METHOD FOR ELIMINATING THE RESIDUAL CAVITY AFTER HEPATIC ECHINOCOCCECTOMY

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Abstract*. Despite significant advances in the surgical treatment of liver echinococcosis (LE), many aspects of this condition, which potentially have a decisive influence on postoperative outcomes and the quality of life of patients, are far from being definitively resolved and remain subjects of further research and discussion. The optimization of tactical and technical aspects of LE surgical treatment is one of the most debated and unresolved areas in surgery. A primary concern remains the recurrence of LE, indicating the need for refining indications for existing treatment options, methods of cavity elimination, and treatment post-echinococcectomy, as well as the development of prognostic scales considering risk factors for different morphological forms of echinococcal cysts. The article highlights current views on the surgical treatment of LE and controversial issues in selecting the optimal strategy.*

Keywords*: organs and tissues, treatment post-echinococcectomy, risk factors.*

Relevance of the problem. According to WHO data, over 2 billion people worldwide suffer from transmissible and parasitic diseases [1]. Echinococci can affect any organs and tissues, with the liver being the most commonly affected organ (44-84%), followed by the lungs (20%), and less frequently the brain, kidneys, and spleen [2, 3, 4.].

Recently, international medical organizations have shown increasing interest in various human parasitic pathologies, with particular emphasis on the cystic form of echinococcosis (cystic echinococcosis - CE). Liver echinococcosis (LE), a cestode zoonosis caused by tapeworms of the genus Echinococcus (family Taeniidae), affects up to 200 people per 100,000 population annually [1].

Studies have shown that echinococcal cysts (ECs) can rupture or acquire secondary infections, leading to life-threatening complications and significantly impacting surrounding structures. According to Nezih Akkapulu et al. (2017), "the rupture of liver ECs is primarily caused by the degeneration of echinococcal membranes. In cases of communicating rupture, echinococcal material passes from the liver EC into the bile ducts, abdominal cavity, or other adjacent organs.

This complication can be facilitated by previous surgical intervention or percutaneous drainage of ECs, with a risk of recurrence or complications up to 50%" [6].

The goal of surgical treatment is the direct inactivation of the parasite, evacuation of the cyst along with removal of the germinal layer, pericystic zone, prevention of peritoneal dissemination of scolices, and treatment of the residual cavity (RC), thereby addressing the issues of complications and the likelihood of recurrence [7]. Currently, the main strategies for the surgical treatment of LE include traditional and laparoscopic echinococcectomy (EE), as well as percutaneous puncture-draining interventions (PAIR and PEVAC techniques), with acceptable morbidity and mortality rates, which are applied depending on the pathological state of the EC. However, with all these treatment methods, the recurrence rate ranges from 7% to 25%, morbidity from 12% to 84%, and mortality from 0.5% to 6.5% [8]. In more complex cases, surgical intervention may be supplemented by other treatment methods, such as minimally invasive procedures and chemotherapy. Therefore, surgical treatment options for LE should have specific indications and contraindications depending on the patient's condition and the manifestations of the disease.

Another interest in LE surgery lies in the application of resection technologies, which allow the removal of the entire cyst or cysts, often ideally (without opening the cyst) together with the fibrous capsule (FC), significantly reducing the risk of disease recurrence on one hand and eliminating the need to address the RC, thereby mitigating the risk of RC-related complications on the other hand. However, the risk of recurrence is only associated with the zone adjacent to the FC, while a high frequency of recurrence outside the primary localization zone has been established.

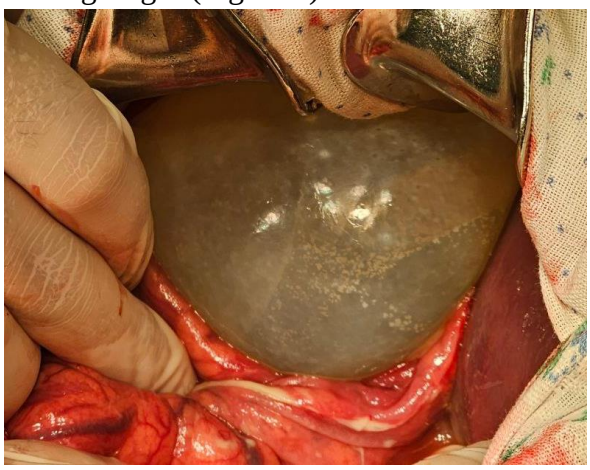
Moreover, performing anatomic or atypical liver resection in the event of recurrence significantly complicates subsequent surgical treatment methods. The exception is cysts with predominantly extra-organic location, where it is possible to perform atypical resection without significant damage to liver tissue. Another advantage of resection technology is their application in cases of deep intraparenchymal localization of ECs, where true resection of a liver fragment is impossible, such as in the localization of hydatids in the liver hilum or deep in other central zones. In these situations, the use of liver parenchyma splitting resection technologies undoubtedly has an advantage, as attempts to open such cysts through the parenchyma could result in either loss of the cyst or massive bleeding from injured liver tissue. Liver resection is also applied in cases of severe bile duct involvement, vascular lesions with lobar atrophy, or recurrence, ensuring the removal of any smaller satellite lesions. However, it is necessary to note that indications for liver resection in LE have still not reached a common consensus.

Materials for the study. The study included 221 patients with primary or recurrent LE, whose residual cavities (RC) had dense, rigid walls. The operations were performed from 2016 to 2023. The multicenter analysis included material from three clinics: The Republican Specialized Scientific-Practical Medical Center of Surgery named after Academician V. Vakhidov, Navoi and Khorezm Regional Multidisciplinary Medical Centers, as well as the Medical-Sanitary Unit of the Regional Administration "Navoi" of the "NMMC" Foundation.

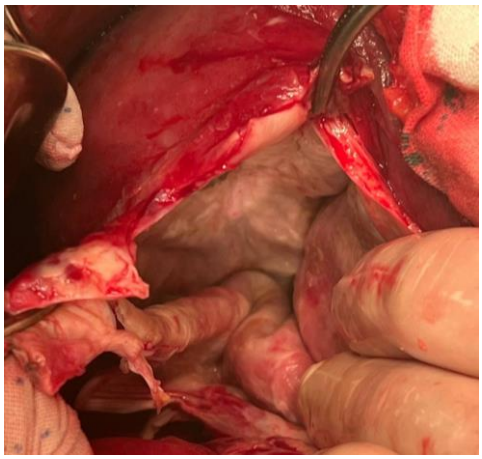
All patients were divided into two groups. The main group included 94 patients (2020-2023) with LE, who, during laparotomic or laparoscopic operations, underwent additional RC treatment according to the proposed method after the echinococcectomy (EE) stage, with a total of 113 cysts removed. The comparison group included 88 patients (2016-2019), who underwent

similar interventions using the traditional method, with a total of 108 cysts removed. In the main group, there were 68 (77.3%) patients with solitary LE, and in the comparison group, there were 75 (79.8%); 20 (22.7%) and 19 (20.2%) patients, respectively, had multiple forms (2 cysts). The number of operated cysts was 108 and 113, respectively. Most patients had CE1-3 stages of parasite development. Overall, in the comparison group, there were 18 (15.9%) cysts at CE1 stage, 52 (46.0%) at CE2, 37 (32.7%) at CE3, and 6 (5.3%) at CE4. In the main group: 13 (12%) cysts at CE1, 51 (47.2%) at CE2, 37 (34.3%) at CE3, and 7 (6.5%) at CE4.

Most of the research focused on two types of operations: open and laparoscopic echinococcectomies (EE), with resection operations included only for the analysis of the structure of operations in LE. In the comparison group, traditional EE was performed in 82 (87.2%) cases, and in the main group, in 60 (68.2%) patients; laparoscopic EE in 8 (8.5%) and 21 (23.9%) patients, respectively; and liver resections (marginal or anatomical) in 4 (4.2%) and 7 (7.9%) patients. The method of treating the rigid fibrous capsule (FC) after EE from the liver includes the following stages (Figure 1):

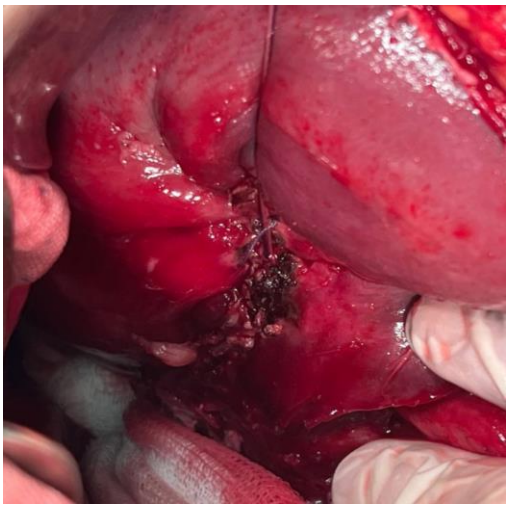


Part of the chitinous shell is located subhepatically due to the tearing of the fibrous capsule.



View of the fibrous capsule from the inside.

The inner surface of the fibrous capsule was subjected to laser treatment with the "Lahta-Milon" device and treated with a FarGALS solution.



After applying Hemobene powder, the residual cavity was tightly sutured.

Figure 1. Stages of echinococcectomy from the liver.

Access to the cyst can be either laparotomic or laparoscopic.

After revision, the EC is removed by puncturing the cyst membrane with suction of the echinococcal fluid, opening the cyst cavity with removal of the chitinous membrane and, if present, daughter cysts.

Perform antiparasitic treatment of the RC with a 3% H2O2 solution, alcohol, and iodine.

Revision of the FC for the presence of bile fistulas and suturing of the latter;

Then, excise the free edges of the FC within the healthy liver tissue.

Perform laser treatment with a high-energy laser "Lahta-Milon" through a monofiber optic with a wavelength of 980 nm, in a pulsed mode at 10 Hz with a power of 10 W in a defocused mode on a spot area of up to 3-5 mm in diameter for 15-20 seconds and a number of impacts 25-30 per 9 cm^2 area.

After that, perform additional antiparasitic chemical treatment with the antiseptic agent "FarGALS," diluted in water for injections in a ratio of 1:1 in a total volume of 50 ml. The solution is introduced into the RC and the entire inner surface of the FC is treated with a swab, after which the excess liquid is removed by suction.

Apply a powdery composition of HEMOBEN to the inner surface of the RC at a rate of 10 mg per 1 cm^2, and after its polymerization for 2-3 minutes, perform either complete suturing of the RC, or suturing with drainage, or drainage (with laparoscopic access).

The advantages of the method are: application in traditional or laparoscopic surgery for dense fibrous walls that do not collapse and are not amenable to suturing; the Lahta-Milon laser radiation penetrates deeply into the tissues, thereby providing controlled destruction of the dense, rigid FC; the radiation also stimulates enhanced regeneration; the FarGALS solution provides additional antiparasitic chemical treatment, and thanks to the prior laser destruction, the solution penetrates into the deep layers of the thickened FC and also accelerates the obliteration processes.

Results and Discussion. In recent years, many hepatological schools around the world have been preferring resection technologies when choosing the method of echinococcectomy (EE), where the cyst(s) are subject to "ideal" removal together with part of the liver parenchyma (as in atypical or anatomical resection). However, it should be noted that in the Republic of Uzbekistan, operations for echinococcosis are very often performed at any level of healthcare, including district hospitals. Liver resection is a complex surgical procedure, and these technologies are often not available in many medical institutions. In conjunction with the lack of objective data showing that liver resections lead to significantly better outcomes in echinococcosis, the main choice of operation remains traditional and, in some cases, laparoscopic interventions.

The frequency of immediate complications after various EE options in the comparison group was 17.6% (6 out of 34 patients) after LapEE, 13.6% (11 out of 81 patients) after Open EE, with a total of 17 (14.5%) complications out of 117 patients. In the main group, after LapEE, the immediate complication occurred in 1 (2.5%) patient (out of 40 patients), after Open EE in 2 (3.2%) out of 62 patients, with a total of 3 (2.9%) complications out of 101 patients. There were no complications in 100 (85.5%) patients in the comparison group and 101 (97.1%) patients in the main group ($\chi2=9.072$; df=1; p=0.003) (Table 1).

Within the first 3 months of observation, various complications were noted in 15 (12.8%) patients in the comparison group and 3 (2.9%) in the main group ($\chi2=7.265$; df=1; p=0.008). Among them, in the comparison group, complications after LapEE accounted for 4 (11.8%) cases,

and after Open EE - 11 (13.6%) cases. In the main group, after LapCE, complications occurred in 1 (2.5%) patient, and after Open EE, in 2 (3.2%) patients (Table 2).

Table 1. The frequency of immediate complications after various EE options

Operation	Comparison group			Main Group		
	n	Complications	%	n	Complications	%
Ideal EE	2	0	0,0%	2	0	0,0%
LapCE	34	6	17,6%	40	1	2,5%
OCE	81	11	13,6%	62	2	3,2%
Patients with complications	117	17	14,5%	104	3	2,9%
Without complications	117	100	85,5%	104	101	97,1%
χ^2	9,072; df=1; p=0,003					

Complications were resolved conservatively in 4 (3.4%) patients in the comparison group and 1 (1.0%) in the main group. Minimally invasive interventions were performed in 7 (6.0%) and 1 (1.0%) cases, respectively. Combined treatment (conservative and minimally invasive) was conducted in another 4 (3.4%) and 1 (1.0%) patients (Fig. 2).

Table 2. The frequency of complications within 3 months after various variants of EE.

Operation	Comparison group			Main Group		
	n	Complications	%	n	Complications	%
Ideal EE	2	0	0,0%	2	0	0,0%
LapCE	34	4	11,8%	40	1	2,5%
OCE	81	11	13,6%	62	2	3,2%
Patients with complications	117	15	12,8%	104	3	2,9%
Without complications	117	102	87,2%	104	101	97,1%
χ^2	7,265; df=1; p=0,008					

In patients with hepatic echinococcosis (CE), the presence of an elastic fibrous capsule allows for effective closure of the residual cavity (RC) in approximately 75-79% of open surgeries. This closure can be complete (54-69%) or partial with drainage (9-20%). In about 12-13% of cases, abdominization of the RC is possible, and only in 9-13% of cases, especially with complex cyst localization (often deep intraparenchymal), is the operation limited to draining the RC with minimal pericystectomy.

In turn, when echinococcal cysts are accessible for laparoscopic intervention, the probability of performing wide abdominization was 42.1-68.9%, with only partial pericystectomy with drainage being carried out in the remaining cases. The use of the proposed method of treating RC with an elastic fibrous capsule in both open and laparoscopic interventions helps reduce the risk of early and late specific complications. Thus, the frequency of complications in the early postoperative period in the comparison group was 14.5%, while in the main group it was 2.9%

(χ2=9.072; df=1; p=0.003), and within 3 months after surgery, this indicator was 12.8% versus 2.9% (χ2=7.265; df=1; p=0.008), which led to a reduction in the need for repeat minimally invasive interventions during this period from 9.4% to 2.0%.

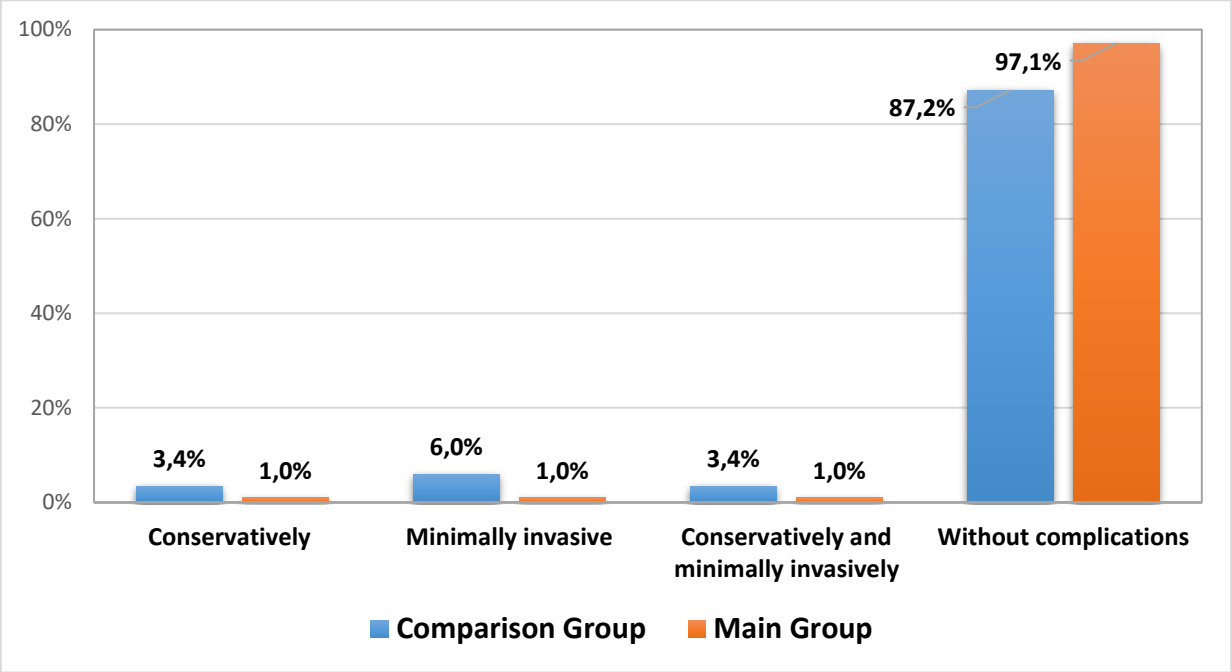


Figure 2. Method of resolving remote complications.

In subgroups with a rigid fibrous capsule, ideal CE was performed in 4 patients in the comparison group and 7 in the main group. In the total sample of this category of patients, the results were analyzed in 94 and 88 patients, respectively.

The frequency of immediate complications after various variants of CE in the comparison group was 37.5% (3 out of 8 patients) after LapCE, 18.3% (15 out of 82 patients) after OpenCE, with a total of 18 (19.1%) complications out of 94 patients. In the main group, after LapCE, the immediate complication occurred in 1 (4.8%) patient (out of 21 patients), after OpenCE in 3 (5.0%) out of 60 patients, with a total of 4 (4.5%) complications out of 88 patients. There were no complications in 76 (80.9%) patients in the comparison group and 84 (95.5%) patients in the main group (χ2=9.121; df=1; p=0.003) (Table 3).

Table 3. Frequency of Immediate Complications after Various Variants of CE

Operation	Comparison group			Main Group		
	n	Complications	%	n	Complications	%
Ideal EE	4	0	0,0%	7	0	0,0%
LapCE	8	3	37,5%	21	1	4,8%
OCE	82	15	18,3%	60	3	5,0%
Total	94	18	19,1%	88	4	4,5%
Without complications	94	76	80,9%	88	84	95,5%
χ^2	9,121; df=1; p=0,003					

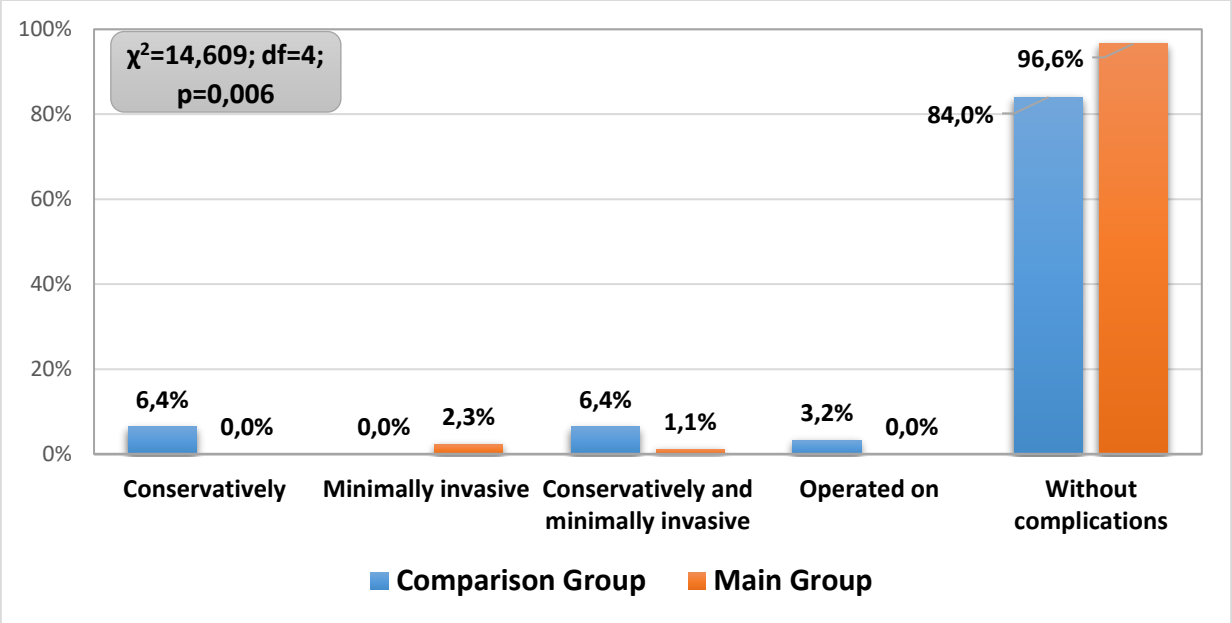
Complications were resolved conservatively in 6 (6.4%) patients in the comparison group, minimally invasive interventions were performed in 2 (2.3%) cases in the main group, combined treatment (conservative and minimally invasive) was performed in another 6 (6.4%) and 1 (1.1%)

patients respectively. In turn, in the comparison group, against the background of unresolvable complications, 3 (3.2%) patients were operated on (Fig. 3).

Table 4. Frequency of Complications within 3 Months after Various Variants of CE

Operation	Comparison group			Main Group		
	n	Complications	%	n	Complications	%
Ideal EE	4	0	0,0%	7	0	0,0%
LapCE	8	2	25,0%	21	1	4,8%
OCE	82	13	15,9%	60	2	3,3%
With complications	94	15	16,0%	88	3	3,4%
Without complications	94	79	84,0%	88	85	96,6%
χ2	8,030; df=1; p=0,005					

Figure 3. Method of resolving remote complications.



Therefore, the use of the proposed method for treating residual cavities with a rigid fibrous capsule, both in open and laparoscopic surgeries, reduces the risk of developing early complications from 19.1% (18 out of 94 patients in the control group) to 4.5% (4 out of 88 patients in the main group; χ2=9.121; df=1; p=0.003), and within 3 months after the operation, this indicator was 16.0% (15) versus 3.4% (3; χ2=8.030; df=1; p=0.005), which reduced the need for repeated minimally invasive interventions during this period from 6.4% to 3.4%. Moreover, 3.2% (3) of patients in the control group were reoperated due to unresolvable complications, while 6.4% had their complications resolved conservatively (χ2=14.609; df=4; p=0.006).

Conclusion. In the studied patient sample with hepatic echinococcosis, intraoperative data revealed rigid fibrosis in 211 patients (52.4%). Resection technologies in echinococcosis surgery can be applied in specialized departments, and their share in the total patient sample was only 3.7% (15 interventions). All liver resections were performed at the Republican Scientific Center for

Emergency Medical Care named after academician V.Vakhidov, so the probability of performing these interventions was 12.4% (out of 121 patients). This indicates that in the vast majority of cases in various medical institutions of the Republic of Uzbekistan, organ-preserving open and laparoscopic operations are performed for echinococcosis.

The condition of the fibrous capsule determines the choice of the method for treating residual cavities. With an elastic fibrous capsule, resection interventions (ideal CE) were performed in 1.7% of patients in the control group and 1.9% in the main group, laparoscopic CE accounted for 29.1% and 38.5%, respectively, and open CE for 69.2% and 59.6%. With a rigid fibrous capsule, resection interventions (ideal CE) were performed in 4.3% of patients in the control group and 8.0% in the main group, laparoscopic CE accounted for 8.5% and 23.9%, respectively, and open CE for 87.2% and 68.2%.

Against this background, the introduction of the proposed method for treating residual cavities with a rigid fibrous capsule has led to changes in the structure of surgical treatment for echinococcosis, including an increase in the proportion of laparoscopic interventions from 8.5% (8 out of 94 in the control group) to 23.9% (21 out of 88 patients in the main group), the proportion of liver resections from 4.3% to 8.0%, and a decrease in the frequency of open surgeries from 87.2% (82 patients) to 68.2% (60 patients) ($\chi2=9.867$; df=2; p=0.008). Moreover, there has also been a change in the structure of methods for eliminating residual cavities; in particular, while there was a non-significant increase in the proportion of abdominalization of residual cavities during laparoscopic CE from 10% (only in 1 out of 10 cysts in the control group) to 40% (in 10 out of 25 cysts in the main group; $\chi2=2.983$; df=1; p=0.085), in open surgeries, the proportion of complete closure of residual cavities increased from 6.2% (in 6 out of 97 cysts in the control group) to 37.5% (27 out of 72 cysts in the main group), the frequency of closure with drainage was 4.1% and 20.8%, respectively, abdominalization was 15.5% and 19.4%, and the frequency of partial pericystectomy with drainage decreased from 74.2% to 22.2% ($\chi2=52.861$; df=3; $p<0.05$).

REFERENCES

1. Framework for control and prevention of soil-transmitted helminthiases in the WHO European Region 2016–2020.
2. Azizzoda ZA, Kurbonov KM, Ruziboyzoda KR, Ali-Zade SG. Efficiency of minimally invasive surgeries in hepatic echinococcosis and its complications. Annals of Surgical Hepatology. 2021;26(1):84-91. https://doi.org/10.16931/1995-5464.2021184-91.
3. Akhmedov IG. Analysis of long-term results of surgical treatment of echinococcosis: methodological aspects. Annals of Surgical Hepatology. 2016;21(4):113-118. https://doi.org/10.16931/1995-5464.20164113-118.
4. EFSA Panel on Biological Hazards (BIOHAZ) Koutsumanis K, Allende A, Alvarez-Ordóñez A, Bolton D, Bover-Cid S, et al. Public health risks associated with food-borne parasites. EFSA J. 2018;16:5495.
5. Ok ÜZ, Kilimcioğlu AA, Özkol M. Türkiye'de İnsanlarda Kistik Ekinokokkoz [Cystic Echinococcosis in Humans in Turkey]. Mikrobiyol Bul. 2020 Jul;54(3):510-522. Turkish. doi: 10.5578/mb.69712. PMID: 32755525
6. Akkapulu Nezih, Aytac H Ozgur, Arer Ilker M, Kus Murat, Yabanoglu Hakan. Incidence and risk factors of biliary fistulation from a hepatic hydatid cyst in clinically asymptomatic patients. Tropical Doctor. 2017;48(1):20–24.

7. Wen H, Vuitton L, Tuxun T, Li J, Vuitton DA, Zhang W, McManus DP. Echinococcosis: Advances in the 21st Century. Clin Microbiol Rev. 2019;32(2):e00075-18. doi: 10.1128/CMR.00075-18.
8. Robles R., Parilla P. Abscesos y quistes hepáticos. Guias Clinicas de la A.E.C. Cirugía Hepática. 2018; 6:106-123.