

E.I. Petrov¹, I.V. Kirgizov^{1,2}, Yu.A. Polaev¹, R.V. Garbuzov¹, E.N. Tsygina¹

¹ Scientific Centre of Children's Health, RAMS, Moscow

² I.M. Sechenov First Moscow State Medical University

Diagnosis, X-ray and Surgical Treatment of Liver Hemangiomas in Children

When highly informative noninvasive diagnostic techniques were introduced into medical practice, the use of the angiographic method declined. However, according to many authors, this is not justified,. Out of all the known modern diagnostic methods angiography was the one that identified pathognomonic signs of liver formations most accurately, especially hemangiomas, and allowed to make a smooth transition from diagnosis to the treatment stage – X-ray vascular occlusion of the hepatic artery. This article presents the methods of diagnosis, the results of examination and treatment of 58 pre-school children with liver hemangiomas.

Key words: *Liver, hemangioma, children, angiography, endovascular embolization.*

Contact information:

Petrov Yevgeny Igorevich, postgraduate student of Surgery Dpt of the Scientific Centre of Children's Health, RAMS.

Address: 119991, Lomonosovsky prospect, 2/1.

Phone: (499)134-14-55

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Introduction

Recently angiography remains one of the most sensitive and specific procedures in the diagnosis of liver hemangiomas [1]. In the past, as it was pointed out by J. Pollard (1966), E. Pantoja (1968), R. Abrams (1969), M. McLoughlin (1971), it was known as the "gold standard" in the diagnosis of cavernous hemangiomas [2].

Since the end of the XIX century, the term "hemangioma" means a tumor proceeding out of blood vessels [3-9]. Hemangioma is especially dangerous in the liver, as it can cause massive bleeding [10]. Hemangioma is the most common benign liver tumor, with tumors of cavernous type [11] being the most often occurring ones. According to S.A. Danilchenko (1974), capillary hemangioma forms from the vestiges of the embryonic vasculature; and cavernous hemangiomas form as a result of volumetric expansion of the capillary vessels of hemangiomas. At the same

time capillary hemangioma vessels differentiate into venous and arterial vessels so that they are repeating, though rather distortingly, the differences of the vascular system in the ontogeny [12].

Typical angiographic features of hepatic hemangiomas were first described by A. Shockman (1963) and J. Pollard (1966). Vessels of normal diameter are shifted away from the pathological formation and gradually narrow. There is no arteriovenous shunt. Gate vein is not enlargening, but significant gaps containing contrast material remain well preserved in the venous phase, being arranged in the form of rings or S-shaped figures [12]. According to G.I. Veronsky (1994), the percentage of hemangiomas of focal liver disease is increasing.

P. Stanley (1989) notes that among 20 newborns having hepatic hemangiomatosis, 7 patients had hemangiomas at other sites (skin - in 7, trachea - in 1, lung - in 1, colon - in 1, intracranial - in 1) .

As a rule, hemangioma of the liver is located in subcapsular injections, often under the diaphragmatic surface of right liver lobe (P. Stanley, 1989). E.I. Halperin (1984) indicates the most frequent localization of the hemangioma in the right liver lobe of the liver. However, H. Wilson (1952) reported more frequent involvement of the left liver lobe rather than the right one.

The appearance and consistency of hemangiomas of the liver are different and depend on the structure of the tumor size and number of vascular caverns filled with blood, on the absence or presence of thrombosis and, mainly, on the extent of connective tissue [12].

According to some authors [13], hepatic hemangiomas are divided by their localization and extent:

- Singles (over 60% of cases);
- Multiple foci (30%);
- Diffusely focused with many small ones and 1-2 of larger size;
- Diffusely distributed (hemangiomatosis of the liver, which provides for the capillary hemangioma).

Diagnosis of hepatic hemangiomas is currently of great complexity, but it should be noted that the majority of cavernous liver hemangiomas has asymptomatic course and is usually accidentally discovered during ultrasonography (USG), computed resonance imaging (CT) or magnetic resonance imaging (MRI), as well as during surgery [14-18].

Sonographically hemangioma is represented by intense blood flow and non-uniform density structure [16]. CT with contrasting feature is the most realistic research, however, it is the most expensive imaging mechanism [19]. Recently, angiography remains one of the most sensitive and specific procedures in the diagnosis of liver hemangioma (H. Takagi, 1985),

because at the stage of diagnosis it allows to perform curative procedure – X-ray and vascular occlusion of the hepatic artery [20].

Complaints are few in most patients, and are often detected only after a deliberate survey [12].

Clinical symptoms are present only in several patients having large hemangiomas, which is confirmed by K. Ishak (1975), M. Grieco (1978), V. Trastek (1983), P. Bornman (1987), J. Scatarige (1987), Y. Adam (1970) and other authors.

The aim of this study is to analyze the methods of diagnosis and treatment outcome of children having liver hemangioma.

Patients and methods

This research was performed in the Child Health Science Center, RAMS. Patient enrollment was carried out in Surgery Department of CHSC, RAMS and in Department of X-ray and surgical diagnosis and treatment of the Russian Child Clinical Hospital of the Health Ministry of Russia. The study included 58 children aged from 8 months to 4 years having liver hemangioma. Mean age was 1.8 years. In all children liver hemangioma was occasionally discovered during abdominal ultrasound (usually at the place of residence).

All patients underwent a full comprehensive examination: general examination, medical history collection, complaints, clinical tests, an ultrasound Doppler study of the liver, CT of the liver in some cases.

The final step was to perform diagnostic angiography of common hepatic artery basin with subsequent transition to embolization of hepatic arteries, that is, moving on to the therapeutic stage.

The first step was to conduct a diagnostic tool ultrasound of the liver, allowing an to establish objectively the depth of hypervascular mass distribution, to identify the presence of major or minor arterial and venous trunks in the thickness of lesions, and most importantly - to determine the hemodynamic parameters of lesions, affecting the future treatment tactics.

To perform the ultrasound there were used machines such as «ULTRAMARK-9" (USA) and «P-700 PHILIPS» (the Netherlands). To clarify the specific features of hypervascular mass opportunities, there was used spectral dopplerography and color duplex mapping. The study was performed on an empty stomach with the use of low-frequency sector, vector and convex probe with a frequency of 2.5 7MHz. Examination of the liver began with the lateral division of the left lobe, then the sensor was promoted to the gate of the liver, and examination ended up on right lobe.

Sonography included the following steps.

- Ultrasound in B-mode in real-time scope;
- Sonography of the discovered mass. At the same time there were assessed the localization of this mass (segment), and the number of its units (single or multiple);
- Assessment of syntopy with portal, arterial and venous vessels of the liver using duplex scanning with color Doppler mapping.

Calculation of vascular formation was carried out according to the formula adopted for measuring soft tissue volume by ultrasonic method:

$V = \left(\frac{\pi}{6}\right) \cdot A \cdot B \cdot C$, where A, B, C stand for height, width and thickness of the tumor respectively; $\pi=3,14$.

In case when localization and prevalence of hypervascular mass remained not entirely clear after ultrasound, there was used computed tomography method.

CT studies were performed on devices "9800 Hilight Advantage» (General Electric, USA) and «LightSpeed 16» (General Electric, USA). Tomograms could show the shape, size and densitometric density of liver. There was estimated the location of hemangiomas and their proportions in comparison with the large liver vessels. There was noted the nature of its contours and formation structure. Particular attention was paid to the presence or absence of compression of bile ducts and blood vessels of the liver. During intravenous contrasting there was traced the character of accumulation of contrast material in tissue of liver hemangioma.

For performing endovascular operations there were used angiographic unit «Advantx» (GE Medical, USA); for automatic injection of contrast agents (RCC) - an automatic injector «Medrad Mark V Provis» (Medrad, USA). Diagnostic angiography of the hepatic artery with further embolization (occlusion) was performed in all surveyed patients (n = 58).

Angiographic study began with the right femoral artery puncture according to Seldinger method - by 1.0-1.5 cm below the inguinal fold and 1.0 cm lateral to the femoral vein (that is transfemoral access from the right, which is considered to be the most convenient). Then there was carried out the common hepatic artery catheterization. At the same time a catheter was consistently pursued into the abdominal aorta, then into the celiac trunk and then into the overall hepatic artery. The catheter must be made of soft material, as catheter manipulations can cause severe vessel spasms or damage to the vein wall, up to its perforation. After catheter installation, there was performed a series of diagnostic catheter shots from the pool of the common hepatic artery, thus specifying location and extent of liver hemangioma.

Using a micro catheter, afferent vessels of liver hemangiomas were superselectively catheterized, and then an embolization of these vessels was performed, using a Gianturko spiral of appropriate size and scope, and / or hydrogel cylinders (Fig. 1). We used the distal, proximal and combined embolization - the use of this particular method is defined by pathological view of the mass and by individual characteristics of the regional angioarchitectonics.

After embolization Z-ray surgical operation was assessed by re-staining liver blood vessels from the pool the common hepatic artery.

Research results and discussion

Out of 58 children examined, 22 children (38%) were male, 36 (62%) were female, which is consistent with the data of R. McLean (1972), in which hepatic hemangiomas occur in 2 times more often in girls than in boys.

The examination with further assessment of medical history and complaints showed this illness is asymptomatic in more than half of the cases (n = 36, 62%). Liver hemangioma exceeding 4 cm had a symphthocomplex, which included hepatomegaly, palpable swelling, and pain (n = 16, 28%). In some cases, liver hemangiomas were combined with cutaneous hemangiomas (n = 6, 10%). Therefore, the identified complaints and objective examination data provide rather poor information for the diagnosis of liver hemangiomas, and its symptoms are nonspecific.

Liver ultrasound was performed in all patients. Focal nature of the changes was established in 100% of cases (n = 58), the diagnosis of "liver hemangioma" was confirmed in 91.3% cases (n = 53). Hemangiomas could be seen through sonographic image of the inhomogeneous density structure with hypoechoic lacunae. General contours of the pathological formation were uneven (Fig. 2).

During ultrasound with use of B-mode, capillary vascular tumor components were characterized by the presence of zones of high or increased echogenicity with small-or mesoporous structure and irregular outlines. Cavernous vascular tumor component was detected by ultrasound as hypo-and anechioc plots having irregularly rounded or oval with irregular contours, and dimensions of which were from 0.2-0.4 to 0.8-1.0 cm

To clarify the specific features of hemangiomas there was used spectral dopplerography and color duplex mapping (Fig. 3).

As a result of ultrasound and dopplerography of liver hemangiomas in children, the following most common symptoms were revealed:

- 1) Within hemangioma sized less than 1 cm³ and consisting of only one node, there is no abundant network of arterial trunks;
- 2) The highest rate of blood flow in the tumor reaches 42-48 cm / s;
- 3) Peripheral resistance causes the great influence on the magnitude of the linear blood flow velocity and waveform of dopplerograms. The latter was progressively decreasing when tumor size and activity of blood in it increased.

Thus, the information content of ultrasound for the detection of liver hemangiomas is close to 100%, but in some cases it is difficult to definitively differentiate hypervascular mass through echographic signs (in this study – only in 5 patients (6.9%) patients). To clarify the nature and location of existing hypervascular mass in these children, we used an additional method of diagnosis – computed tomography. Hemangiomal nature of the changes was discovered in all 5 patients.

Reduced densitometric density of the formations, heterogeneity of the structure, and rough, sharp contours were the main CT features of hemangiomas. Early peripheral enhancement in hemangiomas, further contrasting in its central part and the stability of contrast enhancement were identified in all cases after intravenous bolus injection of contrast agent (Fig. 4).

Therefore, the method of computed tomography is considered to be highly informative in detecting focal hepatic lesions. This study allows to determine the degenerative changes in liver tissue, depending on the size, nature and location of hypervascular mass, and is maximally close to the angiographic research technique.

Therapeutic and diagnostic angiography was performed in all patients (n = 58). After performing diagnosis of arteriography pool of hepatic artery, there was established the projection of segmental liver hemangiomas location in all studied patients (Table).

As the table shows, the highest percentage of hemangiomas has been localized to VII (26%) and VIII (19%) liver segments.

The result of a well-conducted embolization of liver hemangioma was the absence of staining hypervascular mass during the control arteriography of liver vessels, that was held immediately after treatment (Fig. 5)

There were observed no serious complications (necrosis of adjacent tissues) after embolization; superselective embolization was carried out in compliance with the phasing. In addition, during embolization flow and location of the emboli, or spirals in the artery was carefully controlled.

There were used only the non-ionic X-ray contrast agents (XCA) because of their minimal effect on the hemostatic system and better overall tolerability. During this survey no patient received any complications during XCA application.

In 6.9% of children (n = 4) a postpuncture hematoma was observed (due to the damage of femoral artery wall integrity during the puncture).

In 12% of patients (n = 7) pain reactions of varying intensity were observed in the area of occlusion (the region of the right hypochondrium). The intensity of pain depended on the individual susceptibility of the organism, and on the number of arteries embolized at the same time: the greater was the area of embolization, the more pronounced ischemic symptoms remained. Local pain usually appeared within the first postoperative day and disappeared on the second day.

Conclusion

A survey of patients having liver hemangioma revealed that the course of this disease is mostly asymptomatic.

The basis of modern diagnosis of liver hemangioma in children is a liver ultrasound along with dopplerography of vascular bed and the calculation of vascular formation. Information value of ultrasound for detecting hepatic hemangioma is close to 100% and helps to determine the prevalence, syntopy of hypervascular mass, as well as to clarify the structural and morphological type of structure.

In some cases, CT study can be required, which is highly informative for the detection of focal hepatic lesions, and is maximally close to the angiographic research technique. CT also helps to determine the degenerative changes of liver tissue, depending on the size, nature and location of hypervascular mass.

The angiographic technique remains the "gold standard" of diagnosis and treatment of liver hemangioma in children, being one of the most sensitive and specific modern procedures. The angiographic method allows to make an immediate transition from the diagnostic phase of the survey to the treatment through endovascular occlusion of the hepatic artery.

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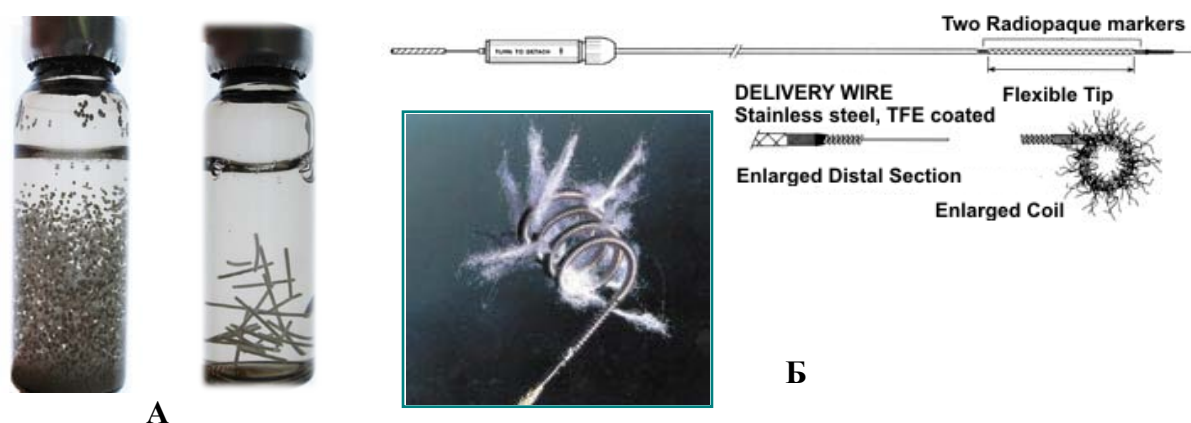


Fig. 1. Embolization of afferent vessels of liver hemangioma by:

A - spheres and cylinders on the basis of hydrogel; B - occlusal spiral

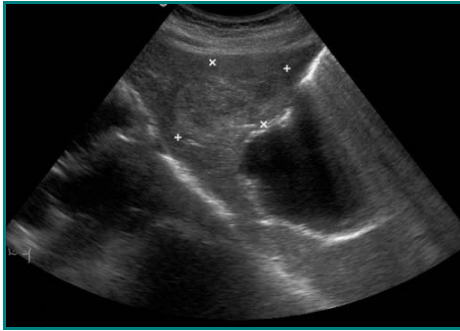


Fig. 2. Echographic example of liver hemangioma in the B-mode (patient D., 3 years 7 months).

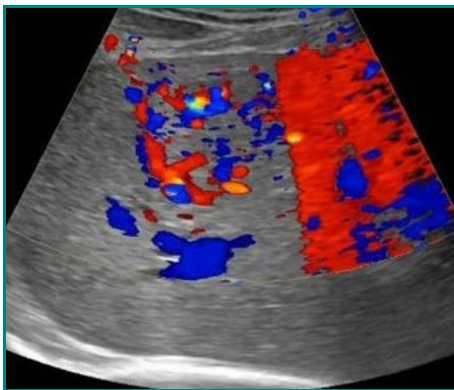
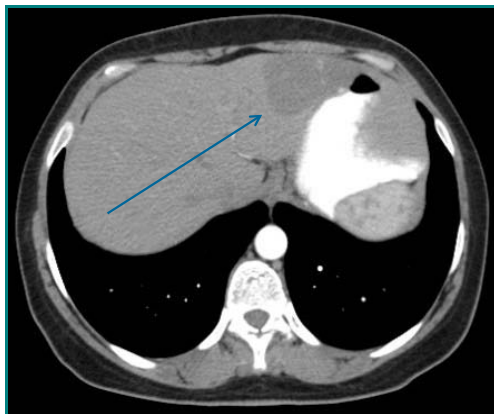


Fig. 3. Dopplerography sample of liver hemangioma (patient H, 1 year 8 months)



Arterial phase



Venous phase

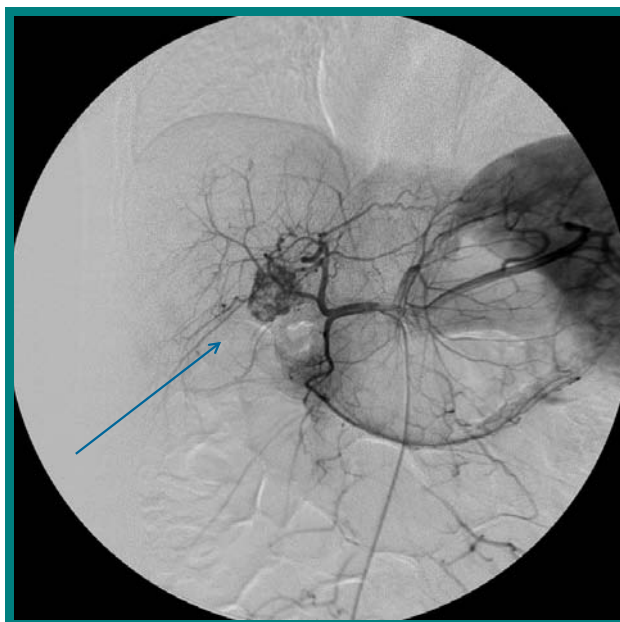
Fig. 4. Patient B., 3 years 8 months. Diagnosis: "Liver hemangioma" There can be observed the accumulation of X-ray facilities in the arterial and venous phases of blood flow

Table. Liver hemangioma distribution by liver segment

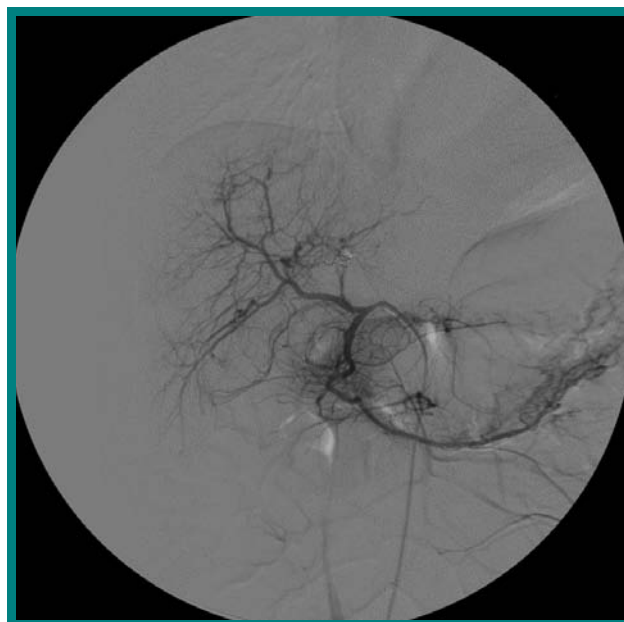
Таблица. Распределение гемангиом по сегментам печени

	Segments
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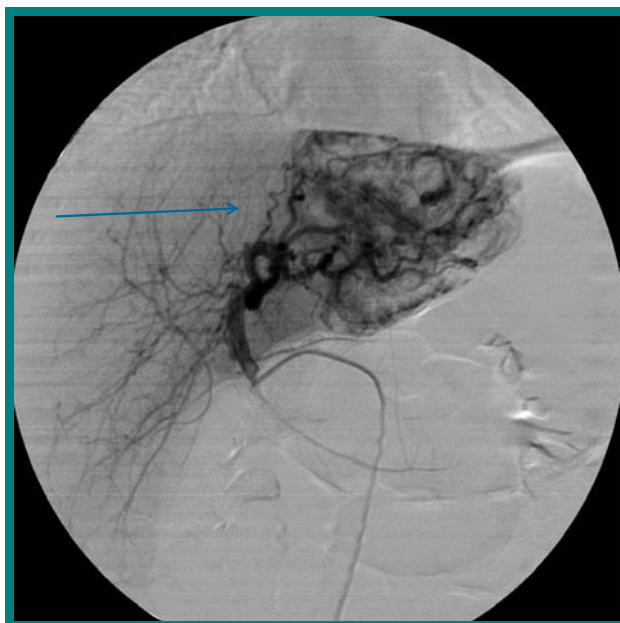
Segment localization	I	II	III	IV	V	VI	VII	VIII
Amount of observations (n=58)	2	4	4	10	9	3	15	11



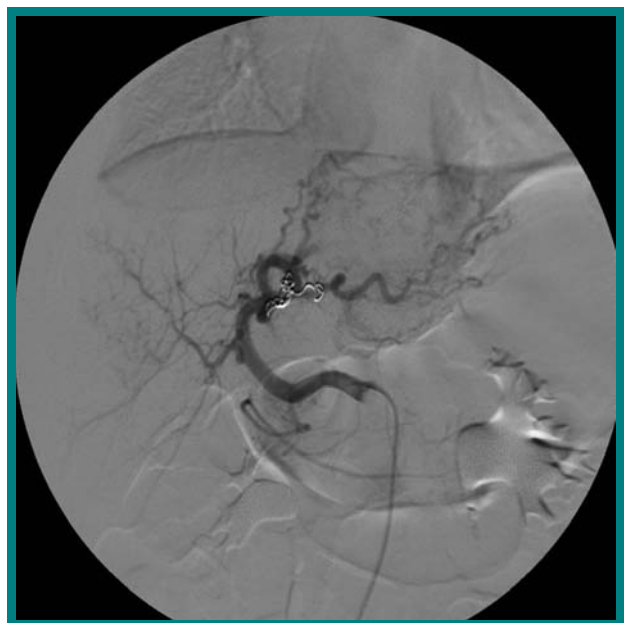
A



B



C



D

Fig. 5. Examples of the results of embolization (occlusion) on liver hemangiomas
 Patient P., 1 year 3 months. A - before embolization, B - after embolization
 Patient I, 1 year 11 months. C - before embolization, D - after embolization