Review Article Pol J Public Health, Vol. 135 (2025): 14-18

KACPER BARTOSIK[1], JUSTYNA TURCZAK[1], JUSTYNA WYROŚLAK-NAJS[2]

Management of hepatic echinococcosis: Should surgical intervention be the first-line therapeutic option?

Abstract

Introduction. Echinococcosis is a serious zoonotic disease, especially in endemic regions. Its treatment remainsthe subject of debate,, including pharmacotherapy, percutaneous techniques, and surgery. Without intervention, mortality can reach 90%. Common symptoms include weight loss, right upper quadrant discomfort, and, less frequently, jaundice with cholangitis.

Materials and methods. This unsystematic literature review covers studies from PubMed and Google Scholar (2020-2025) focused on echinococcosis treatment. Keywords included: echinococcosis, treatment outcomes, diagnostic methods, surgery, cystic echinococcosis (CE).

Results. Thechoice of therapy depends of thedisease stage. The most effective strategy is radical surgical resection combined with benzimidazole-based therapy, which has a low recurrence rate. However, surgery carries risks such as bleeding, bile leakage, infections, and bowel obstruction. Despite these complications, it remains the gold standard, offering favorable long-term results. In cases with hydatid cyst abscess, non-radical surgery is preferred to reduce postoperative complications. Albendazole monotherapy is suitable only for lesions under 5 cm, extending 10-year survival in 80% of cases. Due to the long latency and nonspecific early symptoms, surgery is required in most cases.

Conclusions. Pharmacotherapy alone is rarely sufficient. Surgery remains the most effective approach, ensuring parasite removal and lowering recurrence risk. The best outcomes are achieved with a combined approach: initial albendazole therapy, followed by surgery after cyst shrinkage, and continued albendazole use postoperatively.

Keywords: echinococcosis, treatment methods, treatment outcomes, surgery, Cystic Echinococcosis (CE).

DOI: 10.12923/2083-4829/2025-0004

INTRODUCTION

Hepatic echinococcosis is a serious parasitic disease caused by the larvae of a tapeworm from the Echinococcus family [1,2]. It is currently considered one of the most dangerous parasitic diseases worldwide, with an untreated case mortality rate of up to 90% [3-6]. The life cycle of Echinococcus requires a definitive host, which is usually a dog, and an intermediate host, which is often a sheep [6]. Humans can become infected with Echinococcus larvae as incidental hosts through contact with carnivore feces containing parasite eggs [7,8]. In clinical practice, two types of echinococcosis are distinguished: cystic echinococcosis, which causes 95% of human infections and is caused by Echinococcus granulosus sensu lato, and alveolar echinococcosis, caused by Echinococcus multilocularis [9-11]. Both forms of echinococcosis have slightly different clinical courses in patients, as cystic echinococcosis usually has a milder course, characterized by slow cyst development and late onset of clinical symptoms. In contrast, alveolar echinococcosis exhibits a more invasive, tumor-like growth pattern, leading to faster damage of the affected organs [1,2]. Cystic echinococcosis is a globally distributed disease, while alveolar echinococcosis occurs in endemic regions, including Central Europe (Mediterranean basin) and Japan [12-15]. In endemic regions, the annual incidence of CE ranges from less than 1 to 200 cases per 100,000 individuals, whereas for AE, it ranges from 0.03 to 1.2 per 100,000 [2,3].

In 2020, a total of 529 cases of echinococcosis were reported in the EU, including 243 caused by E. granulosus and 114 by E. multilocularis, while the species was not identified in 172 cases [5,7]. Recent reports indicate an increasing problem in Central and Eastern Europe, where a significant rise in echinococcosis cases has been observed [7,8]. Due to portal circulation, the liver is the most commonly affected organ by Echinococcus, accounting for approximately 70-80% of all infections, followed by the lungs and, less commonly, the spleen [9,16-20].

AIM

The aim of this study was to present current epidemiological data on echinococcosis and to analyze and summarize the latest treatment guidelines, including pharmacological and surgical options, with a particular focus on the indications for their use and the necessity of surgical interventions.

[1] Students' Scientific Association at the II Chair and Department of General and Gastrointestinal Surgery and Surgical Oncology of the Alimentary Tract, Medical University of Lublin, Poland

[2] II Chair and Department of General and Gastrointestinal Surgery and Surgical Oncology of the Alimentary Tract, Medical University of Lublin, Poland

© 2025 Author(s) This is an open access article distributed under the Creative Commons Attribution -NonComercial-No Derivs licence (http://creativecommons.org/licenses/by-nc-nd/3.0/)

MATERIAL AND METHODS

This structured, non-systematic review was based on literature retrieved from the PubMed and Google Scholar databases, covering the period from January 2020 to March 2025. The search strategy employed a combination of keywords and Boolean operators, including: "echinococcosis", "cystic echinococcosis", "liver", "treatment", "surgery", "diagnostic methods", and "treatment outcomes". Only articles published in English were considered. The inclusion criteria encompassed original research articles, case series, clinical trials, and review papers concerning the diagnosis and treatment of hepatic cystic echinococcosis, with particular attention given to current guidelines and expert recommendations. The exclusion criteria included studies unrelated to hepatic echinococcosis, preclinical animal studies, articles published prior to 2020, abstracts without full-text access, and publications in languages other than English. Only peer-reviewed, full-text sources were included in the final analysis. As this was a non-systematic review, no formal quality assessment or risk-of-bias evaluation was conducted. Limitations of the review include the absence of standardized critical appraisal and the potential risks for selection or publication bias, particularly due to the use of Google Scholar. Nonetheless, a careful selection was applied to ensure the inclusion of relevant and reliable sources.

State of Knowledge

Epidemiology

Echinococcosis is an endemic disease found in countries such as India, Australia, Turkey, China, South America, the Middle East, Eastern Europe, and the Mediterranean basin, with incidence rates reaches up to 50 per 100,000 inhabitants annually. In regions with high infectious rates, approximately 10% of the population is estimated to be affected [20]. Globally, the incidence of echinococcosis is estimated to range from 1 to 200 per 100,000 people [3]. The majority of echinococcosis cases occur in China [5, 20]. In Western European countries, symptoms of infection most commonly appear in individuals aged 50-60 years, while cases in children are rare. No association between infection and patient gender has been found. In contrast, in Asia, infections are usually diagnosed in individuals aged 40–50 years, with a higher frequency in young adults, mainly women [5,22].

Symptoms

In the early stages, the disease often remains asymptomatic or presents with nonspecific symptoms, which do not lead to the suspicion of echinococcosis. This is frequently the cause of delayed diagnosis [6]. It is believed that this is due to the initially slow growth of the cysts, which do not invade neighboring vital structures, and the granulomatous layer, which serves as a specific isolator of the cyst from the surrounding environment [2,6,23]. Conversely, in individuals with a compromised immune system, the disease may present with rapid symptoms, as the defense mechanisms are suppressed [6]. Usually, the first symptoms appear when the cyst reaches a diameter of approximately 10 cm or when hydatid cysts constitute 70% of the liver parenchyma [2]. At that point, typical symptoms include pain in the right upper abdomen, a sense of mass in that area, and nausea and vomiting [2,6,11,24]. Less commonly, mechanical jaundice occurs as a result of cyst masses compressing the bile ducts [6,23]. The most dangerous complication of hepatic echinococcosis is cyst rupture, which can cause anaphylactic shock, potentially fatal to the patient, or the rupture of the cyst wall, leading to the communication of its contents with bile and causing cholangitis, which also carries a poor prognosis [6,24,25].

Diagnostics

The most important element in diagnosis is a thorough patient medical history, with special attention to potential contact with dogs, other animals, and travel to endemic regions for echinococcosis, followed by a physical examination [2,6,11,24]. In diagnosing hepatic echinococcosis, both laboratory serological tests and imaging methods are utilized [2]. Serological methods have certain limitations, as they do not differentiate between active cystic disease and inactive (previously treated) disease [8,25]. Serological tests such as ELISA, indirect hemagglutination (IHA), and Western blot can be valuable in diagnosing cystic echinococcosis (CE) of the liver [8,26]. The enzyme-linked immunosorbent assay (ELISA) is considered the most important serological tool for diagnosing hepatic echinococcosis. This test, which detects IgG antibodies against Echinococcus granulosus antigens, has a sensitivity of 93.5% and specificity of 89.7% [1,22,24,25]. Routine liver function tests or cholestatic markers typically show hypertransaminasemia and hyperbilirubinemia in only 40% of cases. Similarly, eosinophilia is observed in 25-40% of cases in blood morphology [6,23,27]. Currently, ultrasound is considered the primary diagnostic method for hepatic echinococcosis, with high sensitivity of 90-95% [1,6,27]. Based on cyst characteristics in ultrasound examination, radiologists often face challenges in differentiating it from simple liver cysts [6,30]. The informal Working Group on Echinococcosis of the World Health Organization (WHO-IWGE) developed a classification of echinococcal cysts based on their ultrasound appearance [1,2,8]. According to this classification, cysts are divided into types CE1 to CE5. The „active" stage includes CE1 and CE2 cysts, the „transitional" stage includes CE3a and CE3b, while CE4 and CE5 correspond to the „inactive" phase of the disease [1,2,8]. When limitations arise from the use of ultrasound, computed tomography (CT) is performed, offering even higher sensitivity of around 95%. CT is also used to exclusion of other locations of echinococcosis and to assess the resectability of lesions preoperatively [1,8,11,23]. The most sensitive imaging option is magnetic resonance imaging (MRI), which additionally provides very detailed images of lesion localisation and their communication with the bile duct system [8,11].

The standardized WHO-IWGE classification is shown in Figure 1 [29].

Treatment Methods

The treatment approach is selected based on the evaluation of the cyst's location, size, and the presence or the absence of associated symptoms. Therapy includes pharmacological treatment, observation, percutaneous procedures, and surgery [2,8,11]. Observation is primarily used for cysts that do not cause severe symptoms and do not pose a risk to the patient's health. Patients are regularly monitored to ensure that the cyst does not grow or cause new health problems [28,30,31]. For larger cysts, particularly those greater than 5 cm, and in cases where surgery is not possible but the cyst is considered active, the PAIR (Puncture, Aspiration, Injection, Reaspiration)

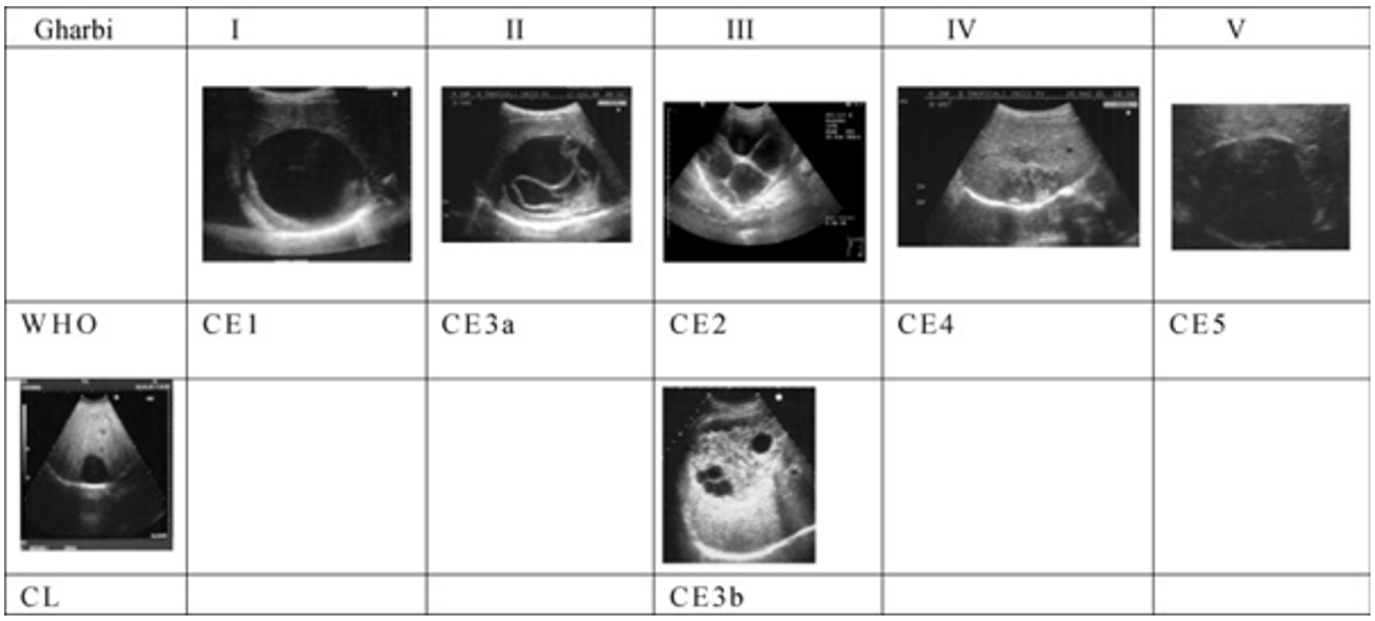

FIGURE 1. WHO-IWGE standardided classification. [29]

method is used. This procedure involves puncturing the cyst, aspirating its contents, injecting disinfectant substances to kill the parasites, and then re-aspirating the fluids [2,25]. The most commonly chosen surgical procedure for eligible patients is partial pericystectomy. This involves removing a portion of the cyst while preserving as much healthy tissue as possible. It is a safe procedure that minimizes the risk of complications, especially in areas near large blood vessels and bile ducts [8,25]. In rare cases where surgical intervention is not required, less invasive techniques, such as catheterisation or a combination of different methods, are used, with albendazole as an adjunctive treatment [2,27,28,30-32].

Pharmacology

In the treatment of echinococcosis, systemic anthelmintic drugs from the benzimidazole group, such as albendazole and mebendazole, have demonstrated efficacy and safety. However, randomised studies have confirmed that albendazole is more effective than mebendazole [2,6,11]. Albendazole, when used in a continuous three-month regimen at a dose of 10-15 mg/kg per day (in two divided doses), is recommended as the primary therapy for small (<5 cm), uncomplicated CE1 and CE3a cysts. This treatment may also be effective for numerous small cysts, deeply located cysts within the parenchyma, and peritoneal cysts, where pharmacological therapy alone may be sufficient [7,11]. Analyses of large databases covering 3,760 cases have shown that albendazole monotherapy can lead to a complete clinical response in approximately 30% of cases, with an additional 40-50% of patients showing objective signs of cyst degradation during follow-up. Furthermore, a randomized study with 55 patients demonstrated that three months of albendazole treatment before surgery led to ultrasound signs of complete cyst membrane collapse in 68% of patients, which correlated with cyst non-viability in 94% of cases during the surgical procedure, in comparison to the control group [11]. Other studies have shown that six months of albendazole therapy results in complete cure in only 18% of patients, so longer monotherapy is recommended only for those not eligible for surgical treatment. All patients undergoing extended benzimidazole therapy should be routinely monitored starting from the second week of treatment for side effects, such as bone marrow suppression and liver function abnormalities [11]. Albendazole also has a role in perioperative treatment, as it significantly reduces the risk of disease recurrence. Treatment should begin at least one month before surgery, ideally three months before the procedure, and should be continued for three months after surgery [7,11,31,32]. Randomised studies have confirmed that this approach significantly reduces the presence of live protoscoleces in cysts during surgery and limits the risk of recurrence. In one study, patients undergoing surgery without albendazole had live protoscoles in 100% of cases, compared to just 5.5% in the group treated with albendazole. Additionally, during a five-year follow-up, no recurrences were reported in the group treated with albendazole, compared to 16.6% in the group that underwent surgery without medication [11]. Another study showed a similar trend: the recurrence rate was 18.75% in the surgical-only group and 4.16% in the group treated with albendazole. In another study, the average time to postoperative recurrence was around 23 months (23.3±5.3; range: 8-48 months). In the context of surgical treatment, scolicidal agents play an important role. These substances aim to destroy the protoscoleces of the parasite within the cyst, especially when the cyst remains open during surgery. Their use is intended to prevent the spread of the parasite and reduce the risk of recurrence. The most commonly used scolicidal agents are hydrogen peroxide solutions, hypertonic saline (usually 20%), and ethanol. However, scolicidal agents should be used cautiously, as some can cause complications, such as tissue necrosis or toxic reactions if they leak outside the cyst [1,2,11].

Surgery

Various surgical approaches are used in the treatment of hepatic echinococcosis (CE), including both conservative and radical techniques, depending on the cyst's size, location, and the patient's overall condition [2,5,11,28,31,32]. In addition to traditional surgeries, minimally invasive techniques, such as percutaneous drainage combined with albendazole therapy and laparoscopic or robotic surgery, are gaining increasing popularity [33.] Although partial cystectomy, a conservative

approach, is considered as safer treatment method compared to radical surgery, it is associated with a higher risk of recurrence. It is estimated that recurrence occurs in 20-25% of patients undergoing this approach, whereas in radical surgeries, the recurrence risk is only 0.6-4%. The main causes of recurrence are the spread of cyst contents during their removal or incomplete removal of the cyst's residual germinal layer, which may promote cyst regeneration [1,2,5]. Additionally, a less common mechanism of recurrence is exogenous vesiculation, where hydatid fluid and the germinal layer of the cyst pass through the pericyst, leading to the growth of a daughter cyst. Although the risk of recurrence is higher, partial cystectomy is also associated with a lower risk of postoperative complications. Most cases of biliary fistulas that may occur after this procedure can be managed conservatively with percutaneous tube drainage. In more complex situations, such as persistent high-output biliary fistulas (lasting over 10 days), endoscopic retrograde cholangiopancreatography (ERCP) with the placement of a biliary stent may be indicated [5]. Laparoscopy and robotic surgery have revolutionised the treatment of hepatic echinococcosis, offering smaller and faster-healing wounds, quicker recovery, and shorter hospital stays. These techniques should be considered, particularly for cysts located in liver segments II, III, IVB, V, and VI, which are accessible for laparoscopic surgery, provided the surgical team has the necessary expertise [5,11]. However, caution should be exercised for cysts with a higher risk of dissemination, which may pose challenges in preventing the spread of the parasite. Modern approaches to the treatment of echinococcosis also include percutaneous drainage combined with albendazole therapy. Studies have shown that this therapy is a safe and effective treatment for uncomplicated CE cysts, offering a lower risk of postoperative complications and a shorter hospital stay compared to traditional surgery [2,22]. In comparative studies, 25 patients underwent percutaneous drainage with albendazole therapy, while another 25 patients underwent cystectomy. The results were comparable in terms of cyst size after treatment and their disappearance during follow-up. However, postoperative complications were significantly lower in the percutaneous drainage group (32%) than in the surgical group (84%), and the average hospital stay was only 4.2 days compared to 12.7 days in the surgical group [5]. The decision to choose the appropriate treatment method depends on several factors, such as cyst size, location, the presence of complications, and the experience of the surgical team. In the case of medium-sized cysts and less complicated cases, drainage therapy with albendazole is an effective alternative to traditional surgery, offering lower risks of complications and shorter recovery times. In more complex cases, particularly with large cysts or cysts with fistulas, radical or laparoscopic surgery may be more appropriate, although it carries a higher risk of complications [2,7,11,28,31,32].

A comparison of surgical treatment outcomes for echinococcosis based on the extent of the surgical margin is presented in Table 1 [34-37]. Based on the data presented, it is evident that only complete resection of cystic lesions with R0 margins ensures long-term survival without disease progression or recurrence of hydatidosis. Incomplete resection significantly worsens the prognosis and is associated with an increased risk of recurrence in the future [34-37].

TABLE 1. Comparison of surgical treatment outcomes for Echinococcosis based on the extent of surgical margin [34-37].

Scope of the operation	Description of the operation	Progression-free survival rate (5-10 years)	Overall survival (5-10 years)	Recurrence
Resection R0	total cyst resection	97.6%	~100%	no recurrence
Resection R1	cystectomy with microscopic parasitic residues	64.3%	~97%	41.2%
Resection R2	cystectomy with macroscopic parasitic residues	33.3%	<50%	41.2%

CONCLUSIONS

Physicians should promptly consider the diagnosis of echinococcosis in patients with positive serology test results and characteristic changes in imaging studies, especially in endemic regions. Treatment depends on the symptoms, disease stage, cyst characteristics, and the experience of the medical team. However, the general treatment approach should always be based on pharmacotherapy as the first-line treatment, followed by surgical intervention, and continuance of pharmacotherapy, most often with albendazole, in the postoperative period. The use of WHO protocols is crucial to limit the high annual costs associated with echinococcosis.

A multidisciplinary approach is essential for achieving good outcomes in patients undergoing surgical resection. Proper assessment of the disease stage and careful selection of the surgical treatment method are crucial to minimalise complications. Surgery is the primary treatment for hepatic echinococcosis, especially in the early stages of the disease. Radical procedures, such as total pericystectomy or liver resection (hepatectomy), provide an opportunity for permanent cure and should be the first choice in the most commonly encountered form of cystic echinococcosis. However, it should be noted that the presence of comorbidities, large cyst size, infiltration, unfavorable anatomical location, and associated inflammation are often contraindications for surgical treatment. In such cases, pharmacological treatment yields the most favorable therapeutic outcomes.

Prevention and education play a crucial role in the reduction of the number of new echinococcosis infections, especially in endemic regions. Example measures include regular deworming of dogs, avoiding consumption of unwashed wild fruits, and education of local communities about the risks associated with contact with wild animals. Raising public awareness and implementing control programs are essential components of an effective public health strategy.

REFERENCES

1. Lundström-Stadelmann B, Rostami A, Frey CF, et al. Human alveolar echinococcosis – global, regional, and national annual incidence and prevalence rates. Clin Microbiol Infect. 2025;31(7):1139-45.
2. Wen H, Vuitton L, Tuxun T, et al. Echinococcosis: progress in the 21st century. Clin Microbiol Rev. 2019;32(1):e00075-18.
3. Tao Y, Wang YF, Wang J, et al. Pictorial review of hepatic echinococcosis: ultrasound imaging and differential diagnosis. Clin Imaging. 2024. PMID: 39474399.
4. European Centre for Disease Prevention and Control. Echinococcosis. In: Annual Epidemiological Report for 2020. Stockholm: ECDC; 2022.

5. Respondek A, Baryła M, Popławska-Ferenc A, et al. Echinococcosis of the liver in Poland – review of the literature and our own clinical material. Clin Exp Hepatol. 2024;10(3):150-8.
6. Govindasamy A, Bhattarai PR, John J. Liver cystic echinococcosis: a parasitic review. Ther Adv Infect Dis. 2023;10:20499361231171478.
7. Eckert J, Deplazes P. Biological, epidemiological, and clinical aspects of echinococcosis, a zoonosis of increasing concern. Clin Microbiol Rev. 2004;17(1):107-35.
8. Fadakar B, Tabatabaei N, Borji H, Naghibi A. Genotyping of Echinococcus granulosus from goats and sheep indicating G7 genotype in goats in the Northeast of Iran. Parasitol Res. 2015;114(5):1931-5.
9. Jia A, Chai JP, Jia SL, et l. Historical changes in surgical strategy and treatment of complications in cystic liver echinococcosis. World J Gastrointest Surg. 2023;15(8):1591-9.
10. Haran JP, Koren O, Harel M, et al. Alzheimer's disease patients have less butyrate-producing bacteria in their gut microbiome. Sci Rep. 2019;9(1):1-9.
11. Keong B, Wilkie B, Sutherland T, et al. Cystic echinococcosis of the liver in Australia: an update on diagnosis and treatment. ANZ J Surg. 2018;88(1-2):26-31.
12. Pavlidis ET, Symeonidis N, Psarras K, Pavlidis TE. Giant hydatid cyst of the liver treated by hepatectomy: report of two cases. Int J Surg Case Rep. 2017;31:79-82.
13. Hajjafari A, Sadr S, Santucci C, et al. Advances in detecting cystic echinococcosis in intermediate hosts and new diagnostic tools: a literature review. Vet Sci. 2024;11(6):227.
14. Kakamad FH, Anwar KA, Ahmed HK, et al. Risk factors associated with human echinococcosis: a systematic review and meta-analysis. Front Vet Sci. 2024;11:1480579.
15. Pavlidis ET, Galanis IN, Pavlidis TE. Current considerations for the management of liver echinococcosis. World J Hepatol. 2024;16(7):645-58.
16. Gunjal PM, Schneider G, Ismail AA, et al. Evidence for induction of a tumor metastasis-receptive microenvironment for ovarian cancer cells in bone marrow and other organs as an unwanted and underestimated side effect of chemotherapy/radiotherapy. J Ovarian Res. 2015;8:41.
17. Sochocka M, Donskow-Łysoniewska K, Diniz BS, et al. The gut microbiome alterations and inflammation-driven pathogenesis of Alzheimer's disease – a critical review. Mol Neurobiol. 2019;56(3):1841-51.
18. Wang J, Xie Y, Wu T, et al. Phytic acid alleviates ochratoxin A-induced renal damage in chicks by modulating ferroptosis and the structure of the intestinal microbiota. Poult Sci. 2024;103(9):104027.
19. Dai M, Yang X, Yu Y, Pan W. Helminth and host crosstalk: new insight into treatment of obesity and its associated metabolic syndromes. Front Immunol. 2022;13:827486.
20. Wencel PL, Blecharz-Klin K, Piechal A, et al. Fingolimod modulates the gene expression of proteins engaged in inflammation and amyloid-beta metabolism and improves exploratory and anxiety-like behavior in obese mice. Neurotherapeutics. 2023;20(5):1388-404.
21. Kulawiak N, Sulima M, Gesing M, et al. Practical aspects and treatment of unilocular echinococcosis – current state of knowledge. Hepatol Pol. 2023;23:58-62.
22. Woolsey ID, Miller AL. Echinococcus granulosus sensu lato and Echinococcus multilocularis: a review. Res Vet Sci. 2021;135:517-22.
23. Bhutani N, Kajal P. Hepatic echinococcosis: a review. Ann Med Surg. 2018;36:99-105.
24. Stojković M, Weber TF, Junghanss T. Clinical treatment of cystic echinococcosis: current knowledge and perspectives. Curr Opin Infect Dis. 2018;31:383-92.
25. Lorenzo C, Ferreira HB, Monteiro KM, et al. Comparative analysis of six major Echinococcus granulosus antigens in a double-blind, randomized, multicenter diagnostic study. J Clin Microbiol. 2005;43:2764-70.
26. Calame P, Weck M, Busse-Cote A, et al. The radiologist's role in diagnosing and managing two forms of hepatic echinococcosis. Insights Imaging. 2022;13:68.
27. Rashid MM, Rabbi H, Ahmed AT, et al. Surgical outcomes of 79 patients with liver hydatidosis: experience at a tertiary care hospital in Bangladesh. J Surg Sci. 2020;22:118-24.
28. Kern P, Menezes da Silva A, Akhan O, et al. Echinococcosis: diagnosis, clinical management and burden of disease. Adv Parasitol. 2017;96:259-369.
29. Brunetti E, Kern P, Vuitton DA, et al. Expert consensus for the diagnosis and treatment of cystic and alveolar echinococcosis in humans. Acta Trop. 2010;114(1):1-16.
30. Li T, Ito A, Chen X, Qiu J. Epidemiology of echinococcosis in China. Parasitol Int. 2022;91:102574.
31. Kawamura N, Kamiyama T, Sakamoto Y, et al. Clinical features and management of hepatic cystic echinococcosis: a single-center experience in Japan. Surg Today. 2019;49(6):516-22.
32. McManus DP, Gray DJ, Zhang W, Yang Y. Diagnosis, treatment, and management of echinococcosis. BMJ. 2012;344:e3866.
33. Steinkraus KC, Etzold S, Reuter S, et al. Robotic liver surgery for alveolar echinococcosis: a single-centre experience. Pathogens. 2022;11(11):1276.
34. Kuscher S, Kronberger IE, Loizides A, et al. Exploring the limits of hepatic surgery for alveolar echinococcosis- 10-years' experience in an endemic area of Austria. Eur Surg. 2019;51(4):189-96.
35. Tuxun T, Zhang JH, Zhao JM, et al. World review of laparoscopic treatment of liver cystic echinococcosis - 914 patients. Int J Infect Dis. 2014;24:43-50.
36. Joliat GR, Melloul E, Petermann D, et al. Outcomes after liver resection for hepatic alveolar echinococcosis: a single-center cohort study. World J Surg. 2015;39(8):2057-65.
37. World Health Organization. Guidelines on the prevention and treatment of hydatid disease. Geneva: WHO; 2020.

Corresponding author
Kacper Bartosik
Students' Scientific Association at the II Chair and Department of General and Gastrointestinal Surgery and Surgical Oncology of the Alimentary Tract, Medical University of Lublin
16 Staszica St., 20-081 Lublin
e-mail: kacper.bart1@gmail.com