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Review

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Current View on the Problem of Treatment for Cystic Echinococcosis of the Liver

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ABSTRACT Echinococcosis of the liver is an important problem of hematology, which in many cases is solved only with the help of surgical methods of treatment. This is primarily due to the significant number of patients with cystic echinococcosis of the liver in endemic regions, despite the implementation of preventive measures. There are still many complicated and unsolved questions concerning differential diagnostics and choice of tactics of surgical treatment for liver echinococcosis.

The problem of surgical treatment of liver echinococcosis is far from its final solution. Depending on the size of the liver lesion area, the nature of the process, severity and type of complications, different forms of treatment for cystic echinococcosis of the liver are chosen. However, during surgical treatment, such complications as liver failure, massive intraoperative bleeding with the development of hemorrhagic shock may develop. After surgical interventions for cystic echinococcosis of the liver, morphologic changes in liver tissues and signs of liver failure do not disappear, but progress; and this negatively affects the long-term treatment outcomes. Therefore, reduction of traumatic operations, prevention of hemorrhagic complications, maximum preservation of functioning liver parenchyma is one of the most important directions of echinococcosis surgery development.

In this paper, we analyze the literature sources of PubMed, eLibrary, RINC databases, which are devoted to the comparison of the effectiveness of methods of surgical treatment for cystic echinococcosis of the liver, published for the last 5 years. The conducted analysis of modern literature testifies to the relevance of the problem of choosing the method of surgical treatment for liver echinococcosis.

In recent years, there has been intensive development of surgical hepatology, which is associated with the introduction of new technologies in the diagnosis and treatment of patients with various focal liver diseases, including cystic echinococcosis. At the same time at present, there are great differences in surgical indications for treatment of hepatic echinococcosis due to differences in the technical level and experience in conducting or mastering these techniques.

Keywords: cystic echinococcosis of the liver, hydatidosis, PAIR, cystectomy

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MoCat — modified catheterization technique
PAI — Puncture, Aspiration, Injection
PAIR — Puncture, Aspiration, Injection, Re-aspiration

INTRODUCTION

Human cystic echinococcosis, or hydatidosis, is caused by the larval stage (metacestode) of Echinococcus granulosus (E. granulosus), and is a severe parasitic disease of humans, common in endemic areas of many countries worldwide. It has remained a serious medical problem for many years. E. granulosus occurs in a wide range of geographic areas [1]. In endemic areas, its prevalence varies from sporadic to high, with recent studies showing a higher prevalence of liver echinococcosis among women and people of working age. The liver is the most common location of echinococcal cysts, accounting for approximately 70% of cases [2, 3].

Our **aim** was to study the literature data on modern methods for surgical treatment of patients with liver echinococcosis.

DISCUSSION

In 2010, the World Health Organization Informal Working Group on Echinococcosis (WHO-IWGE) updated the echinococcosis guidelines and produced an “Expert consensus for the diagnosis and treatment of cystic and alveolar echinococcosis in humans” in the form of recommendations for treatment based on stage and organ involved. Despite this, there is no standard treatment for hepatic hydatid cysts, and it depends on individual patient factors, cyst characteristics, available therapeutic resources, and treatment preferences. There is still debate about the safest and most effective technique, and when it should be used. The situation is further complicated by the lack of large-scale randomized clinical trials evaluating treatment options and, as a result, low levels of evidence in favor of one method over another.

Anthelmintic therapy provides numerous benefits to the patient. It can be used as monotherapy for uncomplicated liver cysts less than 5 cm in diameter, as well as for multiple liver cysts or multiorgan involvement in inoperable candidates. It is also used as a neoadjuvant prior to percutaneous or surgical therapy in order to chemically sterilize the parasite to render the cyst inactive, reduce cyst wall tension, and decrease the risk of intraoperative rupture of a viable cyst [4]. Inactive, degenerating cysts can be observed during interval ultrasound monitoring without pharmacological or surgical intervention [5].

Surgical treatment options for hydatid cysts of the liver can be divided into conservative and radical approaches. Surgery is increasingly being replaced by other treatment modalities for uncomplicated cysts, but retains its central role in complicated cysts (in cases of cyst rupture, biliary fistulas, compression of vital structures, superinfection, bleeding), cysts with a high risk of rupture or large cysts with multiple daughter vesicles that are not suitable for percutaneous treatment. The radical approach, including total cystectomy and liver resection, has been criticized as an aggressive form of therapy associated with significant morbidity in a relatively benign disease process [6].

Many researchers combine radical interventions with resections for the treatment of hydatid cysts. Radical surgery is aimed at removing the entire pericystic membrane and parasitic contents with or without liver resection and can be performed using the "open-cyst" or "closed-cyst" method. The explanation for this is the need for the most complete removal of the fibrous capsule of the cyst. Often, surgical procedures used for hydatid cysts are controversial and include liver resection or opening of parasitic cysts and subsequent removal of the parasite. Removal of the fibrous capsule certainly increases the radicality of the operation, but does not reduce the likelihood of complications [7]. However, given that liver damage in echinococcosis is often multiple, and involvement of the central segments in the pathological process is often observed, resection as a treatment method should be performed with caution, since a large part of the functioning liver parenchyma may be lost.

Laparoscopic or robotic surgery has revolutionized surgical techniques in many areas. The most notable advantages are shorter hospital stay, reduced postoperative complications, and shorter period of analgesia. Researchers believe that laparoscopic liver echinococcectomy is an effective surgical method for the treatment of uncomplicated liver echinococcosis. If surgical experience allows, these minimally invasive approaches should be considered for accessible cysts in segments II, III, IVB, V and VI. Nevertheless, there is concern about the possible increased risk of leakage of cyst contents

into the abdominal cavity. It can be noted that the technique of laparoscopic treatment of hepatic hydatid cysts has been very successfully improved in recent years, in particular, in terms of preventing recurrence of the disease. Thus, laparoscopic partial pericystectomy, also known as modified laparoscopic cystectomy, refers to the resection of the entire endocyst and part of the pericyst (removal of less than 90% of the fibrous capsule). This procedure not only eliminates parasitic foci, but also removes the excess part of the pericyst protruding from the liver, so the rate of postoperative relapses is significantly lower than after laparoscopic cystectomy.

Laparoscopic partial pericystectomy is relatively simple and has a low operative risk, since only the extrahepatic peripheral capsule is removed, without the intrahepatic pericyst. However, compared to laparoscopic total pericystectomy, laparoscopic partial pericystectomy has a clearly higher risk of recurrence of hydatid desease, biliary fistulas, and secondary infection of residual cavity after surgery due to its rigidity [2].

Conventional open liver surgery has not been completely replaced, as it is still used today in cases of large and complex vascular and biliary tract reconstructions. Nevertheless, a wealth of experience has been accumulated in minimally invasive surgery, which continues to expand its boundaries and indications, along with the constant development of technical advances [8].

The introduction of minimally invasive surgical treatment methods for hepatic hydatid cysts has been made possible by new imaging tools, particularly computed tomography and ultrasound. These treatments are aimed either at destroying the germinal layer by scolecidal agents or at evacuating the entire endocyst. Minimally invasive methods are safe and less complicated than radical surgeries, despite the higher risk of recurrence of the disease due to the presence of a residual cavity, which may be associated with insufficient mechanical treatment of the cyst cavity [6]. Minimally invasive surgeries involve removal of contents and sterilization of the residual cavity along with partial resection of the cyst.

Percutaneous approaches to the treatment of liver hydatid cysts include PAIR (Puncture, Aspiration, Injection, Re-aspiration), standard catheterization, and modified catheterization technique (MoCat).

The most frequently used surgical treatment methods are shown in the figure.

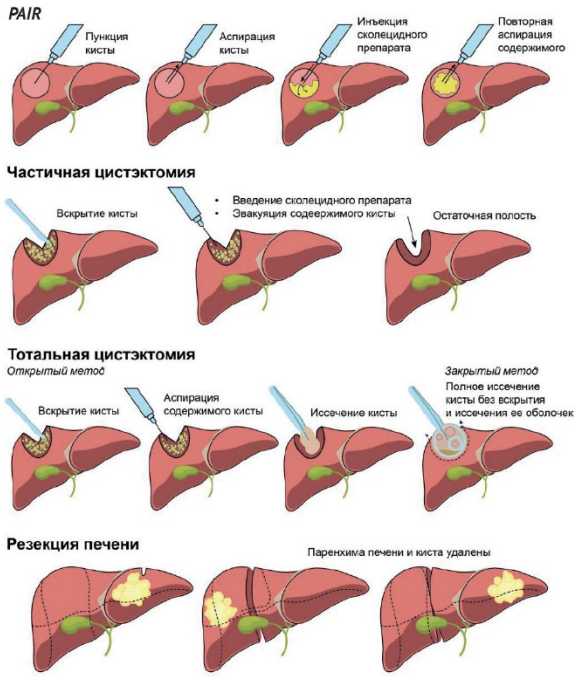

Figure. Modern approaches to the treatment for cystic echinococcosis of the liver
Note:PAIR — Puncture, Aspiration, Injection, Re-aspiration

The most popular method of minimally invasive percutaneous intervention is PAIR. In addition, the PAI (Puncture, Aspiration, Injection) method is used. Percutaneous PAIR and PAI methods are used to treat hepatic hydatid cysts in any location accessible under ultrasound diagnostic imaging or in direct visibility during surgery (open or laparoscopy) [9]. The PAIR/PAI technique is a therapeutic and diagnostic procedure. PAIR therapy has been successfully used for unilocular cysts less than 10 cm in diameter. Concerns about the use of PAIR include cases where safe percutaneous localization of the cyst under ultrasound guidance is not possible, as well as when there is evidence of cystobiliary communication. The first step of the standard PAIR technique is puncture and aspiration of the cyst under ultrasound guidance. A scolicidal agent is then injected into the cyst cavity to sterilize all viable protoscolices and destroy the germ layer. PAIR allows surgeons to confirm the diagnosis (which was only probable before the intervention), remove parasitic material, destroy the germinal membrane of the echinococcal cyst, thereby transferring it to an

inactive state. Some PAIR courses are repeated 2–4 times per procedure or at intervals of several days. Complications and risks after PAIR/PAI do not exceed those after open surgery [4].

Puncture of echinococcal cysts has long been discouraged due to the risk of anaphylactic shock and fluid leakage, however, an increasing number of articles report its safety in the treatment of liver echinococcal cysts. To prevent postoperative complications caused by the presence of a residual cavity, various methods were proposed, including omentoplasty, capitonnage, external drainage, and the use of synthetic fibrin. Nevertheless, a number of researchers agree that external drainage has a significantly higher complication rate (infection of the residual cavity, cholangitis) than omentoplasty or capitonnage. Besides, a higher level of complications has also been demonstrated with a combination of external drainage and omentoplasty. The solution to this problem is the introduction of gentle methods of electrosurgical treatment, in particular argon plasma coagulation.

Standard catheterization technique is used for cysts larger than 10 cm in diameter or cysts with a cyst fluid content of more than 1000 ml. The catheterization technique is based on aspiration of the "solid" cyst contents — endocysts surrounded by pseudocaseous inflammatory material —through a large-diameter catheter. If a cystobiliary communication is detected during PAIR, standard catheterization techniques can be used to control the bile leak. One disadvantage is the increased length of hospital stay. Catheterization and hospital stay may be longer if cystobiliary communication or cystic infection occurs.

MoCat is used to treat uncomplicated cysts and cysts larger than 10 cm in diameter that are difficult to drain or that tend to recur after PAIR, such as multivesicular cysts or those with predominantly solid contents, and daughter cysts. The MoCat approach uses a drainage catheter placed using the Seldinger technique, which allows aspiration of cyst and membrane contents. At the end of the procedure, the catheter is left in place to continue draining the fluid. Like the standard catheterization technique, MoCat results in a longer hospital stay. The features of the clinical observations are given in the table.

Table

Features of clinical observations

Author	Number of patients	Treatment methods	Comparison results
Bayrak M., Altintas Y. (2019) [10]	60	Open surgery was performed in 23 patients, laparoscopic surgery - in 37. The types of laparoscopic surgery were as follows: a) partial pericystectomy (12 patients); b) total cystectomy (2 patients); c) partial pericystectomy + total cystectomy (7); d) cystectomy (16). For open treatment of the residual cavity, partial pericystectomy and omentoplasty (17), total pericystectomy (3), and partial and total pericystectomy (3) were chosen.	Patients who underwent laparoscopic surgery had the advantages of shorter hospital stay and operating time, less blood loss, faster recovery, and lower rates of wound infections. Recurrences were detected in 2.7% of patients who underwent laparoscopic surgery, and in 4.7% of patients who underwent open surgery.
Shaprinskiy V. et al. (2022) [11]	79	Total or subtotal pericystectomy was performed in 53 patients (67.1%), resection of a liver segment in 8 patients (10.1%), dissection of the cyst with removal and treatment of its cavity in 5 patients (6.3%), and the PAIR method was used in 1 patient (1.3%). Echinococcectomy was performed laparoscopically in 12 patients (15.2%).	The use of laparoscopic surgery for liver echinococcosis reduces intraoperative blood loss, duration of surgery, and length of hospital stay. There were no relapses of the disease after radical surgery.
Minaev S.V. et al. (2020) [12]	25	Multiple- and single-port laparoscopy	CL-CE2 echinococcal liver cyst is an indication for laparoscopic echinococcectomy. Multiport laparoscopy has an advantage over single-port laparoscopy, as it reduces not only the time of surgical treatment, but also the incidence of postoperative complications.
Azizzoda Z.A. et al. (2021) [13]	300	In the laparotomy group, open echinococcectomy was performed in 37 cases (28.4%) using various mini-accesses, and two-stage operations using minimally invasive technologies - in 27 cases (20.7%). Laparoscopic echinococcectomy was performed in 23 patients (17.7%), laparoscopic pericystectomy - 12 (9.2%), laparoscopic liver resection - 10 (7.7%)	Minimally invasive technologies demonstrate better immediate results compared to conventional open surgical treatment methods. The incidence of postoperative complications in the laparoscopy group was 17.7%, in the laparotomy group - 51.8%. Postoperative mortality decreased from 2.3 to 0.8%.

In the study by Bayrak M. and Altintas Y., open surgeries were compared with laparoscopic interventions. The authors showed that, compared to open surgery, the laparoscopic method can be safely performed in the treatment of echinococcal liver cysts even with larger cysts and/or cystobiliary communication.

In the study by Shaprinskiy V. et al., the choice of surgical intervention method was determined individually, taking into account the localization of echinococcal cysts, their size, depth, and proximity to important anatomical structures. Laparoscopic surgeries for liver echinococcosis reduced intraoperative blood loss, duration of surgery, and hospital stay.

According to the results of the study by Azizzoda Z.A. et al., minimally invasive technologies demonstrate better immediate outcomes compared to conventional open surgical treatment methods.

Comparison of the effectiveness of multi- and single-port laparoscopy in the treatment of hepatic cystic echinococcosis, conducted by Minaev S.V. et al., showed that CL-CE2 hydatid cyst is an indication for laparoscopic echinococcectomy. Multiport laparoscopy has an advantage over single-port laparoscopy, as it reduces the time of surgical treatment and the incidence of postoperative complications.

In summary, the studies reviewed showed that surgery has traditionally been the gold standard for the treatment of cystic echinococcosis of the liver. Surgery should be considered for complex cysts, including those with rupture or high risk of rupture, fistulization, compression of vital organs or vessels, bleeding, or bacterial infection. Surgery is also an option for cysts that are refractory to medical or percutaneous treatment, and when a watch-and-wait approach is not indicated due to poor access to care. When indicated, percutaneous aspiration, infusion of scolicidal drugs, and reaspiration (PAIR) may be used. Surgical options depend on the size, number, and location of the cysts, and include cyst excision, membrane stripping, cyst evacuation, obliteration, and marsupialization. Laparoscopic and PAIR approaches to the treatment of hepatic cystic echinococcosis are not only safe and effective in specific cases, but also have advantages in terms of less pain, good cosmetic results, rapid postoperative recovery, fewer complications, and shorter hospital stay compared to similar open surgeries.

CONCLUSION

Human cystic echinococcosis is a complex and dynamic disease, with an evolving phase and gradually growing cysts, followed by a process of involution, during which the parasite gradually dies, leaving behind a hardened, often calcified cyst or scar. Each successive active stage of the cyst carries the risk of serious and even life-threatening complications. These differences in the disease process result in a wide range of treatment modalities with an equally wide range of technological skills required to implement those modalities..

Treatment of liver cystic echinococcosis depends on the symptoms of the disease, radiographic, ultrasound stage, size and location of the cyst, presence of complications, and the experience of the treating surgeon. Apart from the frozen seal technique, surgical treatment options can range from conservative (cystectomy) to radical treatment (liver resection) and laparoscopic methods. Controversy still exists about the best surgical treatment: whether it should be a conservative or radical operation in which the cyst is completely removed including the pericyst by total pericystectomy or partial hepatectomy, or whether it should be an open or laparoscopic approach.

It should be noted that to date there are no prospective randomized controlled studies comparing open and laparoscopic liver resection techniques for echinococcosis in a large domestic sample. The currently available data are largely based on observational series, and demonstrate the reproducibility of the method with limited morbidity and mortality.

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