

Practice of Surgical Treatment for Patients with Combined Echinococcosis of Chest and Abdominal Organs

Bekdaulet Akimniyazova ^{1,2,3}, Galina Kausova¹, Temur Yeshmuratov ^{2,3,4}, Daniyar Toksanbayev ^{5,6}, Gulstan Esetova ²

¹ Kazakhstan's School of Public Health, Public Health Department, Almaty, Republic of Kazakhstan, ² Kazakh National Medical University named after S.D. Asfendiyarova, Pulmonology Department, Almaty, Republic of Kazakhstan, ³ Modern Medicine Center «MEDITERRA», Department of Thoracic Surgery and Pulmonology, Almaty, Republic of Kazakhstan, ⁴ Kazakh-Russian Medical University, Department of Surgery, Almaty, Republic of Kazakhstan, ⁵ Kazakh National Medical University named after S.D. Asfendiyarova, Department of Surgical Diseases with a Course of Clinical Anatomy, Almaty, Republic of Kazakhstan, ⁶ Modern Medicine Center «MEDITERRA», Department of Hepatopancreatobiliary Surgery and Gastroenterology, Almaty, Republic of Kazakhstan

Background: Epidemiological significance of echinococcosis is determined by the severe clinical progression leading to disability, incapacitation and death, a wide range of hosts, and formation of synanthropic and mixed lesions. The aim of the work was to analyze cases of combined echinococcosis of the chest and abdominal organs and the results of its surgical treatment in clinics of Almaty (Kazakhstan) from 1997 to 2019.

Materials and Methods: In 413 patients, 534 lesions of echinococcosis were revealed: single and multiple cysts. Concurrent echinococcectomy of 2–3 organs was performed in 261 patients; meanwhile phased echinococcectomy was performed in several organs in 152 patients.

Results: Performed surgical interventions in more than 70% of cases had a favorable outcome.

Conclusion: The choice of rational surgical tactics for combined echinococcosis should be based on an individual approach, taking into account the general condition of the patient, risk analysis and the likelihood of complications.

Key words: Zoonosis; Combined echinococcosis; Chest; Abdominal cavity; Kazakhstan; Thoracic surgery

Received: 15 December 2020

Accepted: 6 February 2021

Correspondence to: Akimniyazova B

Address: Kazakhstan's School of Public Health, Public Health Department, Almaty, Republic of Kazakhstan

Email: bekdaulet.akimniyazova@gmail.com

INTRODUCTION

Global importance of parasitic zoonoses, including echinococcosis, and its impact on state economies and public health were recognized by the Committee of Experts of the World Health Organization (WHO) back in 1980 (1). Echinococcosis caused by cestoids of *Echinococcus multilocularis* and *Echinococcus granulosus* (*E. granulosus*) of the Taeniidae family is one of the most serious zoonotic

pathologies of a zoonotic nature (2). According to the WHO classification, pathology refers to the so-called “neglected diseases” (3). The prevalence of pathology depends on environmental conditions that contribute to the perpetuation of the parasite, abundance of infected definitive hosts, degree of development of animal husbandry, the nature of pastures and grazing animals (4). In addition to areas of active grassland farming, especially

sheep breeding (Argentina, Paraguay, Uruguay, Greece, Asia), lesions of echinococcosis include areas of active distribution of intermediate helminth hosts - Arctic foxes (Alaska and northern Canada), foxes (Austria, Switzerland, Germany, Japan), and coyotes (China). In Russia, foci of echinococcosis are Tatarstan, Bashkortostan, Buryatia, Yakutia, Magadan, Amur Region, and Chukotka. In the territory of the former USSR, the largest number of infected people is observed in Moldova, Kazakhstan, Kyrgyzstan, Uzbekistan, Turkmenistan, and in the south of Ukraine (5).

Some authors consider the reason for the wide spread of the disease in the countries of the former USSR to be the socio-economic changes in agricultural practice after the collapse of the Soviet Union, such as the spread of an underground slaughter or the absence of antihistamine therapy for dogs (6).

As for Kazakhstan specifically, the main sustainable natural and synanthropic lesions of echinococcosis of the republic are Alma-Ata and Pavlodar regions and the region of Lake Balkhash. The epidemiology of echinococcosis in Kazakhstan depends on the technology of extensive animal husbandry, climatic and geobotanical conditions of the area, and on the level and usefulness of veterinary and sanitary measures aimed at preventing infection of the final and intermediate hosts of *E. granulosus* (7). The presence of intraspecific variations (strains, races, or isolates) allowed *E. granulosus* to adapt as much as possible to numerous species of final and intermediate hosts, as a result of which many different biological cycles and pathways of infection arose under different climatic conditions (7). In addition to the presence of extensive lesion of echinococcosis in Kazakhstan, the problem is complicated by the difficulty of establishing reliable diagnosis due to the absence of a pathognomonic symptom in the clinical picture. Patients are often given an erroneous diagnosis (destructive lung disease or tuberculosis), which does not contribute to healing and worsens the quality of life of patients (8).

The organs in which echinococcal cysts are most common are liver (65–70%) and lungs (25%) (9). One of the complex forms of echinococcosis in the diagnostic, tactical, therapeutic and prognostic relations is a combined lesion of the lungs, liver and other organs. Combined echinococcosis of the chest and abdominal organs is one of the causes of morbidity and disability in the Republic of Kazakhstan. In 2017, according to statistics, the incidence was 217 cases per 100,000 people.

The treatment of combined multiple bilateral echinococcosis of the chest and abdomen is a particularly difficult task for the surgeon. Cases of the results of surgical treatment of concomitant echinococcosis of heart and target organs (lungs and liver) are described in the literature (10). As for the combined multiple bilateral echinococcosis of the chest and abdominal organs, systematic studies of many years of experience in the surgery of this pathology are limited to only 3 publications (11–13). Operations of pulmonary echinococcosis are technically uncomplicated, and most surgeons prefer capitonnage of a fibrous capsule (12). Meanwhile, in the case of combined forms, intractable tactical problems arise. A small number of publications and clinical observations on surgical treatment lead to a lack of awareness of doctors about the diagnostic features and possibilities of surgical treatment. High risk of postoperative complications after echinococectomy and lack of a universal method are underscored by the fact that problems of surgical interventions with combined multiple bilateral echinococcosis of chest and abdominal organs remain “open”.

Based on this, the aim of the study was to analyze and evaluate the prevalence of cases of combined echinococcosis of the chest and abdominal organs and the results of its surgical treatment in clinics of Almaty. This analysis will fill the knowledge gap in the surgery of complex combined forms of echinococcosis and will solve some issues in the tactics of surgical treatment.

MATERIALS AND METHODS

A retrospective analysis of data from 413 patients with combined forms of echinococcosis was performed. The data were taken from the case histories of inpatients, hospital databases and archived patient records from 1997 to 2019. The study, approved by the local ethics committee, was carried out in 3 medical institutions in Almaty (Kazakhstan):

1. A.N. Syzganov. National Scientific Center of Surgery, Department of Thoracic Surgery (306 patients);
2. Center of Thoracic Surgery, City Clinical Hospital No. 1 (60 patients);
3. Department of Thoracic Surgery and Pulmonology of the Mediterra Medical Center (47 patients).

The data of 187 women and 226 men aged 3 years to 75 years were analyzed. Patients whose card data were used in the study, signed the informed voluntary consent to data processing. The legal representatives of the children (parents or guardians) also agreed to the processing of the data. All ethical aspects of the study, including confidentiality and non-disclosure of personal information, were observed.

The following indicators were studied and statistically processed: gender, age, social status of the patient, contact with dogs, presence of comorbidity, nature of the combined organ damage, number and localization of echinococcal cysts, types of surgical interventions and the outcome of the surgery.

Diagnosis of echinococcosis was carried out on the basis of objective data and medical history, laboratory and radiation methods and pathomorphological studies. To assess the success of surgical treatment, we used indicators of the visual analogue scale (VAS) (14) and analyzes of ultrasound examination (ultrasound), chest X-ray (OGC), and magnetic resonance imaging of the abdominal cavity and retroperitoneal space (MRI) and spirometry; subjective indicators (patient complaints) were also taken into account. A relapse of echinococcosis was considered to be the return of subjective and objective symptoms after surgical intervention. With such an intervention, the possibility of damage due to the irradicality of the first operation or its technical errors that led to the dissemination of the parasite was excluded. Relapse of echinococcosis was detected using enzyme immunoassay,

ultrasound, computed tomography and pathomorphological studies.

The results of surgical treatment were considered good in the absence of complaints, a satisfactory general condition of the patient, absence of residual cavities during ultrasound, changes in the X-ray of the thoracic organs, and with proper spirometry and MRI of the abdomen and retroperitoneal space. In the presence of complaints of coughing and shortness of breath at the slightest exertion, chest pain on the side of surgery and symptoms of chronic bronchitis the result was found to be satisfactory. An unsatisfactory result was considered in the detection of recurrence of echinococcosis, presence of acquired chronic suppurative diseases of the lungs and pleura (residual cavities with suppuration, formation of non-parasitic cysts, hepatic cirrhosis, pleural empyema) requiring surgical correction, since this causes disability, and death due to underlying disease. Statistical analysis of the data was carried out using MS Office Excel 2007. Arithmetic means and standard deviation (Mean \pm SD) were calculated. Differences were considered significant at $p \leq 0.05$.

RESULTS

As can be seen from Table 1, the most common combination of echinococcosis is observed in children and adolescents aged 8 to 18 years (104-25.2%), and echinococcosis in people of working age from 19 to 59 years is also noted (267- 64.6%).

Table 1. Patient distribution by gender and age*

Age	Gender				Total patients	
	Male		Female		Abs. №	%
	Abs. № **	%	Abs. №	%		
Up to 3 years	4	1.0	1	0.3	5	1.3
4-7 years	15	3.6	11	2.6	26	6.2
8-14 years	34	8.2	16	3.9	50	12.1
15-18 years	31	7.5	23	5.6	54	13.1
19-34 years	72	17.4	62	15.1	134	32.5
35-59 years	64	15.4	69	16.7	133	32.1
60-75 years	7	1.6	4	1.0	11	2.6
%Total	226	54.7	187	45.3	413	100.0

* $P < 0.05$, statistically significant differences between the groups

**hereinafter, absolute number of cases

Data on the social status of patients and contact with animals are presented in Table 2. The vast majority of infected patients are working people who have contact

with dogs. Presence of patients of middle and older age groups determined the presence of comorbidity in 97 patients (in 31.8% of cases) (Table 3).

All patients based on the nature of the combined lesions of echinococcosis of several organs are divided into 6 groups (Table 4). The pathology characteristics according to the number of echinococcal cysts and organ damage are presented in Table 5.

In the vast majority of cases, multiple cysts of both hepatic lobes (~ 25%) and multiple lung cysts (~ 18%) were diagnosed. Given the nature of the combined lesion of echinococcosis, patients have an individual approach to surgical tactics, which implies a combination of one-stage-one-stage methods (removal of parasitic cysts of the lung and liver with one access), one-stage-sequential (transition from thoracotomy to thoracotomy or from thoracotomy to laparotomy) and phased (division intrathoracic and intra-abdominal stages of the operation) method; while the surgical intervention included two groups:

Group I included patients who underwent simultaneous consecutive echinococectomy from two to three organs - 261 (63.3%) patients.

In group II - patients who underwent phased echinococectomy from several organs with an interval of 2 weeks to 6 months - 152 (36.7%) patients.

The criteria for determining indications and contraindications for simultaneous and stepwise surgical interventions were: localization, size and number of cysts, presence of complications and / or the likelihood of their occurrence, patient's age, presence of concomitant pathologies and / or previous surgery (not related to echinococcosis). In 63% of cases, simultaneous surgery was performed i.e. mainly left thoracotomy, echinococectomy from the lung and laparotomy, and echinococectomy from the liver (Table 6).

Surgical interventions had a favorable outcome in more than 70% of cases (Table 7).

Table 2. Distribution of patients with combined echinococcosis by factors of social status, contact with dogs and place of residence*

Place of residence	Social status					Contact with dogs	
	Children up to 7	School children	Students	Working people	Non-working people	Yes	No
City - 50,8%	2.60%	9.50%	4.60%	28.80%	5.20%	20.30%	30.50%
210	11	39	19	119	22	84	126
Village - 49,2%	5%	12.80%	8.20%	9.20%	14.10%	37.40%	11.80%
203	21	53	34	38	58	154	49
Total - 100%	7.60%	22.30%	12.80%	38.00%	19.30%	57.70%	42.30%
413	31	92	53	157	80	238	175

*P < 0.05, statistically significant differences between the groups

Table 3. Distribution of patients depending on comorbidity

Comorbidity	Number	%
Coronary heart disease	17*	5.6
Coronary atherosclerosis	8*	2.6
Arterial hypertension	12**	3.9
Valvular heart disease	2*	0.6
Gastric ulcer, remission	13**	4.2
Chronic obstructive bronchitis	10*	3.3
Chronic calculous cholecystitis	9*	2.5
Pneumosclerosis, pulmonary emphysema	5*	1.6
Hepatocirrhosis, chronic hepatitis	2*	0.6
Diabetes mellitus, compensation	4*	1.3
Hyperadiposity, degree iii-iv	2*	0.6
Lower extremity varicose vein disease	11**	3.6
Residual effects of cerebrovascular accident	2*	0.6
Total	97	31.8

*P < 0.05, statistically significant differences between the groups

**no statistically significant differences

Table 4. Nature of the combined lesion of echinococcosis of the chest and abdomen*

Nature of organ damage	Number	
	Abs. No.	%
Lungs echinococcosis	100	24.1
Echinococcosis of the right lung and hepatic	134	32.4
Echinococcosis of the left lung and hepatic	97	23.6
Echinococcosis of the lungs, hepatic and abdominal cavity	58	14.1
Echinococcosis of the lung and mediastinum	19	4.6
Echinococcosis of the right lung, diaphragm and retroperitoneal space	5	1.3
Total	413	100

*P < 0.05, statistically significant differences between the groups

Table 5. Pathology characteristics by the number of echinococcal cysts and organ damage

Type of damage	Number of damaged organs	
	Abs.	%
Single cysts of the right lung	30*	5.6
Single cysts of the left lung	21*	4.0
Single lung cysts	9*	1.7
Multiple cysts of the right lung	84*	15.7
Multiple cysts of the left lung	51**	9.5
Multiple cysts of the right lung	96*	17.9
Multiple cysts of both lobes of hepatic	132*	24.7
Single cyst of the diaphragmatic surface of hepatic	40*	7.4
Multiple cysts of hepatic and abdomen	53**	9.9
Multiple mediastinal cysts	14*	2.6
Multiple cysts of the diaphragm, retroperitoneal space	4*	0.7
Total	534	100

*P < 0.05, statistically significant differences between the groups

**no statistically significant differences

Table 6. Types of surgical interventions with a combined lesion of echinococcosis of the chest and abdominal organs

Name of operative intervention	Stage wise operative treatment		Single-step operative treatment	
	abs./%		abs./%	
Bilateral thoracotomy, echinococcectomy from the lungs	16*	10.8	17**	6.5
Bilateral thoracotomy, echinococcectomy from the lungs			8**	3.0
Thoracotomy on the left, echinococcectomy from the lung. Transmediastinal echinococcectomy from the right lung			9**	3.6
Thoracotomy on the right, echinococcectomy from the lung. Laparotomy, echinococcectomy from the hepatic	18*	12.1	19*	7.2
Thoracophrenicotomy on the right, echinococcectomy from the lung and hepatic			18**	6.8
Thoracoscopy on the right, echinococcectomy from the lung, phrenotomy, echinococcectomy from hepatic			16*	6.2
Thoracotomy on the left, echinococcectomy from the lung. Laparotomy, echinococcectomy from hepatic	12	8.2	29*	11.1
Thoracoscopy on the left, echinococcectomy from the lung. Laparotomy, echinococcectomy from hepatic			11*	4.3
Laparotomy, echinococcectomy from hepatic and abdominal cavity	8	5.5	22*	8.5
Thoracic phrenicotomy, echinococcectomy from the lung, diaphragm and retroperitoneal space			3*	1.3
Thoracotomy, echinococcectomy from the lung and mediastinum			12*	4.6
Total	152	36.7 %	261	63.3 %

*P < 0.05, statistically significant differences between the groups

**no statistically significant differences

Table 7. Analysis of treatment results for patients with combined complicated echinococcosis of the chest and abdominal organs

Outcome	Number of patients	
	abs.	%
Favorable	305*	73.8
Satisfactory	100*	24.2
Unsatisfactory	6**	1.5
Fatal	2**	0.5
Total	413	100

*P < 0.05, statistically significant differences between the groups

**no statistically significant differences

DISCUSSION

Gender and age

As can be seen from Table 1, men predominate slightly by gender (226 against 187). A similar gender distribution was observed in a study conducted by Iraqi scientists (2).

As for age, both children from 3 years old and elderly people are affected. The greatest number of cases was recorded among people of working age from 19 to 59 years of both genders (267-64.6%), as well as in children and adolescents aged 8 to 18 years old (104-25.2%). Similar results were obtained in Iraq, where the maximum number of infected was found in the age group of 40–59 years (2). A high prevalence of pathology among children is observed in Jordan and Kyrgyzstan (2).

The high infection rate among children and adolescents can be explained by the fact that the latter are more likely to have contact with invasive domestic animals, especially with the main hosts of the parasite (dogs).

The frequency of echinococcosis in people of working age from 19 to 59 years underlines social significance of the problem under consideration. For adults, infection with echinococcus is more possible by alimentary way (through contaminated water and vegetation), as well as household items.

Social status, animal contact and place of residence

Due to the fact that the incidence of echinococcosis is influenced by social aspects, such as the nature of the profession, migration processes and contact with animals, an analysis of these factors, as being likely in terms of

infection with the parasite, is carried out. The data presented in table 2, are interesting from several points of view.

The first position is the place of residence. Among 413 patients, 210 (50.8%) are residents of the city, and 203 (49.2%) live in the village. In our studies, the proportion of city residents with a combined lesion of echinococcosis was higher, in contrast to the statistics of other researchers, which is associated with the urbanization of the population in recent years. At the same time, the role of dogs, which are now considered one of the family members of the urban population, should also be considered in maintaining the incidence of echinococcosis. Among children of preschool age of the urban population in 11 (2.6%) cases, and in 21 (5.0%) children of the rural population of the same age, combined echinococcosis of organs of two adjacent cavities was determined; for schoolchildren this indicator is 39 (9.5%) among children of the urban population and 53 (12.8%) children from the village. Of the 53 (12.8%) selected students, 34 (8.2%) were from rural areas, while 19 (4.6%) students were residents of the city. Among residents of the city, working category in 119 (28.8%) cases revealed combined echinococcosis of the chest and abdominal organs; the bulk of these patients used to live in rural areas. In 38 (9.2%) cases, the working rural population has the above diagnosis; they are employees of local government, educational institutions, and law enforcement officials. Among officially unemployed people, proportion of the rural population significantly prevails over urban unemployed people: 58 (14.1%) versus 21 (5.2%).

The second position is animal contact. 238 (57.7%) patients had close and prolonged contact with animals: 154 (37.4%) resident of the agricultural region, and 84 (20.3%) patients of the urban population. 175 (42.3%) sick people denied contact with animals, of which 49 (11.8%) were villagers and 126 (30.5%) patients lived in the city. Our data, showing that more than half have had close contact with dogs, support the theory that communicating with

dogs is one of the main transmission routes for echinococcosis (15).

The third position is social status: 157 (38.0%) of the diseased was the working population, 92 (22.3%) are schoolchildren, 80 (19.3%) are people who are not officially employed and people of retirement age, and the list is closed by preschool children - 31 (7.6%). However, apparently, it should be recognized that these factors are risk factors in terms of parasite infection, since only 126 (30.5%) of 413 infected patients living in cities, not visiting endemic areas and not being in contact with animals in their immediate environment, had no obvious reason for the development of the disease. The indirect conclusion follows from this that even the exclusion of these undesirable factors does not guarantee against cestoids invasion, although the likelihood of infection (already not very high) is reduced by about an order of magnitude. Given the role of dogs in maintaining the incidence of echinococcus, and a significant percentage of the city population keeping animals, the likelihood of contact with the parasite increases significantly.

Comorbidity

Study of comorbidities is undoubtedly of great importance for predicting and minimizing the risks of deaths and complications during surgical treatment. According to the data given in table 3, the prevailing comorbidities were coronary heart disease (5.6%), gastric ulcer (4.2%) and hypertension (3.9%).

These pathologies are widespread in the republic. Of particular importance is coronary heart disease (CHD) hospital mortality from which in Kazakhstan is about 10%, and about 10% of patients with coronary artery disease die within a year (16). Presence of comorbidity such as coronary heart disease significantly complicates the conduct of surgical treatment and is a predictor of hospital lethality and major perioperative cardiac complications in cases of surgical intervention, and anticoagulant therapy in patients with coronary artery disease after angioplasty and

stenting of the coronary arteries increases the risk of massive bleeding during surgery (17).

Type of damage

By nature of combined lesion, in 100 (24.1%) of 413 patients there was involvement of both lungs, which ranks second after echinococcosis of the right lung and liver observed in 134 (32.4%) patients. Echinococcosis of the left lung and liver was detected in 97 (23.6%) patients. In 58 (14.1%) patients there was a combined lesion of echinococcosis of both lungs, liver and abdominal cavity. Of the rare localizations of echinococcosis with a combined lesion: echinococcosis of the lung and mediastinum - 19 (4.6%) patients and echinococcosis of the right lung, diaphragm and retroperitoneal space - 5 (1.3%) patients (Table 4). It should be noted that in the vast majority of world cases of echinococcosis, hepatic damage is most common, followed by lung damage with an appropriate frequency of 60% and 20-30%. At the same time, the right lung is more often affected than the left (18), and 80% of the hydrostatic cysts are located in the right lobe of the liver (19).

One of the important problems in this type of damage is the asymptomatic pathology and a wide range of visualizing representations for diagnosis - for example, simple unicellular cysts, cysts with intralesional secondary cysts, a rough wall or intra-articular calcifications - mainly depending on the stage of the disease. It is especially dangerous if hepatic echinococcosis is mistakenly diagnosed as simple hepatic cysts. In this case, an operation can be performed that will lead to the spread of fluid from the cyst to the abdominal cavity or even anaphylactic shock (20). In case of a correct diagnosis, the course of hepatic echinococcosis can be associated with a wide range of complications in about a third of patients (19). With regard to pulmonary echinococcosis, it is also difficult to diagnose, since the density and tendency of cysts to develop spontaneously can lead to confusion with squamous cell carcinoma, adenocarcinoma, single metastasis and an abscess (21). Complications of

pulmonary echinococcosis hydatidosis include rupture, secondary infection, pneumothorax and suppuration (22). Some of these complications are potentially life-threatening and therefore require urgent surgery.

Pathology characteristics by the number of echinococcal cysts and organ damage

Characteristics of the pathology by the number of echinococcal cysts and organ damage are presented in Table 5. A single cyst of the right lung was detected in 30 (5.6%) cases, a single cyst of the left lung in 21 (4.0%); single cysts of the lungs in 9 (1.7%), multiple cysts of the right lung in 84 (15.7%), multiple cysts of the left lung in 51 (9.5%), and multiple cysts in 96 (17.9%). Multiple cysts of both lobes of liver were found in 132 (24.7%), a single cyst of the subphrenic surface of liver in 40 (7.4%), multiple cysts of hepatic and abdominal cavity in 53 (9.9%), multiple mediastinal cysts in 14 (2.6%). In 4 (0.7%) cases, multiple echinococcal cysts were located in the diaphragm and retroperitoneal space. Previously, single unilateral cysts in the lungs were recorded in 81.1% of Sarkar et al. (18), multiple pulmonary cysts were recorded in 30% of cases (21).

Types of surgical interference

WHO informal working group on echinococcosis (WHO-NERH) offers 4 treatment options for zoonosis: percutaneous treatment using the PAIR technique (puncture, aspiration, injection, re-aspiration); surgical intervention; drug therapy and observation (for inactive asymptomatic cysts) (23). Moreover, timely surgical treatment in combination with benzimidazole medications administered before and / or after surgery is the most effective (24). A delay in the operation in the hope of self-healing after cestoid dies, as in some of the described cases in the indigenous population of Chukotka and a number of other northern regions, calcification of dead cysts or successful conservative therapy can significantly increase the risk of complications and reduce the effectiveness of the operation (25).

Therefore, all the patients observed by us were operated on; they received 649 surgical interventions. In

group I, 408 surgical interventions were performed in 261 (63.3%) patients; while 152 (36.7%) patients in group II underwent 241 operations (Table 6). Due to the risk of mediastinitis and hepatobiliary fistula, none of our patients with concomitant hepatic cysts underwent median sternotomy. All patients with combined complicated forms of echinococcosis received antiparasite therapy in the postoperative period.

The decision on the order of removal of cysts from the affected organs was made on the basis of a number of factors, such as size of the cyst and effect on the functioning of the organ. Absolute indications were large sizes of cysts with secondary cysts; suppurative cysts, single cysts of the liver located superficially and / or directly adjacent to the biliary tract or other vital organs, due to the risk of rupture (spontaneous or with injury). In most cases, they started with lung operations in the thoracic department. This principle is justified in terms of reducing the risk of developing pulmonary insufficiency during removal of hepatic cysts, as well as reducing the risk of rupture of the cyst with seeding of the pleural cavity and anaphylactic shock (26).

In most cases, a simultaneous intervention was performed (63%). Researchers have previously shown that a single-stage thoracotomy is an appropriate surgical option for multiple pulmonary cysts (13).

Absolute advantage of radical surgical intervention is the cure of the patient, however, this method of treatment is always associated with a high risk of complications, which are recorded in 2-10% of interventions, and fatal outcomes range from 0.5-4%. To reduce these risks in the surgical treatment of hepatic and lung echinococcosis, it is most advisable to use laser scalpels in combination with low-intensity laser radiation, which provides a high aseptic, hemostatic, parasitic and microbicidal effect, and stimulation of reparative processes (27).

It should be noted that at present an alternative treatment option for echinococcosis is minimally invasive interventions (PAIR - puncture aspiration-injection-re-aspiration) in combination with antiparasite therapy and

videothoroscopic echinococcectomy. These procedures can reduce the time of anesthetic and surgical aggression, the length of the patient's stay in the hospital up to 5-7 days, which is 3-5 times less than the duration of hospital days compared to other procedures used for pulmonary echinococcosis (25).

Analysis of the results of treatment of patients with combined complicated echinococcosis of the chest and abdominal organs

The vast majority of surgical outcomes were favorable (~74%), and the percentage of deaths was very low (0.5%). This is an excellent indicator because according to the WHO data for cystic echinococcosis, surgical mortality rate for surgical patients is about 2.2% (28).

CONCLUSION

An analysis of the cases of treatment of combined echinococcosis of the organs of the chest and abdominal cavity showed a high efficiency of surgical intervention and a low percentage of deaths. Simultaneous surgical treatment has proven effective. Thoracotomy is one of the most optimal methods for surgical removal of cysts, but still cannot be considered the gold standard of treatment. Each time, the choice of rational surgical tactics for combined echinococcosis should be based on an individual approach, taking into account the general condition of the patient, risk analysis and the likelihood of complications.

Conflict of Interest

The authors have stated explicitly that there are no conflicts of interest in connection with this article.

REFERENCES

1. WHO/OIE Manual on Echinococcosis in Humans and Animals: a Public Health Problem of Global Concern Edited by J. Eckert, M.A. Gemmell, F.-X. Meslin and Z.S. Pawłowski. World Organisation for Animal Health (Office International des Epizooties) and World Health Organization, 2001.
2. Mirzanejad-Asl H. *Echinococcus* contamination ratio and its related risk factors in Moghan plain, northwest of Iran. *Trop Parasitol* 2019;9(2):83-87.
3. World Health Organization World Health Assembly Adopts Resolution on Neglected Tropical Diseases. [(accessed on 18 July 2020)]; Available online: https://www.who.int/neglected_diseases/WHA_66_seventh_day_resolution_adopted/en/
4. Chalechale A, Hashemnia M, Rezaei F, Sayadpour M. *Echinococcus granulosus* in humans associated with disease incidence in domestic animals in Kermanshah, west of Iran. *J Parasit Dis* 2016;40(4):1322-1329.
5. Shaikenov BS, Vaganov TF, Torgerson PR. Cystic echinococcosis in Kazakhstan: an emerging disease since independence from the Soviet Union. *Parasitol Today*. 1999 May;15(5):172-4.
6. Shaikenov BS, Torgerson PR, Usenbayev AE, Baitursynov KK, Rysmukhambetova AT, Abdybekova AM, et al. The changing epidemiology of echinococcosis in Kazakhstan due to transformation of farming practices. *Acta Trop* 2003;85(2):287-93.
7. Torgerson PR, Oguljahan B, Muminov AE, Karaeva RR, Kuttubaev OT, Aminjanov M, Shaikenov B. Present situation of cystic echinococcosis in Central Asia. *Parasitol Int*. 2006;55 Suppl:S207-12.
8. Shevchenko Yu.L, Nazirov F.G, Zainiddinov F.A, Hasan Özkan. Modern Approaches to Echinococcosis Diagnosis and Treatment. *Bulletin of the NMHTs them. N.I. Pirogov*. 2020; 1 (15): 13-22.
9. Lianos GD, Lazaros A, Vlachos K, Georgiou GK, Harissis HV, Mangano A, et al. Unusual locations of hydatid disease: a 33 year's experience analysis on 233 patients. *Updates Surg* 2015;67(3):279-82.
10. Gafurovich NF, Amanullaevich AH, Miralimovich AM, Zhumabaevich BK, Toshevich TN. Surgical treatment of combined echinococcosis of heart and target organs (lungs, liver). *European science review* 2018; ;9:41-4.
11. Dalal U, Dalal AK, Singal R. Concomitant Lung and Liver Hydatid Cyst Managed as One-Stage Surgery. *Maedica (Bucur)* 2017;12(1):19-22.

12. Yeshmuratov TSh, Sundetov MM, Shirtayev BK, Zharylkapov NS, Zhunisov NA, Yeleusizov AM, et al. The improvement of medical tactics of combined echinococcosis of right lung and liver. *Bulletin of Surgery of Kazakhstan* 2015;2(43):35-7.
13. Aghajanzadeh M, Kiaabadi A, Mohtasham B, Saravi M, Mosafai O, Ghotbi F. One-staged anterolateral thoracotomy for bilateral lung hydatid cysts. *Annals of Tropical Medicine and Public Health* 2017;10(6): 1601-6.
14. Hawker GA, Mian S, Kendzerska T, French M. Measures of adult pain: Visual Analog Scale for Pain (VAS Pain), Numeric Rating Scale for Pain (NRS Pain), McGill Pain Questionnaire (MPQ), Short-Form McGill Pain Questionnaire (SF-MPQ), Chronic Pain Grade Scale (CPGS), Short Form-36 Bodily Pain Scale (SF-36 BPS), and Measure of Intermittent and Constant Osteoarthritis Pain (ICOAP). *Arthritis Care Res (Hoboken)* 2011;63 Suppl 11:S240-52.
15. Torgerson PR, Robertson LJ, Enemark HL, Foehr J, van der Giessen JWB, Kapel CMO, et al. Source attribution of human echinococcosis: A systematic review and meta-analysis. *PLoS Negl Trop Dis* 2020;14(6):e0008382.
16. Tetali B, Grahf DC, Abou Asala ED, Axelson D. An Atypical Presentation of Cystic Echinococcosis. *Clin Pract Cases Emerg Med.* 2020 Feb 24;4(2):164-166.
17. Gafurovich NF, Amanullaevich AH, Miralimovich AM, Zhumabaevich BK, Toshevich TN. Surgical treatment of combined echinococcosis of heart and target organs (lungs, liver). *European science review.* 2018(9-10-2).
18. Sarkar M, Pathania R, Jhobta A, Thakur BR, Chopra R. Cystic pulmonary hydatidosis. *Lung India* 2016;33(2):179-91.
19. Greco S, Cannella R, Giambelluca D, Pecoraro G, Battaglia E, Midiri M, et al. Complications of hepatic echinococcosis: multimodality imaging approach. *Insights Imaging* 2019;10(1):113.
20. Ran B, Aji T, Jiang T, Zhang R, Guo Q, Abulizi A, et al. Differentiation between hepatic cystic echinococcosis types 1 and simple hepatic cysts: A retrospective analysis. *Medicine (Baltimore)* 2019;98(1):e13731.
21. Dudha M, Shaikh Z, Bhaiyat M, Wadiwala IJ, Bhaiyat ZT. A Case of Echinococcal Cyst of the Lung. *Respir Med Case Rep* 2018;25:286-292.
22. Aghajanzadeh M, Asgary MR, Hemmati H, Delshad MS, Samidos t P MO. Multiple and bilaterally pulmonary hydatid cystic and liver mimicking metastatic lesion from ovarian malignancy. *JLRDT* 2018;4:73-5.
23. Pensel PE, Elissondo N, Gambino G, Gamboa GU, Benoit JP, Elissondo MC. Experimental cystic echinococcosis therapy: In vitro and in vivo combined 5-fluorouracil/albendazole treatment. *Vet Parasitol* 2017;245:62-70.
24. Velasco-Tirado V, Alonso-Sardón M, Lopez-Bernus A, Romero-Alegría Á, Burguillo FJ, Muro A, et al. Medical treatment of cystic echinococcosis: systematic review and meta-analysis. *BMC Infect Dis* 2018;18(1):306.
25. <https://cyberleninka.ru/article/n/lechenie-ehinokokkoza-legkih/viewer>.
26. Pyshkin SA, Kuliashov AI, Aladin AS, Pinelis LG, Borisov DL. Multiple combined echinococcosis. *Khirurgiia (Mosk)* 2006;(6):64-6.
27. Polyakov NV, Romikh VV, Safarov RV, Polyakov VE. Single-chamber (hydidi) echinococcosis. *Research and Practice in Medicine* 2015;2(1):27-35.
28. World Health Organization. Newsletter. Echinococcosis fact sheet. 2019. Available from: URL: <https://www.who.int/en/news-room/fact-sheets/detail/echinococcosis>