Evaluation of liver fibrosis using shear wave elastography

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Objective
Chronic liver disease promotes hepatic inflammation and fibrosis. When diagnosing and treating hepatic diseases such as chronic hepatitis C, it is important to evaluate the degree of liver fibrosis. Our aim was to determine diagnostic capabilities of shear wave elastography (SWE) in patients with liver disease.

Methods
Ultrasound examination of the abdomen was used to evaluate liver stiffness, size of the liver and spleen, portal vein flow velocity, portal vein diameter and flow pattern of hepatic veins in 39 participants. Patient group consisted of subjects with diagnosed cirrhosis and other liver diseases (cholecystitis, steatohepatitis and etc.). Control group consisted of apparently healthy volunteers. All measurements were performed using ElastPQ SWE on Philips EPQ 7 ultrasound system. Scans were conducted by one observer with 30 years of abdominal US experience. The ultrasonographer was blinded to the subjects’ clinical data. Participants were in the supine position. First, size of the liver and spleen, portal vein flow velocity, portal vein diameter and flow pattern of hepatic veins were evaluated. Next, liver stiffness of the right hepatic lobe was measured. The detection site was fixed at least 1.5 cm beneath the liver capsule, away from the intrahepatic vessels and gallbladder (Figure 1). When the elasticity imaging mode was selected, subjects were asked to hold breath at mid-respiration for 3–5 s. When the region of interest (ROI) was located, the ultrasonographer initiated the SWE measurement. The hepatic stiffness was expressed in kilopascals (kPa). The mean value of 10 consecutive measurements was used for statistical analysis.

Results
The baseline characteristics of all participants are listed in Table 1. The mean liver stiffness value was 4.18±1.15 kPa and 16.19±12.31 kPa in control and patient groups, respectively (p<0.001). In this study the mean liver stiffness values were found to be increased in patient group compared with control group (p<0.001). ROC curve analysis showed that, with an optimal SWE cut-off value of 5.51 kPa, the predicted sensitivity and specificity for detecting liver fibrosis is 88% and 93%, respectively (Figure 2). Fibroscan was performed on 3 (12.5 %) participants in patient group. Comparing the diagnostic performance of Fibroscan and SWE, the same stage of hepatic fibrosis was found in 2 out of 3 participants, in one patient SWE showed lower degree of fibrosis (F2–F3) than Fibroscan (F4). Liver stiffness was found to be positively correlated with portal vein diameter and flow pattern of hepatic veins (r=0.4, p<0.008). The analysis showed that SWE value is 9.87 kPa higher than average value when hepatic vein flow pattern is biphasic and 12.28 kPa higher when monophasic. No significant correlation between liver stiffness and size of the liver and spleen or portal vein flow velocity was found.

Table 1. The main participants’ characteristics and SWE results

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Control group (n=15)</th>
<th>Patient group (n=24)</th>
<th>P Value</th>
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<tbody>
<tr>
<td>Sex (m)</td>
<td></td>
<td></td>
<td>0.542</td>
</tr>
<tr>
<td>Female</td>
<td>6 (40.0)</td>
<td>12 (50.0)</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>9 (60.0)</td>
<td>12 (50.0)</td>
<td></td>
</tr>
<tr>
<td>Age (y)</td>
<td>52.73 ± 11.73</td>
<td>57.21 ± 14.42</td>
<td>0.338</td>
</tr>
</tbody>
</table>

Figure 1. Image shows how measurements were obtained. The quadrangular white box is ROI. The median stiffness in this case is 3.26 kPa.

Figure 2. The performance of ElastPQ for predicting liver fibrosis

Conclusion
Liver is stiffer in subjects with diagnosed liver disease than in those who are apparently healthy. Sensitivity of SWE is 88%, specificity 93% with cut-off value of 5.51 kPa. Greater hepatic stiffness is associated with increased portal vein diameter, monophasic and biphasic flow patterns of hepatic veins.

Key words
Ultrasound; shear wave elastography; liver fibrosis;