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● *Original Contribution*

POINT SHEAR WAVE ELASTOGRAPHY TO EVALUATE AND MONITOR CHANGING PORTAL VENOUS PRESSURE IN PATIENTS WITH DECOMPENSATED CIRRHOSIS

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Abstract—This study evaluated whether the stiffness of the liver and spleen, measured using the point shear wave elastography (pSWE) technique, correlates with portal venous pressure (PVP) and whether the result extends to estimate the diminishing change in PVP (ΔPVP) in patients with decompensated cirrhosis. We evaluated the data of 67 prospectively enrolled patients who underwent both transjugular intrahepatic portosystemic shunt (TIPS) and pSWE. The stiffness of liver and spleen were evaluated by measuring shear wave velocity (SWV) to determine the statistical correlation with PVP. We also analyzed whether change in SWV (ΔSWV) correlates with ΔPVP. The correlations were assessed with Spearman's rank correlation coefficients. Furthermore, receiver operating characteristic (ROC) curves were constructed to evaluate diagnostic capacity of ΔSWV. Spleen stiffness (SS) was positively correlated with PVP before and after TIPS ($p < 0.002$), although no correlation between liver stiffness and PVP was detected. A strong relationship between ΔSWV in SS and ΔPVP change in portal hypertension ($r = 0.871$) was also found in the overall population. The area under the ROC curve for the diagnosis of TIPS technical success was 0.869 and at a ΔSWV cut-off value of 0.36 m/s sensitivity was 77%. Measurement of SS can be used for non-invasive assessment and monitoring of PVP in patients with decompensated cirrhosis. (E-mail: mingyi2008@163.com) © **2017 World Federation for Ultrasound in Medicine & Biology.**

Key Words: **Ultrasound, Elastography, Shear wave, Portal hypertension, Cirrhosis.**

INTRODUCTION

Portal hypertension (PH) is one of the main complications of cirrhosis and contributes to patient mortality (de Franchis and Baveno VI Faculty 2015). The portal venous pressure (PVP) and hepatic vein pressure gradient (HVPG) are considered the reference standard for the evaluation of the presence and severity of PH in patients with cirrhosis (Bosch et al. 2009). Measurement of HVPG response to therapy offers additional relevant information: A decrease in HVPG of at least 10% from baseline or to ≤12 mmHg after treatment is clinically relevant in the setting of primary prophylaxis (de Franchis and Baveno VI Faculty 2015). However, the main drawback of PVP and HVPG measurement is that they are invasive techniques that are not widely available (Groszmann and Wongcharatrawee 2004). Therefore, development of non-invasive, simple, objective, reproducible and accurate alternatives to assess PH has become a research priority.

Non-invasive methods that measure the degree of liver fibrosis or spleen stiffness (SS) have recently been developed. Transient elastography (TE) is considered a non-invasive method to evaluate PH (de Franchis and Baveno VI Faculty 2015). While applicability of liver stiffness (LS) and SS by TE are suboptimal because of technical limitations (*e.g.,* obesity, narrow intercostal spaces, ascites, small spleen size). Point shear wave elastography (pSWE) integrated into a conventional ultrasound (US) platform, is a new shear wave–based method that can evaluate the stiffness of a given tissue by measuring the speed propagation of shear waves generated by US pushes across it. Many recent studies have shown that pSWE imaging is an accurate non-invasive modality compared with TE (Bota et al. 2013; Sporea et al. 2013; Trovato et al. 2015). However, very limited data exist about the performance of LS and SS by pSWE for the evaluation of PH.

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The purpose of our study was to investigate whether LS and SS measured by pSWE correlate with PVP and the validity of stiffness for monitoring changes in PVP (ΔPVP).

MATERIALS AND METHODS

Patients

This study was approved by the Ethical Committee of Nanjing University, and written informed consent was obtained from all patients.

Between August 2014 and May 2016, 80 consecutive patients with PH and without non-selective β-blocker treatment underwent transjugular intrahepatic portosystemic shunt (TIPS) therapy. Inclusion criteria were as follows: Liver cirrhosis, resulting from hepatitis B viral disease (HBV) or hepatitis C viral disease (HCV), confirmed by clinical data and diagnosed through laboratory and imaging examinations in accordance with the American Association for the Study of Liver Diseases practice guidelines (Terrault et al. 2016). Exclusion criteria were as follows: Liver cirrhosis resulting from alcohol consumption; autoimmune liver disease; metabolic liver disease or other diseases; portal vein thrombosis; splenectomy; concomitant liver cancer or other cancers; or other concomitant systemic diseases. As a result, 67 patients were included in this study (Fig. 1).

Conventional US and pSWE of the liver. We used a 4 C-1 curved array transducer (Acuson S2000, Siemens Medical Solutions, San Jose, CA, USA) to perform both real-time gray-scale imaging and pSWE. All measurements were performed by two observers (H.H. and J.Y.) who had at least 5 y of experience in sonographic examination and were blinded to the clinical data.

Patients were placed in a supine position to measure the LS. During real-time gray-scale imaging, we used pSWE to measure the shear wave velocity (SWV) of the liver using the intercostal approach. The measurements were standardized according to the following protocol: (i) The region of interest (ROI) was acquired 1–2 cm from the capsule of the liver. (ii) The location of ROI was placed in the parenchyma of liver to avoid reverberation artifacts and to keep away from "visible" vessels. (iii) The patients were instructed to hold their breath at the end of expiration. Assessment of SS was performed by the same methodology used for liver elastography. For SS, the ROI was placed through an intercostal approach between the central region and the lower pole in a position near the abdominal wall.

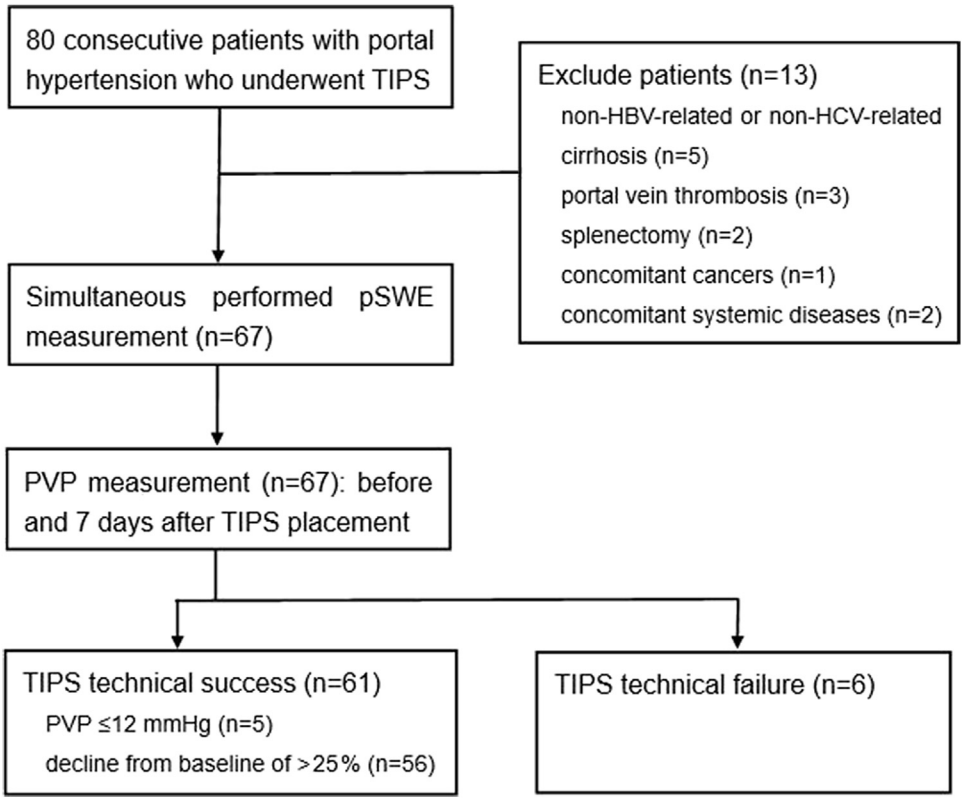

Fig. 1. Flowchart of the study population. TIPS = transjugular intrahepatic portosystemic shunt; HBV = hepatitis B viral disease; HCV = hepatitis C viral disease; pSWE = point shear wave elastography; PVP = portal venous pressure.

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