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Original paper

Ultrasonic cavitation and decasan irrigation for residual cavity management in liver cystic echinococcosis: a retrospective comparative study from an endemic region

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ABSTRACT. Most often, *Echinococcus* parasitizes in the liver, causing the need for surgical treatment, the results of which currently do not meet expert expectations due to the high frequency of postoperative complications and the risk of relapse. The aim of the study is to improve the results of surgical treatment of liver echinococcosis by improving the tactical aspects of treatment and elimination of the residual cavity after echinococcectomy to prevent the development of purulent-septic complications. The object of the study was 442 patients with liver echinococcosis treated in the abdominal surgery of the Khorezm Regional Multidisciplinary Medical Center for the period from 2010 to 2023. To achieve the research goal and address the objectives, the following methods were used: general clinical, biochemical, instrumental and statistical methods. When determining the tactics and volume of surgical intervention, we recommend using the proposed method for treating the residual cavity using ultrasonic cavitation and a 0.02% Decasan solution, which minimized the development of purulent-septic complications in the immediate and long-term period after surgery. The new approach significantly reduced postoperative drainage needs (63.8% vs 36.6%, $P < 0.001$), complications (12.5% vs 5.4%, $P < 0.001$), and increased uncomplicated recovery (93.1% vs 80.0%). Drainage duration decreased from 11.3% to 3.5% in the long-term follow-up.

Keywords: liver echinococcosis, purulent-septic complications, ultrasonic cavitation, residual cavity, postoperative drainage, Decasan solution

Introduction

According to the WHO, over one million people worldwide are affected by echinococcosis, with incidence rates varying more than 200-fold between endemic and non-endemic regions [1]. Currently, the most relevant research in the world practice is to verify the genetic characteristics of various types of echinococcosis with the definition of etiological sources for each genotype of the parasite, epidemiology of causal factors of parasitization in humans, with the identification of features of the lesion and localization in various organs. Particularly relevant are the issues of studying the physicochemical characteristics and antiparasitic properties of various methods of treating the residual cavity (OP) after echinococcectomy, in particular, studies are being conducted to compare the scolicidal efficiency of nanoparticles of such substrates as silver, iron, copper, silica and zinc oxide, which in general will be aimed at reducing the risk of relapse of the disease against the

background of the removal of verified hydatids and the probability of preservation of parasite particles in the area of the fibrous capsule (FC).

At present, large-scale work on social protection of the population and improvement of the health care system continues. In this direction, in particular, in improving the surgical treatment of patients with liver echinococcosis (EP), positive results have been achieved. At the same time, improving the care provided to these patients requires evidence-based results on improving the effectiveness of surgical intervention, taking into account reducing the frequency of complications and preventing relapse of the disease.

Echinococcus granulosus is one of the global diseases that threaten human life. In 50–70% of cases, *Echinococcus* affects the liver, the second most common organ is the lung (20–30%), other organs are less often affected. The absence of symptoms is one of the most dangerous characteristics, so the size of cysts can reach gigantic, which is fraught with the possibility of their rupture with contamination of the abdominal cavity [2]. Among the complicated forms of echinococcosis of the liver most often occurs suppuration of the cyst. A cyst breakthrough into the bile ducts, abdominal and pleural cavities is much less common [3]. The mortality rate is between 2% and 4%, but may increase significantly if inadequate care is not provided [4].

Treatment of EP remains an urgent problem. One of the reasons is the lack of highly effective antiparasitic drugs, which necessitates complex surgical interventions [5]. Currently, the only drugs that have an antiparasitic effect in echinococcosis are benzimidazole derivatives: mebendazole and albendazole. Currently, there is no alternative drug to albendazole for the treatment of echinococcosis, and new compounds are urgently needed. Recently obtained genomic and proteomic information can become a platform for improving diagnostics and finding new targets for drugs and vaccines, which in the future will have a direct impact on the fight against echinococcosis, which continues to be a global problem [6].

In the literature, radical surgical interventions with removal of the fibrous capsule and organ-preserving operations are distinguished for EP [7]. Some authors use the term open and semi-open methods [8,9]. Classical surgical procedures used to treat echinococcal liver cysts are divided in relation to the pericyst into operations without resection of the pericyst (cystectomy) and operations with resection of the pericyst (partial pericystectomy, pericystoresection, hepatectomy). All these interventions are accompanied by procedures that should be used to treat OP: external drainage, drainage of the cavity and main bile duct, marsupilization, capitonage, etc. It should also be noted that liver transplantation can be a treatment option when it is not possible to save at least 25–30% of the total volume of the liver parenchyma or in cases where para- or post-hydatic cirrhosis of the liver [10].

At the same time, issues related to specific indications for surgical methods for eliminating the residual liver cavity, the choice of surgical intervention, access, and analysis of both immediate and long-term treatment results remain not fully understood. To solve such an urgent problem, taking into account the clinical experience accumulated over the past decades, it is necessary to develop new ways to improve the methods of surgical treatment of patients with liver echinococcosis and systematize adequate therapeutic tactics for differentiated treatment of this category of patients. In the light of the above, further research is needed to improve the known and develop new methods of surgical treatment of OP after echinococcectomy [11].

Thus, the question of eliminating residual cavities and preventing purulent-septic complications and relapses in solitary, multiple and recurrent echinococcosis is still open. The analysis of the literature concerning theoretical aspects and clinical experience of using technologies to improve modern interventions, tactical aspects related to the choice of the most rational method of surgery for long-term prognosis, indicates that this is one of the priority areas of surgery.

The aim of the study is to improve the results of surgical treatment of liver echinococcosis by improving the tactical aspects of treatment and elimination of the residual cavity after echinococcectomy to prevent the development of purulent-septic complications [12].

Materials and Methods

The study was based on the results of diagnostics and treatment of 442 patients with EP in the abdominal surgery of the Khorezm Regional Multidisciplinary Medical Center for the period from 2010 to 2023. The study was conducted in two

Table 1. Distribution of patients by group and type of surgery

Methodology	Uncomplicated echinococcosis		Complicated echinococcosis		Total	
	No.	%	No.	%	No.	%
Main group						
Treatment of the residual cavity with Decasan	170	100.0%	32	100.0%	202	100.0%
Ultrasonic cavitation of the fibrous capsule	121	71.2%	29	90.6%	150	74.3%
Suturing (complete or partial) of the residual cavity	140	82.4%	23	71.9%	163	80.7%
Comparison group						
Traditional treatment of the residual cavity	206	100.0%	34	100.0%	240	100.0%
Suturing (complete or partial) of the residual cavity	129	62.6%	8	23.5%	137	57.1%

Table 2. Distribution of patients by the number of cysts in the liver

Number of cysts	Main group		Comparison group	
	abs.	%	abs.	%
Solitary cyst	145	71.8%	178	74.2%
Multiple cysts	57	28.2%	62	25.8%
Total	202	100.0%	240	100.0%

stages. A program was developed for each stage, which included the content and scope of work, the indicators studied, and the expected results.

The materials of the study were information obtained from the archive by reviewing information from the medical records of an inpatient patient: socio-demographic characteristics (area of residence), medical history of the disease, the number of cysts, localization of cysts, the nature of the postoperative course in terms of relapse development, relapse rate.

All patients were divided into two groups: the first (main) group included 202 patients who were treated with OP after echinococcectomy from the liver using an improved technique, and the second group included 240 patients who were treated with OP using traditional methods (Table 1).

As can be seen from the table, out of 202 patients in the main group, 170 patients were operated on with a diagnosis of uncomplicated EP and 32 patients with a diagnosis of complicated EP. In the comparison group, out of 240 patients with uncomplicated EP, 206 patients and 34 patients with complicated EP were operated on.

When distributing patients by the number of cysts in the liver, it was noted that solitary parasite was diagnosed in 145 (71.8%) patients from the main group and in 178 (74.5%) patients from the comparison group, multiple EP was diagnosed in 57 (28.2%) from the main group and in 62 (25.8%) patients from the comparison group (Table 2).

The distribution of patients with solitary EP in the compared groups is shown in Table 3. As can be seen from the table, the dominant method of surgical intervention in the main group was suturing of the residual cavity, which was performed in 87 (60.0%) patients, and in the comparison group this intervention was performed in only 56 (31.5%) patients.

Table 4 shows the distribution of patients with multiple cysts in the liver by type of surgery. The number of patients from the main group who

Table 3. Distribution of patients with solitary liver cysts by type of surgery

Operation type	Main group							
	Up to 5.0 cm		5.1–10.0 cm		More than 10.0 cm		Total	
	abs.	%	abs.	%	abs.	%	abs.	%
Closure of the residual cavity	4	2.8%	38	26.2%	45	31.0%	87	60.0%
Suturing the residual cavity on drainage	0	0.0%	9	6.2%	16	11.0%	25	17.2%
Perfect echinococcectomy	0	0.0%	2	1.4%	4	2.8%	6	4.1%
Residual cavity drainage	0	0.0%	5	3.4%	12	8,3%	17	11.7%
Abdominization of the residual cavity	0	0.0%	6	4.1%	4	2.8%	10	6.9%
Abdominization and drainage of the residual cavity	0	0.0%	0	0.0%		0.0%	0	0.0%
Total	4	2.8%	60	41.4%	81	55.9%	145	100.0%
Operation type	Comparison group							
	Up to 5.0 cm		5.1–10.0 cm		More than 10.0 cm		Total	
	abs.	%	abs.	%	abs.	%	abs.	%
Closure of the residual cavity	1	0.6%	31	17.4%	24	13.5%	56	31.5%
Suturing the residual cavity on drainage	0	0.0%	17	9.6%	26	14.6%	43	24.2%
Perfect echinococcectomy	0	0.0%	2	1.1%	1	0.6%	3	1.7%
Residual cavity drainage	2	1.1%	15	8.4%	25	14.0%	42	23.6%
Abdominization of the residual cavity	2	1.1%	6	3.4%	5	2.8%	13	7.3%
Abdominization and drainage of the residual cavity	0	0.0%	9	5.1%	12	6.7%	21	11.8%
Total	5	2.8%	80	44.9%	93	52.2%	178	100.0%

underwent suturing of all residual cavities also prevailed here (38.6% vs. 19.4%, respectively).

Table 5 shows the distribution of patients by type of complication of liver echinococcosis. The intergroup representativeness by complication type corresponded to 1.54.

Characteristics of clinical research methods

We applied clinical, radiological, laboratory and immunological research methods. Clinical studies included a detailed study of complaints, medical and life history, and objective examination.

Laboratory tests included: general blood and urine tests in dynamics, biochemical blood tests, total bilirubin and its fractions, AlT, AsT, urea, residual nitrogen, creatinine, total protein and its fractions, blood clotting time.

Surgical treatment methods depended on their location, prevalence, presence of certain complications, and severity of the patient's condition. Generally accepted methods of echinococcectomy were used: pericystectomy and OP treatment with various methods of suturing, such as capitonage, suturing with pouch sutures along the Delba, and with marginal locations – ideal echinococcectomy without opening the cavity. All surgical interventions were performed after preoperative preparation, the volume and duration

Table 4. Distribution of patients with multiple liver cysts by type of surgery

Type of operation	Main group							
	2 cysts		3–4 cysts		5 or more cysts		Total	
	abs.	%	abs.	%	abs.	%	abs.	%
Closure of all residual cavities	20	35.1%	2	3.5%	0	0.0%	22	38.6%
Suturing of residual cavities on drainage	11	19.3%	3	5.3%	0	0.0%	14	24.6%
Suturing 1-2 residual cavities and draining others	0	0.0%	6	10.5%	3	5.3%	9	15.8%
Drainage of residual cavities	2	3.5%	2	3.5%	2	3.5%	6	10.5%
Abdominization of residual cavities	1	1.8%	1	1.8%	1	1.8%	3	5.3%
Abdominization and drainage of residual cavities	0	0.0%	1	1.8%	2	3.5%	3	5.3%
Total	34	59.6%	15	26.3%	8	14.0%	57	100.0%
Type of operation	Comparison group							
	2 cysts		3–4 cysts		5 or more cysts		Total	
	abs.	%	abs.	%	abs.	%	abs.	%
Closure of all residual cavities	12	19.4%	0	0.0%	0	0.0%	12	19.4%
Suturing of residual cavities on drainage	13	21.0%	3	4.8%	0	0.0%	16	25.8%
Suturing 1-2 residual cavities and draining others	0	0.0%	6	9.7%	1	1.6%	7	11.3%
Drainage of residual cavities	9	14.5%	4	6.5%	4	6.5%	17	27.4%
Abdominization of residual cavities	2	3.2%	1	1.6%	0	0.0%	3	4.8%
Abdominization and drainage of residual cavities	4	6.5%	2	3.2%	1	1.6%	7	11.3%
Total	40	64.5%	16	25.8%	6	9.7%	62	100.0%

Table 5. Distribution of patients by type of complication of liver echinococcosis

Type of complication	Main group		Comparison group	
	abs.	%	abs.	%
Cyst suppuration	14	6.9%	15	6.3%
Calcification	2	1.0%	3	1.3%
Cystobiliary fistulas	10	5.0%	11	4.6%
Breakthrough in the biliary tract	2	1.0%	1	0.4%
Breakthrough in the abdominal cavity	2	1.0%	3	1.3%
Breakthrough in the pleural cavity	2	1.0%	1	0.4%
Total	32	15.8%	34	14.2%

Table 6. Distribution of patients according to the method of treatment of residual cavities after echinococcectomy

Treatment of residual cavities	Main group		Comparison group	
	abs.	%	abs.	%
Complete elimination of residual cavities	115	56.9%	71	29.6%
Partial elimination of residual cavities	48	23.8%	66	27.5%
Drainage of residual cavities	26	12.9%	87	36.3%
Abdominization of residual cavities	13	6.4%		16 6.7%
Total	202	100.0%	240	100.0%
	Criterion $\chi 2$=43.545; df=3; P<0.001			

of which were individual depending on the severity of the condition and complications. Mostly (82.3%) organ-preserving operations (closed and semi-closed echinococcectomies) were performed.

A retrospective analysis of medical records revealed that 5% iodine solution and 96% ethyl alcohol were used to treat OP. Subsequently, we applied the following scheme for the treatment of OP: treatment with 5% iodine solution, 70% ethyl alcohol, 0.02% Decasan solution. In addition, for medium and large OP sizes and intrahepatic location, ultrasonic cavitation was used using the SIGMA-01 apparatus (Manufacturer: XYZ, France; 1990) with a frequency of 26.4–26.6 kHz.

Methods of statistical analysis

Statistical processing of the material was carried out on a Pentium IV computer using MS Office Excel for Windows XP application programs. The arithmetic mean (M), its error (m), and the mean square deviation (σ) were calculated, and the significance of differences was established using the Student-Fisher criteria (t).

Ethical approval and consent to participate

The study was conducted according to the ethical standards of Urgench Branch of Tashkent Medical Academy and Khorezm Regional Medical Center. Retrospective data analysis was approved by the Institutional Review Board (Protocol No. 06-2023/UBTMA).

Results

The comparative analysis was carried out taking into account the representative division between the main group of patients who underwent various types of residual cavity (OP) elimination, taking into

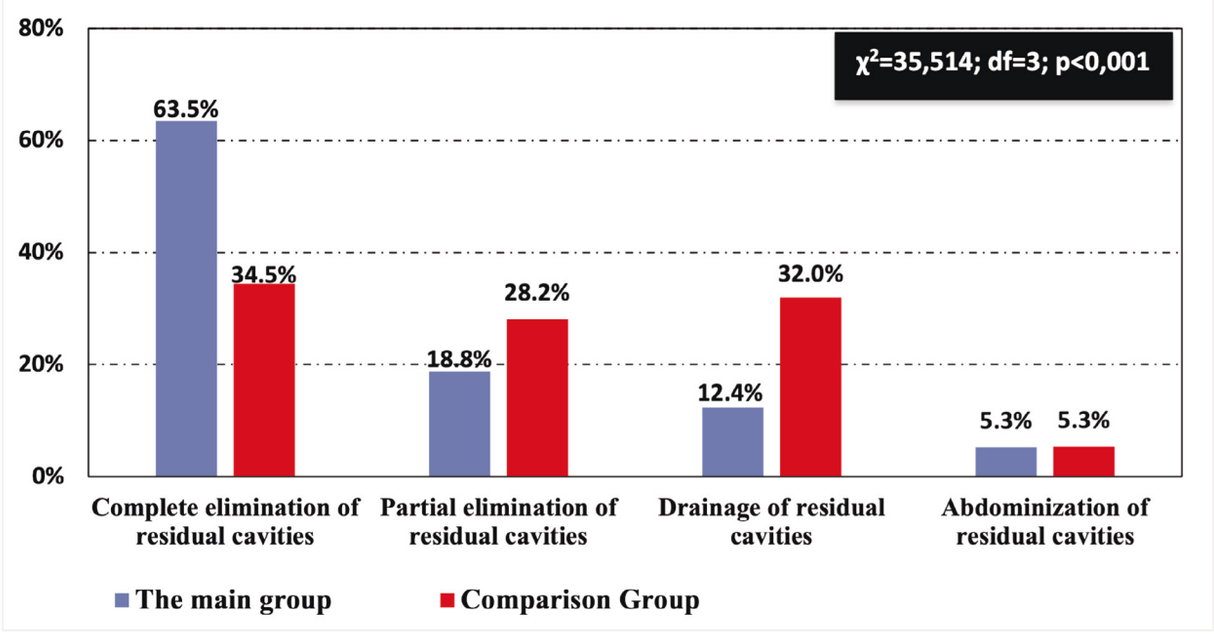

Figure 1. Distribution of patients according to the method of treatment of residual cavities after surgery for uncomplicated echinococcosis

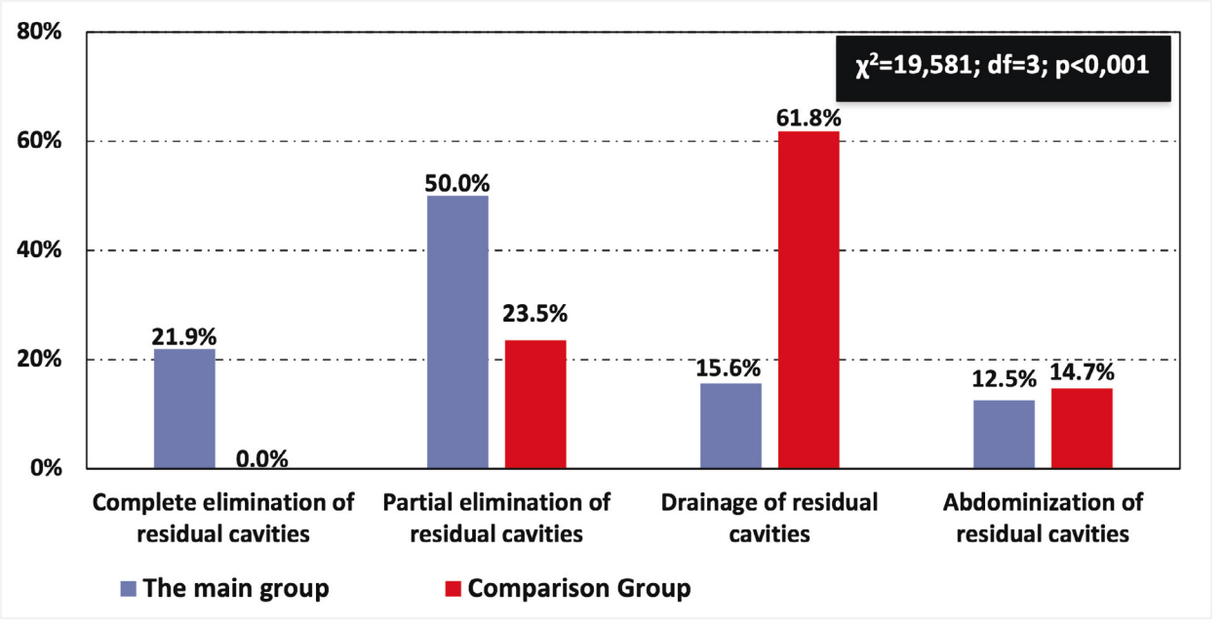

Figure 2. Distribution of patients according to the method of treatment of residual cavities after surgery for complicated echinococcosis (all complications)

account their pretreatment with an antiseptic in combination with ultrasonic cavitation, and the comparison group, whose patients underwent the same type of intervention with pretreatment of OP by traditional methods.

The nature of operations performed in the compared groups included: complete elimination of residual cavities, partial elimination of residual cavities, drainage of residual cavities, abdominization of residual cavities.

The comparative analysis was carried out taking into account the study of the results of the immediate period, the long-term period, and the assessment of QOL after various types of echinococcectomy.

Table 6 shows the summary results of the distribution of patients according to the method of OP treatment after echinococcectomy. As can be seen from the table, complete elimination of OP was performed in 115 (56.9%) patients from the main group and in 71 (29.6%) patients from the comparison group; partial elimination of OP was performed in 48 (23.8%) patients from the main group and in 66 (27.5%) patients from the comparison group; drainage of OP 26 (12.9%) patients from the main group and 87 (36.3%) patients from the comparison group were performed; OP abdominization was performed in 13 (6.4%) patients from the main group and 16 (6.7%) patients from the comparison group.

The next stage of comparison was the distribution of patients according to the method of OP treatment, taking into account the clinical course of echinococcosis (complicated and uncomplicated), which is reflected in Figures 1 and 2.

Thus, the distribution of patients according to the method of treatment of OP with uncomplicated EP (Fig. 1) showed that complete elimination of OP was performed in 108 (56.9%) patients from the main group and 71 (29.6%) patients from the comparison group; partial elimination of OP was performed in 32 (18.8%) patients from the main group and 58 (32.0OP drainage was performed in 21 (12.4%) patients from the main group and 66 (32.0%) patients from the comparison group; OP abdominization was performed in 9 (5.3%) patients from the main group and 11 (5.3%) patients from the comparison group. The significance of differences between groups was assessed using $\chi 2 = 35.514$; df = 3; $P < 0.001$.

The distribution of patients according to the method of treatment of residual cavities with complicated EP is shown in Fig. 2. As can be seen from the diagram, only 7 (21.9%) patients from the main group were completely eliminated; 16 (50.0%) patients from the main group and 8 (23.5%) patients from the comparison group were partially eliminated; 5 (15.6%) patients from the main group were drained. Abdominal surgery was performed in 4 (12.5%) patients from the main group and in 5 (14.7%) patients from the comparison group. The significance of the difference in the compared

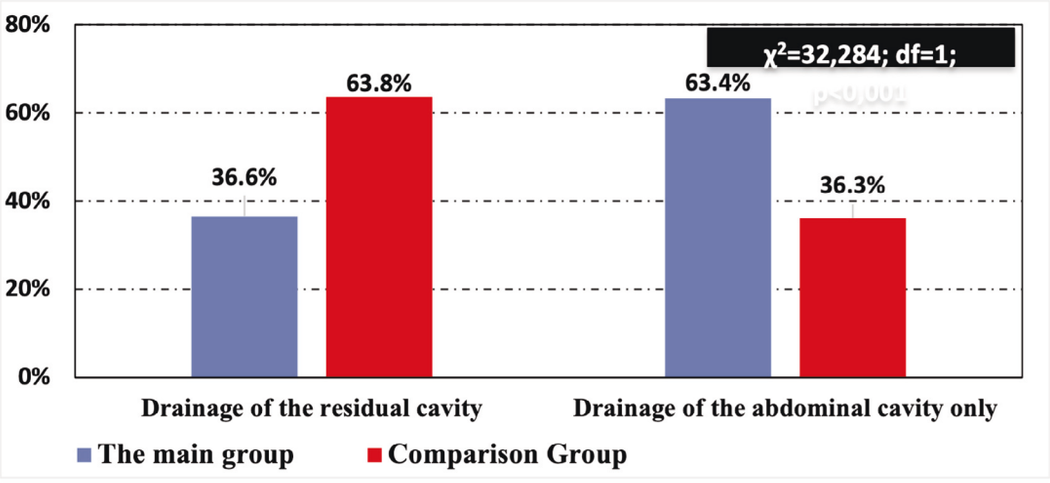

Figure 3. Distribution of patients by OP drainage frequency

Table 7. The nature and amount of drainage discharge from the residual cavity in the early postoperative course

Type and volume of discharge	Main group		Comparison group	
	abs.	%	abs.	%
Serous	26	12.9%	26	10.8%
up to 50 ml	17	8.4%	9	3.8%
50–100 ml	7	3.5%	12	5.0%
more than 100 ml	2	1.0%	5	2.1%
Serous-hemorrhagic	36	17.8%	82	34.2%
up to 50 ml	23	11.4%	66	27.5%
50–100 ml	11	5.4%	11	4.6%
more than 100 ml	2	1.0%	5	2.1%
Purulent	3	1.5%	19	7.9%
up to 50 ml	2	1.0%	14	5.8%
50–100 ml	1	0.5%	4	1.7%
more than 100 ml	0	0.0%	1	0.4%
Bile	9	4.5%	26	10.8%
up to 50 ml	6	3.0%	11	4.6%
50–100 ml	2	1.0%	9	3.8%
more than 100 ml	1	0.5%	6	2.5%
Total patients with residual cavity drainage	74	36.6%	153	63.8%

groups was determined in the limits $\chi 2 = 19.581$; df = 3; $P < 0.001$.

Figure 3 shows the distribution of patients by the frequency of drainage of residual cavities. At the same time, in the main group, OP drainage was performed in 74 (36.6%) patients, and in the comparison group – in 153 (63.8%) patients. The significance of differences between groups was assessed using $\chi 2 = 32.284$; df = 1; $P < 0.001$.

According to the nature and amount of OP discharge from the drainage, which are reflected in Table 7, patients were distributed as follows: serous

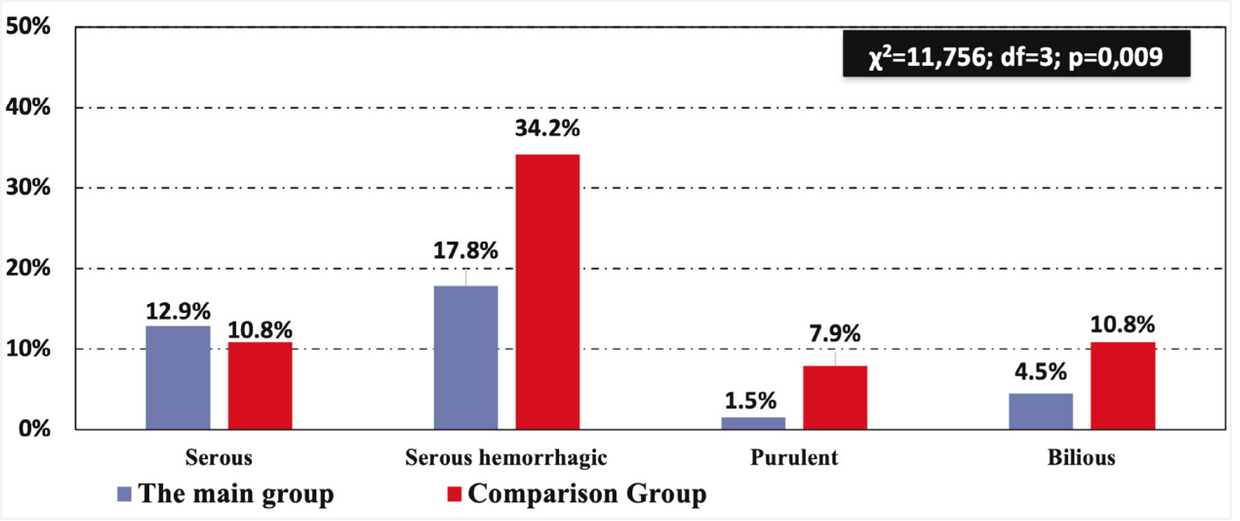

Figure 4. Comparative data on the nature of drainage discharge from the residual cavity in the early postoperative course

discharge was observed in 26 (12.9%) patients from the main group, with a maximum (more than 100 ml/day) in only 2 (1.0%) of them; in the comparison group, serous discharge was observed in 26 (12.9%) patients from the main group. discharge was also observed in 26 (10.8%) patients, but with maximum discharge in 5 (2.1%) of them. Serous-hemorrhagic discharge occurred in 36 (17.8%) patients from the main group, with maximum discharge in 2 (1.0%) of them; in the comparison group-in 82 (34.2%) patients, with maximum discharge in 5 (2.1%) of them. Purulent discharge was observed in only 3 (1.5%) patients from the main group, with discharge up to 100 ml /day in 1 (0.5%) of them; in the comparison group – in 19 (7.9%) patients, with maximum discharge in 1 (0.4%) of them. Bile discharge was observed in 9 (4.5%) patients from the main group, with maximum discharge in only 1 (0.5%) of them; in the comparison group – in 26 (10.8%) patients, with maximum discharge in 6 (2.5%) of them. A more vivid picture of significant differences in the comparative analysis of data on the nature of drainage discharge from the OP in the early postoperative course is shown in the diagram of Fig. 4. The statistical significance was confirmed by $\chi 2 = 11.756$; df = 3; $P = 0.009$.

Figure 5 shows the number of patients discharged with drains. So, 62 (30.7%) patients from the main group and 138 (57.5%) patients from the comparison group were discharged with

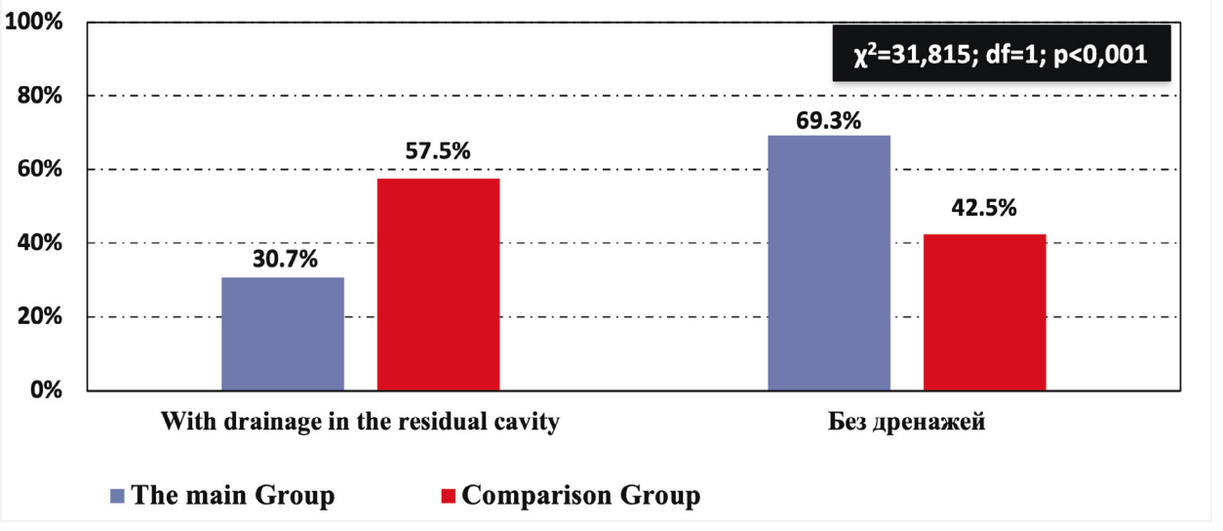

Figure 5. Percentage of patients discharged with residual cavity drainage

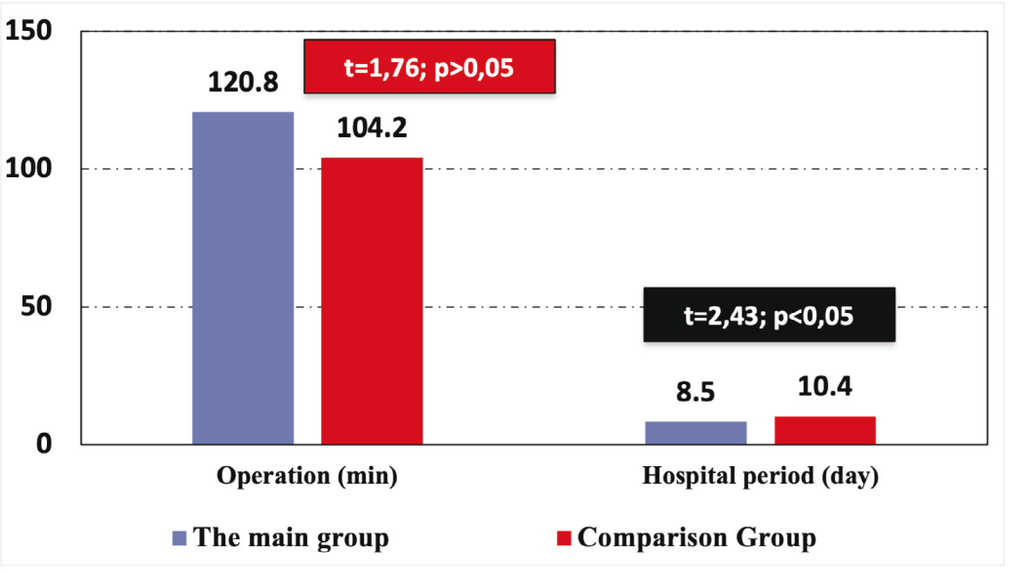

Figure 6. Average duration of surgery and hospital stay

drainage in the residual cavity. Accordingly, 140 (69.3%) patients from the main group and 102 (42.5%) patients from the comparison group were discharged without drainage.

When analyzing the average duration of the operation and the duration of the hospital period, it was noted that in the main group, the duration of the operation on average corresponded to 120.8 minutes, and in the comparison group – 104.2 minutes (t = 1.76; $P > 0.05$), while the duration of hospitalization on average corresponded to 8.5 days in the main group, and in the comparison period – 10.4 days (t = 2.43; $P < 0.05$) (Fig. 6).

Thus, the proposed tactical aspects of surgical treatment of EP, taking into account the peculiarities of physical and chemical treatment of OP and the extended use of its elimination by complete or partial suturing, including large or complicated cysts, reduced the need for OP drainage from 63.8% (153 out of 240 patients in the comparison group) to 36.6% (74 out of 202 patients in the main group; $\chi 2$= 32,284; df = 1; $P < 0.001$), reduce the incidence of postoperative complications from 12.5% (30 patients in the comparison group) to 5.4% (11 patients in the main group; $\chi 2$= 21,469; df = 1; $P < 0.001$), and, in general, increase the proportion of discharged patients without safety drainage from 42.5% (102 patients in the comparison group) to 69.3% (140 patients in the main group; $\chi 2$= 31.815; df = 1; $P < 0.001$).

The main criteria for assessing the long-term period were: timing of drainage removal, complications in the long-term period, relapse of the disease, assessment of QOL in the long-term period.

Table 8 shows data on the timing of drainage removal after surgery. So, before 10 days, drains were removed in 140 (69.3%) patients from the main group and 102 (42.5%) patients from the

Table 8. Timing of drainage removal after echinococcectomy from the liver

Timing after surgery	Main group		Comparison group	
	No.	%	No.	%
In the nearest period (up to 10 days)	140	69.3%	102	42.5%
11–20 days	45	22.3%	66	27.5%
21–30 days	10	5.0%	45	18.8%
1–2 months	5	2.5%	21	8.8%
3 months or more	2	1.0%	6	2.5%
Total	202	100.0%	240	100.0%
	Criterion $\chi 2$=41,096; df=4; $P<0.001$			

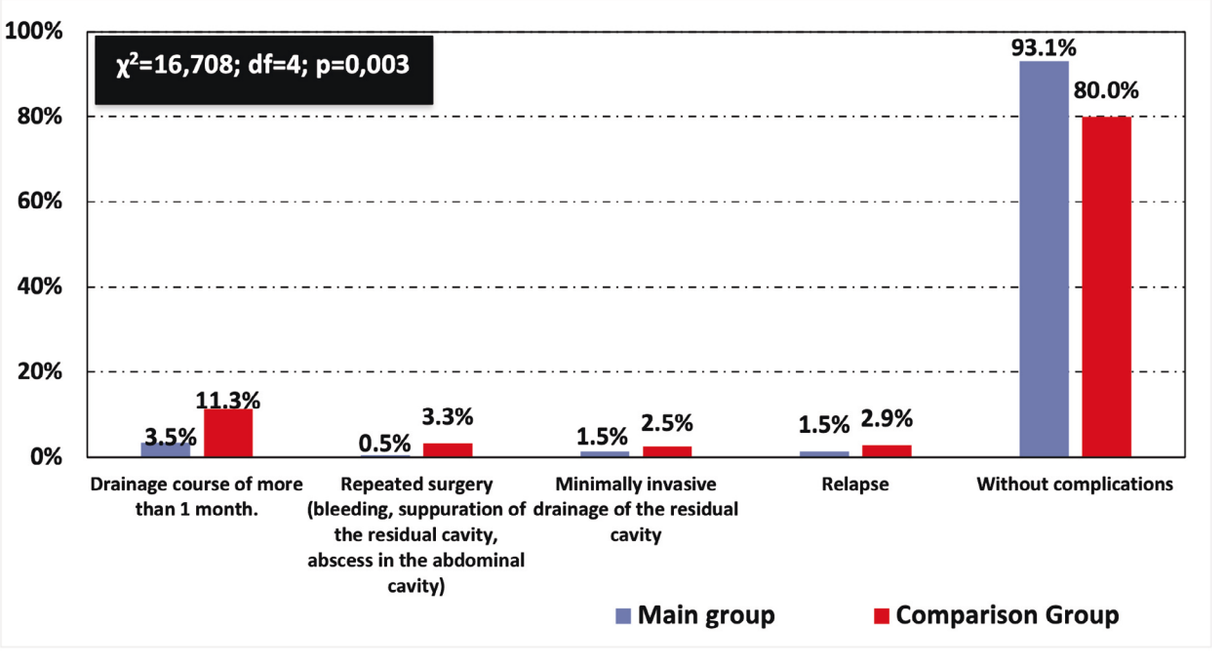

Figure 7. Summary results of surgical treatment of liver echinococcosis for up to 3 years of follow-up

comparison group; on days 11–20–45 (22.3%) patients from the main group and 66 (27.5%) patients from the comparison group; on days 21–30–10 (5.0%) patients from the main group and 45 (18.8%) patients from the comparison group; after 1–2 months-5 (2.5%) patients from the main group and 21 (8.8%) patients from the comparison group; after 3 months or more – 2 (1.0%) patients from the main group and 6 (2.5%) patients from the comparison group. The significance of differences between groups was assessed using $\chi 2 = 41,096$; df = 4; $P < 0,001$.

The structure and frequency of complications in the long-term postoperative course was tracked for up to 3 years and presented in Table 5 and 6. In total, the complicated course of the long-term period was observed in 9 (7.0%) patients from the main group and in 22 (15.0%) patients from the comparison group. As can be seen from Table 9, fluid accumulation in the OP was observed in 3 (2.3%) patients from the main group and in 8 (5.4%) patients from the comparison group; suppuration of the OP – in 2 (1.6%) patients from the main group and in 5 (3.4%) patients from the comparison group; abdominal abscess cavities – in 1 (0.8%) patient from the main group and in 2 (1.4%) patients from the comparison group; PEPR-in 3 (2.3%) patients from the main group and in 7 (4.8%) patients from the comparison group.

A more visual picture of the long-term period can be traced by the summary results of surgical treatment of EP in terms of up to 3 years of follow-up, which is shown in Fig. 7.

As can be seen from the diagram, an uncomplicated course of the long-term period after surgery was observed in 188 (93.1%) patients from

Table 9. Structure and frequency of complications in the long-term postoperative course up to 3 years

Complication	Main group (n=202)		Comparison group (n=240)	
	abs.	%	abs.	%
Fluid accumulation in the residual cavity 3	2.3%	8	5.4%	
Suppuration of the residual cavity	2	1.6%	5	3.4%
Abscess in the abdominal cavity	1	0.8%	2	1.4%
Relapse	3	2.3%	7	4.8%
Patients with complications	9	7.0%	22	15.0%

the main group and in 192 (80.0%) patients from the comparison group. The significance of differences between groups was assessed using $\chi 2 = 16.708$; df = 4; $P = 0.003$.

Discussion

Evaluation of the results of surgical treatment of liver echinococcosis with determination of the quality of life after surgery [13]. One of the most important indicators for evaluating the results of surgical treatment of EP is the subsequent determination of the patient's quality of life [14]. The result was evaluated as: good – no drains, no complications, satisfactory-complications resolved conservatively, long-term drainage, minimally invasive interventions on the residual cavity. Unsatisfactory: A. Repeated operations on the background of complications, B. Relapse of the disease.

The proposed tactical aspects of surgical treatment of EP, taking into account the features of physical and chemical treatment of the residual cavity and the extended use of its elimination by complete or partial suturing, including large or complicated cysts, reduced the need for drainage of the residual cavity from 63.8% to 36.6% ($\chi 2= 32.284$; df = 1; $P < 0.001$ reduced the rate of postoperative complications from 12.5% to 5.4% ($\chi 2= 21.469$; df = 1; $P < 0.001$) and, in general, increase the proportion of discharged patients without safety drainage from 42.5% to 69.3% ($\chi 2= 31.815$; df = 1; $P < 0.001$).

In the comparative aspect, in the follow-up period up to three years after liver echinococcectomy, the proposed tactical aspects of treatment of the residual cavity made it possible to reduce the need for the long-term drainage from 11.3% to 3.5%, reduce the frequency of repeated operations (from 3.3% in the comparison group to 0.5% in the main group) and minimally invasive interventions for complications (from 2.5% to 1.5%) and generally increase the proportion of uncomplicated course of the postoperative course from 80.0% to 93.1% ($\chi 2= 16.708$; df = 4; $P = 0.003$).

In a comparative aspect, in the follow-up period up to three years after liver echinococcectomy, the proposed tactical aspects of treatment of the residual cavity and postoperative monitoring allowed reducing the probability of an unsatisfactory treatment outcome, taking into account repeated interventions for complications and relapse of the disease, from 6.3% to 2.0%, and increasing the proportionof good results from 65.4% to 85.1% ($P < 0.001$).

Conclusions

This retrospective study provides compelling evidence that the combined use of ultrasonic cavitation and 0.02% Decasan irrigation for managing the residual cavity after liver echinococcectomy significantly improves both early and long-term clinical outcomes in patients with hepatic cystic echinococcosis [15]. The improved technique was associated with a marked reduction in purulent-septic complications (from 12.5% to 5.4%), decreased reliance on postoperative drainage (from 63.8% to 36.6%), shortened hospital stay, and a higher proportion of patients discharged without drains. Furthermore, the method contributed to a lower recurrence rate (2.3% vs. 4.8%) and enhanced the overall quality of life during long-term follow-up, with 93.1% of patients in the intervention group experiencing an uncomplicated recovery compared to 80.0% in the control group [16].

These findings are especially relevant in endemic settings where surgical intervention remains the cornerstone of treatment, and access to advanced antiparasitic therapies may be limited. By integrating a physical (ultrasound-based) and chemical (antiseptic) approach, this method provides a practical, cost-effective solution that aligns with global efforts to improve outcomes in parasitic diseases [17].

The promising results of this study warrant further investigation through multicenter prospective trials to validate reproducibility and generalizability [18]. Future research should also explore the microbiological mechanisms behind Decasan's scolicidal action in conjunction with cavitation and assess its effectiveness across different echinococcal genotypes. Incorporating real-time imaging and intraoperative assessment tools may further refine cavity management strategies. Additionally, combining this approach with adjuvant antiparasitic therapy could offer a comprehensive perioperative protocol that significantly reduces relapse risk [19]. Wider implementation of this technique, particularly in resource-constrained environments, could play a crucial role in reducing the global burden of cystic

echinococcosis, aligning with WHO targets for controlling neglected tropical diseases.

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