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DOCTORAL THESIS ABSTRACT

Management of pulmonary hydatid cyst in children

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The doctoral thesis comprises:

- 124 pages, including 16 pages in the general part
- 75 figures, of which 9 in the Introduction and general part
- 17 tables
- 9 diagrams
- 320 bibliographic references

Note: In this summary, the content has been preserved in the same form as in the doctoral thesis.

Introduction

Cystic hydatid disease is an endemic condition caused by the larval stage (metacestode) of the parasite Echinococcus granulosus, belonging to the class cestoda. This disease requires two or more host species to complete its life cycle. It is characterized by the formation of cysts in various organs, predominantly in the liver and lungs. Approximately 1% of surgical admissions are attributed to hydatid disease. Studies estimate that over three million people worldwide are affected by this condition. Poor hygiene is associated with the disease, and it is found in various geographic regions globally. In Europe, the prevalence of hydatid disease is higher in countries such as Turkey, Greece, Italy, Spain, and France. This condition is also present in Romania and the Republic of Moldova.

The incidence of human hydatid disease varies from 0.1 to 7.74 cases per 100,000 inhabitants, while in endemic areas, it ranges from 1 to 200 cases per 100,000. In the Republic of Moldova, the incidence of this disease is 4.74 per 100,000 population, with the southern regions being the most affected, where this figure is 3-4 times higher than the national average. The prevalence of the disease and the demand for surgical treatment are higher in rural areas compared to urban areas, especially among young individuals.

Adults are most commonly affected by hydatid cysts, with the majority of human infestations occurring during childhood and adolescence. The exact global incidence of hydatid disease in children is not known, but in some countries, such as Turkey, the incidence rate is as high as 150 cases per 100,000 children. Recent studies indicate that hepatic hydatid disease is the most frequently encountered type, accounting for 50%-80% of all cases of the disease and particularly affecting children. The incidence of concurrent lung and liver involvement in hydatid

disease is 5-25%. According to one study, the ratio of liver to lung involvement in hydatid disease can vary from 2:1 to 7:1. Some studies have found a higher prevalence of pulmonary hydatid cysts in children (64%) compared to the hepatic form (28%). Additionally, there is an increasing number of cases with multi-organ involvement. The mortality rate associated with this parasitic condition is approximately between 0.3% and 2%.

The rate of complicated pulmonary hydatid cyst rupture ranges from 24.1% to 61%. These high values are attributed to the increased incidence of diagnostic errors, which fluctuate between 22.3% and 40%, responsible for a heightened level of postoperative complications (19% - 47.5%), with a mortality rate of about 1.4%.

Currently, there are differing opinions regarding the management of residual cavities in cases of pulmonary or hepatic hydatid cysts, especially in complicated and recurrent cases of the disease. Moreover, the proposed methods for addressing this issue have shown low efficiency, and controversial opinions persist regarding the sequence, optimal timing, and interval between staged surgical interventions, as well as the extent of surgical procedures in patients with bilateral pulmonary hydatid cysts or combined with hepatic involvement. Despite the successes of contemporary diagnostic and treatment methods, the rate of early postoperative complications in pulmonary hydatid cysts ranges from 3.9% to 46.3%, and in late forms, it ranges from 6% to 28%.

Objective of the Study: To evaluate the morphopathological changes and long-term outcomes of medical and surgical treatment in children with pulmonary hydatidosis, with the aim of improving treatment based on the form and severity of the parasitic lesion.

Study Objectives:

1. Evaluate the morphopathological changes in cases of pulmonary hydatid cysts subjected to surgical interventions with pulmonary echinococcectomy and residual cavity capitonnage, which later developed suture insufficiency and compressive pneumothorax in the postoperative period.
2. Conduct an immunohistochemical study to assess the lymphocytic population in the inflammatory infiltrate of the adventitial layer (pericyst) and pericystic tissues in various clinical and morphological forms of pulmonary hydatid cysts in children.
3. Analyze the efficacy of medical and surgical treatment applied to children with pulmonary hydatidosis based on the form, location, and size of the parasitic lesion.

4. Analyze the frequency of postoperative complications and recurrences, assessing the degree of functional recovery of the affected organ based on the surgical resolution method of pulmonary hydatidosis, while developing a rational medical and surgical approach and an optimal set of measures based on the form of the parasitic lesion and the severity of local inflammatory changes.

The thesis is structured into four chapters.

Chapter 1: CURRENT STATE OF KNOWLEDGE REGARDING PULMONARY HYDATID CYST IN CHILDREN

This chapter represents the current state of knowledge regarding pulmonary hydatid cyst in children and is divided into four sub-chapters:

1.1 Historical considerations in hydatid cysts:

This sub-chapter provides a historical overview of the knowledge regarding hydatid cyst, a parasitic condition, and the evolution of its treatment. It mentions that human hydatidosis has a long history, dating back to ancient times.

The term "echinococcosis" was introduced after it was established that humans are intermediate hosts of the parasite. Over time, discoveries were made regarding the parasite's life cycle and its mode of transmission.

Concerning treatment, it has evolved over the years, from two-stage surgical interventions to more complex surgical methods and various approaches. It also mentions the contributions of doctors and researchers from Romania and the Republic of Moldova to the study and treatment of hydatid cyst.

1.2 Biological characteristics of the parasitic agent E. Granulosus:

Echinococcus granulosus is a small-sized parasite that causes hydatidosis in humans. The parasite has a complex life cycle involving definitive hosts (dogs and animals from the Canidae family) and intermediate hosts (herbivores, including humans).

The parasitic structure called a metacestode or hydatid cyst develops in various organs of intermediate hosts and can vary in size. The parasite releases scoleces into the cystic fluid, which can accumulate to form a structure called "hydatid sand."

There are varieties of this parasite, and genetic diversity can affect the parasite's life cycle, pathogenicity, and disease control strategies. The human host's response to the parasite can vary depending on individual factors and the host's health.

The hydatid cyst is surrounded by a pericystic layer that serves protective and nutritive functions.

1.3 Clinical and evolutionary aspects and diagnosis in pulmonary hydatid cysts:

Pulmonary hydatidosis poses a significant health problem in endemic areas. This condition can be unilateral or bilateral, consist of a single cyst or multiple cysts, and can affect any organ in the human body, but the lung is most commonly involved, presenting various symptoms and complications. The importance of diagnosis and imaging techniques, as well as serological tests, in detecting and managing this condition is emphasized.

1.4 Contemporary treatment options for pulmonary hydatid cysts:

Surgical intervention remains the most effective means of cure. Medical treatment with drugs like mebendazole or albendazole can be used as adjuvant therapy or in combination with surgery before or after the operation.

However, these medications are not approved by regulatory organizations and may have adverse effects. Various surgical procedures can be employed, including conservative and radical approaches, depending on the size and condition of the cysts. Thoracotomy is the preferred procedure for pulmonary cysts, while thoracoscopy is becoming more common, offering advantages such as rapid recovery and reduced morbidity.

Surgical treatment of hepatopulmonary hydatid cysts involves complex approaches, and the sequence and interval between surgeries must be carefully planned. Alternatives such as scolicidal treatment during surgery and radiotherapy are also discussed, but the results are controversial in some cases.

B. Special part

CHAPTER 2: MATERIALS AND RESEARCH METHODS

2.1 Clinical characteristics of thestudy group:

This section analyzes the study conducted at the Laboratory of Surgical Infections in Children at the "Nicolae Testemițanu" State University of Medicine and Pharmacy and at the National Scientific-Practical Center of Pediatric Surgery "Natalia Gheorghiu" of the Mother and Child Institute. The study reflects the results of a comprehensive retrospective and prospective analysis of clinical, imaging, morphopathological observations, and medical-surgical treatment of 110 children with pulmonary hydatidosis and coexisting hepatic forms operated on during the period from 2000 to 2020.

The study group included 90 (81.82%) patients with pulmonary hydatidosis and 20 (18.18%) patients with hepatic-pulmonary hydatid cysts aged between 2 and 18 years. In the majority of cases, the patients came from rural areas, accounting for 75.45% of cases.

Among the total number of patients included in the study group, the majority were boys, both in the pulmonary hydatid cyst group – 66.67%, and in the group with coexisting hepatic forms – 65%, with the highest frequency recorded in the 7-14 age group in both patient groups.

At the time of hospitalization, the youngest age among patients with pulmonary hydatidosis was 3 years, while among those with hepatic-pulmonary hydatid cysts, it was 2 years and 10 months.

Regarding the location, in the group of patients with isolated pulmonary hydatid cysts, the right lung was more frequently affected - 52 (57.78%) cases, compared to the left lung - 21 (23.33%) cases, and in 17 (18.9%) cases, the parasitic lesion involved both lungs. More frequently, the lower pulmonary lobes were affected (Table 2.3), with the lower lobe of the right lung being the most common (38.9%).

Single hydatid pulmonary cysts predominated - 63 (70%) cases compared to multiple parasitic cyst formations - 27 (30%) cases. Giant pulmonary cysts with a diameter over 10 cm were found in 32 (35.56%) cases, and 19 (21.11%) cases presented with complicated forms due to the rupture of the pulmonary hydatid cyst, including:

- Hydatid cyst complicated by spontaneous endobronchial rupture – 9 (10%) cases.

- Hydatid cyst complicated by post-traumatic endobronchial rupture – 4 (4.44%) cases.
- Hydatid cyst complicated by intrapleural rupture – 2 (2.22%) cases.
- Hydatid cyst complicated by simultaneous endobronchial and intrapleural rupture – 3 (3.33%) cases.
- Infected hydatid cyst – 1 (1.11%) case.

In the group of patients with hepatic-pulmonary hydatid cysts, involvement of the right lung was observed in 9 (45%) cases, the left lung in 6 (30%) cases, and both lungs in 5 (25%) cases. In this group of patients, the right lobe of the liver was affected in the majority of cases - 13 (65%) cases, compared to the left lobe - 3 (15%) cases, with both hepatic lobes being affected in 4 (20%) cases. In 3 (15%) patients with hepatic-pulmonary hydatid cysts, both lungs and both hepatic lobes were involved. Among these patients, three children aged 2-6 years had multiple parasitic cyst formations in both the lungs and the liver.

Most cases of uncomplicated pulmonary hydatid cysts, 39 (54.93%) cases, were asymptomatic and were diagnosed incidentally. Symptomatic forms accounted for 45.07% (32 cases) of the total number of uncomplicated hydatid cyst cases. These patients presented with nonspecific symptoms, more frequently complaining of a dry cough (53.12%), fatigue (46.87%), fever (43.37%), and dyspnea (28.12%) (Table 2.4). Typically, symptomatic forms were observed in patients with larger or giant pulmonary hydatid cysts or in cases with pericystic inflammatory changes.

According to the data from Table 2.5, cough and expectoration were the most frequent symptomatic findings in children with complicated pulmonary hydatid cysts due to cyst rupture. Besides these symptoms, patients with pulmonary hydatid cysts complicated by rupture usually presented varying degrees of dyspnea (63.16%), cutaneous allergic manifestations (36.84%), subfebrile or febrile episodes (47.37%), fatigue (47.37%), chest pain (57.89%), and hemoptysis (31.57%).

Anamnestic data revealed the presence of hydropneumothorax in 36.84% of cases, and expectoration of chitinous membrane fragments was observed in 2 patients. In most cases, children with pulmonary hydatid cysts complicated by rupture presented with two or more symptoms.

Most patients with hepatic-pulmonary hydatid cysts presented with respiratory symptoms (13 cases), including one case with traumatic rupture of a giant pulmonary hydatid cyst and one case with spontaneous rupture of a pulmonary hydatid cyst. Abdominal symptoms observed in 5 patients were characterized by right hypochondrial pain (2 cases), hepatomegaly (3 cases), and

bulging in the epigastric region (2 cases) or right hypochondrium (1 case). Two patients had respiratory symptoms associated with abdominal symptoms.

2.2 Investigation methods:

This study employed various investigative methods, including a range of medical and laboratory procedures, to assess patients with pulmonary hydatidosis and coexisting hepatic forms. These methods were applied preoperatively and included:

Routine laboratory tests: All patients underwent routine laboratory tests. Imaging investigations: The following imaging investigations were conducted for visual assessment of the conditions:

- Chest X-ray: This procedure was performed on all patients using Shimadzu Sonialvision G4 X-ray machines.
- Computed Tomography (CT): Pulmonary CT was performed using a Toshiba Aquilion Prime 80-slice CT scanner. It provided tomographic sections in different modes, including pulmonary, mediastinal MPR, and virtual bronchoscopy.
- Abdominal Ultrasound: This procedure aimed to evaluate patients' abdominal conditions.
- Pulmonary Perfusion Scintigraphy: This was conducted to assess pulmonary artery perfusion in peripheral areas using the radioisotopic agent macroaggregated albumin (MAA)-Tc99m.

Morphopathological study: This was conducted in the pathology department of the Mother and Child Institute and involved the intraoperative collection of samples from the pericyst and lung parenchyma (in 33 cases). These samples were subjected to hematoxylin-eosin staining.

Histopathological study: This included the examination of the parasitic metacestode, pericyst (fibrous capsule), and pericystic lung tissue samples obtained intraoperatively. A total of 935 tissue samples were analyzed using staining methods such as hematoxylin & eosin, van Geison, Orcein, and A&E.

Immunohistochemical testing: This testing was conducted to assess the populations of T lymphocytes, B lymphocytes, and macrophages involved in the inflammatory process. Specific monoclonal antibodies for surface markers CD3, CD4, CD8, CD20, and CD68 were used. Patients were divided into three groups for immunohistochemical analysis.

These procedures were implemented to obtain detailed information about the condition of patients with pulmonary hydatidosis and coexisting hepatic forms, including identifying pathological changes and associated inflammation.

CHAPTER 3: EVALUATION OF MORPHOLOGICAL CHANGES IN VARIOUS FORMS OF PULMONARY HYDATID CYSTS

3.1 Morphopathological features in intact pulmonary hydatid cysts and those complicated by rupture with persistent postoperative air leak disorders:

This chapter focuses on evaluating morphological changes in various forms of pulmonary hydatid cysts, with an emphasis on intact cysts and those complicated by rupture. Here are the main findings and results from this study:

The research aimed to examine morphopathological changes in children undergoing the removal of pulmonary hydatid cysts, which also involved the closure of residual cavities. In some cases, there was failure in suturing these cavities, while in others, compressive pneumothorax occurred.

The cases were divided into three groups based on the severity of perifocal changes observed in radiological examinations: a group with minimal changes, a group with significant inflammatory changes around the cyst, and a group with cysts complicated by rupture.

A direct correlation was found between the severity of changes in the fibrous capsule (pericyst) structure and the pericystic lung parenchyma and the incidence of postoperative closure suture failure. In cases with minimal perifocal changes, residual cavity obliteration was observed within the first 5-6 months postoperatively, even for large cysts. In these cases, viable and fertile hydatid larval cysts were found, along with viable germinal elements (protoscoleces). Changes in the fibrous capsule in these cases included scattered necrotic changes with eosinophilic granulocytic infiltrates and lymphocytic pseudofollicular infiltrates.

Cases of hydatid cysts complicated by endobronchial rupture exhibited necrotic changes in the laminar cuticle, uneven reduction of laminar structures, and signs of homogenization. Patients with severe complications documented inflammatory, necrotic, and destructive changes in the structural elements of the parasite, as well as vascular thrombotic processes. In some cases, daughter cysts and dead protoscoleces were observed. The periparasitic fibrous capsule

exhibited necrotic lesions, inflammatory reactions, and mesenchymal proliferation. The bronchial system was affected, manifesting exulcerative granulomatous bronchitis and hyperplasia of lymphoid follicular structures.

Severe changes led to postoperative complications such as suture closure failure and bronchial fistula persistence. In conclusion, pulmonary hydatid cysts with minimal changes have a higher regenerative potential and can be treated conservatively in some cases. However, cases complicated by rupture presented significant alterations in parasite structure and had a higher risk of postoperative complications and recurrence.

3.2 Characterization of the cellular spectrum of lymphocyte and macrophage populations in the fibrous capsule and pericystic lung tissue in pulmonary hydatid cysts in children:

This study aimed to examine the cellular composition in pulmonary hydatid cysts in children, focusing on the lymphocyte and macrophage populations in the fibrous capsule and pericystic lung tissue. Various clinical-morphological forms of this condition were investigated.

In the first group of patients, it was observed that inflammatory infiltrates in pericystic lung parenchyma were dominated by CD3+ lymphocytes, with significantly higher density than CD4+ and CD8+ subpopulations. CD20+ B lymphocytes were present in infiltrates in the lung parenchyma adjacent to the fibrous capsule but absent in the fibrous capsule. CD68+ macrophages were observed in areas adjacent to the fibrous capsule, perivascular areas, and regional pleura.

In the second group of patients, the density of CD3+ lymphocytes in the inflammatory infiltrate was comparable to that of CD4+ and CD8+ subpopulations. CD3+ lymphocytes were diffusely distributed in pericystic parenchyma. CD4+ subpopulation had higher density and was localized near the fibrous capsule. CD8+ subpopulation had higher density and was observed near the fibrous capsule and peribronchial spaces. CD20+ B lymphocytes were present in pericapsular infiltrates.

In the third group of patients with complicated forms of pulmonary hydatid cysts, there was an increased density of CD3+ lymphocytes, with no significant difference from the other groups. CD3+ lymphocytes were concentrated in sectors adjacent to the fibrous capsule, peribronchial areas, and interalveolar septa. CD4+ subpopulation had a similar density to the other groups and was localized in pericapsular infiltrates and peribronchial spaces. CD8+ subpopulation had a higher density and was observed near the fibrous capsule, peribronchial

spaces, and distant tissues. CD20+ B lymphocytes were present in pericapsular and peribronchial infiltrates.

In conclusion, the study highlighted significant differences in the cellular composition of inflammatory infiltrates in pulmonary hydatid cysts in children, depending on the clinical form of the disease. CD3+ T lymphocytes were predominant in all groups, and CD68+ macrophages exhibited variable density. These findings suggest that inflammatory processes in pericystic lung parenchyma are involved in the disease's progression in children and can be assessed using immunohistochemical markers to evaluate disease stage and the need for surgical intervention

CHAPTER 4: EVALUATION OF TREATMENT OUTCOMES IN CHILDREN WITH DIFFERENT FORMS OF PULMONARY HYDATID CYSTS BASED ON SURGICAL TECHNIQUES

The purpose of this study was to retrospectively assess the surgical treatment outcomes in various forms of pulmonary hydatid cysts based on the method of resolving post-echinococcectomy residual cavities, relying on morphopathological examination results.

Patients were divided into three subgroups. All children were placed in a lateral decubitus position and underwent endotracheal general anesthesia. The majority of patients (67.27%) underwent a standard posterolateral thoracotomy to resolve pulmonary hydatid cysts, while the rest had a posterolateral thoracotomy with muscle preservation.

In cases of bilateral pulmonary hydatid cysts, staged surgical treatment was performed, initially addressing the part with the major-sized or complicated parasitic cyst. Hepatopulmonary hydatid cysts also required staged surgical treatment, with initial intervention to resolve the pulmonary hydatid cyst. Following pleural cavity opening, adhesiolysis (pulmonary decortication and debridement) was performed in most cases to treat lung adherence to the internal chest wall. In cases of bleeding, an argon coagulator was used.

For uncomplicated pulmonary hydatid cyst cases, aspiration of hydatid fluid with intraoperative inactivation of the parasitic larval cysts using scolicidal substances was preferred. Subsequently, cystotomy (pneumostomy) was performed, followed by larval cyst extraction.

Various scolicidal substances were used, such as 96% alcohol, Betadine, 10% hypertonic saline solution, and 1.5% silver nitrate solution. After treating the remaining cavity with scolicidal substances, bronchial openings were closed.

During the postoperative period, patients received antibiotic therapy, anti-inflammatory treatment, and other metabolic correction measures. Chemotherapy with scolicidal agents was

indicated for multiple pulmonary hydatid cysts, hepatopulmonary hydatid cysts, and complicated forms of the disease.

For closing residual cavities, quilting techniques were preferred over pneumostomy or pulmonary resections. No lethal cases or severe postoperative complications requiring surgical reintervention were recorded.

In conclusion, the study demonstrated that surgical treatment of pulmonary hydatid cysts in children can be effective and safe, with favorable outcomes in most cases. The quilting technique for closing residual cavities was preferred and yielded good results compared to pneumostomy or pulmonary resection, especially in cases of large and complicated hydatid cysts.

Discussion. The treatment of hydatid cysts has been a topic of discussion since 1804 when Laennec noted that these parasitic formations represent a phase in the life cycle of a tapeworm. Subsequently, several surgical procedures and chemotherapeutic treatment schemes have been proposed. Despite advances in medical treatment for hydatid cysts in children, the preferred therapeutic option remains surgical intervention, which can be performed safely with low morbidity and negligible mortality rates.

The lateral-posterior thoracotomy technique with muscle preservation, initially proposed by Noirclerc et al. in 1973 and later described by Bethencourt and Holmes in 1987, has been adapted and used in neonatal and pediatric thoracic surgery with relatively good results, including in the surgery of pulmonary hydatid cysts. The technique of thoracotomy with muscle preservation, as described by Jawad A.J. in 1997, offers excellent exposure in neonatal and pediatric thoracic surgical pathologies without intraoperative complications and with relatively good postoperative cosmetic results. While the removal of the parasitic larval cyst is universally accepted as an echinococcectomy, there are differing opinions on the management of residual cavities. In the surgical management of hydatid cysts, the efficient resolution of residual cavities is of major importance, especially in complicated forms. The non-quilting technique, applied when eliminating residual cavities after echinococcectomy, is presented by several authors as an alternative because it does not shorten hospitalization or the duration of air drainage through the thoracic tube, nor does it prevent complications such as empyema, persistent bronchial fistulas, air leaks, or recurrence. The closure of the residual cavity margins is not mandatory because lung parenchyma compresses and occupies the space, and the lung's surface is covered by the pleura in the residual cavity area. This approach, called non-quilting, is considered a viable option, even in children, for post-echinococcectomy residual cavities.

The technical procedure of creating direct communication between the residual cavity

and the pleural space, with the closure of bronchopleural fistulas and external drainage after removing the hydatid metacestode, was proposed by Yacoubian H.D. and Dajani T. in 1963. It is considered applicable in intact forms of pulmonary hydatid cysts as well as in complicated forms. The method aims to maintain the functional integrity of pericystic lung tissue, and the efficiency and safety of this strategy have been described by multiple authors. This procedure, called "pneumonostomy," was also used in the treatment of pulmonary abscesses. Several authors support the idea that quilting of residual cavities after echinococcectomy is not essential in the surgical treatment of pulmonary hydatid cysts. They argue that the lung can expand to fill the cavity after a short postoperative period. At the same time, some authors advocate for surgical interventions that preserve lung parenchyma and quilt residual cavities, a technique supported by others, especially in complicated forms of the disease. This technique avoids the development of bronchopleural fistulas, prolonged air leaks, the formation of purulent collections in the residual cavity and pleural cavity, etc.

The decision to perform lobectomy, supported by some authors in certain situations, must be carefully considered, even in cases of infected hydatid cysts, giant cysts, or multiple cysts involving the same lobe. Preserving lung parenchyma is preferred, especially in children and endemic areas, where the risk of recurrence is a real concern. It should be noted that most authors have suggested pulmonary resections as a last-resort option in cases of giant pulmonary hydatid cysts, with an intervention rate of 6%-13%. Some studies have adopted specific criteria for pulmonary resections, such as severe bleeding in complicated hydatid cysts with rupture, giant pulmonary hydatid cysts with destruction exceeding 50% of a lung lobe, cavity suppuration, simultaneous aspiration with lobe rigidity. Given the excellent regenerative capacity of lung tissue in children, there is a contrary opinion suggesting that these types of surgeries, which have high rates of postoperative complications, including wound infection (19.4%), pneumonia (11.1%), atelectasis (8.3%), empyema (8.3%), prolonged air leaks (5.5%), etc., should be avoided. It should be noted that the Ugon enucleation technique, which involves the intact removal of the parasitic cyst, can be primarily applied in small-sized hydatid cysts with a low risk of rupture.

Among the surgical treatment options for large-sized pulmonary hydatid cysts, the Barrett/Posadas technique has proven to be quite widespread, consisting of cystotomy with closure of bronchopleural fistulas with or without quilting.

5. Conclusion:

1. Degenerative and inflammatory pericystic changes in intact pulmonary hydatid cysts in children create favorable conditions for the development of suture insufficiency in closing remaining fistulas and residual cavities, especially in cases with significant perifocal inflammatory changes in pulmonary hydatid cysts and parasitic cyst formations complicated by rupture. In these cases, additional plombage of bronchial fistulas and residual pockets with an acellular matrix of connective tissue can be considered.
2. Pulmonary hydatid cyst complicated by endobronchial rupture is characterized by necrotic degenerative changes in the pericystic layer, the development of vascular thrombotic syndrome within the pericystic and adjacent pulmonary parenchyma, and an acute granulocytic inflammatory process with an eosinophilic component. In the pericystic parenchymal regions of complicated pulmonary hydatid cysts, pneumopathy is evident, characterized by fibrin and fibrino-leukocytic alveolitis, while the pleural area exhibits inflammatory-proliferative micropapillary mesothelial phenomena. These morphopathological manifestations lead to prolonged postoperative morbidity.
3. The procedure of cystotomy with complete removal of the parasitic larval cyst, along with closure of the airway communications and quilting of the remaining cavity while preserving adjacent lung parenchyma, represents an effective method for treating pulmonary hydatid cysts in children. This surgical method has a lower incidence of postoperative morbidity compared to the use of pneumostomy.
4. In uncomplicated pulmonary hydatid cysts in children, pericystic tissues have an increased potential for regenerative processes, significantly influencing the favorable progression of repair and obliteration processes in cases of quilting suture dehiscence. In this context, it is believed that children with quilting suture dehiscence can be treated conservatively.
5. The higher rate of postoperative complications compared to uncomplicated forms of the disease, along with the presented evolutionary aspects, confirms the need for optimization of surgical methods for the eradication of post-echinococcectomy residual cavities in cases of uncomplicated and complicated pulmonary hydatid cysts. The goal is to reduce postoperative morbidity and hospitalization duration, considering the significant risks associated with prolonged persistence of residual cavities.

6. Novelty and originality of the Study:

This work represents a comprehensive, multi-planar study that includes the evaluation of clinical and evolutionary characteristics of different forms of pulmonary hydatid cysts in children, comparative analysis of imaging diagnostic methods against the results of morphopathological examination and surgical treatment, adapted according to the clinical-evolutionary form of the disease.

This study is among the few that aimed to evaluate the morphopathological and immunohistochemical correlations in pediatric pulmonary cystic echinococcosis. The novelty of this work lies in the estimation and comparative analysis of the spectrum of morphopathological changes within the parasitic larval cyst and pericystic tissues, along with the immunohistochemical testing of the lymphocyte population within the inflammatory infiltrate of the adventitial layer (pericyst) and pericystic tissues in various clinical-morphological forms of pulmonary hydatid cysts in children.

According to the results of the immunohistochemical examination, lymphocytes T CD3 prevail in the chronic inflammatory infiltrate of the pericystic parenchyma in pulmonary hydatid cysts compared to the fibrous capsule, where necrotic processes predominate. In the inflammatory infiltrate of the underlying lung parenchyma beneath the fibrous capsule, a higher number of CD68 macrophages were found compared to the fibrous capsule and the pleura, along with an increased number of CD20 cells due to aggravated inflammatory processes in the pericystic parenchyma in complicated forms of the disease.

From both immediate and long-term results, the value and effectiveness of the technical procedures used in the surgical treatment of various forms of pediatric pulmonary hydatid cysts have been evaluated comparatively. New methods have been proposed for resolving residual cavities after the removal of the hydatid larval cyst.

7. Clinical applicability

The practical value of this work lies in identifying risk factors contributing to the association of complications with a significant impact on the negative outcomes of surgical treatment for pediatric pulmonary hydatid cysts. This work aims to modify management principles for pediatric pulmonary hydatid cysts, scientifically substantiating the approach to each clinical-evolutionary form of the disease. It is hoped that the results obtained in our modest study will contribute to improving the diagnosis and treatment of pediatric pulmonary hydatid cysts, combating the empirical decision-making nature regarding treatment options for certain clinical forms of this serious parasitic disease.

The evaluation of the spectrum of morphopathological changes characteristic of various forms of pulmonary hydatid cysts has proven to be of major importance in scientifically justifying their responsibility for recurrences and complications in the resolution of residual cavities, justifying the choice of therapeutic conduct for each clinical form of the disease. According to the obtained results, the procedure of quilting the residual cavity completed with plombage showed higher efficiency compared to the non-quilting method.

This study has demonstrated the informativeness of histological and immunohistochemical examinations in evaluating the severity of morphopathological changes. Based on these findings, the methodology and logistical support for guiding the clinical application of diagnostic and surgical treatment methods for pediatric pulmonary hydatid cysts, including complicated forms, have been developed and recommended.