"Innovations technologies in science and practice"

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MORPHOLOGICAL AND ULTRASONIC CRITERIA FOR EVALUATION OF LIVER FUNCTION IN THE CIRRHOTIC PATIENTS

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Background. Surgical treatment of a cirrhotic patients is connected with high risk of acute – on – chronic liver failure [1-3, 5-8, 10-12]. Hepatic biopsy with morphological examination is a "gold" standard in evaluation of functional liver reserve while such modern noninvasive methods of examination like Doppler ultrasound can also be used to achive this goal [4-10].

The purpose of this study is to define new criteria of functional liver reserve in cirrhotic patients in order to improve results of their surgical treatment.

Methods and results. We included 137 patients with liver cirrhosis, at whom surgical treatment was performed. In 81 (59,12%) cases was performed the distal splenorenal shunt by Warren, in 56 (40,88%) – devascularization surgery. Mophological examinations with morphometry of intraoperative liver biopsies were done by V.Syplyviy method [12]. Doppler ultrasound of portal blood vessels was done at admission by Moriyasu et al. method [13]. The statistical analysis was performed by use of "Microsoft Excel 2000" and "SPSS 10.0 for Windows".

On the basis of the analysis three (A, B, C) types of cirrhosis with statistically significant differences in area of unchanged hepatocytes, volume of dividing hepatocytes, connective tissue area, stroma to parenchyma ratio, volume of hepatocytes in the state of necrosis and/or necrobiosis were determined. At transition of A-type cirrhosis into C-type volume of hepatic parenchyma becomes to be decreased, while volume of connective tissue becomes to be increased. This is accompanied by decrease in area of unchanged hepatocytes, increase in connective tissue area and stroma to parenchyma ratio (table 1).

Table 1.

Morphometrical characteristics of intraoperative liver biopsies in cirrhotic patients

Parameter	A – type	B - type	C - type
Connective tissue area, μm ²	66,73±1,71	126,69±12,5*	240,16±13,4 *, **
Area of unchanged hepatocytes, μm ²	234,13±11,5	205,34±13,8	178,69±18,7*
Stroma to parenchyma ratio	0, 285±0,019	0,617±0,031*	1,344±0,089*, **
Volume of hepatocytes in the state of necrosis and/or necrobiosis, %	11,21±0,74	17,32±0,63*	23,97±0,75*, **
Volume of dividing hepatocytes, %	10,23±0,57	15,43±0,48*	11,07±0,58*, **

Differences are statistically significant :*- in comparison with A-type; **- in comparison with B-type.

Results of Doppler ultrasound were also different for three morphological types of cirrhosis (table 2).

At patients with A-type cirrhosis portal vein and splenic vein diameters, portal congestion index does not increase, linear portal blood velocity and volumic portal blood velocity does not decrease. At B-type cirrhosis portal vein diameter increases in comparison with healthy persons and A-type cirrhotic patients (P<0,001), while splenic vein diameter does not enlarge.

Table 2.

Portal blood circulation indices and state of portal blood vessels in liver cirrhotic patients depending on type of morphological changes

Parameter	A - type	B - type	C - type
Portal vein diameter, cm	1,13 ± 0,014	1,22 ± 0,013*	1,5 ± 0,026*,**
Splenic vein diameter, cm	0,85 ± 0,073	0,88 ± 0,012	1,32 ± 0,035*,**
Linear portal blood velocity, cm/sec	17,35 ± 0,41	14,5 ± 0,86*	10,8 ± 0,48*,**
Volumic portal blood velocity, ml/min	1055,06 ± 34,4	1024,65 ± 61,65	997,57 ± 72,11
Portal congestion index, cmxsec	0,05 ± 0,001	0,08 ± 0,005*	0,14 ± 0,015*,**

Differences are statistically significant :*- in comparison with A-type; **- in comparison with B-type.

Linear portal blood velocity decreases (P<0,02) with simultaneous increase in portal congestion index (P<0,001). Volumic portal blood velocity decreases in comparison with A-type cirrhotic patients, but differences are statistically insignificant. These changes of potal hemodynamics can be explained by increase in connective tissue part in hepatic parenchyma at patients with B-type cirrhosis.

At C-type cirrhotic patients portal vein and splenic vein diameters (P<0,001), portal congestion index (P<0,005) becomes to be increased, linear portal blood velocity becomes to be decreased (P<0,005) in comparison with A-and B-type cirrhotic patients. Volumic portal blood velocity decreases at transition of B-type into C-type cirrhosis patients, but differences are statistically insignificant. Such changes in portal blood vessels and disturbances of portal hemodynamics corresponds to the results of liver morphometry, illustrating most expressive development of connective tissue at C-type cirrhosis.

Analysis of portal Doppler ultrasound results depending on morphological types of cirrhosis revealed that linear portal blood velocity together with portal congestion index are most significant parameters, reflecting character of pathological liver changes. At C-type cirrhotic patients linear portal blood velocity was 1,6 times less both portal congestion index 2,8 times more than at A-type cirrhotic patients.

Analysis of factors which were predisposing for postoperative acute – on-chronic liver failure in cirrhotic patients, revealed, that it occurred in cases, when portal vein and splenic vein diameters with portal congestion index becomes to be increased with simultaneous decrease of linear portal blood velocity (table 3).

Table 3.

Clinical flow of postoperative period depending on indices of portal blood vessels and portal hemodynamics

Index	Patients with postoperative hepatic failure	Patients without postoperative complications
Portal vein diameter, cm	1,22±0,013	1,5±0,026*
Splenic vein diameter, cm	0,88±0,012	1,32±0,035*
Linear portal blood velocity, cm/sec	14,5±0,86	10,8±0,48*
Volumic portal blood velocity, ml/min	1024,65±61,65	997,57±72,11
Portal congestion index, cmxsec	0,08±0,005	0,14±0,015*

*-differences are statistically significant

Acute-on-chronic liver failure occurred at 52,6 % patients with B-type and at 77,8% patients with C-type cirrhosis at portal vein diameter more than 1,5 cm, linear portal blood velocity less than 10,8 cm/sec, portal congestion index more than 0,14 cmxsec.

Conclusion. Morphological changes in liver are intercommunicated with disturbances of portal hemodynamics in cirrhotic patients.

Morphological changes in liver of the cirrhotic patients are different by area of unchanged hepatocytes, volume of dividing hepatocytes, connective tissue area, stroma to parenchyma ratio, volume of hepatocytes in the state of necrosis and/or necrobiosis, that permite to divide morphology of cirrhosis in to three types – types A, B, C.

In transition of cirrhosis from A-type in to C-type, signs of portal hypertension progresses, which is accompanied by increase in diameters of portal and spleenic veins, decrease in linear portal blood velocity, volumic portal blood velocity, increase

in potal congestion index.

Linear portal blood velocity and portal congestion index most exactly reflexes the character of pathological changes in liver.

References

1. Sarin SK, Choudhury A, Sharma MK, et al. Acute-on-chronic liver failure: consensus recommendations of the Asian Pacific Association for the Study of the Liver (APASL): an update. Hepatol Int 2019;13:353-390.
2. Mahmud N, Kaplan DE, Taddei TH, Goldberg DS. Incidence and mortality of acute-on-chronic liver failure using two definitions in patients with compensated cirrhosis. Hepatology 2019;69:2150-2163.
3. Hernaez R, Kramer JR, Liu Y, et al. Prevalence and short-term mortality of acute-on-chronic liver failure: a national cohort study from the USA. J Hepatol 2019;70:639-647.
4. Шерлок Ш., Дули Дж. Заболевания печени и желчных путей: Практическое руководство.: Пер. с англ. /Под ред. З.Г.Апросиной, Н.А.Мухина.- Москва: Гэотар Медицина, 1999.-864с.
5. Gustot T, Fernandez J, García E, et al. Clinical Course of acute-on-chronic liver failure syndrome and effects on prognosis. Hepatology 2015;62:243-252.
6. O'Leary JG, Reddy KR, Garcia-Tsao G, et al. NACSELD acute-on-chronic liver failure (NACSELD-ACLF) score predicts 30-day survival in hospitalized patients with cirrhosis. Hepatology 2018;67:2367-2374.
7. Sarin SK, Kedarisetty CK, Abbas Z, et al. Acute-on-chronic liver failure: consensus recommendations of the Asian Pacific Association for the Study of the Liver (APASL) 2014. Hepatol Int 2014;8:453-471.
8. Amarapurkar D, Dharod MV, Chandnani M, et al. Acute-on-chronic liver failure: a prospective study to determine the clinical profile, outcome, and factors predicting mortality. Indian J Gastroenterol 2015;34:216-224.
9. Thuluvath PJ, Thuluvath AJ, Hanish S, Savva Y. Liver transplantation in patients with multiple organ failures: feasibility and outcomes. J Hepatol 2018;69:1047-1056.
10. Sundaram V, Jalan R, Wu T, et al. Factors associated with survival of patients with severe acute-on-chronic liver failure before and after liver transplantation. Gastroenterology 2019;156(5):1381-1391.e3.
11. Artru F, Louvet A, Ruiz I, et al. Liver transplantation in the most severely ill cirrhotic patients: a multicenter study in acute-on-chronic liver failure grade 3. J Hepatol 2017;67:708-715.
12. Дистальний спленоренальный венозный шунт: клинические и патофизиологические последствия, прогнозирование исходов операции / Сипливий В.А., Береснев А.В.- Харьков: ХНАДУ, 2007.-152 с.
13. Moriyasu F., Nishida O., Ban N., Nakamura T, Miura K., Sakai M., Miyake L. Uchino H. Measurement of portal vascular resistance in patients with portal hypertension // Gastroenterology.- 1986.- Vol. 90, №3.- P.710-717.