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THE COMPARATIVE STUDY OF TRANSIENT ELASTOGRAPHY AND SHEAR WAVE ELASTOGRAPHY OF LIVER IN PATIENTS OF CHRONIC LIVER DISEASE.

Radiodiagnosis

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ABSTRACT

we aim to compare transient elastography and shear wave elastography in chronic liver disease patients for liver stiffness. Our objective was to calculate mean shear wave pressure by transient elastography and shear wave elastography methods and to compare the outcome of these two methods.A total of 190 Chronic Liver disease patients who clinically recommended transient elastography and shear wave elastography in Department of Radiodiagnosis SMS Medical College Jaipur.The mean shear wave pressure for transient elastography and ultrasound shear wave elastography was 10.77±6.88 and 10.88±7.05, respectively.

KEYWORDS

Elastography, Transient, Shear Wave, Mean.

INTRODUCTION

Liver fibrosis results from several molecular events resulting from liver damage. Chronic liver injury causes inflammation that activates myofibroblasts which act via several cellular pathways to produce collagens and extracellular matrix proteins, which accumulate in the liver. (1-2)

- Chronic liver injury leads to increased fibrosis and ultimately chronic liver fibrosis (cirrhosis). Increased fibrosis can increase the risk of hepatocellular carcinoma and hepatic decompensation, both of which are serious complications in patients with end-stage liver disease (3-4)
- **Shear wave elastography** is a method based on acoustic radiation force as a compression source to induce subtle tissue displacement (5). The tissue displacements generated by acoustic push pulse used in shear wave elastography is related to tissue stiffness, while tissue recovery response is related to tissue viscoelastic properties (6). Also, shear wave elastography is positively correlated with the major mechanical properties of tissue indicating material rigidity (7). Although acoustic radiation force induced transient elastography has been used for delineating tissue structure via mechanical properties in numerous applications including chronic liver diseases (8-9)
- **Transient elastography** is an ultrasound-based method that maps the elastic properties of soft tissue and shows considerable accuracy and reproducibility for detecting cirrhosis. (10-11)
- Transient elastography uses a mechanical piston that 'punches' the body surface, creating shear waves within the liver. (12) The ultrasound probe reads the velocity of the shear waves produced by the mechanical vibration, thereby giving a measurement of tissue stiffness (13)

AIMS

We aim to compare transient elastography and shear wave elastography in chronic liver disease patients for liver stiffness.

OBJECTIVES

To calculate mean shear wave pressure by transient elastography and shear wave elastography methods and to compare the outcome of these two methods.

MATERIALAND METHODS

A total of 193 Chronic Liver disease patients who clinically recommended transient elastography and shear wave elastography in Department of Radiodiagnosis SMS Medical College Jaipur.

INCLUSION CRITERIA

1. Chronic Liver disease patients who are referred to the Radiodiagnosis department for transient elastography and shear wave elastography.
2. Those who are willing to give written and informed consent to be included in the study.

EXCLUSION CRITERIA

1. Medical disorders
a. Cardiac disease
b. Bronchial asthma
c. High BMI
d. Ascitic patients

METHODOLOGY

The ethics committee, which is equivalent to an institutional review board, at our institution, approved this study. This study was carried out in the Radiology department of SMS Medical College, Jaipur on 190 patients presenting with chronic liver disease for an approximate period of 24 months. The study was conducted on chronic liver disease patients who fulfilling inclusion and exclusion criteria. After proper counseling regarding the purpose of the study, a written and informed consent were taken. Than prepare patients for transient elastography and shear wave elastography by-

- Fasting for 8 hours and no alcohol for 12 hours.
- Patients Placed in the supine position with the right arm extended above the head on a pillow and the right knee was bent up to approximately 90° to encourage a flattening of the spine and opening of the rib spaces.
- Encourage the patient to be relaxed and coached in the appropriate breathing technique before measurements were commenced.
- Gently suspend respiration during the examination.

For Transient elastography, all subjects are required to have undergone a satisfactory measurement using the FibroScan TE device utilizing the medium transducer as per the manufacturer's recommendations. Transducer placement was at 9/10 or 10/11 rib spaces with effective contact achieved as indicated by blue light illuminating on the transducer. The rib spaces were identified by palpation of the xiphoid sternum initially, with transducer placement at this anatomical level on the lateral rib margin. TE provides an image showing the propagation of the shear wave over time in the region of interest (ROI) at the 6 cm depth. If the measurement was considered unsuccessful by the TE, a software stiffness value was not given. A reliable data set of 10 readings is defined as having an interquartile range (IQR)/median value ratio × 100 of less than 30%. Machine-generated mean shear wave pressure values in KPa for all chronic liver disease patients were noted. All TE measurements were conducted by a single experienced operator (SH).

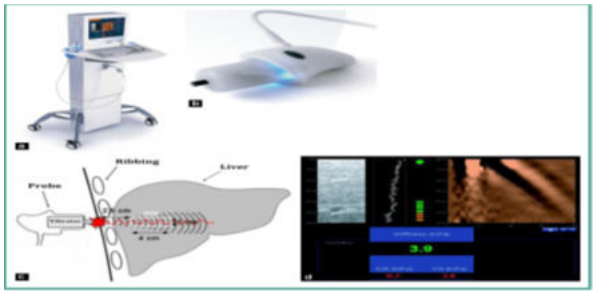


Figure 1- Fibroscan®: a: Fibroscan instrument; b: Fibroscan probe; c: diagram summarizing the principle of a measurement; d: example of the result produced by the device.

For Shear wave elastography all measurements are acquired by a single operator (SO) using the Toshiba Aplio 500 system with the operator blinded to the TE results. The 6C1 curvilinear transducer was utilized to register all measurements. Shear wave frequency was set to 2.2 MHz with a tracking frequency of 0. The elastogram was set to a box size of 2.5 × 3 cm with a 10 mm circle ROI. A maximum of three ROIs was placed within the elastogram at a similar liver depth. The xiphoid sternum is palpated with transducer placement initially on the lateral rib spaces at this anatomical level. The anterior and posterior branches of the right portal vein were identified, and the elastogram was placed cephalad to this to register measurements in segments 5/7/8 of the liver. Total 9 measurements were taken and machine-generated mean shear wave pressure of all chronic liver disease patients was noted.

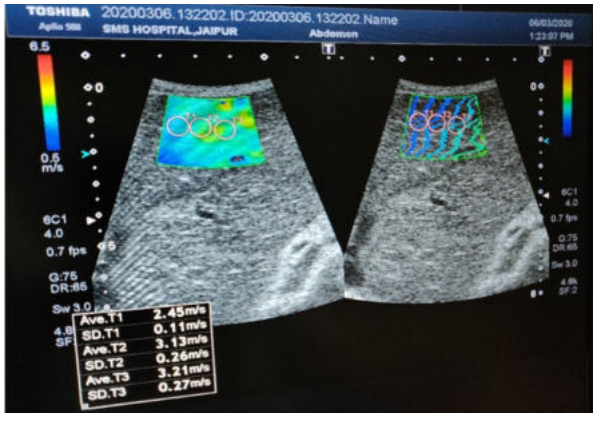


Figure 2- Stiffer liver demonstrated by Elastogram of lighter color and widening of the distance between lines on propagation map on 2D-shear wave elastography.

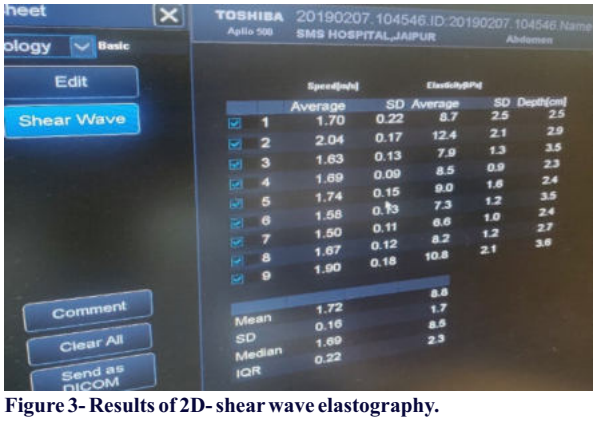


Figure 3- Results of 2D- shear wave elastography.

Then the calculation of mean shear wave pressure in kpa for 190 chronic liver disease patients by both transient elastography and 2D shear wave elastography method was done.

Interpretation of liver fibrosis by shear wave elastography in kPa divided the entity into no fibrosis (F0), mild fibrosis (F1), severe fibrosis (F2), significant fibrosis (F3) and cirrhosis (F4).Automatic median value generated by the ultrasound software was used to establish the elastography grade as follows < 4.6 = F0, 4.6-5.6 = F1, 5.7-7.0 = F2, 7.1-12.0 = F3 and > 12 = F4.(14)

Comparative analysis of the results was done.
Data was entered in MS office Excel 2007 and analyzed in MS office Excel 2007, SPSS Ver. 15, and Epi info (3.5) data software.

RESULTS

190 patients with chronic liver disease recruited in our study. Transient elastography and 2D shear wave pressure elastography studies were conducted on each patient.

Table 1: Mean shear wave pressure according to Clinical Diagnosis

Clinical diagnosis	Number of Cases	TE		SWE		p-value
		Mean	SD	Mean	SD	
Chronic hepatitis B	13	10.36	3.94	10.23	3.91	0.933
Chronic hepatitis C	8	14.10	2.57	14.45	2.73	0.795
NAFLD	69	6.43	1.40	6.48	1.38	0.840
Portal hypertension	35	16.65	8.27	16.34	7.35	0.868
Liver parenchymal disease	18	7.53	2.88	7.57	3.07	0.964
others	47	13.56	8.03	14.10	9.16	0.762
Total	190					

In our study, most of the cases were with the clinical diagnosis of NAFLD (69).13 were with chronic hepatitis B,8 were with chronic hepatitis C,35 were with portal hypertension, 18 were with the liver parenchymal disease,47 were with another clinical diagnosis (EHPVO, cirrhosis, CLD, autoimmune hepatitis, iron deficiency anemia, etc.). The highest value of mean shear pressure was 16.65 of TE and 16.34 of SWE in portal hypertension patients.

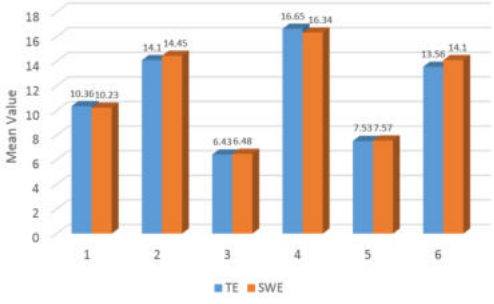


Table 2: Mean shear wave pressure according to the stage of fibrosis.

	Number of Cases	TE		SWE		p-value
		Mean	SD	Mean	SD	
F0	8	3.90	0.22	4.10	0.22	0.195
F1	16	5.48	0.50	5.48	0.53	1.00
F2	54	6.68	0.19	6.72	0.21	0.386
F3	64	8.63	0.85	8.74	0.79	0.568
F4	48	17.80	7.35	17.99	7.66	0.884
Total	190					

In our study, most of the cases were with the F3 stage of fibrosis (64). The highest value of mean shear pressure was 17.80 of TE and 17.99 of SWE in stage F4 of fibrosis. That was not statistically significant.

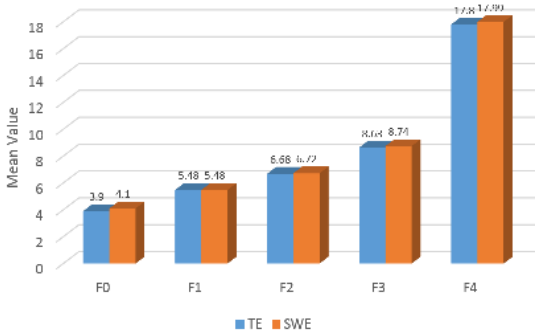
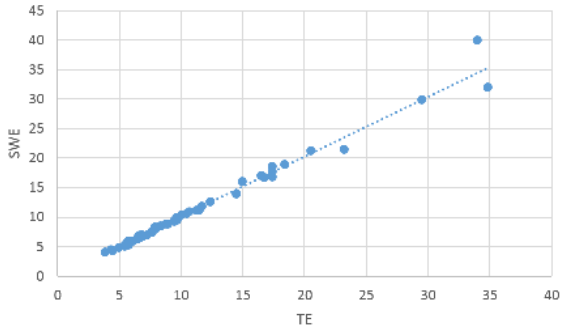


Table 3: MEAN SHEAR WAVE PRESSURE of TE and 2D-SWE

TRANSIENT ELASTOGRAPHY RESULT	2D-SWE RESULT
Mean shear wave pressure (10.77±6.88)	Mean shear wave pressure (10.88±7.05)
p-value = 0.885 (NS)	

In our study, the mean shear wave pressure of transient elastography was 10.77±6.88, and the mean shear wave pressure of 2D-SWE was 10.88±7.05 which was statistically not significant.



Scatterplot of transient elastography (TE) versus 2D-shear wave elastography (SWE) kilopascals demonstrating the line of equal values.

SUMMARY AND CONCLUSION

The present study was conducted in the Department of radiodiagnosis, SMS Medical College, Jaipur from May 2019 to August 2020 to compare transient elastography and shear wave elastography of liver in chronic liver disease patients for liver stiffness fulfilling inclusion and exclusion criteria were enrolled in the study.

190 patients with chronic liver disease were included in our study. Transient elastography and 2D shear wave pressure elastography studies were conducted on each patient.

The following salient features of the results were seen in the study: -

1. Maximum number of cases were in the age group 20-40 and 41-60 yrs, 83 and 82 respectively. The mean age of our cases was 44.53±13.31. The highest value of mean shear pressure was 14.19 of TE and 13.98 of SWE in the age group of >60 yrs. which was statistically not significant.
2. 85 numbers were male and 105 were female. The highest value of mean shear pressure was 11.18 of TE and 11.44 of SWE in male cases. Which was statistically not significant.
3. 62 cases were of rural areas and 128 were of urban areas. The highest value of mean shear pressure was 11.10 of TE and 11.26 of SWE in urban cases. Which was statistically not significant.
4. Most of the cases were with the clinical diagnosis of NAFLD (69).13 were with chronic hepatitis B,8 were with chronic hepatitis C,35 were with portal hypertension, 18 were with the liver parenchymal disease,47 were with another clinical diagnosis (EHPVO, cirrhosis, CLD, autoimmune hepatitis, iron deficiency anemia, etc.). The highest value of mean shear pressure was 16.65 of TE and 16.34 of SWE in portal hypertension patients. Which was statistically not significant.
5. Most of the cases were with the F3 stage of fibrosis (64). The highest value of mean shear pressure was 17.80 of TE and 17.99 of SWE in stage F4 of fibrosis. Which was statistically not significant.
6. We found that the stage of fibrosis of our cases by transient elastography and 2D shear wave pressure were similar to F0 (8), F1 (16), F2 (54), F3 (64), F4 (48). Which was statistically not significant.
7. mean values of SGPT for chronic hepatitis B, chronic hepatitis C, NAFLD, portal hypertension, liver parenchymal disease, others were 37.54, 37.50, 26.93, 33.00, 32.67, and 34.94 respectively. Mean values of SG0T for chronic hepatitis B, chronic hepatitis C, NAFLD, portal hypertension, liver parenchymal disease, others were 41.62, 35.00, 26.38, 36.49, 32.17, and 35.34 respectively.
8. Mean shear wave pressure of transient elastography was 10.77±6.88 and mean shear wave pressure of 2D-SWE was 10.88±7.05 which was statistically not significant.

CONCLUSION

Accurate staging of the degree of fibrosis is essential in the management and determination of the prognosis of patients with chronic liver disease. Although liver biopsy is considered to be the reference standard for assessment of fibrosis, biopsy has several limitations, including its invasive nature, inability to assess the degree of fibrosis throughout the liver, sampling error, and incidence of complications.

SWE shows almost similar diagnostic performance compared to fibroscan which was considered recently as a main non-invasive tool in liver fibrosis staging with minimal tendency to overestimate the degree of fibrosis. SWE can be used with high performance as an alternative to fibroscan especially when fibroscan is not able to obtain adequate results as in obesity and massive ascites. Also, SWE gives the operator a real-time visualization of the selected area with a large surface area compared to fibroscan.

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