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The impact of share wave elastography in differentiation of hepatic hemangioma from malignant liver tumors in pediatric population

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ABSTRACT

Objective: In children it is crucial to differentiate malignant liver tumors from the most common benign tumor, hepatic hemangiomas since the treatment strategies are quite different. We aimed to evaluate the efficiency of shear wave elastography (SWE) technique in differentiation of malignant hepatic tumors and hepatic hemangiomas.
Methods: Twenty patients with hepatic tumor were included in our study. Two radiologists performed SWE for 13 patients with malignant hepatic tumors including hepatoblastoma ($n = 7$), hepatocellular carcinoma ($n = 3$), metastasis ($n = 2$), embryonal sarcoma ($n = 1$) and 7 patients with hepatic hemangioma. All of our patients were between the age of 1 and 192 months (mean age: 56.88 months). Receiver operating characteristic analysis was achieved to evaluate the diagnostic accuracy of SWE and to determine the optimal cut-off value in differentiation hepatic hemangioma from malignant hepatic tumors.
Results: The mean SWE values (in kPa) for the first observer were 46.94 (13.8–145) and 22.38 (6.6–49.6) and those for the second observer were 57.91 (11–237) and 23.87 (6.4–57.5), respectively for malignant hepatic tumors and hepatic hemangiomas. The SWE values of malignant hepatic tumors were significantly higher than those of hepatic hemangioma ($p = 0.02$). The inter-observer agreement was almost perfect (0.81). The area under the receiver operating characteristic curve of SWE for differentiating the hepatic hemangioma from malignant hepatic tumors was 0.77 with a sensitivity of 72.7% and a specificity of 66.7% at a cutoff value of 23.62 with 95% confidence interval.
Conclusion: Shear wave elastography can be helpful in differentiation of malignant hepatic tumors and hepatic hemangioma.

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1. Introduction

Hepatoblastoma (HB) is the most common malignant tumor of liver in childhood and constitutes about 80% of all malignant pediatric tumors [1]. Besides, vascular tumors are the most common benign tumor in pediatric population. The term "hepatic hemangioma" refers to completely different lesions in pediatric and adult practice. Furthermore the radiologic and histopathological features of them are quite different. Hepatic hemangiomas are known as vascular tumors in children according to ISSVA (International Society for the Study of Vascular Anomalies) classification. Hepatic hemangiomas can be divided into two subtypes; infantile and congenital hemangiomas. Congenital hemangiomas are also divided into rapidly involuting and non-involuting subtypes. Heterogeneous appearance, presence of calcifications and the existence of peripheral enhancement with poor central enhancement are in favor of congenital hemangiomas rather than infantile hemangioma [2]. However it is not always possible to differentiate congenital hemangiomas from infantile hemangiomas even with biopsy [3–6]. Clinical course of hemangiomas is directly correlated with the behavior pattern and complication risk rather than the histologic subtypes.

Ultrasonography (US) is typically used as a first-line imaging tool to evaluate liver masses especially in pediatric patients since it does not have any risk of radiation exposure and does not require sedation. Although there are some disadvantages both for computed tomography (CT) and magnetic resonance (MR) imaging including radiation exposure risk, sedation and contrast material administration, sectional radiologic methods can be considered as

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the next step examinations. It is important to predict the focal liver masses whether they are benign or malignant especially in children since the prognosis and treatment procedures are quite different.

US is typically the most innocent radiologic tool for pediatric patients. Recently, elastography techniques which estimate the tissue stiffness have been developed to increase the diagnostic impact of US. Share wave elastography (SWE) is a novel method which can create a 2-dimensional (D) real-time measurable image of tissue stiffness. There are published reports in literature that focused on the impact of sonoelastography in differential diagnosis of focal liver tumors in adulthood [7–12]. Our goal is to explore the efficiency of SWE in differentiation hepatic hemangioma from the malignant liver tumors in pediatric population.

2. Materials and methods

2.1. Patients

This prospective study was approved by the institutional review board and written consent was obtained from the parents of each patient. From March 2013 to December 2013, 33 patients with suspected liver mass were referred to our radiology department for SWE examination. Four patients who were incompatible for SWE examination or unable to perform breath-hold, 4 patients who received chemotherapy before SWE examination and 2 patients who had liver mass deeper than 6 cm were excluded. Also 3 patients who had the diagnosis of hepatic hemangioma with imaging and clinical findings were not included in the study since they did not have liver biopsy and were followed up.

Finally the remaining 20 patients [14 boys (70%) and 6 girls (30%)] were included in the study. The mean age of the patients that were included in the study was 56.88 months (ranging between 1 and 192 months). Percutaneous liver biopsy was performed and the diagnosis was confirmed by histopathological examination in each of the participants following the SWE examination.

2.2. Share wave elastography acquisition

Two radiologists with 7 and 15 years of clinical experience in conventional US, respectively performed SWE independently using Aixplorer ultrasound system (SuperSonic Imagine S.A., Aix-en-Provence, France) with a convex broadband probe (SC6–1). The radiologists were blind to the clinical and laboratory results of the patients. Each of the patients was assessed in a supine position with the right arm in maximal abduction. Initially the radiologists recorded the sizes and conventional sonographic properties of the liver masses then SWE acquisition was achieved from each of the patients by placing a circular region of interest (ROI) with a standard size of 4 mm × 4 mm in the masses and then the mean and standard deviation of the elasticity values in kPa within the ROI were displayed. The radiologists chose small sized ROI to exclude calcific or necrotic areas inside of the lesions. Both radiologists obtained between 4 and 12 values that vary due to the tumor size from multiple parts of each masses and recorded in an excel table. They avoided including vascular structures, calcific and/or cystic-necrotic areas in ROI during data acquisition. Only one lesion of interest was chosen in case of the existence of multiple liver lesions.

2.3. Statistical analysis

All statistical analyses were performed with SPSS software (v. 18.0.0, Chicago, IL, United States). The mean and standard deviation values of malignant hepatic lesions and hepatic hemangioma were calculated with descriptive analysis. Chi-square test was used to evaluate the difference between the groups of malignant hepatic lesion and hepatic hemangioma. A p value less than 0.05 was accepted as statistically significant.

Receiver operating characteristic analysis was achieved to evaluate the diagnostic accuracy of SWE and to determine the optimal cut-off value in differentiation of hepatic hemangioma from malignant hepatic tumors. Cut-off value was chosen by maximizing the Youden index on the estimated curves.

We performed Kendall tau rank correlation coefficient to assess the inter-observer agreements.

3. Results

3.1. Patient groups

Percutaneous liver biopsy was performed in all of 20 patients. According to the histopathology results; hepatoblastoma ($n = 7$), hepatocellular carcinoma ($n = 3$), metastases ($n = 2$) and embryonel carcinoma ($n = 1$) which were among the malignant liver tumors and hepatic hemangioma ($n = 7$) were undergone SWE examination. The metastatic lesions of liver originated from colon adenocarcinoma and neuroblastoma respectively (Fig. 1). There was a male predominance in patients with malignant liver tumors

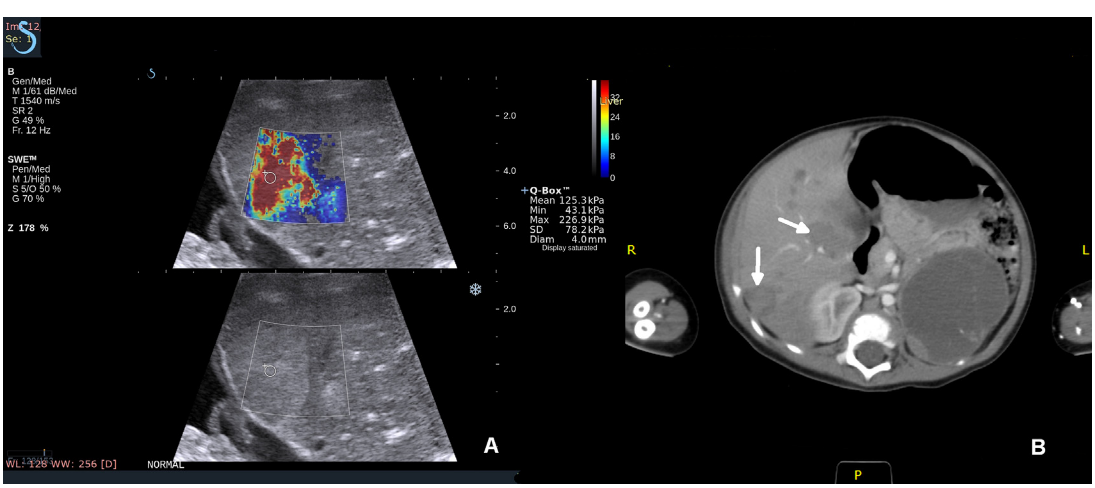

Fig. 1. (A) SWE images of a 9 year-old boy who had neuroblastoma metastases revealed higher elasticity values inside of the masses. (B) CT image which was obtained at arterial phase of the same patient showed discrete hypodense lesions regarding to neuroblastoma metastases (white arrows).

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