Fedulenkova Yu.Ya.[1,2], Vikman Ya.E.[1,2]

POSSIBILITIES OF DOPPLER ULTRASONOGRAPHY IN VALUING OF MORFOFUNCTIONAL CONDITION OF LIVER FOR PATIENTS WITH VIRAL HEPATITIS AND HEPATOCIRRHOSIS

[1]Kharkov National Medical University, Ukraine

[2]LTD Medical Diagnostic Center «Expert-Kharkov», Ukraine

Abstract. Objective: *To study possibilities of dopplerography in the estimation of progress and gravity of chronic viral hepatitis and cirrhosis of liver, and also to define possibilities of dopplerography in the estimation of degree of expression of inflammatory process in a liver from data of ultrasonography.*

Materials and methods: *50 patients were inspected with the chronic diffuse diseases of liver (34 patients with chronic viral hepatitis and 16 patients with a hepatocirrhosis), and also 15 patients of group of control. The following Doppler indexes were measured: hepatic artery resistive index, hepatic artery pulsativity index, portal vein velocity, modified hepatic index , hepatic vascular index and diameters of hepatic and splenic veins, sizes of spleen, velocity of blood flow in a portal vein, velocity of volume blood flow in a portal vein. These indexes were compared between 3 groups on the degree of inflammation.*

Results: *velocity of blood flow in portal vein, hepatic vascular index and modified hepatic index were the most informative for differential diagnostics of cirrhosis and hepatitis.*

Conclusions: *Doppler ultrasonography is a highly sensitive method for diagnostics of changes of parameters of blood flow at an inflammatory process and fibrosis of liver.*

Key words: *chronic hepatitis, hepatocirrhosis, portal vein, hepatic artery.*

Chronic viral hepatitis (CVH) is one of the most widespread diseases in the world and is the predictor of such dangerous pathological states such as cirrhosis and hepatocellular carcinoma. A hepatocirrhosis is very dangerous from such

complications as ascites, portal hypertension, bleeding from varicose extended veins of esophagus [1, 2].

Any chronic process in a liver is accompanied by activating of fibrogenesis that results in violation of structure of conjunctive tissue framework of liver, the degree of which determines functional inability of subsequent processes of regeneration. [3]. Exactly rates of fibrogenesis and determine speed of progress of chronic diffuse diseases of liver and forming them in cirrhosis.

Growth of actuality of problem of fibrosis of liver in the last years is linked with data about convertibility of cirrhotic changes in a liver and researches of efficiency of different variants of therapy, that would allow promoting efficiency of treatment and improving the prognosis of patients with CDDL [4,5] Forming of fibrosis of liver is not a linear, slowly progressing process [6, 7], and influence of a few damaging factors considerably accelerates it [8]. Determination of the stage of fibrosis of liver and possibility of estimation of rates of its progress is extraordinarily important, as it will allow forecasting efficiency of antiviral therapy and developing strategy of management of patient with CDDL in every case.

Presently ultrasonography remains the most often used radiologic method of research due to the availability. Without regard to that for such patients changes in the parenchyma of liver, such as steatosis and periportal fibrosis in most cases can be revealed. At the use of only the two-dimensional mode sonographic data will be within the limits of norm [8,9]. Many authors proved that an inspection of patients with the diffuse damages of liver with a help only of the two dimensional mode is poor informative, especially on the early stages, and the revealed changes of parenchyma of liver are not specific [9, 10]. Therefore until now opened is a question of the use of the various Doppler methods with the calculation of indexes and measuring of velocities of blood flow in vessels [10]. Variability of histological picture at CDDL: unevenly located foci of inflammation, regeneration and normal parenchyma of liver can create complications at a biopsy on the early stages of disease (false-negative results), and because this method is an invasion and not always well carried by patients, and also dangerous is appearance of complications,

actual is a problem of non-invasive diagnostics of this state, especially on the early stages.

Materials and methods

We investigated 50 patients (37 men and 13 women in age from 18 to 70 years) with CDDL, and also 15 patients of control group which did not have diseases of GIT, and passed sonographic investigation on other reasons. The diagnosis of CVH was established serologically on 34 patients. Serologic investigations showed that in 16 patients hepatitis C was found out, hepatitis B was in 12 patients, both hepatitis B and C – in 6 patients. In 16 patients hepatocirrhosis was diagnosed.

The degree of activity of inflammatory process for patients was estimated on the level of aminotransferases (AST,ALT) - minimum activity was characterized by the increase of level of AST and ALT up to 1,5-2 norms, low – up to 3-5 norms, moderate – up to 9 norms, high – higher than 9 norms. Sonographic investigations were performed to the patients in the morning on an empty stomach. All studies were performed on a sonography system (Xario SSA 660, Toshiba Medical Systems) by a single experienced sonologist. The sizes of liver and spleen, diameters of portal and splenic veins, degree of steatosis, velocity of blood flow in portal vein (PVV) were measured. Volume velocity of blood flow in portal vein (VVPV) was calculated by multiplying of peak linear velocity of portal blood flow on square of cross-sectional area of portal vein. Hepatic artery resistive index (HARI), hepatic artery pulsativity index (HAPI), modified hepatic index (MHI) - PVV/HARI, hepatic vascular index (HVI) – PVV/HAPI were calculated.

The degree of steatosis was determined as follows: **soft**, insignificant increase of echogenicity of liver, when the walls of intrahepatic vessels and diaphragm are well visualized; **moderate** - moderate increasing of echogenicity of liver, when the walls of intrahepatic vessels and diaphragm are badly visualized; **expressed,** when it is impossible to see a diaphragm and walls of intrahepatic vessels due to the considerable increasing of liver echogenicity.

Results and discussion

Changes in a hepatic hemodynamics at CDDL are lighted up in many works, but information is a contradictory. Estimation of changes of hepatic blood flow only on the basis of change of portal blood flow velocity not always gives the possibility adequately estimate pathological processes, especially on the early stages, that is why for more objective estimation we decided to investigate the new indexes of changes of hepatic blood flow, such as modified hepatic index (MHI), hepatic artery resistive index (HARI), hepatic artery pulsativity index (HAPI), modified hepatic index(MHI), hepatic vascular index (HVI), and also diameters of hepatic and splenic veins, sizes of spleen, velocity of blood flow and volume blood flow in portal vein. In domestic works there is not the systematized information in relation to application of these indexes in practice. In this research we tried to define importance of Doppler ultrasonography in diagnostics and dynamic monitoring of patients with CDDL and role of the above-mentioned Doppler parameters for diagnostics and dynamic management of this group of patients, and also to compare findings with the changes of biochemical indexes (AST, ALT) which represent expression of syndrome of cytolysis and cholestasis, and also allow to estimate the degree of activity of inflammatory process in liver.

All patients were divided into 3 groups: 1 group (34 patients) with CVH, 2 group (16 patients) with cirrhosis and 3 group (15 patients) – control group.

HARI, HAPI, MHI, and HVI in all groups are presented in the table 1. In the group of cirrhosis the mean values of HARI and HAPI were considerably higher, than in the group of hepatitis and control group, those indexes in the group of hepatitis were considerably higher, than in the group of control. MHI and HVI in the group of hepatitis were considerably less than in the group of control, and in the group of cirrhosis these values were less than in the group of hepatitis and control group ($R<0,001$).

Statistical discrepancies in the group of cirrhosis and other two groups are presented in the table 2.

Table 1.

Values of HARI, HAPI, MHI, HVI in all groups

Values in the group	HARI	HAPI	MHI cm/s	HVI cm/s
Control (n=15)				
Minimal	0,66	0,81	30,2	20,2
Maximal	0,76	1,39	57,3	39,1
Medium	0,71 ±0,05	1,1 ±0,1	43,8 ±7,2	28 ±5,5
CVH (n=34)				
Minimal	0,62	0,98	17,59	7,5
Maximal	0,91	3,13	47,8	26,2
Medium	0,76 ±0,01	2,06 ±0,5	32,5 ±0,9	16,9 ±0,01
Cirrhosis (n=16)				
Minimal	0,62	1,11	10,3	4,08
Maximal	0,99	3,12	42,52	20,19
Medium	0,8 ±0,03	2,1 ±0,3	26,4 ±7,3	11,5 ±4

Diameters of portal and splenic veins in patients with cirrhosis were considerably higher than in the group of hepatitis and control group. The mean value of PVPV in the group of cirrhosis was considerably less than in the group of control and group of hepatitis (P <0,001). There was not a meaningful difference of this index between the group of hepatitis and control group. Velocity of volume blood flow in portal vein did not differentiate in all three groups. (P > 0,05).

Patients from the group of CVH depending on the level of activity of transaminasis were divided on 3 sub-groups: 1 sub-group (12 patients) – increasing of indexes up to 3-5 norms, 2 sub-group (13 patients) – up to 5-9 norms, 3 sub-group (9 patients) – more than 9 norms.

The values of the Doppler indexes depending on activity of inflammatory process in liver are indicated in the table 3.

HARI and HAPI in 2 groups were considerably higher, than in a group 1, and HARI in group 3, more than in group 1. MHI in group 1 was more than in group 3.

There were not found meaningful distinctions between PPVV and HVI in all three sub-groups.

Table 2.

Values of PPVV, diameters of portal and splenic veins, sizes of spleen in all groups as compared to the group of cirrhosis

Values in the group	PPVV, cm/s	Diameter of portal vein, mm	Diameter of splenic vein, mm	Length of spleen, mm
Control (n=15)				
Minimum	18	6,5	5	80
Maximal	35	12	9	128
Medium	26,5±4,5	9,3 ±1,3	7 ±1	104±12
CVH (n=34)				
Minimum	11	7,5	5	82
Maximal	29	14	11	149
Medium	20±4	10,8 ±1,2	8 ±1,5	115,5±11
Cirrhosis (n=16)				
Minimum	6	9	6	112
Maximal	25	18	21	245
Medium	15,5 ±3,5	13,5 ±2	13,5 ±3	178,5 ±34

The results of group of cirrhosis were compared separately to each of groups.

*P <0,001

Conclusions.

1. Pathological changes of hepatic hemodynamics at viral hepatitis and cirrhosis of liver depending on the degree of inflammation it is possible to estimate with the help of Doppler ultrasonography.

2. The most informative for determination of activity of inflammatory process in liver are hepatic artery resistive index and hepatic artery pulsativity index. Hepatic vascular index, velocity of blood flow in portal vein and modified hepatic index are informative at differential diagnostics of cirrhosis and hepatitis.

3. Doppler ultrasonography is highly sensitive method for diagnostics of changes of parameters of blood flow at inflammatory process and fibrosis of liver. Two-dimensional sonography does not allow estimating progress of chronic hepatitis and gravity of liver cirrhosis without the use of dopplerography.

Table 3.

Values of HARI, HAPI, MHI, HVI, PPVV depending on activity of inflammatory process in liver.

	Level of transaminasis		
Index	1 Low 3-5 norms (n=12)	2 Medium 5-9 norms (n=13)	3 High more than 9 norms(n=9)
HARI *Minimal* *Maximal* *Medium*	 0,71 0,79 0,75 ±0,02	 0,7 0,98 0,84 ±0,06	 0,55 0,82 0,68 ±0,05
HAPI *Minimal* *Maximal* *Medium*	 0,98 1,22 1,1 ±0,08	 1,1 1,98 1,54 ±0,5	 1,03 1,86 1,44 ±0,2
MHI *Minimal* *Maximal* *Medium*	 32 39 35,5 ±2,5	 22 38,5 30,25 ±3	 19 49 34 ±7,4
HVI *Minimal* *Maximal* *Medium*	 19 28 23,5 ±2	 8 22 15 ±3	 6 23 14,5 ±4
PPVV *Minimal* *Maximal* *Medium*	 19 27 23 ±2	 16 30 23 ±3	 10 34 22 ±5,5

References.

1. Kumar V, Abbas AK, Fausto N et-al. Robbins and Cotran pathologic basis of disease. W B Saunders Co., 2005.-592 p.

2. Bluth EI. Ultrasound, a practical approach to clinical problems. Thieme Publishing Group, 2008. – 376 p.

3. McGahan JP, Goldberg BB. Diagnostic ultrasound. Informa Health Care, 2008. - 145 p.

4. Brant WE, Helms CA. Fundamentals of diagnostic radiology. Lippincott Williams & Wilkins, 2007. – 223 p.

5. Jha P, Poder L, Wang ZJ et-al. Radiologic mimics of cirrhosis. AJR Am J Roentgenol. 2010;194 (4): 993-9.

6. Nadeem M, Yousaf MA, Zakaria M.The value of clinical signs in diagnosis of cirrhosis. Pak J Med Sci 2005; 21:121-4.

7. Vigano M, Visentin S, Aghemo A, Rumi MG, Ronchi G, Colli A, et al.US features of liver surface nodularity as a predictor of severe fibrosis in chronic hepatitis C. Radiology 2005;234: 641.

8. Castellares C, Barreiro P, Martín-Carbonero L, et al. Liver cirrhosis in HIV-infected patients: prevalence, aetiology and clinical outcome. J Viral Hepat. 2008 Mar;15(3):165-72.

9. Martinez SM, Crespo G, Navasa M, Forns X. Noninvasive assessment of liver fibrosis. Hepatology 2011;53:325-35.

10. Gordon A. Hepatic steatosis in chronic hepatitis B and C: Predictors, distribution and effect on fibrosis / A. Gordon, C. A. McLean // Journal of Hepatology. - 2005. - Vol. 43. - Issue 1. - P. 38 - 44.

Received: 14.04.2014 *Accepted: 19.05.2014*