Eur J Gen Med 2015; 12(2): 109-113
DOI : 10.15197/sabad.1.12.23

Original Article

Non-Invasive Evaluation of Liver Fibrosis Using Real-Time Elastography and Comparison of Intercostal and Subcostal Approaches

Abdulaziz Uslu[1], Abdussamet Batur[2], Murat Bıyık[3], Saim Acıkgozoglu[4]

ABSTRACT

In patients with chronic liver diseases, the identification of significant fibrosis is of special interest, because the presence of fibrosis is an important parameter for the estimation prognosis, for survelliance and for treatment decisions in patients with Chronic Liver Diseases. Although percutaneous liver biopsy is the gold standart method for assessing liver fibrosis, it has some limitations including its invasive nature, inconvenience, sampling errors, inadequate specimen size and interobserver variability in pathology interpretation. Therefore many studies have focused on the evaluation of noninvasive methods for the assessment of liver fibrosis stage. One of these methods is real time elastography which measures tissue elasticity. In the present study, we assessed intercostal and subcostal measurement methods to discriminate between normal and fibrotic liver.

Key words: *Liver fibrosis, elastography, subcostal and intercostal approach*

Gerçek Zamanlı Ultrason Elastografide Karaciğer Fibrozisini Değerlendirmede İnterkostal ve Subkostal Ölçüm Tekniklerinin Karşılaştırılması

ÖZET

Karaciğerde fibrozis gelişimi kronik karaciğer hastalıklarında istenmeyen ancak oldukça sık karşılaşılan bir durumdur. Tedavi ve takip için fibrozis varlığının ve derecesinin tespiti önemlidir. Karaciğer biyopsisi fibrozisi değerlendirmek için altın standart olarak kabul edilmektedir. Ancak bu işlem ağrılı ve major komplikasyonlara yol açabilen invaziv bir işlemdir. Özellikle küçük biyopsi materyallerinde örnekleme hataları oluşabilmektedir. Ayrıca fibrozisin progresyonunu izlemek için tekrarlanması gereken bir yöntemdir. Bu nedenle karaciğer fibrozisini değerlendirmede basit, güvenilir, non invaziv yöntemlere ihtiyaç duyulmaktadır. Ultrason elastografi dokuların elastisitesini görüntüleyen yeni bir teknikdir. Bununla birlikte karaciğer fibrozisini tahmin etmedeki rolü hakkında ve tekniğin ölçüm yöntemleri hakkında literatürde az sayıda çalışma vardır. Çalışmamızda kronik karaciğer hastaları ile normal gruptaki olguların arasında doku sertliği farkının US elastografi ile belirlenmesinde; subkostal ve interkostal ölçüm teknikleri arasında anlamlı fark olup olmadığını araştırmayı amaçladık.

Anahtar kelimeler: *Karaciğer fibrozisi, elastografi, subkostal ve interkostal yaklaşım*

[1]Aksaray State Hospital, Department of Radiology, Aksaray, [2]Yüzüncüyıl University, Dursun Odabaş Medical Center, Department of Radiology, Van, [3]Necmettin Erbakan University, Meram School of Medicine, Department of Internal Medicine, Division of Gastroenterology, Konya, [4]Necmettin Erbakan University Meram Faculty of Medicine, Department of Radiology, Konya, Turkey.

Correspondence: *Abdussamet Batur,*
Department of Radiology, Yüzüncüyıl University, Dursun Odabaş Medical Center, Van, Turkey
Tel: 00905067928305 Fax: 00904322167519
E-mail: drsamet56@yahoo.com

Received: 27.11.2013, Accepted: 23.02.2014

INTRODUCTION

It is important to determine the degree of liver fibrosis for the estimation prognosis, for survelliance and for treatment decisions in patients with Chronic Liver Diseases (CLD).

Although percutaneous liver biopsy is the gold standart method for assessing liver fibrosis, it has some limitations including its invasive nature, inconvenience, sampling errors, inadequate specimen size and interobserver variability in pathology interpretation (1). Therefore many studies have focused on the evaluation of noninvasive methods for the assessment of liver fibrosis stage. One of these methods is real time elastography which measures tissue elasticity. This device generates shearwaves at a focal point in the tissue, where the velocity of the wave provides an estimate of tissue stiffness (2,3). Three different implementations of the shearwave technique, including Transient Elastography (TE), Acoustic Radiation Force Impulse (ARFI) and Shearwave Elastography (SWE), have allowed clinical use in the liver (3).

In the present study, we assessed intercostal and subcostal measurement methods to discriminate between normal and fibrotic liver.

MATERIAL AND METHODS

Patients

This was a prospective study conducted between October 2011 and April 2012 in the Department of Radiology, Meram School of Medicine, Konya, Turkey. The study was approved by the local ethics commitee of our instutition and informed written consent was obtained from all patients. Thirty-nine patients with CLD, proved histopathologically, and thirty-four volunteers were examined with real time elastography. Twenty-one patients had a history of hepatitis B, thirteen had a history of hepatitis C and five with unknown etiology. All patients received stiffness measurements of the liver after 6h fasting. Patients with a history of carcinoma, systemic inflammatory disorder, ascites or over 3 cm in diameter from skin to liver were excluded. All stiffness measurements were made by the same radiologist blinded from the diagnosis obtained by histology.

The right lobe of the liver, on the level of midaxillary line, was approached intercostally and subcostally with the patient in supine position with both arms above the head and holding the breath during the examination. The results were statistically compared in the control group and patient group.

Liver histology and determination of liver fibrosis stage

The liver specimens were fixed in formalin, embedded in parafin, and stained with hematoxylin and eosin. The METAVIR scoring system (1, 6) for chronic hepatitis was used to assess the fibrosis stage, as follows: score 0, no fibrosis (F0); score 1, portal fibrosis without septa (F1, n=16), score 2, few septa (F2, n=15); score 3, numerous septa without cirrhosis (F3, n=6); and score 4, cirrhosis (F4, n=2). Patients were grouped according to the degree of fibrosis.

Elastography

Hepatic elasticity was measured using real time tissue elastyography (Toshiba Aplio XG) performed with a linear probe with a frequency of 12 MHz. The average duration of total elastographic exams (acquisitions and placement of regions of interest (ROI))was at least 10 minutes per patient. ROI with large blood vessels and biliary tracts was avoided. The measurement depth was 6 mm from the liver capsule corresponding to the middle of ROI (12x12 mm). During each measurement, the ROI was placed at the centre of the field.

In both subcostal (SC) and intercostal (IC) approach, the strain of the liver parenchyma was compared with the subcutaneous adipose tissue, muscle tissue, pericapsular adipose tissue, and total tissue on the anterior abdominal wall, respectively. In addition, parenchymal strains were compared among themselves. The obtained stiffness measurements were coded as IC1 for the parenchyma and subcutaneous adipose tissue ratio, IC2 for the parenchyma and muscle tissue, IC3 for the parenchyma and pericapsular adipose tissue, IC4 for the parencyma and total tissue on the anterior abdominal wall, and ICPS for liver parenchymal strain, respectively (Figure 1). Therewithal SC1, SC2, SC3, SC4 and SCPS abbrevation were used for the same tissue rations as above mentioned which were measured subcostally (Figure 2).

Statistical Analysis

Statistical analysis were performed with SPSS software (version 16.0, SPSS). Parametric independent sample test was used to assess the difference between two groups where a “p” value less than 0.05 was considered significant.

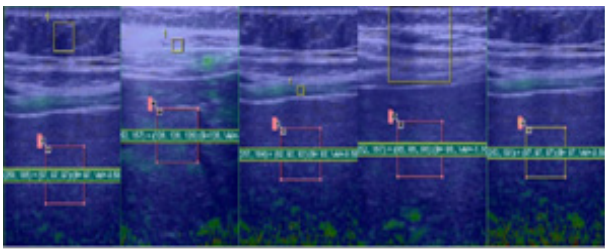

Figure 1*.The stiffness measurements, obtained via subcostal approach, are coded as SC1 for the parenchyma and subcutaneous adipose tissue ratio, SC2 for the parenchyma and muscle tissue, SC3 for the parenchyma and pericapsular adipose tissue, SC4 for the parencyma and total tissue on the anterior abdominal wall, and SCPS for liver parenchymal strain, respectively*

RESULTS

Thirty-four healthy volunteers (19 man, 15 women; mean age 40.06) thirty-nine patient with chronic liver disease (22 men, 17 women; mean age 46.46) were examined with real-time elastography. The mean distance from skin to liver was 17.2 mm in normal group and 18.5 mm in patients with CLD. Liver fibrosis was scored using METAVIR scoring system and patients were grouped in stage (Table 1) and the degree of fibrosis according to this scoring system (Table 2). The strain indices of 39 patients with CLD and 34 volunteers, were measured intercostal and subcostal, are presented in table 4 and table 5, respectively. The strain indices in normal group and patients with CLD were compared statistically. There was no significant difference between the groups in measurements from intercostal view (Table 3 and 4), whereas there was statistically difference in all parameters in measurements from subcostal view (Table 5 and 6).

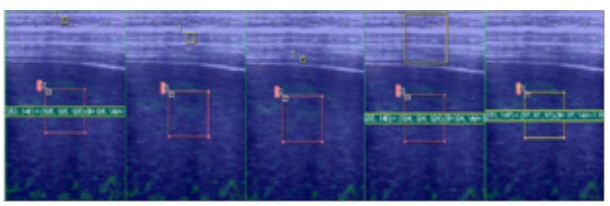

Figure 2*. The stiffness measurements, obtained via intercostal approach, are coded as IC1 for the parenchyma and subcutaneous adipose tissue ratio, IC2 for the parenchyma and muscle tissue, IC3 for the parenchyma and pericapsular adipose tissue, IC4 for the parencyma and total tissue on the anterior abdominal wall, and ICPS for liver parenchymal strain, respectively*

Table 1*. Liver fibrosis is scored using METAVIR scoring system and patients are grouped in stage.*

Stage-1	*Satage-2*	*Stage-3*	*Stage-4*	*Stage-5*
7	*15*	*8*	*8*	*1*

DISCUSSION

In patients with chronic liver diseases, the identification of significant fibrosis is of special interest, because the presence of fibrosis is an important parameter for indications for treatment (2). Histopathological evaluation of liver parenchyma is still gold standart for the evaluation of fibrosis (4, 5, 7). However, it has some disadvantages such as its invasiveness, serious complications, intra- and interobserver variability, and sampling errors (8). Therefore, alternative non-invasive methods have been developed. Serum markers are useful in predicting liver fibrosis, but accuracy of serum markers is not satisfactory in the assessment of fibrosis.

There are several ultrasound based elastography fort he evaluation of liver fibrosis such as TE, ARFI and real time elastograpgy (RTE). TE is one of extensively applied non-invasive methods using the FibroScan device, and its usefulness has been widely reported (8). However, evaluation is difficult in patients with ascites or morbid obesity (9). With ARFI, there is no need to get special equipment to assess liver stiffness since the function to generate a wave is integrated in the probe that an ultrasound machine provides (10). RTE is a recently developed utility for the assessment of liver fibrosis and it can evaluate patients with ascites or severe obesity such as ARFI (8). It is easy to verify the position because the images are juxtaposed with B-mode reference images (11). Using RTE system, elastography information is obtained by applying longitudinal pressure on a tissue and measuring displacement of reflection nuclei of this tissue as a result of the applied pressure (12). RTE is a novel non-invasive ultrasound modality for measuring liver elasticity that has been recently applied to quantitative assessment of liver

Table 2*. Liver fibrosis is scored using METAVIR scoring system and patients are grouped in the degree of fibrosis.*

F1	*F2*	*F3*	*F4*
16	*15*	*6*	*2*

***Table 3**. There is no significant difference in strain indices between the groups in measurements from intercostal view (IC; Intercostal, ICPS; Intercostal parenchymal strain)*

	Control	Chronic liver Disease
IC1	0.75	0.78
IC2	1.23	1.04
IC3	1.20	1.87
IC4	0.87	0.72
ICPS	0.076	0.061

***Table 5**. There is difference in strain indices between the groups in measurements from subcostal view (SC; Subcostal, SCPS; Subcostal parenchymal strain)*

	Control	Chronic liver Disease
SC1	0.46	0.77
SC2	0.78	1.22
SC3	1.24	2.04
SC4	0.53	0.86
SCPS	0.096	0.070

fibrosis (13). Unlike other studies in the literature, the aim of this study was to assess the differences between intercostal and subcostal approaches in the evaluation of liver stiffness.

In intercostal measurement, there was no significant difference between the patient and control group (ratio of liver parenchyma to subcutaneous fat tissue, to intercostal muscle tissue, to pericapsular fat tissue, to total rate of the frontal wall of the abdomen and to the liver parenchymal strain) (table 3), on the other hand in subcostal measurements there was statistically difference in all parameters (table 4).

In subcostal method, pressure was transmitted better to liver parenchyma and the anterior abdominal wall. For this reason subcostal approach gives better results than intercostal approach in terms of determining the elasticity of the liver. Furthermore, in addition to SC4 we used SC1, SC2 and SC3 parameters. Although similar p values were obtained from SC1, SC2 and SC4 measurements, we obtained statistically significant lower p values in SC3 measurement.

In conclusion, the present study demonstrated that using RTE can be an alternative or adjunctive predictive approach in liver fibrosis evaluation in patients with CLD. Study findings suggest that subcostal approach to the liver parenchyma is significantly superior to intercostal approach for the evaluation of stiffness via real time elastography.

Acknowledgments: Material from this report has not been presented anywhere.

Conflict of interest: The authors declare that they have no conflict of interest.

REFERENCES

1. *Chen S-H, Li Y-F, Lai H-C, et al. Noninvasive assessment of liver fibrosis via spleen stiffness measurement using acoustic radiation force impulse sonoelastography in patients with chronic hepatitis B or C. J Viral Hepat 2012; 19:654-63*
2. *Kanamoto M, Shimada M, Ikegami T, et al. Real time elastography for noninvasive diagnosis of liver fibrosis. J Hepatobiliary Pancreat Surg 2009;16: 463-7*
3. *Guibal A, Boularan C, Bruce M, et al. Evaluation of shear-wave elastography for the characterisation of focal liver lesions on ultrasound. Eur Radiol 2013; 23:1138-49*
4. *Bataller R, Brenner DA. Liver fibrosis. J Clin Invest 2005; 115:209-18*
5. *Ichida F, Omata M, Tsuji T, Ichida T, Inoue K, Uemura A. New Inuyama classification: new criteria for histological assessment of chronic hepatitis. Hepatol Commun 1996; 6:112-9*
6. *Bedossa P, Poynard T. An algorithm fort he grading of activity in chronic hepatitis C. The METAVIR cooperative study group. Hepatology 1996;24:289-93*
7. *Desmet VJ, Gerber M, Hoofnagle JH, Manns M, Scheuer PJ. Classification of chronic hepatitis: diagnosis, grading and staging. Hepatology 1994;19:1513-20*
8. *Chung J-H, Ahn H-S, Kim SG, et al. The usefulness of transient elastography, acoustic-radiation-force impulse elastography, and real-time elastography for the evaluation of liver fibrosis. Clinical and Molecular Hepatology 2013;19:156-64*

***Table 4**. There is no significant difference in p values between the groups in measurements from intercostal view (IC; Intercostal, ICPS; Intercostal parenchymal strain)*

IC1	IC2	IC3	IC4	ICPS
0.919	0.495	0.056	0.555	0.084

***Table 6**. There is statistically difference in p values in all parameters in measurements from subcostal view (SC; Subcostal, SCPS; Subcostal parenchymal strain)*

SC1	SC2	SC3	SC4	SCPS
0.030	0.033	0.019	0.038	0.022

9. Wong VW, Vergniol J, Wong GL, et al. Diagnosis of fibrosis and cirrhosis using liver stiffness measurement in nonalcoholic fatty liver disease. Hepatology 2010;51:454-62

10. Palmeri ML, Wang MH, Rouze NC, et al. Noninvasive evaluation of hepatic fibrosis using acoustic radiation force-based shear stiffness in patients with nonalcoholic fatty liver disease. J Hepatol 2011;55:666-72

11. Koizumi Y, Hirooka M, Kisaka Y, et al. Liver fibrosis in patients with chronic hepatitis C: noninvasive diagnosis by means of real-time tissue elastography establishment of the method for measurement. Radiology 2011;258:610-7

12. Sandulescu L, Rogoveanu I, Gheonea IA, Cazacu S, Saftoiu A. Real-time elastography applications in liver pathology between expectations and results. J Gastrointestinal Liver Dis 2013;22:221-7

13. Xie L, Chen X, Guo Q, Dong Y, Guang Y, Zhang X. Real-time elastography for diagnosis of liver fibrosis in chronic hepatitis B. J Ultrasound Med 2012;31:1053-60