ISSN: 2755-1067

Journal of Diseases Disorders & Treatments

SCIENTIFIC Research and Community

Research Article

Open Access

Duplex Ultrasound in the Diagnosis of Liver Tumors

Abdullaiev RY[1], Kulikova FI[2], Kutsyak TL[2], Stus VV[3], Rusan LV[3], Gorodetsky SG[3], Rebyakova AI[3], Spirina EV[3]

[1]Kharkiv Medical Academy of Postgraduate Education, Kharkiv, Ukraine

[2]Dneprovsk State Medical University, Dnipro, Ukraine

[3]Dnepropetrovsk regional clinical Hospital named after I.I. Mechnikov, Dnipro, Ukraine

ABSTRACT

Objective: To investigate the diagnostic value of duplex ultrasound in the diagnosis of liver tumors.

Method: The present study included 152 cases of liver tumors; there were 87 malignant and 65 benign tumors. Visualization of liver tumors was carried out of duplex ultrasound using a convex transducer in the frequency range of 2-5 MHz on Philips HD-11. The p-value <0.05 was regarded as having a significant difference.

Results: The hepatocellular carcinoma was diagnosed in 29 cases, the cholangiocellular carcinoma – in 21 cases, the metastatic liver cancer – in 37 cases, the capillary hemangioma – in 39 cases and the cavernous hemangioma – in 26 cases, respectively. In 115 cases (P<0,001), liver tumors were localized in the right lobe, in 37 cases – in the left lobe. In 59 cases, the tumor morphology was regularly, in 93 cases – irregularly. In 74 cases, the tumor boundary edge was clearly, in 78 cases – unclearly. Acoustic halo at the edge of the tumors was observed in 27 cases, of which HCC in 19 (65.5 ± 8.8%) cases (P<0,001). Isoechoic lesions were registered in 19 cases of liver tumors, of which in 11 (52.4±10, 9%) cases of cholangicarcinoma – significantly (P<0.001) higher than the rest.

Conclusions: Duplex ultrasound allows you to identify the malignant and benign liver tumors. The most significant ultrasonographic signs of malignancy of the formation are fuzzy contours, heterogeneous internal structure, hypoechogenicity and increased vascularization of the pathological formation.

***Corresponding author**

Abdullaiev RY, Kharkiv Medical Academy of Postgraduate Education, Kharkiv, Ukraine. Email: rizvanabdullaiev@gmail.com

Received: December 12, 2022; **Accepted:** December 19, 2022; **Published:** December 26, 2022

Keywords: Duplex Ultrasound, Liver Tumors, Hepatocellular Carcinoma, Cholangiocellular Carcinoma, Metastatic Liver Tumors, Capillary Hemangioma, Cavernous Hemangioma

Introduction

Among the tumors of the digestive system in terms of prevalence, the leading place is occupied by neoplasms of the liver, which are benign and malignant [1]. If among benign liver tumors, hemangioma occupies the first place, then among malignant ones - hepatocellular carcinoma. The incidence of liver cancer ranks sixth among oncological diseases in the worldwide, and third in mortality rate, after lung cancer and gastric cancer [2]. In the United States, hepatocellular carcinoma is the ninth leading cause of cancer death [3]. Hepatocellular carcinoma occurs more frequently in men than in women (2.4:1), with a higher incidence in East and South Asia, Central and West Africa, and China [4]. Among those who die from hepatocellular carcinoma, about 45% are Chinese [5]. Chronic viral hepatitis B and C, which lead to liver cirrhosis, remain the most important risk factors for the development of hepatocellular hepatoma [6]. Early differential diagnosis of the benign and malignant nature of the liver tumor is important for choosing the tactics of treating patients [7]. Concomitant liver dysfunction at a later stage of the tumor further complicates therapeutic therapy. Because most patients with hepatocellular carcinoma have a history of chronic disease and cirrhosis, early detection of the tumor can minimize irreversible liver damage and preserve liver function. Diagnosis of hepatocellular carcinoma at small sizes and at early stages of development has an important prognostic value for patients [8].

Ultrasonography is most commonly used worldwide for real-time imaging of hepatic neoplasms. Ultrasound diagnosis of hepatocellular carcinoma in two-dimensional mode is based on determining the shape, boundaries, contours, and the degree of heterogeneity of the internal structure of the tumor. USG characteristics of the internal structure of hepatocellular carcinoma can be varied (hyperechoic pattern 12–38%, hypoechoic pattern 23–54%, heterogeneity 17–38%) depending on the size of the tumor [9]. In addition, macroscopic configuration is important for predicting recurrence and prognosis in patients with hepatocellular carcinoma. There are the following macroscopic types of hepatocellular carcinoma: small nodular type with indistinct edges, simple nodular type, simple nodular type with extra nodular growth, confluent multinodular type and infiltrative type [10].

Color Doppler makes it possible to visualize tumor vessels and determine the direction of blood flow. In most cases of hepatocellular carcinoma less than 2 cm in size, the blood flow is weak, and as the size of the tumor increases, the volume of blood flow in it increases, and with moderately differentiated hepatocellular carcinoma, which has a capsule and expansive growth, a mesh image of the vessels is observed [11].

The use of contrast agents in USG allows visualization of small vessels, thereby diagnosing tumors up to 2 cm in size. The study of the structure of hepatocellular carcinoma in USG with contrast enhancement led to a noticeable improvement in image quality. Details regarding the vascularization of hepatocellular carcinoma are important because the blood supply and the grade of hepatocellular carcinoma are closely related. A strong correlation was found between intranodal arterial and portal nutrition assessed by CT and the degree of malignancy of hepatocellular nodules. Detection of hyper vascularization by Doppler sonography is more sensitive than contrast-enhanced CT findings [12-14].

Objective

determine the most significant ultrasonographic features of liver tumors using two-dimensional and color Doppler modes.

Materials and Methods

The results of ultrasonography (USG) of 152 (89 men and 63 women) patients with liver tumors aged 35 to 78 years (average 41.7±8.1 years) were analyzed. Among all the patients, 59 (38,8%) was asymptomatic, 93 (61.2%) patients had clinical symptoms, 83 (54,6%) patients had a medical history of hepatitis, 36 (23,7%) patients had a liver cirrhosis. The clinical characteristics of all of the patients with liver tumors are shown in Table 1.

Ultrasound examination was performed on Philips HD-11 devices according to the generally accepted technique with visualization of all segments of the liver.

Student's t-test was used to assess differences in quantitative indicators between groups. Differences were considered significant at $P < 0.05$.

Table 1: Characteristics of Patients

Characteristics	Values
Male/Female	89/63
Age range (yrs)	35–78
Average age (yrs)	41.7±8.1
Asymptomatic, n (%)	59 (38.8%)
Symptomatic, n (%)	93 (61.2%)
History of hepatitis, n (%)	83 (54.6%)
Liver cirrhosis, n (%)	36 (23.7%)

Results

According to the results of histological examination (biopsy or surgery) among the 152 liver tumors, there were 65 benign tumors and 87 malignant tumors. The benign tumors were including 39 cases of capillary hemangioma (CapH), 26 cases of cavernous hemangioma (CavH). The malignant tumors were including 28 cases of hepatocellular carcinoma (HCC), 21 cases of intrahepatic cholangiocellular carcinoma (IHChCC), and 38 cases of metastatic liver cancer (MLC). The tumors size ranged from 15.3 mm to 98.16 mm, and the average size was 43.2±12.5 mm. The characteristics of all liver tumors are shown in Table 2.

Table 2: Characteristics of liver tumors

Characteristics	Values
Capillary hemangioma, n (%)	39 (25,7%)
Cavernous hemangioma, n (%)	26 (17,1%)
Hepatocellular carcinoma, n (%)	28 (18,4%)
Intrahepatic cholangiocellular carcinoma, n (%)	21 (13,8%)
Metastatic liver cancer, n (%)	38 (25,0)
Lesion size range (mm)	15,3–98,6
Average lesion size (mm)	43,2±12,5

When assessing the ultrasound symptoms of liver tumors, we took into account: the form of tumors, its localization in the segments and in relation to the liver capsule, echogenicity, echo structure, the presence of a hypo- or hyperechoic rim, and vascularization by color or power Doppler modes. The echogenicity of the tumor depended on the cellular structure, the presence or absence of necrosis, fibrosis, fatty degeneration, and the intensity of blood supply.

The number, predominant localization and sizes of liver tumors are presented in Table 3. As can be seen from the table, in 115 cases, liver tumors were localized in the right lobe - of which hepatocellular carcinoma (HCC) in 25 (86.2 ± 6.4%) cases, cholangiocellular carcinoma (ChCC) - in 18 (85.7 ± 7, 6%) of cases, metastatic liver cancer (MLC) - in 29 (78.4±6.8%) cases, capillary hemangioma (CapH) - in 23 (59.0±7.9%) cases, cavernous hemangioma (CavH) - in 21 (80.8±5.3%) cases, respectively. In 37 cases, liver tumors were localized in the left lobe - of which HCC in 4 (13.8 ± 6.4%) cases, ChCC - in 3 (14.3 ± 7, 6%) of cases, MLC - in 8 (21.6±6.8%) cases, CapH - in 16 (41.0±7.9%) cases, CavH - in 5 (19.2±5.3%) cases, respectively. Except for capillary hemangioma, all liver tumors in the right lobe were localized significantly ($P<0.001$) more often than in the left lobe. In addition, the frequency of localization of HCC, ChCC and CavH in the right lobe was significantly ($P<0.01$, $P<0.05$ and $P<0.05$) higher than CapH.

Table 3: Ultrasonic Characteristics of Liver Tumors: Location, Sizes

Ultrasonic characteristics of liver tumors.	HCC	ChCC	MLC	CapH	CavH
	n=29	n=21	n=37	n=39	n=26
	1	2	3	4	5
Location in the right liver, n=115	25 (86,2±6,4%) P1-4<0,01 P<0,001	18 (85,7±7,6%) P2-4<0,05 P<0,001	29 (78,4±6,8%) - P<0,001	23 (59,0±7,9%) - -	21 (80,8±5,3%) P5-4<0,05 P<0,001
Location in the left liver, n=37	4 (13,8±6,4%)	3 (14,3±7,6%)	8 (21,6±6,8%)	16 (41,0±7,9%)	5 (19,2±5,3%)
Single node, n=97	23 (79,3±7,5%) P<0,001	19 (90,5±6,4%) P<0,001	12 (32,4±7,6%)	24 (61,5±7,8%) P<0,05	19 (73,1±8,7%) P<0,001
Multiple node, n=55	6 (20,7±7,5%)	2 (9,5±6,4%)	25 (67,6±7,6%) P3-1<0,001 P3-2<0,001 P3-4<0,01 P3-5<0,001	15 (38,5±7,8%)	7 (26,9±8,7%)
Tumor sizes < 20 mm, n=32	-	-	9 (24,3±6,8%)	23 (59,0±7,9%) P 4-3<0,01	-
Tumor sizes 21-40 mm, n=43	3 (10,3±5,6%)	2 (9,5±6,4%)	19 (51,4±8,2%) P3-1<0,001 P3-2<0,001 P3-5<0,05	12 (30,8±7,4%)	7 (26,9±8,7%)
Tumor sizes 41-80 mm, n=58	15 (51,7±9,3%) P 1-3<0,01 P 1-4<0,001	16 (76,2±9,3%) P 2-3<0,001 P 2-4<0,001	7 (18,9±6,4%)	4 (10,3±4,9%)	16 (61,6±9,5%) P 5-4<0,001 P 5-3<0,001
Tumor sizes > 80 mm, n=19	11 (37,9±9,0%) P1-2<0,05 P1-5<0,05	3 (14,3±7,6%)	2 (5,4±3,7%)	-	3 (11,5±6,3%)

HCC – Hepatocellular Carcinoma; ChCC – Cholangiocellular Carcinoma; MLC – Metastatic Liver Cancer; CapH – Capillary Hemangioma; CavH – Cavernous Hemangioma.

In 97 cases, liver tumors were represented by single nodules, of which HCC in 23 (79.3 ± 7.5%) cases, ChCC - in 19 (90.5 ± 6,4%) of cases, MLC - in 12 (32.4±7.6%) cases, CapH - in 24 (61.5±7.8%) cases, CavH - in 19 (73.1±8.7%) cases, respectively. In 55 cases, liver tumors were represented by single nodules, of which HCC in 6 (20.7 ± 7.5%) cases, ChCC - in 2 (9.5 ± 6,4%) of cases, MLC - in 25 (67.6±7.6%) cases, CapH - in 15 (38.5±7.8%) cases, CavH - in 7 (26.9±8.7%) cases, respectively. Metastatic liver tumors in the form of multiple nodes were significantly more common (P<0.001) than the rest.

The sizes of liver tumors were classified by us as less than 20 mm, from 21 mm to 40 mm, from 41 mm to 80 mm and more than 80 mm. The sizes less than 20 mm were registered in 32 cases, of which MLC - in 9 (24.3±6.8%) cases, CapH - in 23 (59.0±7.9%) cases (P<0,01). The sizes 21-40 mm were registered in 43 cases, of which HCC in 3 (10.3 ± 5.6%) cases, ChCC - in 2 (9.5 ± 6,4%) of cases, MLC - in 19 (51.4±8.2%) cases, CapH - in 12 (30.8±7.4%) cases, CavH - in 7 (26.9±8.7%) cases, respectively. Metastatic liver tumors of this sizes were significantly more common (P<0.001 and P<0,05) than the rest.

The sizes 41-80 mm were registered in 58 cases, of which HCC in 15 (51.7 ± 9.3%) cases, ChCC - in 16 (76.2 ± 9,3%) of cases, MLC - in 7 (18.9±6.4%) cases, CapH - in 4 (10.3±4.9%) cases, CavH - in 16 (61.6±9.5%) cases, respectively. HCC, ChCC and CavH of this sizes were significantly more common (P<0.001) than MLC and CapH.

The sizes more than 80 mm were registered in 19 cases, of which HCC in 11 (37.9 ± 9.0%) cases, ChCC - in 3 (14.3 ± 7,6%) of cases, MLC - in 2 (5.4±3.7%) cases, CavH - in 3 (11.5±6.3%) cases, respectively. This sizes of HCC were significantly more common (P<0.05) than ChCC, MLC and CaVH.

Ultrasonic characteristics of liver tumors structures are presented in Table 4. As can be seen from the table, in 59 cases, liver tumors had regular morphology structures - of which HCC in 3 (10.3 ± 5.6%) cases, ChCC - in 2 (9.5 ± 6,4%) of cases, MLC - in 11 (29.7±7.5%) cases, CapH - in 35 (89.7±5.6%) cases, CavH - in 8 (30.8±9.1%) cases, respectively. The frequency of regular morphology structures in CapH was significantly (P<0.001) higher than the rest.

In 93 cases, liver tumors had irregular morphology structures - of which HCC in 26 (89.7 ± 5.6%) cases, ChCC - in 19 (90.5 ± 6,4%) of cases, MLC - in 26 (70.3±7.5%) cases, CapH - in 4 (10.3±5.6%) cases, CavH - in 16 (69.2±9.1%) cases, respectively.

Clear boundary of liver tumors was registered in 74 cases - of which HCC in 8 (27.6 ± 8.3%) cases, ChCC - in 1 (4.8 ± 4,7%) of cases, MLC - in 18 (48.6±8.2%) cases, CapH - in 36 (92.3±3.5%) cases, CavH - in 11 (42.3±9.7%) cases, respectively.

Unclear boundary of liver tumors was registered in 78 cases - of which HCC in 21 (72.3 ± 8.3%) cases, ChCC - in 20 (95.2 ± 4,7%) of cases, MLC - in 19 (51.4±8.2%) cases, CapH - in 3 (7.7±3.5%) cases, CavH - in 15 (57.7±9.7%) cases, respectively.

The frequency of clear boundary of CapH was significantly (P<0.001) higher than the rest. The frequency of unclear boundary of ChCC was significantly highest, than the MLC, CapH and CavH.

Acoustic halo at the edge of the tumors was registered in 27 cases – of which HCC in 19 (65.5 ± 8.8%) cases, ChCC - in 3 (14.3 ± 7,6%) of cases, MLC - in 4 (10.8±5.1%) cases, CavH - in 1 (3.8±3.7%) cases, respectively. The frequency of acoustic halo at the edge of HCC was significantly (P<0.001) higher than the rest.

With respect to internal echo there were hypoechoic, isoechoic, hyperechoic, and mixed echoic, respectively. Hypoechoic lesions were registered in 15 (51.7 ± 9.3%) cases of HCC, in 6 (28.6 ± 9,9%) cases of ChCC, in 18 (48.6±8.2%) and in 9 (34.6±9.3%) cases of CavH, without statistically significant differences between them.

Isoechoic lesions were registered in 1 (3.4 ± 3.4%) case of HCC, in 11 (52.4 ± 10,9%) cases of ChCC, in 4 (10.8±5.1%) cases of MLC, in 1 (2.6±2.5%) case of CapH and in 2 (7.7±5.2%) cases of CavH. The frequency of isoechoic lesions in ChC was significantly (P<0.001) higher than the rest.

Table 4: Ultrasonic Characteristics of Liver Tumors Structures

Ultrasonic characteristics of liver tumors.	**HCC**	**ChCC**	**MLC**	**CapH**	**CavH**
	n=29	**n=21**	**n=37**	**n=39**	**n=26**
	1	**2**	**3**	**4**	**5**
Regular morphology, n=59	3 (10,3±5,6%)	2 (9,5±6,4%)	11 (29,7±7,5%)	35 (89,7±5,6%) P<0,001	8 (30,8±9,1%)
Irregular morphology, n=93	26 (89,7±5,6%) P<0,001	19 (90,5±6,4%) P<0,001	26 (70,3±7,5%) P<0,001	4 (10,3±5,6%) -	18 (69,2±9,1%) P<0,01
Clear boundary, n=74	8 (27,6±8,3%)	1 (4,8±4,7%)	18 (48,6±8,2%)	36 (92,3±3,5%) P<0,001	11 (42,3±9,7%)
Unclear boundary, n=78	21 (72,4±8,3%) P<0,001	20 (95,2±4,7%) P<0,001	19 (51,4±8,2%) -	3 (7,7±3,5%)	15 (57,7±9,7%)
Acoustic halo at the edge of the tumors, n=27	19 (65,5±8,8%) P 1-2<0,001 P 1-3<0,001 P 1-5<0,001	3 (14,3±7,6%)	4 (10,8±5,1%)	-	1 (3,8±3,7%)
Hypoechoic, n=48	15 (51,7±9,3%)	6 (28,6±9,9%)	18 (48,6±8,2%)	-	9 (34,6±9,3%)
Isoechoic, n=19	1 (3,4±3,4%)	11 (52,4±10,9%) P2-3<0,001 P2-1<0,001 P2-4<0,001 P2-5<0,001	4 (10,8±5,1%)	1 (2,6±2,5%)	2 (7,7±5,2%)
Hyperechoic, n=62	4 (13,8±6,4%)	1 (4,8±4,7%)	12 (32,4±7,7%)	38 (97,4±2,5%) P4-1<0,001 P4-2<0,001 P4-3<0,001 P4-5<0,001	7 (26,9±8,7%)
Mixed echoic, n=23	9 (31,1±8,6%) P2-3<0,05	3 (14,3±7,6%)	3 (8,1±4,5%)	-	8 (30,8±9,1%) P5-3<0,05

HCC – Hepatocellular Carcinoma; ChCC – Cholangiocellular Carcinoma; MLC – Metastatic Liver Cancer; CapH – Capillary Hemangioma; CavH – Cavernous Hemangioma.

Hyperechoic lesions were registered in 4 (13.8 ± 6.4%) cases of HCC, in 1 (4.8 ± 4,7%) case of ChCC, in 12 (32.4±7.7%) cases of MLC, in 38 (97.4 ± 2.5%) cases of CapH and in 7 (26.9±8.7%) cases of CavH. The frequency of hyperechoic lesions in CapH was significantly (P<0.001) higher than the rest.

Mixed echoic lesions were registered in 9 (31.1 ± 8.6%) cases of HCC, in 3 (14.3 ± 7,6%) cases of ChCC, in 3 (8.1±4.5%) cases of MLC and in 8 (30.8±9.1%) cases of CavH. The frequency of mixed echoic lesions in HCC and CavH was significantly (P<0.05) higher than in ChC and MLC (Figs. 1-4).

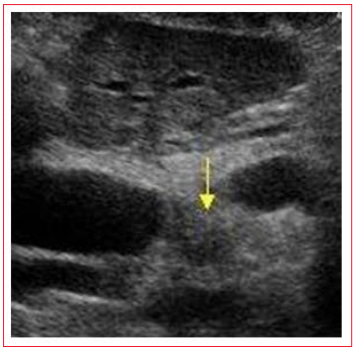

Figure 1: Cholangicarcinoma (arrow) is presented Ultrasonographically as an Isoechoic Formation without Clear Contours, around which the Bile Ducts are dilated

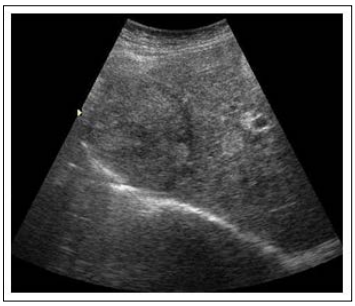

Figure 2: Hepatocellular Carcinoma is Ultrasonographically presented as a large formation of an Heterogeneous Structure, around which an Acoustic Halo is determined

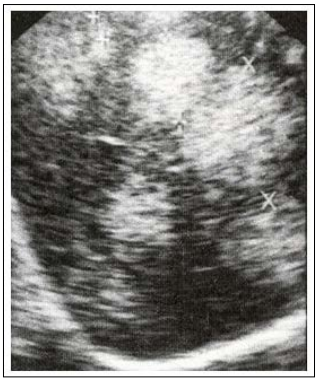

Figure 3: Metastatic Liver Tumors are Ultrasonographically presented as a multiply Hyperechoic Formations in Right Lobe

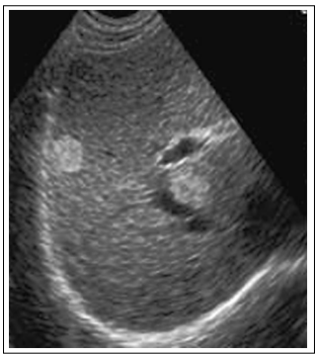

Figure 4: Capillary Hemangioma is Ultrasonographically presented as a small Hyperechoic Formation with clear body edge, Homogeneous Internal Structure, at the Right Lobe of liver

Doppler characteristics of blood flow of liver tumors are presented in Table 5. The blood supply of liver tumors was classified as avascular (no obvious blood flow signals), hypovascular, moderate vascular and hypervascular.

Table 5: Color Doppler Characteristics of Blood Flow within the Liver Tumors

Color Doppler characteristics of intratumoral blood flow.	HCC	ChCC	MLC	CapH	CavH
	n=29	n=21	n=37	n=39	n=26
	1	2	3	4	5
Avascular, n=52	3 (10,3±5,6%)	5 (23,8±9,3%)	21 (56,8±8,1%) P 3-1<0,001 P 3-2<0,01	23 (59,0±7,9%) P 4-1<0,001 P 4-2<0,01	-
Hypovascular, n=27	2 (6,9±4,7%)	3 (14,3±7,6%)	7 (18,9±6,4%)	12 (30,8±7,4%)	3 (11,6±6,3%)
Moderate vascular, n=41	8 (27,6±8,3%)	7 (33,3±10,3%)	6 (16,2±6,1%)	4 (10,3±4,9%)	16 (61,5±9,5%) P 5-1<0,01 P 5-2<0,05 P 5-3<0,001 P 5-4<0,01
Severe vascular, n=32	16 (55,2±9,2%) P1-2<0,05 P1-3<0,001 P1-5<0,05	6 (28,6±9,9%)	3 (8,1±4,5%)	-	7 (26,9±8,7%)

HCC – Hepatocellular Carcinoma; ChCC – Cholangiocellular Carcinoma; MLC – Metastatic Liver Cancer; CapH – Capillary Hemangioma; CavH – Cavernous Hemangioma.

Avascular type of Doppler pattern was observed in 52 cases - of which in 3 (10.3 ± 5.6%) cases of HCC, in 5 (23.8 ± 9.3%) cases of ChC, in 21 (56.8 ± 8,1%) cases of MLC, in 23 (59.0±7.9%) cases of CapH. The frequency of avascular type of Doppler pattern in MLC and was significantly (P<0.01) higher than in HCC and ChC.

Hypovascular type of Doppler pattern was observed in 27 cases - of which in 2 (6.9 ± 4.7%) cases of HCC, in 3 (14.3 ± 7.6%) cases of ChC, in 7 (18.9 ± 6,4%) cases of MLC, in 12 (30.8±7.4%) cases of CapH and in 3 (11.6 ± 6.3%) cases of CavH.

Moderate vascular type of Doppler pattern was observed in 41 cases - of which in 8 (27.6 ± 8.3%) cases of HCC, in 7 (33.3 ± 10.3%) cases of ChC, in 6 (16.2 ± 6,1%) cases of MLC, in 4 (10.3±4.9%) cases of CapH and in 16 (61.5 ± 9.5%) cases of CavH. The frequency of moderate vascular type of Doppler pattern in CavH was significantly (P<0.01) higher than in rest.

Severe vascular type of Doppler pattern was observed in 32 cases - of which in 16 (55.2 ± 9.2%) cases of HCC, in 6 (28.6 ± 9.9%) cases of ChC, in 3 (8.1 ± 4,5%) cases of MLC and in 7 (26.9 ± 8.7%) cases of CavH. The frequency of severe vascular type of Doppler pattern in HCC was significantly (P<0.01) higher than in rest (Figs 5-7).

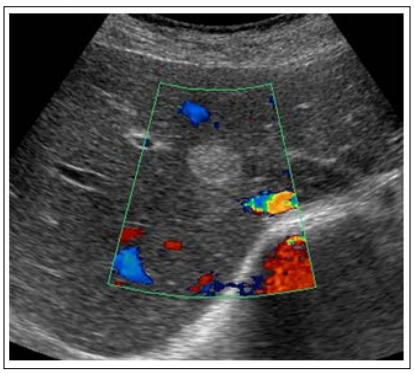

Figure 5: Capillary Hemangioma is registered at the Right Lobe of Liver. Color Doppler study does not show vessels inside Capillary Hemangioma

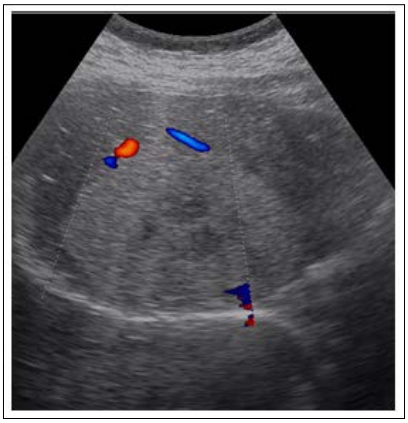

Figure 6: Cavernous Hemangioma is Ultrasonographically presented as a large formation with clear body edge, weak heterogeneous internal structure. In Color Doppler study single vascular signals are visible along the periphery of the hemangioma

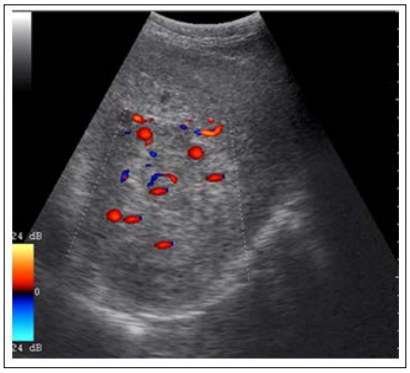

Figure 7: Hepatocellular Carcinoma is Ultrasonographically presented as a large formation with unclear body edge, heterogeneous internal structure. In color Doppler study multiply vascular signals are visible inside of the tumor

Discussion

Currently, ultrasonography is the most common method for detecting focal liver lesions in a grayscale mode. This method allows you to evaluate the localization, size, internal structure and relationship with the surrounding intact tissue according to the degree of visualization of the edges of the pathological formation. All this helps to conduct a differential diagnosis between focal lesions of the liver [15-18].

In our study, among 152 tumors, there were 87 malignant lesions and 65 benign lesions. Taking into account the internal structure of the tumor, the border, echogenicity and intensity of color Doppler blood flow signals, differential diagnosis of liver lesions was carried out. Most of the benign formations had a homogeneous structure, increased echogenicity, and low vascularization. Hepatocellular carcinoma and cholangiocarcinoma were distinguished by indistinct tumor borders, heterogeneity of the internal structure, and moderate or enhanced vascularization.

These data are consistent with those of other researchers [10, 19, 20].

We also made a differential diagnosis between HCC and cavernous hemangioma, since these 2 pathologies have very similar ultrasound symptoms. A complex of ultrasound symptoms - an acoustic halo, fuzzy contours of the pathological lesion, a predominantly heterogeneous structure and reduced echogenicity of the formation were significantly more often observed in hepatocellular carcinoma.

Conclusion: Duplex ultrasound allows you to identify the malignant and benign liver tumors. The most significant ultrasonographic signs of malignancy of the formation are fuzzy contours, heterogeneous internal structure, hypoechogenicity and increased vascularization of the pathological formation.

Conflict of interest

The authors declared no potential conflict of interest with respect to the research, authorship, and/or publication of this article.

References

1. Gail Houste L, Gomez Santos L, Ochiya T (2013) Potential applications of miRNAs as diagnostic and prognostic markers in liver cancer. Front Biosci 18: 199-223.
2. Estfan B, Byrne M, Kim R (2013) Sorfenib in advanced hepatocellular carcinoma: hypertension as a potential surrogate maker for efficacy. Am J Clin Oncol 36: 319-324.
3. Center for Disease Control and Prevention (CDC) (2010) Hepatocellular carcinoma-United States 2001–2006. MMWR Morb Mortal Wkly Rep 59: 517-520.
4. Crissien AM, Frenette C (2014) Current Management of hepatocellular carcinoma. Gastroenterol Hepatol 10: 153-161.
5. Wang CH, Wey KC, Mo LR, Chang KK, Lin RC, et al. (2015) Current trends and recent advances in diagnosis, therapy, and prevention of hepatocellular carcinoma. Asian Pac J Cancer Prev 16: 3595-3604.
6. Zangneh HF, Wong WWL, Sander B, Bell CM, Mumtaz K, et al. (2019) Cost effectiveness of hepatocellular carcinoma surveillance after a sustained virologic response to therapy in patients with hepatitis C virus infection and advanced fibrosis. Clin Gastroenterol Hepatol 17: 1840-1849.
7. Hu J, Yuan R, Huang C, Shao J, Zou S, et al. (2016) Double primary hepatic cancer (hepatocellular carcinoma and intrahepatic cholangiocarcinoma) originating from hepatic progenitor cell: a case report and review of the literature.

World J Surg Oncol 14: 218.

8. Balogh J, Victor D, Asham EH, Burroughs SG, Boktour M, et al. (2016) Hepatocellular carcinoma: a review. J Hepatocell Carcinoma 3: 41-53.
9. Hatanaka K, Minami Y, Kudo M, Inoue T, Chung H, et al. (2014) The gross classification of hepatocellular carcinoma: usefulness of contrast-enhanced US. J Clin Ultrasound 42: 1-8.
10. Kee KM, Lu SN (2017) Diagnostic efficacy of ultrasound in hepatocellular carcinoma diagnosis. Expert Rev Gastroenterol Hepatol 11: 277-279.
11. Yen HH (2018) Progress in the ultrasonographic microvascular imaging. J Med Ultrasound 26: 1-2.
12. Nishigaki Y, Hayashi H, Tomita E, Suzuki Y, Watanabe N, et al. (2015) Usefulness of contrastenhanced ultrasonography using Sonazoid for the assessment of therapeutic response to percutaneous radiofrequency ablation for hepatocellular carcinoma. Hepatol Res 45: 432-440.
13. Kono M, Minami Y, Kudo M (2017) Contrast-enhanced tissue harmonic imaging versus phase inversion harmonic sonographic imaging for the delineation of hepatocellular carcinomas. Oncology 92: 29-34.
14. Hu J, Zhou ZY, Ran HL, Yuan XC, Zeng X, et al. (2020) Diagnosis of liver tumors by multimodal ultrasound imaging. Medicine (Baltimore) 99: e21652.
15. Assy N, Nasser G, Djibre A, Beniashvili Z, Elias S, et al. (2009) Characteristics of common solid liver tumors and recommendations for diagnostic workup. World J Gastroenterol 15: 3217-3227.
16. Kaltenbach TEM, Engler P, Kratzer W, Oeztuerk S, Seufferlein T, et al. (2016) Prevalence of benign focal liver tumors: ultrasound investigation of 45,319 hospital patients. Abdom Radiol (New York) 41: 25-32.
17. Mo HY, Zhong JH (2016) Comment on stereotactic body radiation therapy for small primary or recurrent hepatocellular carcinoma. J Surg Oncol 113: 181-187.
18. Bartolotta TV, Taibbi A, Matranga D, Midiri M, Lagalla R (2015) 3D versus 2D contrast enhanced sonography in the evaluation of therapeutic response of hepatocellular carcinoma after loco regional therapies: preliminary findings. Radiol Med 120: 695-704.
19. Tanaka H (2020) Current role of ultrasound in the diagnosis of hepatocellular carcinoma. Journal of Medical Ultrasonic 47: 239-255.
20. Vivarelli M, Montalti R, Risaliti A (2013) Multimodal treatment of hepatocellular carcinoma of cirrhosis: an update. World J Gastroenterol 19: 7316-7326.