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● *Original Contribution*

COMPARATIVE STUDY CONCERNING THE VALUE OF ACOUSTIC RADIATION FORCE IMPULSE ELASTOGRAPHY (ARFI) IN COMPARISON WITH TRANSIENT ELASTOGRAPHY (TE) FOR THE ASSESSMENT OF LIVER FIBROSIS IN PATIENTS WITH CHRONIC HEPATITIS B AND C

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Abstract—Our aim was to compare liver stiffness (LS) measurements by means of acoustic radiation force impulse (ARFI) elastography and transient elastography (TE) in patients with chronic hepatitis B and C, according to the severity of fibrosis. We also compared the correlation strength of ARFI and TE measurements with liver fibrosis. We included 53 patients with hepatitis B and 107 with hepatitis C in which liver biopsy, ARFI and TE measurements were performed in the same session. The mean LS values measured with ARFI were similar in patients with chronic hepatitis B and C and depended on the stage of fibrosis. The correlation strength of LS measurements by ARFI and by TE with fibrosis was similar in chronic hepatitis B and C patients. In conclusion, for the same stage of fibrosis, the mean LS values by ARFI were similar in patients with chronic hepatitis B and C. ARFI had similar predictive value with TE in both chronic viral hepatitis. (E-mail: isporea@umft.ro) © **2012 World Federation for Ultrasound in Medicine & Biology.**

Key Words: **ARFI, Acoustic radiation force impulse elastography, Liver stiffness, Chronic hepatitis B, Chronic hepatitis C, Transient elastography, FibroScan®, Liver fibrosis.**

INTRODUCTION

Noninvasive methods for liver fibrosis evaluation in chronic hepatopathies have become more and more popular in the last 10 years, especially in Europe, tending to replace at least a part of liver biopsies (LB). Among them, the most studied ultrasound based elastographic method is transient elastography (TE) (Sporea et al. 2011a; Papageorgiou et al. 2011; Friedrich-Rust et al. 2010). In the last 2 years, acoustic radiation force impulse (ARFI) elastography, a new noninvasive elastographic method for liver fibrosis assessment appeared on the market (Sporea et al. 2011b; Friedrich-Rust et al. 2009).

Several published papers confirmed the value of TE for the evaluation of patients with moderate, advanced and severe fibrosis (Castera et al. 2005; Ziol et al. 2005). Two well known meta-analyses (Talwalkar et al. 2007; Friedrich-Rust et al. 2008) suggest that liver stiffness (LS) assessment by means of TE is excellent for the diagnosis of liver cirrhosis (AUROC around 0.94) but it has only moderate value for the differentiation of mild from significant fibrosis. Many papers concerning the value of TE for LS evaluation were focused on chronic C viral infection (Castera et al. 2005; Ziol et al. 2005) but lately some studies proved this method to be valuable also in patients with chronic hepatitis B (Marcellin et al. 2009; Sporea et al. 2011c). Some studies analyzed the performance of TE for the evaluation of liver fibrosis in patients with chronic hepatitis C vs. those with chronic hepatitis B but the results were discordant (Sporea et al. 2010; Seo et al. 2007; Ogawa et al. 2007).

The principle of ARFI elastography is that compression of the examined tissue induces a smaller strain in hard tissues than in soft ones. The ultrasound probe automatically produces an acoustic "push" pulse that generates shear-waves that propagate into the tissue. Their speed, measured in meters/second (m/s), is displayed on the screen. The propagation speed increases with fibrosis severity. Using image-based localization and a proprietary implementation of ARFI technology, shear wave speed may be quantified, in a precise anatomic region, focused on a region-of-interest, with a predefined size, provided by the system. Measurement value and depth are also

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reported and the results are expressed in meters/second (m/s) (Mauldin et al. 2008; Nightingale et al. 2002).

The advantage of ARFI elastography is that this method is included into an ultrasound machine (that can also perform real time ultrasound evaluation, Doppler examination and contrast enhanced ultrasonography). Also, unlike TE, ARFI can be performed also in patients with ascites.

Some studies tried to show the noninferiority of ARFI in comparison with TE (Sporea et al. 2011b; Friedrich-Rust et al. 2010; Lupsor et al. 2009) and if it can be demonstrated, then ARFI can be included as a standard method of evaluation in patients with chronic hepatopathies.

The aim of this article was to compare LS measurements assessed by means of ARFI elastography and TE in patients with chronic hepatitis B and C, according to severity of histological fibrosis. We also compared the correlation strength of ARFI and TE measurements respectively, with liver fibrosis.

PATIENTS AND METHODS

Patients

Our study included 160 patients, mean age 47.6 ± 11.9 years: 53 with chronic hepatitis B (AgHBs positive for at least 6 months and PCR DNA-HBV > 10,000 copies/mL) and 107 patients with chronic hepatitis C (anti-HCV antibodies positive for at least 6 months and PCR HCV RNA positive). Patients were admitted in our Department during September 2009–July 2011 and, in each patient, in the same session, LB and LS measurements by means of ARFI elastography and TE were performed. All patients signed the informed consent; the study was approved by the local Ethics Committee and was in accordance with the Helsinki Declaration of 1975.

An abdominal ultrasound examination was performed in all the patients. All the subjects included in our study had a homogeneous liver structure (without liver masses) and did not have ascites.

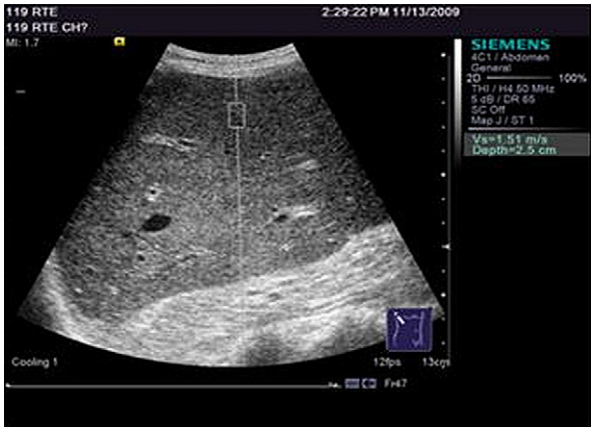

Fig. 1. Acoustic radiation force impulse (ARFI) measurement.

ARFI elastography

ARFI was performed in all patients with a Siemens Acuson S2000™ ultrasound system (Siemens AG, Erlangen, Germany) with a 4CI transducer, by five operators (each operator had at least 2 years of experience in conventional ultrasound examination and more than 100 ARFI measurements performed). Scanning was performed in the right liver lobe, between the ribs, with the patient in left lateral decubitus, 1–2 cm under the capsule, with minimal scanning pressure applied by the operator, while the patients were asked to stop breathing for a moment, to minimize breathing motion. The operator can select the depth at which the liver elasticity is evaluated, by placing a "measuring box" (10 mm long and 5 mm wide) in the desired place (Fig. 1). We performed 10 valid measurements in every patient and a median value was calculated; the results were measured in m/s. If the measurement was not reliable, "X-X-X" was

Table 1. The main characteristics of patients with chronic hepatitis B and C

Parameter	Chronic hepatitis B	Chronic hepatitis C	*p* value
Number of patients	50	96	
Gender: male:	*n* = 46 (92%)	*n* = 38 (39.6%)	**<0.0001**
female:	*n* = 4 (8%)	*n* = 58 (60.4%)	**<0.0001**
Mean age (years)	39.5 ± 13.8	51.4 ± 9	**<0.0001**
Mean body mass index (BMI) (kg/m^2)	25.4 ± 3.7	25.8 ± 4.1	0.56
Fibrosis (F) (according to the METAVIR score)	-F0: *n* = 0	-F0: *n* = 6 (6.2%)	–
	-F1: *n* = 8 (16%)	-F1: *n* = 9 (9.3%)	0.35
	-F2: *n* = 25 (50%)	-F2: *n* = 37 (38.6%)	0.25
	-F3: *n* = 12 (24%)	-F3: *n* = 31 (32.3%)	0.39
	-F4: *n* = 5 (10%)	-F4: *n* = 13 (13.6%)	0.71
Activity (according to the METAVIR score)	-A1: *n* = 12 (24%)	-A1: *n* = 4 (4.2%)	**0.0008**
	-A2: *n* = 16 (32%)	-A2: *n* = 50 (52.1%)	**0.03**
	-A3: *n* = 22 (44%)	-A3: *n* = 42 (43.7%)	0.88
Mean alanine aminotransferase (ALT) values (Normal value = 10–35 U/L)	107.2 ± 94.3	68.2 ± 46.2	**0.001**
Patients with ALT level higher than 3 × upper limit of normal (ULN)	*n* = 8 (16%)	*n* = 11 (11.4%)	0.59
Mean length of liver biopsies (LB) specimen (cm)	3.2 ± 0.9	3.9 ± 1.1	**0.0002**
Mean number of portal triads	20.7 ± 9.6	27.8 ± 10.2	**0.0001**

Numbers in bold are statistically significant.