Original Article

Evaluation of Usability and Efficacy of Strain Elastography Method Concurrently with Preoperative Ultrasonography in Cases of Hydatid Cyst

Emrah Karatay[1]*, Ozlem Turkoglu[2], Abdulkadir Eren[3], Mirkhalig Javadov[4]

[1]Department of Radiology, Ministry of Health Tuzla State Hospital, Istanbul, Turkey, [2]Department of Radiology, University of Health Sciences, Taksim Training and Research Hospital, Istanbul, Turkey, [3]Department of Radiology, Istanbul Medipol University Mega Hospital, Istanbul, Turkey, [4]Department of General Surgery, Medicana International Atasehir Hospital, Istanbul, Turkey

Abstract

Background: Hydatid cysts (HCs), which are among the cystic lesions of the liver, are frequently encountered in endemic areas. Routine imaging modalities are sometimes insufficient to differentiate HC types, and ultrasound (US) elastography has just begun to be used for this purpose. In this study, the effectiveness of the strain elastography (SE) method in preoperative HC cases was investigated, and the relationship between HC types and elastography values was evaluated. **Methods:** HC cases that underwent SE simultaneously with preoperative US between January 2019 and February 2021 were evaluated retrospectively, and 75 cases were included in the study. In addition to elastography data, cyst typing according to the World Health Organization (WHO) classification was also available. **Results:** Thirty cases were male and 45 cases were female, the median age was 48 years, and the interquartile range was 41 years. According to the WHO classification, 15 cases were Type I, 27 cases were Type II, and 33 cases were Type III HC. Median strain ratio (SR) values were 5.69 (4.07–14.47) for Type I, median 1.49 (1.26–1.74) for Type II, and median 0.21 (0.13–0.30) for Type III, and there was a highly significant relationship between HC types and SR values ($P < 0.001$). There was also a very strong (-) directional correlation between HC type and strain rate ($P < 0.001$, Spemann rho (ρ): −0.928). **Conclusion:** US elastography is a new modality in the diagnosis of HC types, and there are few studies available. In this study, unlike the literature, it is the first time that HC typing and discrimination have been used using the SE technique, which is remarkable.

Keywords: Hydatic cyst, strain elastography, strain ratio, ultrasound, World Health Organization classification

Introduction

Cystic lesions are frequently encountered in radiological imaging of the liver. Hydatid cysts (HCs) are among these lesions and are common in endemic areas. HC is asymptomatic in most cases and is detected incidentally during routine abdominal ultrasound (US), control US, or computed tomography (CT) for other pathologies.[1] Initially, the Gharbi classification was used to differentiate and type liver HCs in US imaging. Afterward, the classification of the World Health Organization (WHO) began to be used, and today both classifications are the most preferred.[2] In both classifications, Type I represents a pure cystic lesion and Type V represents a pure calcific lesion. In the WHO classification, unlike Gharbi, the location of Type II and Type III lesions has changed. Cyst typing is very important, and treatment options vary accordingly.[1-3]

US and CT are the imaging modalities routinely used to distinguish HC types.[4] In addition, the real-time elastography method performed under US guidance has begun to be used more frequently in daily practice. Elastography is a relatively new US approach to examining tissue stiffness that involves applying force to soft tissues in the form of compression or vibration.[5] Tissue compression applied to the US probe by the practitioner forms the basis of strain elastography (SE).

Address for correspondence: Dr. Emrah Karatay, Department of Radiology, Ministry of Health Tuzla State Hospital, İçmeler Mahallesi, Piri Reis Caddesi, No: 74 Tuzla, Istanbul, Turkey. E-mail: emrahkaratay1984@gmail.com

Received: 26-10-2023 **Revised:** 30-11-2023 **Accepted:** 11-01-2024 **Available Online:** 07-03-2024

Access this article online

Quick Response Code:

Website: https://journals.lww.com/jmut

DOI: 10.4103/jmu.jmu_134_23

How to cite this article: Karatay E, Turkoglu O, Eren A, Javadov M. Evaluation of usability and efficacy of strain elastography method concurrently with preoperative ultrasonography in cases of hydatid cyst. J Med Ultrasound 2025;33:23-8.

Changes in the size and shape of the lesion occur as a result of pressure on the tissue, which can be measured by strain index (SI) or strain ratio (SR) parameters.[6] The most suitable organs for evaluation in SE application are the organs that can be compressed.[5,6] Noninvasive and radiation-free real-time SE is widely used in addition to ultrasonography (USG) for the breast, thyroid gland, lymph nodes, prostate, and liver imaging and lesion evaluation.[5-7] There are very few studies in the literature on the use of US elastography in HC cases.[8,9]

In this study, the effectiveness of the real-time SE method performed simultaneously in HC cases that underwent USG before surgery was investigated. In addition, it was evaluated whether there was a significant relationship between the SR values obtained by this method and the HC types in the WHO classification.

Materials and Methods

Study participants and design

Ethics committee approval was obtained before the study, and written consent forms for USG procedures were available (IRB: 20/318-46418926). HC cases that underwent preoperative USG and SE between January 2019 and February 2021 were retrospectively screened. Patients with previous abdominal surgery, presence of multiple HCs, inflammatory bowel disease, biliary tract cystic disease, polycystic kidney disease, a history of malignancy, body mass index ≥40, and patients under 18 years of age were excluded from the study. In addition to US, real-time SE method was applied, and 75 patients who met the criteria were identified and included in the study. All included cases had positive serology tests (IHA [Indirect hemagglutination] and enzyme-linked immunosorbent assay) during surgical follow-up. In these cases, US data on cyst types according to the WHO classification were available. SR values obtained as a result of SE performed simultaneously with preoperative USG were noted for each case, respectively.

Ultrasound imaging and strain elastography measurements

All USG and SE examinations were performed by the same radiologist with 12 years of experience in abdominal USG and elastography. During these procedures, an Aplio 500 (Toshiba Medical Systems, Tochigi, Japan) US device with a 6–1.9 MHZ convex probe was used. First, the patient was placed in the supine position, and the localization of the HC in the liver was determined using B-mode US, and its typing was done using the WHO classification [Figure 1]. After the USG evaluation of the liver and cyst, SE measurements were started by pressing the Elasto button. Periodic compression and decompression phases were created with the USG probe, and symmetrical sinusoidal waves formed at the bottom of the screen in SE mode were followed. When these waves were evaluated, the compression phase was above the baseline, and the decompression phase was below it. Since the decompression phase is less affected by compression and is safer, elastography measurements were made in this phase. In the SE application of the device, the standard region of interest (ROI) was set

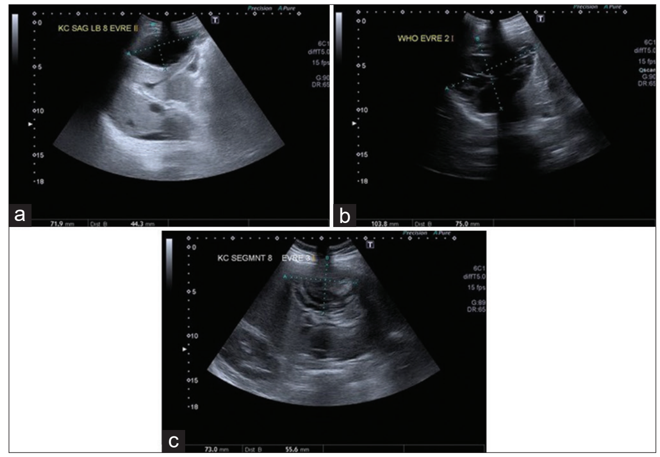

Figure 1: In preoperative B-mode abdominal ultrasonography scanning, there were hydatid cyst lesions located in the liver and the World Health Organization classification was used. Respectively, (a) Type I cyst in the left lobe of the liver, (b) Type II cyst in the right lobe of the liver, and (c) Type III cyst in the right lobe of the liver have been shown. WHO: World Health Organization

to 4 mm, and a 4 mm ROI was used for each case without changing its size. The reference ROI was placed as close to the center of the cyst as possible, and the second ROI was placed in the normal liver parenchyma [Figure 2]. The percentages of liver parenchyma and HC tension, and the semi-quantitative SR value obtained from them, were automatically calculated by the SE software. Elastography measurements were repeated twice by the operator, and the software installed on the US gave the averages.

Statistical analysis

Statistical analysis of all data was performed using SPSS v18.0 software (IBM, Chicago, IL, USA). One-sample Kolmogorov–Smirnov test was performed to analyze the distribution of the data. Descriptive statistical methods (median, frequency, percentage, minimum, and maximum) were used to express central tendency. Pearson χ^2 test and Fisher's exact test were used to evaluate the significant relationship and difference between categorical data. Spearman's rho correlation coefficient was used to determine the correlations between elastography values and HC types. Since there was no normal distribution, the Mann–Whitney U and Kruskal–Wallis H tests were used to analyze gender, elastography values, and HC types. A 95% confidence interval was valid during data analysis, and $P < 0.05$ was considered statistically significant.

Results

There were a total of 75 patients, and all of them had a single cyst in their liver parenchyma. Fifty-one of the cysts were located in the right lobe and 24 in the left lobe. There were 30 males and 45 females, and the youngest case in both cases was 24 years old. The oldest case was 54 years old in males and 65 years old in females. The median age for all patients was 48 years, and the interquartile range was 41 years. Liver craniocaudal (cc) size was minimum 136-maximum 157 mm

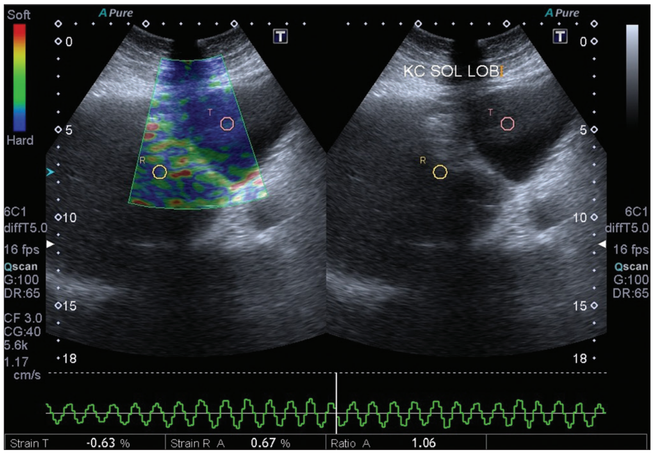

Figure 2: Sinusoidal waveforms (green color) with compression and decompression phases were created using strain elastography in a patient with the World Health Organization Stage I hydatid cysts in the left lobe of the liver. The region of interest (ROI) marked with a pink T was placed in the center of the cyst, and the other ROI marked with a yellow R was placed in the adjacent liver parenchyma, and then the strain elastography values shown in the bar below were obtained (strain T, strain R, and ratio)

and median of 146 mm for males, minimum 128-maximum 166 mm and median of 151 mm for females, and total minimum 128-maximum 166 mm and median 149 mm. Similarly, the HC diameter ranking was determined as minimum 43.70-maximum 118.20 mm and median of 61.17 mm for men, minimum 40.85-maximum 120.20 mm and median 67.40 mm for women, and minimum 40.85-maximum 120.20 mm and median 93.40 mm in total [Table 1]. It was examined whether there was a relationship between gender, age, liver CC, and HC diameters, but no statistical significance was found ($P > 0.05$). The HC and liver strain percentages and SR values for males and females, as well as the SE values obtained for all patients, are summarized in Table 1. No statistical significance was found when SE values were compared according to gender and age ($P > 0.05$).

According to the WHO classification, 15 cases were Type I, 27 cases were Type II, and 33 cases were Type III. Liver cc and HC diameters were also calculated according to HC types. Liver cc and HC diameters were also calculated according to HC types. For Type I, liver cc was minimum 129/maximum 156 and median 144 mm; for Type II, liver cc was minimum 128/maximum 166 and median 146 mm; and for Type III, liver cc was minimum 128/maximum 161 mm and median 152 mm. Similarly, for Type I, HC diameter was minimum 56.5/maximum 118.20 and median was 72.83 mm; for Type II, HC diameter was minimum 40.85/maximum 114.00 and median was 59.90 mm; for Type III, HC diameter was minimum 41.86/maximum 120.20 mm and median was 64.30 mm [Table 2]. When the relationship between liver cc and HC diameters according to HC types was evaluated, respectively, with the Kruskal–Wallis test, no statistical significance was detected ($P > 0.05$). No correlation or statistical significance was detected between liver cc and HC diameter values ($P > 0.05$).

Table 1: Demographics

Gender	Minimum	Maximum	Percentiles (IQR)		
			Q1	Median	Q3
Male (*n*=30)					
Age	24	54	26	32	50.25
Liver cc (mm)	136.00	157.00	138.00	146.00	156.25
HC diameter (mm)	43.70	118.20	51.92	61.17	91.40
HC strain (%)	0.05	6.76	0.58	1.28	2.67
Liver strain (%)	0.03	2.93	0.61	1.30	2.40
SR	0.01	22.80	0.45	1.59	3.69
Female (*n*=45)					
Age	30	65	37	53	60
Liver cc (mm)	128.00	166.00	132.00	151.00	161.00
HC diameter (mm)	40.85	120.20	50.40	67.40	99.90
HC strain (%)	0.13	12.06	0.60	0.97	0.60
Liver strain (%)	0.05	2.67	0.14	0.87	1.34
SR	0.01	6.15	0.20	0.32	1.52
Total (*n*=75)					
Age	24	65	30	48	55
Liver cc (mm)	128.00	166.00	137.00	149.00	156.50
HC diameter (mm)	40.85	120.20	51.42	93.40	65.60
HC strain (%)	0.05	12.06	0.61	1.27	3.86
Liver strain (%)	0.03	2.93	0.28	0.93	1.52
SR	0.01	22.80	0.24	1.21	1.84

IQR: Interquartile range, HC: Hydatid cyst, cc: Craniocaudal, SR: Strain ratio

According to HC types, SE values are expressed as minimum, maximum, and median for each type [Table 3]. When evaluated with Spearman correlation, there was a (-) moderate correlation between HC type and liver strain (P: 0.048, Spearman rho (ρ): −0.400). There was a very strong (-) correlation between HC type and SR ($P < 0.001$, Spearman rho (ρ): −0.928). In addition, there was a moderate (-) correlation between SR and strain cyst (P: 0.031, Spemann rho (ρ): −0.432). There was a moderate (+) correlation between SR and liver strain (P: 0.049, Spemann rho (ρ): 0.397). There was a moderate (+) correlation between liver strain and strain cyst (P: 0.043, Spemann rho (ρ): 0.407). According to the Kruskal–Wallis test, there was a highly significant relationship between HC type and SR ($P < 0.001$). When evaluated with the Chi-square test and Fisher's exact test, no significant relationship was found between cyst type-gender and right-left lobe-gender, respectively (P: 0.188, P: 0.065). There was no significant correlation between cyst location (right–left liver lobe) or HC size and SR values ($P > 0.05$).

Discussion

The elastography technique, developed to evaluate tissue stiffness and the pathologies affecting it, is being used more and more frequently in daily practice. US elastography is a relatively new and developing method and is used in research to determine clinical applications. This method is based on the comparison of signals obtained before and after the affected tissue.[10] Clinical applications of elastography were initially

Table 2: Hydatid cyst types and ultrasonography values

HC type (WHO grading)	USG values (mm)	Minimum	Maximum	Percentiles (IQR)		
				Q1	Median	Q3
Type I (*n*=15)	Liver cc	129.00	156.00	130.50	144.00	151.00
	HC diameter	56.55	118.20	64.02	72.83	107.80
Type II (*n*=27)	Liver cc	128	166	134.00	146.00	160.00
	HC diameter	40.85	114.00	52.97	59.90	94.65
Type III (*n*=33)	Liver cc	128.00	161.00	146.00	152.00	157.00
	HC diameter	41.86	120.20	48.70	64.30	86.50

IQR: Interquartile range, HC: Hydatid cyst, WHO: World Health Organization, USG: Ultrasonography, cc: Craniocaudal

Table 3: Hydatid cyst types and strain elastography parameters

HC types (WHO grading)	SE parameters	Minimum	Maximum	Percentiles (IQR)		
				Q1	Median	Q3
Type I (*n*=15)	HC strain (%)	0.05	8.28	0.09	0.44	4.77
	Liver strain (%)	0.74	2.93	0.77	1.14	2.10
	SR	3.31	22.80	4.07	5.69	14.47
Type II (*n*=27)	HC strain (%)	0.27	6.76	0.70	0.97	1.81
	Liver strain (%)	0.14	2.71	0.77	1.46	2.48
	SR	1.06	1.90	1.26	1.49	1.74
Type III (*n*=33)	HC strain (%)	0.46	12.06	0.63	2.75	6.50
	Liver strain (%)	0.03	1.59	0.12	0.33	1.34
	SR	0.01	0.52	0.13	0.21	0.30

IQR: Interquartile range, HC: Hydatid cyst, WHO: World Health Organization, SE: Strain elastography, SR: Strain ratio

performed on easily translocated tissues such as thyroid, lymph nodes, breast, prostate, and blood vessels. While B-mode USG traditionally shows the morphology of tissue, elastography additionally measures deformations in the tissue and adds the data to US images.[11] After obtaining positive results in the clinical application of US elastography in soft tissues, studies have begun on the liver and other internal organs, especially since they are challenging and easy to relocate. There are different types of US elastography according to the working principle and the parameters obtained. These are mainly defined as strain, shear wave, acoustic radiation force impulse (ARFI), and transient elastography, and they have their own advantages and prominent features.[10,11] Strain wave elastography allows measurements in ascitic cases that are not possible with other types of elastography.[10-12] In our study, this advantage was taken into consideration, and SE was used in the measurement of HC cases. SE shows the operator dependency of other elastography techniques and gives semi-quantitative values such as SI or SR. On the contrary, quantitative values are obtained in ARFI, transient, and shear-wave elastography (SWE).[13]

The first US elastography applications for the liver were aimed at detecting pathologies with widespread parenchymal involvement, such as fibrosis.[10,12] In a study including 415 patients, Bota *et al*. evaluated liver fibrosis with ARFI elastography. A strong correlation was found between fibrosis and ARFI measurements ($r = 0.722$, $P < 0.0001$), and these results emphasized the importance of elastography in diagnosis.[14] Cheng *et al*. prospectively evaluated liver fibrosis using the combined use of transient elastography and SE. The Ishak histological classification was used as reference and 73 patients were evaluated with SE. It has been stated that SE alone can perform similar to other elastography techniques in evaluating liver fibrosis, but transient elastography is more effective for severe fibrosis-cirrhosis.[15]

There are many types of nodular lesions in the liver, such as simple cyst, HC, hemangioma, FNH, hepatocellular carcinoma (HCC), and metastasis. To reduce invasive procedures such as biopsy in the diagnosis of liver lesions, it is essential to distinguish between benign and malignant lesions with imaging methods. Imaging modalities are inadequate for the differential diagnosis of these lesions, so US elastography has begun to be used additionally in the identification of liver parenchymal disease and focal liver lesions.[16,17] Onur *et al*. examined 82 patients with the SE method to differentiate benign and malignant liver masses. The results of the study showed that the use of SE may be helpful in differentiating benign and malignant liver masses. However, it has also been stated that this is a limitation as there is some intersection in the SI values of benign and malignant liver masses.[17] Yu *et al*. used ARFI elastography to distinguish liver masses in 89 patients. There was a present in a total of 105 liver masses, and it was shown that this US elastography technique could be especially useful in distinguishing metastases from benign liver masses.[16] Park *et al*. also tried to distinguish benign and malignant liver lesions using the ARFI elastography method. According to a prospective study, ARFI was useful in distinguishing malignant lesions, especially HCC, from benign liver lesions.[18]

In the differential diagnosis of HC, biliary cystadenoma, hemorrhagic or infected cysts, pyogenic liver abscess, and cystic metastases are primarily considered. Future studies on elastography with larger case numbers may be guiding in the diagnosis and differentiation of these cystic lesions.[6,18,19] With USG evaluation, Type I HC is often confused and cannot be differentiated since it has similar echo structure and morphology to a simple cyst.[2,3] Therefore, additional CT and magnetic resonance imaging (MRI) are often required, and both imaging modalities may sometimes be inadequate in the differential diagnosis.[20,21] US elastography has been applied to HC cases to overcome this problem and measure its usefulness in differential diagnosis, and there are two studies reported in the literature. The first study was conducted by Duymuş *et al*., and the SE method was used similar to our study. Gharbi classification was used in HC typing, and a total of 33 patients were included in the study. SI values were measured by two observers for 5 of the HC types, respectively, and an 8 mm ROI was used in addition to the standard 4 mm ROI. There was no statistically significant difference between the SI values of HC types ($P > 0.05$) and ROI sizes between observers ($P > 0.05$), and the cyst types could not be distinguished by SE.[8] Differently, in the second study, ARFI elastography application and shear-wave waves were used, and only simple cyst and type I HC were tried to be distinguished. Before puncture-aspiration-injection-reaspiration treatment, 22 simple cysts and 51 Type I HC were evaluated with this method, and unlike SE, quantitative values were obtained for both groups. Despite this advantage and relatively different elastography values, no statistically significant difference could be detected between the SWE measurements of Type I HCs and simple cysts ($P > 0.05$).[9]

This study has notable advantages over two other elastography studies of HC types. Unlike the literature, for the first time in our study, a significant difference was found between the SR values of HC types. With 75 patients, our study has the largest number of cases known in the literature. Thus, with a larger number of patients with homogeneous HC type and SR values, it could become statistically significant without a significant intersection.[8,9] In this study, unlike Duymuş *et al*., HC typing was done with the newer WHO classification instead of Gharbi.[8] Unlike Durmaz *et al*., this study focused on HC cases and tried to evaluate only HC types and obtain as much data as possible with SE method.[9]

Despite the significant results, this study had some limitations. The first limitation is the relatively low number of cases, although it has the highest number reported in the literature with 75 cases. The second limitation is that Type IV and Type V cysts cannot be evaluated with SE before surgery. Because in the tertiary care center where we worked, only the first three types were operated by general surgeons and we did not have SE data for the other two HC types. The third limitation was that there were only two elastography studies for liver HC cases that we could compare with, and only one was performed with SE.[8,9]

Conclusion

Liver cystic lesions are frequently encountered in radiological imaging, and a clear distinction must be made due to differences in follow-up and treatment. HC, one of these cystic lesions, are common in endemic areas, and US, CT, and MRI may sometimes be insufficient in diagnosis and HC typing. The use of US elastography for HC typing and differentiation is quite new, and there are few studies and data on this subject so far. Compared to the literature, this study has shown for the first time that HC typing and differentiation can be made using US elastography, and it is promising. However, new studies with higher case numbers are needed to popularize and standardize this method in the use of HC types.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Botezatu C, Mastalier B, Patrascu T. Hepatic hydatid cyst – Diagnose and treatment algorithm. J Med Life 2018;11:203-9.
2. Turgut AT, Akhan O, Bhatt S, Dogra VS. Sonographic spectrum of hydatid disease. Ultrasound Q 2008;24:17-29.
3. Keong B, Wilkie B, Sutherland T, Fox A. Hepatic cystic echinococcosis in Australia: An update on diagnosis and management. ANZ J Surg 2018;88:26-31.
4. Giorgio A, Di Sarno A, de Stefano G, Farella N, Matteucci P, Scognamiglio U, *et al.* Percutaneous treatment of hydatid liver cyst. Recent Pat Antiinfect Drug Discov 2009;4:29-36.
5. Sigrist RM, Liau J, Kaffas AE, Chammas MC, Willmann JK. Ultrasound elastography: Review of techniques and clinical applications. Theranostics 2017;7:1303-29.
6. Conti CB, Cavalcoli F, Fraquelli M, Conte D, Massironi S. Ultrasound elastographic techniques in focal liver lesions. World J Gastroenterol 2016;22:2647-56.
7. Ozturk A, Grajo JR, Dhyani M, Anthony BW, Samir AE. Principles of ultrasound elastography. Abdom Radiol (NY) 2018;43:773-85.
8. Duymuş M, Menzilcioğlu MS, Gök M, Erdem A, Avcu S, Kırış A. The avaibility of strain elastography in a hydatid cyst – Interobserver study. Pol J Radiol 2016;81:310-6.
9. Durmaz F, Ozgokce M, Turkoglu S, Dundar İ, Goya C. Ultrasound elastography in the differentiation of simple cyst and type I hydatid cyst of the liver. Ultrasound Q 2021;37:129-32.
10. Havre R, Gilja OH. Elastography and strain rate imaging of the gastrointestinal tract. Eur J Radiol 2014;83:438-41.
11. Shiina T, Nightingale KR, Palmeri ML, Hall TJ, Bamber JC, Barr RG, *et al.* WFUMB guidelines and recommendations for clinical use of ultrasound elastography: Part 1: Basic principles and terminology. Ultrasound Med Biol 2015;41:1126-47.
12. Ferraioli G, Wong VW, Castera L, Berzigotti A, Sporea I, Dietrich CF, *et al.* Liver ultrasound elastography: An update to the world federation for ultrasound in medicine and biology guidelines and recommendations. Ultrasound Med Biol 2018;44:2419-40.
13. Ozturk A, Olson MC, Samir AE, Venkatesh SK. Liver fibrosis assessment: MR and US elastography. Abdom Radiol (NY) 2022;47:3037-50.
14. Bota S, Sporea I, Sirli R, Popescu A, Dănilă M, Sendroiu M. Factors that influence the correlation of acoustic radiation force impulse (ARFI), elastography with liver fibrosis. Med Ultrason 2011;13:135-40.
15. Fang C, Virdee S, Jacob J, Rufai O, Agarwal K, Quaglia A, *et al.* Strain elastography for noninvasive assessment of liver fibrosis: A prospective study with histological comparison. Ultrasound 2019;27:262-71.

16. Yu H, Wilson SR. Differentiation of benign from malignant liver masses with acoustic radiation force ımpulse technique. Ultrasound Q 2011;27:217-23.
17. Onur MR, Poyraz AK, Ucak EE, Bozgeyik Z, Özercan IH, Ogur E. Semiquantitative strain elastography of liver masses. J Ultrasound Med 2012;31:1061-7.
18. Park H, Park JY, Kim DY, Ahn SH, Chon CY, Han KH, *et al.* Characterization of focal liver masses using acoustic radiation force impulse elastography. World J Gastroenterol 2013;19:219-26.
19. Martelletti C, Armandi A, Caviglia GP, Saracco GM, Pellicano R. Elastography for characterization of focal liver lesions: Current evidence and future perspectives. Minerva Gastroenterol (Torino) 2021;67:196-208.
20. Oruç E, Yıldırım N, Topal NB, Kılıçturgay S, Akgöz S, Savcı G. The role of diffusion-weighted MRI in the classification of liver hydatid cysts and differentiation of simple cysts and abscesses from hydatid cysts. Diagn Interv Radiol 2010;16:279-87.
21. Hołody-Zaręba J, Zaręba KP, Kędra B. Assessment of the accuracy of preoperative imaging methods in the diagnosis of hepatic single-chamber echinococcosis. Pol Przegl Chir 2013;85:693-8.