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DIAGNOSTIC OPPORTUNITIES OF COMPREHENSIVE ULTRASONIC EXAMINATION IN LIVER CIRRHOSIS AND PORTAL HYPERTENSION

Kutumov Khursand Yusupbayevich
Tashkent State Medical University,
Department of Medical Radiology No. 2
ORCID: https://orcid.org/0009-0002-4490-6237

Yusupaliyeva Gulnora Akmalovna
Tashkent State Medical University,
Department of Medical Radiology No. 2
ORCID: https://orcid.org/0000-0002-0768-6936

Abstract. Objective: to assess the diagnostic value of multiparametric liver ultrasound combined with Doppler evaluation of portal and arterial blood flow and shear wave elastography (SWE) in patients with liver cirrhosis.

Material and methods: 104 patients with liver cirrhosis of various etiologies were examined. B-mode ultrasound, Doppler assessment of portal and arterial circulation, and liver SWE were performed. Disease severity was assessed using the Child–Pugh classification. Results: progressive reduction in linear and volumetric portal blood flow velocities was observed with increasing cirrhosis severity, along with a significant increase in liver stiffness on SWE showing strong correlations with portal hemodynamic parameters.

Conclusion: multiparametric ultrasound is an effective noninvasive method for early diagnosis of liver cirrhosis and portal hypertension.

Keywords: liver cirrhosis, ultrasound imaging, Doppler ultrasound, portal hypertension, elastography, SWE

Introduction: Liver cirrhosis (LC) is a pressing socio-economic and clinical-epidemiological problem. The incidence of CP is 20-40 per 100,000 population. Diagnosis is complicated by the late manifestation of clinical symptoms. Regardless of the etiology, the pathogenesis of cirrhosis is characterized by hepatocyte necrosis, hypoxia, fibrogenesis, and impaired architectonics of the liver parenchyma, leading to portal hypertension and systemic complications.

In recent years, multiparametric ultrasound diagnostics, including dopplerography and elastography, has made it possible to assess both structural and functional changes in the liver, allowing for earlier diagnosis and monitoring of disease progression. Ultrasound is widely used as a first-line method in patients suspected of having chronic liver diseases due to its accessibility, safety, and cost-effectiveness.

Goal. Assess the diagnostic significance of multiparametric ultrasound in combination with Doppler assessment of portal and arterial blood flow and liver elastography in patients with cirrhosis.

Materials and methods. The study included 104 patients with various etiologies of liver cirrhosis, examined between 2003 and 2010. 61 patients (58.6%) had morphological confirmation of the diagnosis. The etiology of cirrhosis included alcoholic (39.4%), viral (31.7%), and other forms (biliary, autoimmune, Wilson's disease). The severity of the disease was assessed according to Child-Pugh classification: A stage - 1 patient (20.2%), B stage - 38 patients (36.5%), C stage - 45 patients (43.3%). The control group consisted of 18 healthy volunteers, and the comparison group consisted of 29 patients with diffuse liver diseases.

Ultrasound studies were performed on an Aplio 500 device with a 3.5 MHz convex sensor. In the B-regime, the liver size, contours, echogenicity, parenchyma homogeneity, spleen size, and the presence of ascites were assessed. Dopplerography was used to assess the portal and splenic veins, the hepatic and splenic arteries, and the abdominal trunk. Elastography (SWE) was performed in the right lobe of the liver, avoiding vessels and bile ducts; the average stiffness value was calculated based on 5 measurements.

Statistical analysis: The data is presented as M±m. A comparative analysis was conducted between the groups and stages of cirrhosis. Statistical significance was taken at $p<0.05$.

Results in the B-regime revealed a decrease in liver size and uneven, bumpy contours, hypertrophy of the caudate lobe, increased echogenicity, and splenomegaly, predominantly in stages B and C. Ascites and collateral venous circulation were observed in 40.2% of patients.

Table 1. Portal hemodynamics indicators in liver cirrhosis (according to Child-Pugh)

Indicator	Control	Child-Pugh A	Child-Pugh B	Child-Pugh C
Portal vein diameter, mm	11.2 ± 1.1	13.4 ± 1.3*	15.1 ± 1.6*	14.8 ± 1.5*
LSC of portal vein, cm/s	18.6 ± 2.4	14.9 ± 2.1*	11.3 ± 1.9*	8.7 ± 1.6*
CSR of portal vein, ml/min	980 ± 110	760 ± 95*	540 ± 88*	410 ± 72*
Direction of blood flow	hepatopetal	hepatopetal	hepatopetal	hepatopetal/reversible (2.8%)

Note: *p<0.05.				

Table 2. Liver stiffness indicators according to SWE data and correlation with portal blood flow

Group	Liver hardness, kPa (M ± m)	Correlation with LSC (r)	Correlation with CSR (r)
Control	5.6 ± 0.9	-	-
Diffuse liver disease	6.8 ± 1.2	-0.21	-0.18
Child-Pugh A	9.8 ± 1.6*	-0.42*	-0.39*
Child-Pugh B	15.7 ± 2.4*	-0.56*	-0.52*
Child-Pugh C	23.9 ± 3.8*	-0.62*	-0.58*.
Note: p<0.05.			

Discussion. The results show that changes in portal hemodynamics are a reliable marker of liver cirrhosis progression. The linear and volumetric velocity of portal blood flow significantly decreases with increasing severity of the disease, while arterial indicators remain variable and non-specific. SWE allows for the quantitative assessment of fibrosis in its early stages and the identification of pathology before the appearance of morphological signs of portal hypertension. Comparison with literature data (Petta et al., Şirli et al., Roccarina et al., Villani et al.) confirms the high diagnostic value of integrating SWE and Doppler ultrasound for dynamic observation and prediction of complications. These studies emphasize the importance of a comprehensive approach in assessing liver functional and structural changes.

Conclusion. Multiparametric ultrasound examination in combination with portal blood flow dopplerography is a valuable non-invasive method for diagnosing liver cirrhosis and early detection of portal hypertension. It is recommended to conduct control studies every 6 months to monitor the progression of the disease and timely identify potential life-threatening complications. In addition to standard ultrasound and Doppler imaging, the use of a shear wave elastography (SWE) allows for a quantitative assessment of liver rigidity, identifying early signs of fibrosis and cirrhotic changes. Significant changes in arterial blood flow in the abdominal cavity vessels were not detected in patients with liver cirrhosis. Multiparametric ultrasound diagnostics of the liver, including B-rejim, dopplerography, and SWE, is a highly effective non-invasive method for detecting and monitoring liver cirrhosis. SWE allows for the quantitative assessment of fibrosis, and dopplerography allows for the

assessment of functional hemodynamic changes. Dynamic monitoring of patients with cirrhosis is recommended every 6 months.

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