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Evaluation of spleen stiffness in healthy population: a vibration-controlled transient elastography study

Haluk Tarık Kani[1], Çağlayan Keklikkıran[1], İlkay Ergenç[1], Yusuf Yılmaz[1,2]

[1]Marmara University, Faculty of Medicine, Department of Gastroenterology, İstanbul, Turkey
[2]Marmara University, Institute of Gastroenterology, İstanbul, Turkey

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ABSTRACT

Aim: Vibration-controlled transient elastography (VCTE) is an accurate technique that has an increasing use. In recent years, VCTE was started to use in predicting spleen stiffness (SS). Portal vein pressure and flow have an impact on SS and in previous studies it was used to predict portal hypertension, esophageal varices. In this study, our aim was to evaluate the SS measurements in healthy population and its correlation with age, sex, liver stiffness measurement (LSM), continued attenuation parameter (CAP) and body mass index (BMI).

Material and Method: We enrolled healthy volunteers who were agreed to participate to the study and collected age, sex, smoking history, alcohol consumption, body mass index before the VCTE procedure. Liver and spleen elastography were performed to all patients by VCTE.

Results: A total of 97 participants were enrolled to the study, 15 patients were excluded and 82 patients included for the final analysis. There was no significant difference in SS, liver stiffness measurement LSM, CAP and BMI between females and males. There was no correlation between age and SS. There was a weak correlation between SS and LSM, SS and CAP and no correlation was found between SS and BMI.

Conclusions: SS had a weak correlation with LSM and CAP but not with BMI, age and sex. There is no extra-large probe use in SS measurement and it was a challenge in participants with increased submucosal fat thickness. Multiple and repeatable studies needed to set an accurate cut-off point and evaluate the factors that impact on SS in healthy individuals.

Keywords: Liver stiffness; Spleen stiffness; Vibration-controlled transient elastography

INTRODUCTION

Non-invasive diagnosing techniques have an important role with the advances in technology. Eventually, the use of non-invasive technology in diagnostic modalities increasing rapidly. Vibration-controlled transient elastography (VCTE) is an accurate technique that has an increasing use in recent decade. VCTE uses share wave imaging to predict liver stiffness and does not need an ultrasound guidance prior to examination. This technique was accurately predicted the liver stiffness such as advanced fibrosis, cirrhosis, and distinguishing cirrhosis in patients with portal hypertension (1-3).

In recent years, VCTE was started to use in predicting spleen stiffness (SS). It could be affected from chronic fibrosis and could be affected from the splenic blood flow. Portal vein pressure and flow have an impact on SS and in previous studies it was used to predict portal hypertension, esophageal varices (4-6).

Normal and abnormal values and cut-off points of VCTE measurement are not clear in healthy population. It is important to differentiate safe and impaired results. Even predicting a disease is important by VCTE, excluding the heathy population is also important for clinician. Evaluating healthy population is crucial to set accurate cut-off points and affecting factors with multiple and repeatable studies.

In this study, our aim was to evaluate the SS measurements in healthy population and its correlation with other factors.

MATERIAL AND METHOD

This cross-sectional observational single-center study was conducted out at Marmara University, School of Medicine, Department of Gastroenterology out-patient clinic. The study was approved by the Marmara

Corresponding Author: Haluk Tarık Kani, drhtkani@gmail.com
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University Clinical Research Ethics Committee (Date: 06.11.2020, Decision No: 09.2020.1210). and the Helsinki Declaration guidelines were followed throughout the study. Written informed consent was obtained from all participants prior to the study.

We enrolled healthy volunteers who were agreed to participate to the study. Age under 18 years old, history of major clinical illness, pregnancy, ineffective spleen stiffness measurement was excluded from the study. We collected age, sex, smoking history, alcohol consumption, body mass index before the VCTE procedure.

Liver and spleen elastography were performed to all patients by FibroScan Expert 630 (Echosens, Paris France) with a concurrent ultrasound examination before the spleen stiffness measurement (7, 8). VCTE was performed by a trained and experienced physician (> 200 procedures) following an 8-hours fasting without any caffeine intake. Medium and x-large probes were used according to the patient's subcutaneous fat thickness. Liver stiffness measurement procedure was performed on the right lobe of the liver through the intercostal area. Spleen stiffness procedure was performed through the left intercostal area in supine position. Following confirming spleen with transabdominal ultrasonography, we put the SS meausrement probe on the previously confirmed area through the intercostal space and performed the measurement (9, 10). The physician performed at least 10 LS and SS measurements for each patient. We included the results with at least 10 valid measurements, a success rate above 60% were included to the study (11).

Normally distributed data will be expressed as mean±standard deviation, and the non-normal distributed data was expressed with the median values. Chi-square was used to test the difference between categorical variables and student's t-test or the Mann-Whitney U test was used to test the difference between continuous variables. The Spearman's rank correlation coefficient was used to measure the linear relationship between SS and age, body mass index (BMI), liver stiffness measurement (LSM) and continued attenuation parameter (CAP). p value < 0.05 accepted as significant.

RESULTS

A total of 97 participants were enrolled to the study. SS could not measure duo to the obesity and increased subcutaneous fat thickness in fifteen participants and they excluded from the study. Mean age was 37.80±11.13 years, 49 (59.8%) were female. Thirty-eight (46.3%) patients had alcohol consumption and 49 (59.8%) were non-smoker. The mean BMI was 26.67±5.12 kg/m² (**Table 1**).

Table 1. General characteristics of the participants

	All Patients (n=82)
Sex	
Female (n/%)	49 (59.8%)
Male (n/%)	33 (40.2%)
Age (years) (mean±SD)	37.80±11.13
BMI (kg/m²) (mean±SD)	26.67±5.12
Tobacco use (n/%)	
Current smoker	16 (19.5%)
Ex-smoker	17 (20.7%)
Non-smoker	49 (59.8%)
Alcohol consumption (n/%)	38 (46.3%)
LSM (kPa) (median, min-max)	4.40 (2.10-75.00)
CAP (dB/m) (mean±SD)	231.78±51.93
SS (n/%)	18.35 (7.20-80.10)

BMI: Body mass index; CAP: Continued attenuation parameter, LSM: Liver stiffness measurement; SS: Spleen stiffness, Data are presented as means and SD, counts, or medians and interquartile ranges, as appropriate.

There was no significant difference in SS [18.2 (range: 10.5-40.1) vs 18.9 (range: 7.2-80.1)] and LSM [4.4 (range:2.1-12.0) vs 4.4 (range: 2.5-75.0)] between females and males (p=0.891 and 0.925 respectively). Also, there was no significant difference in CAP values between females and males (226.06±56.24 vs 240.27 44.24, p =0.205). BMI was also similar in both females and males (26.48±5.64 vs 26.95±4.29, p=0.668).

The median age was 36 years. When we divide the cohort into two groups with a cut-off age of 36, there was no difference was seen in SS between older and youngers [17.8 (range:10.5-39.1 and 19.1 (range: 7.2-80.1), p =0.361]. Also, there was no correlation between age and SS (p=0.273).

Liver stiffness has a weak correlation with SS (0.388, p < 0.0001). When we evaluate the correlation between SS and CAP, there is also a weak correlation was found between two variables (r: 0.226, p=0.041). However, there was no correlation was found between SS and BMI (p=0.828) (**Figure 1**).

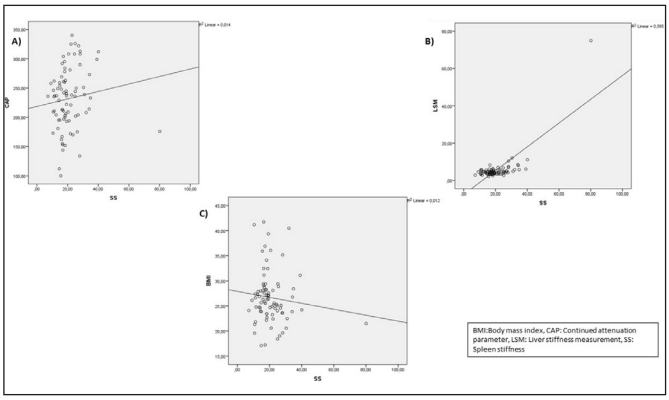

Figure 1. The Spearman's correlation between body mass index, continued attenuation parameter, liver stiffness measurement and spleen stiffness.

DISCUSSION

In our study, we found a positive significant correlation between SS and CAP and also between SS and LSM. On the other hand, there was no correlation was found between SS and BMI. There was no difference was found between male and females in SS, and there was no correlation was found between SS and age. We could not measure SS in 15 participants duo to obesity or increased subcutaneous fat thickness and excluded from the study. There is only medium probe available in spleen stiffness and SS could not be measured in especially participants with increased subcutaneous fat thickness.

In a previous that was similarly conducted with healthy controls, there was no relation was found between SS and BMI, age and sex and it is also similar with our study (12). In another healthy control study, there was no correlation was found between SS and age, SS and sex (13). In another study that was conducted with share wave elastography, there was no correlation was found between SS and age, also SS and BMI (14). Our result is in light with the current literature and there is no correlation of SS with BMI, age and sex.

In a study which was evaluated SS in chronic hepatitis C patients, there was a correlation was found with LSM (15). Also, in another study in hepatitis C, SS was found significantly higher in patients with F2 and F3 when compared with patients with F1 and F2 which was also evaluated with TE (16). We found a positive but wear correlation between LSM and SS in healthy controls and this result is similar with previous studies.

The absence of anatomic values of spleen such as spleen volume and diameter were limitations of our study. However, absence of portal venous pressure and diameter values was also a limitation. Single operator was an advantage to prevent bias on measurements. On the other hand, inter-observer evaluation could be a valuable information for the accuracy and may be a limitation at the same time.

CONCLUSION

SS was in correlation with LSM and CAP but not with BMI, age and sex. There is no extra-large probe use in SS measurement and it was a challenge in participants with increased submucosal fat thickness. Multiple and repeatable studies needed to set an accurate cut-off point and evaluate the factors that impact on SS in healthy individuals.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was approved by the Marmara University Clinical Research Ethics Committee (Date: 06.11.2020, Decision No: 09.2020.1210).

Informed Consent: All patients signed the free and informed consent form.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

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Author Contributions: All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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