

## A NEW COMPLEX APPROACH FOR EVALUATION OF LIVER FUNCTION IN THE CIRRHOTIC PATIENTS

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**Abstract.** *The morphological and Doppler ultrasound investigations in 137 patients with liver cirrhosis were done. Three types of morphological signs of liver cirrhosis were discharged. Ultrasound characteristics of general hepatic blood circulation, state of blood vessels and portal hemodynamics for each morphological type of cirrhosis were identified.*

**Keywords:** *liver cirrhosis, morphometry, portal hemodynamics.*

**Background.** Surgical treatment of a cirrhotic patients is connected with high risk of postoperative hepatic 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 achieve 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. Morphological 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, $\mu\text{m}^2$                              | 66,73±1,71  | 126,69±12,5* | 240,16±13,4 *, ** |
| Area of unchanged hepatocytes, $\mu\text{m}^2$                       | 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              | $1,13 \pm 0,014$   | $1,22 \pm 0,013^*$  | $1,5 \pm 0,026^{*,**}$  |
| Splenic vein diameter, cm             | $0,85 \pm 0,073$   | $0,88 \pm 0,012$    | $1,32 \pm 0,035^{*,**}$ |
| Linear portal blood velocity, cm/sec  | $17,35 \pm 0,41$   | $14,5 \pm 0,86^*$   | $10,8 \pm 0,48^{*,**}$  |
| Volumic portal blood velocity, ml/min | $1055,06 \pm 34,4$ | $1024,65 \pm 61,65$ | $997,57 \pm 72,11$      |
| Portal congestion index, cmxsec       | $0,05 \pm 0,001$   | $0,08 \pm 0,005^*$  | $0,14 \pm 0,015^{*,**}$ |

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 portal 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 hepatic 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. Hepatic 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 and differs by 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, 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 splenic

veins, decrease in linear portal blood velocity, volumic portal blood velocity, increase in portal congestion index.

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

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