p < 0.01$), VLDL ($p < 0.01$), AST ($p < 0.01$) and ALT ($p < 0.01$) showed a statistically significant correlation with each increase in value. The triglyceride, VLDL, AST, ALT show a significant difference between normal and pathological groups for hepatomegaly liver size mean values. Similarly, the grade increases with increasing degree of liver craniocaudal length and increasing values of BMI, AST and ALT. Hence, an increase in the value of SWV indicated a statistically significant correlation. No significant difference found between normal BMI and high BMI SWV values statistically. SWV values did not show any statistically significant difference between patients with hepatomegaly and those having normal liver sizes.

Discussion

In order to avoid possible complications of liver biopsy and conventional B mode imaging may be in accurate measurement of liver stiffness, which correlates well with liver fibrosis, by ARFI elastography is a promising alternative imaging technology [6-8].

We found that ARFI elastography correlates well with significant fibrosis in NAFLD patients and is similar to results from a previous study in rats [9]. In order studies; it is reported that SWV is increased according to the degree of fibrosis observed by pathological specimens. Thus ARFI may be a better technic over other elastographic methods due to it is capability of both qualitative measurement [7,8]. As shown in previous studies presence of both steatosis and hepatic inflammation may complicate SWV measurement. Palmeri et al [10] found no relationship between SWV values and hepatocyte ballooning or inflammation while in another study decrease in SWV was reported proportional to do degree of steatosis. Based on current evidence it can be concluded that steatosis decreases SWV while with inflammation SWV values increase in NAFLD in ARFI elastography [6,11]. Some of NAFLD patients with different hepatic inflammatory activity levels shows significantly varied SWV values [1,12].

Conversely, our study demonstrated increase SWV in patients with hepatosteatosis but we didn't correlate SWV values with liver biopsy. We didn't know the extent of hepatic inflammation. This may be the cause of contradiction between previous studies and ours. These results may indicate that fibrosis started to develop in our patients.

There are several limitations in our study. First, we lack comparison with novel elastographic technologies such as Magnetic Resonance Elastography in NAFLD patients. Second, due to technical factors we are uncertain of whether our measurements failed diagnostic accuracy.

In this study we aimed only to measure stiffness of liver in NAFLD patients. Our case series is more than the other study which was planned as non-invasive.

Conclusion

The presence and severity of hepatic steatosis measured SWV values by ARFI elastography. SWV values were increased with the degree of hepatic steatosis. ARFI imaging can be used as a preliminary assessment examination with laboratory tests and at least 10 measurements, using the average value so that it may be more accurate. To detect decreased stiffness in liver (on average 2 and over SWV values) with increased of triglycerides, AST and ALT in patients ARFI can be most useful. This study shows that ARFI is a useful non-invasive tool for evaluation of decreased stiffness in liver on NAFLD.

References

1. Shaker M, Tabbaa A, Albeldawi M, Alkhouri N. Liver transplantation for nonalcoholic fatty liver disease: New challenges and new opportunities. World Journal of Gastroenterology. WJG 20.18 2014;5320–30.
2. Rinella ME. Nonalcoholic fatty liver disease: a systematic review. JAMA (Systematic review). 2014;313(22):2263–73.
3. Sanyal A J. AGA Technical Review on Nonalcoholic Fatty Liver Disease. Gastroenterology. 2002;123(5):1705-25.
4. Clark JM, Diehl AM. Nonalcoholic fatty liver disease: an underrecognized cause of cryptogenic cirrhosis. JAMA.2003;289 (22): 3000–04.
5. McCulough, Arthur J. The clinical features, diagnosis and natural history of nonalcoholic fatty liver disease. Clinics in Liver Disease.2004;8(3):521-33.
6. Yoshioka K, Hashimoto S, Kawabe N. Measurement of liver stiffness as a non-invasive method for diagnosis of non-alcoholic fatty liver disease. Hepatology Research. 2015;45(2):142-51.
7. De Robertis R, D'Onofrio M, Demozzi E, Crosara S, Canestrini S, Mucelli RP. Noninvasive diagnosis of cirrhosis: A review of different imaging modalities. World Journal of Gastroenterology: WJG. 2014;20(23):7231.
8. Ziol M, Handra-Luca A, Kettaneh A, Christidis C, Mal F, Kazemi F, et al. Noninvasive assessment of liver fibrosis by measurement of stiffness in patients with chronic hepatitis C. Hepatology. 2005;41(1):48–54.

9. Yanrong G, Haoming L, Xinyu Z, Huiying W, Siping C, Xin C. The influence of hepatic steatosis on the evaluation of fibrosis with non-alcoholic fatty liver disease by acoustic radiation force impulse. Conf Proc IEEE Eng Med Biol Soc. 2017;2988-91.
10. Palmeri ML, Wang MH, Rouze NC, Abdelmalek MF, Guy CD, Moser B, et al. Noninvasive evaluation of hepatic fibrosis using acoustic radiation force-based shear stiffness in patients with nonalcoholic fatty liver disease. Journal of Hepatology. 2011;55(3):666–72.
11. Fierbinteanu Braticevici C, Sporea I, Panaitescu E, Tribus L. Value of acoustic radiation force impulse imaging elastography for non-invasive evaluation of patients with nonalcoholic fatty liver disease. Ultrasound in Medicine & Biology. 2013;39(11):1942–50.
12. Yoneda M, Suzuki K, Kato S, Fujita K, Nozaki Y, Hosono K, et al. Nonalcoholic Fatty Liver Disease: US-based Acoustic Radiation Force Impulse Elastography 1. Radiology. 2010;256(2):640–7.