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Cystic Echinococcosis in Pediatric Patients in Sivas Province: Clinical, Laboratory, Surgical, and Radiological Findings

Sivas İlindeki Pediatrik Hastalarda Kistik Ekinokokoz: Klinik, Laboratuvar, Cerrahi ve Radyolojik Bulgular

Kübra Fırtına Topcu[1], Levent Cankorkmaz[2], Mürşit Hasbek[1]

[1]Sivas Cumhuriyet University Faculty of Medicine, Department of Medical Microbiology, Sivas, Türkiye
[2]Sivas Cumhuriyet University Faculty of Medicine, Department of Pediatric Surgery, Sivas, Türkiye

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ABSTRACT

Objective: This study aimed to retrospectively evaluate the serological, clinical, and radiological findings in the diagnosis of cystic echinococcosis (CE) in pediatric patients. The relationship between serological test results and clinical and radiological findings was also investigated.

Methods: The study included 216 pediatric patients (under 18 years old) who underwent indirect hemagglutination assay (IHA) testing for CE differential diagnosis between January 2016 and December 2023. Demographic data, clinical symptoms, radiological imaging results, and surgical status were obtained from the hospital information management system. IHA tests were performed using a commercial kit (Hydatidose, Fumouze Laboratoires, France) following the manufacturer's protocol. A titer of ≥1/320 was considered positive, 1/160 as borderline, and <1/160 as negative. Statistical analysis was performed using SPSS 23.0, and a p-value <0.05 was considered significant.

Results: CE was diagnosed in 40 (18.5%) of 216 patients based on combined clinical, laboratory, and radiological evaluations. The mean age of the patients was 11.92±4.14 years, and 52.5% were male. IHA test results were positive in 31 (77.5%) patients and negative in 9 (22.5%). Radiological imaging showed a single cyst in 67.5% of patients and multicystic appearance in 32.5%. The most common cyst localizations were liver (67.5%), lung (22.5%), spleen (7.5%), and brain (2.5%). Surgery was performed in 42.5% of patients, while 22.5% were followed non-surgically. No statistically significant relationship was found between cyst number, localization, and IHA positivity (p>0.05).

Conclusion: The findings emphasize the importance of evaluating clinical, laboratory, and radiological data together for accurate and early diagnosis of CE. Due to the variable sensitivity of the IHA test, negative results should be confirmed with additional diagnostic methods. While radiological imaging provides critical information about cyst localization, further studies are needed to investigate the correlation between cyst number, localization, and clinical course. Larger patient series would help improve the diagnostic process and clinical management of pediatric CE.

Keywords: Cystic echinococcosis, serological diagnosis, indirect hemagglutination, cyst hydatid

ÖZ

Amaç: Bu çalışma, pediatrik hastalarda kistik ekinokokkoz (KE) tanısında serolojik, klinik ve radyolojik bulguların retrospektif olarak değerlendirilmesini amaçlamaktadır. Çalışmada, serolojik test sonuçları ile klinik ve radyolojik bulgular arasındaki ilişkiler incelenmiştir.

Yöntemler: Ocak 2016 - Aralık 2023 tarihleri arasında hastanemizde KE ayırıcı tanısı için indirekt hemaglütinasyon (İHA) testi çalışılan 18 yaş altındaki 216 hastanın verileri retrospektif olarak analiz edildi. Hastaların demografik verileri, klinik belirtileri, radyolojik görüntüleme sonuçları ve cerrahi durumları hastane bilgi yönetim sisteminden elde edildi. İHA testleri, üretici firmanın protokolüne uygun olarak ticari bir kit (Hydatidose, Fumouze Laboratoires, Fransa) kullanılarak çalışıldı. Test sonuçlarında ≥1/320 pozitif, 1/160 şüpheli ve <1/160 negatif olarak değerlendirildi. İstatistiksel analizler SPSS 23,0 yazılımı ile yapıldı ve p<0,05 değeri anlamlı kabul edildi.

Address for Correspondence/Yazar Adresi: Asst. Prof. Kübra Fırtına Topcu, Sivas Cumhuriyet University Faculty of Medicine, Department of Medical Microbiology, Sivas, Türkiye
E-mail/E-Posta: drkubrafirtina@gmail.com **ORCID ID:** orcid.org/0000-0002-3260-5309

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Bulgular: Toplam 216 hastanın 40'ında (%18,5) klinik, laboratuvar ve radyolojik bulguların birlikte değerlendirilmesiyle KE tanısı konuldu. Hastaların yaş ortalaması 11,92±4,14 yıl olup, %52,5'i erkekti. İHA testi 31 hastada (%77,5) pozitif (≥1/320), 9 hastada (%22,5) negatif (<1/320) olarak bulundu. Radyolojik görüntülemeler sonucunda hastaların %67,5'inde tek kist, %32,5'inde ise multikistik görünüm tespit edildi. Kistlerin en sık yerleşim bölgeleri karaciğer (%67,5), akciğer (%22,5), dalak (%7,5) ve beyin (%2,5) olarak saptandı. Hastaların %42,5'i opere edilmiş, %22,5'i cerrahi dışı takip edilmişti. Kist sayısı, kist yerleşim yeri ile İHA pozitifliği arasında istatistiksel olarak anlamlı bir ilişki saptanmadı (p>0,05).
Sonuç: Elde edilen veriler, KE tanısının doğru ve erken konulabilmesi için klinik, laboratuvar ve radyolojik bulguların birlikte değerlendirilmesi gerektiğini vurgulamaktadır. İHA testinin duyarlılığı değişkenlik gösterebildiğinden, negatif sonuçların kesin tanı için ek testlerle desteklenmesi önerilmektedir. Radyolojik görüntüleme yöntemleri, hastalığın lokalizasyonu açısından önemli bilgiler sunsa da, kist sayısı ve yerleşiminin klinik seyirle ilişkisi daha fazla araştırılmalıdır. Daha geniş hasta gruplarıyla yapılacak çalışmalar, tanısal süreçlerin geliştirilmesine katkı sağlayacaktır.
Anahtar Kelimeler: Kistik ekinokokkoz, serolojik tanı, indirekt hemaglütinasyon, kist hidatik

INTRODUCTION

Cystic echinococcosis is a zoonotic parasitic disease caused by *Echinococcus* species (1,2). The parasite is transmitted to humans through ingestion of food or water contaminated with parasite eggs shed in the feces of infected dogs, or through direct contact with contaminated environments (3). Humans are intermediate hosts for *Echinococcus*, meaning they are not the parasite's primary targets (4). In Türkiye, the disease is a significant public health issue, particularly in the Eastern and Central Anatolian regions and in rural areas (5). The liver is the most commonly affected organ, followed by the lungs. In pediatric cases, pulmonary involvement is more frequent than hepatic involvement (4). Due to the possibility of hematogenous spread, the parasite can affect various organs and, although rare, may localize in virtually any part of the body (5,6).

The clinical presentation of the disease varies depending on factors such as the location, size, pressure effects, and possible rupture of the cyst. However, the disease may remain asymptomatic for many years (4,7). A definitive diagnosis requires a combination of methods, including serology, histology, nucleic acid detection, and imaging techniques (3). Serological diagnosis is typically established using a screening test such as indirect hemagglutination assay (IHA) or ELISA, followed—if positive—by confirmation with Western blot testing (8). Treatment options for cystic echinococcosis include medical treatment, surgery, percutaneous interventions, and a watch-and-wait strategy, depending on the size, location, and clinical presentation of the cyst (4,9).

The aim of this study was to evaluate the clinical findings, IHA results, surgical status, and radiological characteristics of patients diagnosed with cystic echinococcosis and to investigate the relationships among these variables.

METHODS

Study Design and Sample Collection

This study was approved by the Sivas Cumhuriyet University Ethics Committee with decision number 2024-12/06, dated December 19, 2024. A total of 216 samples from patients under 18 years of age, submitted between January 2016 and December 2023 from various departments of our hospital for the differential diagnosis of hydatid cyst, were retrospectively analyzed.

Clinical signs and symptoms, surgical status, radiological imaging findings, and demographic data of the patients were obtained from the hospital information management system. Repeated test results performed for treatment follow-up after an initial positive result were excluded from the study.

Serological Analysis

In the routine practice of our laboratory, sera were separated from blood samples and tested using a commercial kit (Hydatidose, Fumouze Laboratoires, France) according to the manufacturer's instructions. Upon arrival at the laboratory, the samples were stored at +4 °C and processed within 48 hours. The IHA was performed using U-bottom microplates.

Serum dilutions (1/80, 1/160, 1/320, and 1/640) were prepared and mixed with antigen-coated erythrocyte suspension. The absence of sedimentation or the presence of irregular lace-like sedimentation was considered a positive reaction. A negative result was defined as the formation of a compact button-like sediment in the center of the wells due to gravity.

According to the manufacturer's instructions, titers of 1/320 and above were reported as positive. A titer of 1/160 was considered borderline, and repeat testing was recommended 2-3 weeks later.

Statistical Analysis

The collected data were analyzed using the SPSS version 23.0 (IBM Corp., Armonk, NY, USA). Categorical variables were presented as numbers and percentages. Descriptive statistics were expressed as mean ± standard deviation, minimum-maximum values, numbers, and percentages. Comparisons between categorical variables were performed using the Pearson chi-square test. When expected cell counts were less than five, Fisher's exact test or Fisher-Freeman-Halton exact test was used as appropriate. A p-value of <0.05 was considered statistically significant.

RESULTS

In this study, cystic echinococcosis was identified in 40 patients based on laboratory, clinical, and radiological findings. Of these patients, 21 were male (52.5%) and 19 were female (47.5%), and the mean age was 11.92±4.14 years (range: 4-17). A positive IHA result (≥1/320) was detected in 31 patients (77.5%), while nine patients (22.5%) had negative IHA results (<1/320). Imaging modalities used for diagnosis included ultrasonography, computed tomography, and magnetic resonance imaging. A single cyst was observed in 27 patients (67.5%), whereas multiple cysts were present in 13 patients (32.5%).

Regarding cyst localization, the liver was the most commonly affected organ (67.5%), followed by the lungs (22.5%), spleen (7.5%), and brain (2.5%). Seventeen patients (42.5%) underwent surgical treatment, nine patients (22.5%) were followed without surgery, and the surgical status of 14 patients (35%) could not be determined.

At presentation, 34 patients (85%) had at least one symptom, whereas six patients (15%) were diagnosed incidentally during

imaging studies performed for unrelated conditions. Abdominal pain was the most frequently reported symptom among patients with hepatic cysts, while cough was observed in patients with pulmonary involvement. No statistically significant association was found between cyst localization and presenting symptoms (p>0.200). Detailed demographic and clinical characteristics of the patients are presented in Table 1.

The distribution of IHA titers among patients was also evaluated. Five patients (12.5%) had titers below 1/160, four patients (10.0%) had a titer of 1/160, seven patients (17.5%) had a titer of 1/320, and twenty-four patients (60.0%) had titers of 1/640. Nine patients had negative IHA results. Despite negative serology, these patients were diagnosed with cystic echinococcosis based on compatible clinical findings and characteristic radiological features.

The relationship between cyst number and IHA positivity was also evaluated. IHA positivity was detected in 20 of 27 patients (74.1%) with a single cyst and in 11 of 13 patients (84.6%) with multiple cysts. No statistically significant association was found between cyst number and IHA positivity (Fisher's exact test, p=0.690).

Regarding cyst localization, the liver was the most commonly affected organ (27/40, 67.5%), followed by the lungs (9/40, 22.5%), spleen (3/40, 7.5%), and brain (1/40, 2.5%). The distribution of cyst localization according to affected organs is illustrated in Figure 1. The association between cyst localization and IHA positivity was analyzed by grouping cyst localization as pulmonary, hepatic, and other sites. IHA positivity was observed in 7 of 8 patients (87.5%) with pulmonary cysts, 21 of 26 patients (80.8%) with hepatic cysts, and 3 of 6 patients (50.0%) with cysts located at other sites. No statistically significant association was found between cyst localization and IHA positivity (Pearson chi-square test, χ^2=3.22, df=2, p=0.200) (Table 2).

Surgical management according to cyst localization was also evaluated. Surgical treatment was performed in patients with pulmonary, hepatic, and other organ involvements. However, no statistically significant association was found between cyst localization and surgical status (Fisher-Freeman-Halton exact test, p=0.413). The distribution of surgical status and presenting symptoms according to cyst localization is shown in Table 3. The location of the cyst and the most common associated symptoms are shown in Table 4.

Table 1. Demographic and clinical characteristics of patients with cystic echinococcosis (n=40)

Variable	n (%)
Sex	
Male	21 (52.5)
Female	19 (47.5)
Age (years)	11.92±4.14
Cyst number	
Single cyst	27 (67.5)
Multicystic	13 (32.5)
IHA result	
Positive	31 (77.5)
Negative	9 (22.5)
IHA titers	
<1/160	5 (12,5)
1/160	4 (10)
1/320	7 (17.7)
1/640	24 (60)
Surgical status	
Operated	17 (42.5)
Follow-up without surgery	9 (22.5)
Unknown	14 (35)
Clinical presentation	
Symptomatic	34 (85)
Incidental diagnosis	6 (15)

n: Number of patients, IHA: Indirect hemagglutination assay

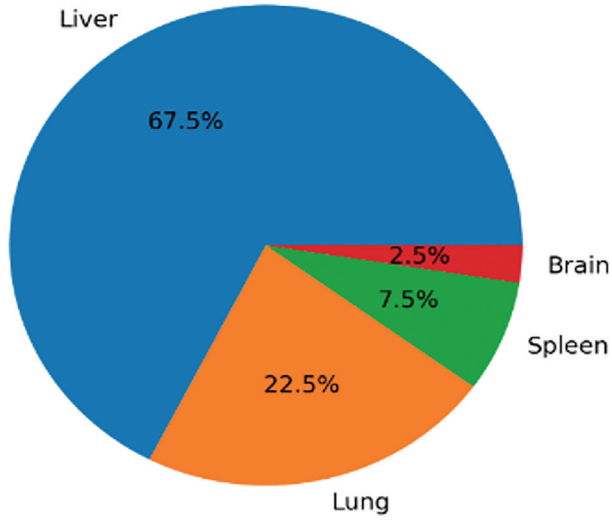

Figure 1. Distribution of cyst localization according to affected organs in patients with cystic echinococcosis.

Table 2. Relationship between cyst characteristics and IHA positivity

Variable	IHA positive, n (%)	IHA negative, n (%)	p
Cyst number			
Single cyst	20 (74.1)	7 (25.9)	0.69
Multicystic	11 (84.6)	2 (15.4)	
Localization			
Lung	7 (87.5)	1 (12.5)	0.2
Liver	21 (80.8)	5 (19.2)	
Other	3 (50)	3 (50)	

Pearson chi-square test was used for comparisons; Fisher's exact test was applied when expected cell counts were less than five
IHA: Indirect hemagglutination assay

Table 3. Distribution of surgical status and symptoms according to cyst localization

	Surgical status			p
Localization	**Operated, n (%)**	**Follow-up, n (%)**	**Unknown, n (%)**	
Lung	3 (17.6)	1 (11.1)	4 (28.6)	0.413
Liver	10 (58.8)	7 (77.8)	9 (64.3)	
Brain	1 (5.9)	0	0	
Lung + liver	2 (11.8)	0	0	
Spleen	1 (5.9)	1 (11.1)	1 (7.1)	

Due to small expected cell counts, comparisons were performed using Fisher-Freeman-Halton exact test

Table 4. Presenting symptoms by localization (main symptoms)

	Localization			
Symptom	**Lung**	**Liver**	**Brain**	**Spleen**
Abdominal pain	1	17	0	1
Cough	2	0	0	0
Fever	1	0	0	0
Febrile convulsion	0	0	1	0
No complaint	1	4	0	1

DISCUSSION

Cystic echinococcosis remains an important zoonotic and public health problem in Türkiye, as reported by the Ministry of Health and several epidemiological studies (10,11). Although infection may be acquired during childhood, the disease is often diagnosed later in life because hydatid cysts grow slowly. Previous studies have reported that only 10-20% of cases are diagnosed in individuals younger than 16 years (12). In the present study, 40 of 216 pediatric patients were diagnosed with cystic echinococcosis, indicating that the disease continues to represent a significant health concern in children and emphasizing the importance of early recognition and diagnosis.

In our study, no statistically significant difference in IHA positivity was observed between male and female patients. Similar findings have been reported in previous studies, suggesting that sex may not represent a major determinant of serological response in cystic echinococcosis (13,14).

The reported localization sites in various studies are summarized in Table 5. In addition to hepatic and pulmonary involvement, splenic and cerebral hydatid cysts were also identified in our study. In several studies (15-19), the lungs have been reported as the most frequently involved organ in pediatric cases, whereas other studies have identified the liver as the most commonly affected organ, similar to adult populations (11,16,20,21).

Table 5. Various cyst localization sites reported in the literature

Localization Site	Age, sex	Reference
Spleen	Child, female	Mansour et al. (22)
Thyroid	Adult, female	Zorluoğlu et al. (23)
Pelvis	Adult, female	Arac et al. (24)
Kidney	Adult, female	Yeşil et al. (25)
Iliac bone	Child, female	Çelebi Çongur et al. (26)
Heart	Child, male	Mutlu et al. (27)
Brain	Child, case series	Assamadi et al. (28)
Ovary	Adult, female	Mohammed and Arif (29)
Bone, eye, bladder, spinal cord, pancreas, colon	Child, case series	Anadol et al. (18)

In our study, the liver was the most frequently involved organ (67.5%), followed by the lungs (22.5%). The mean age of the patients in our study was 11.9 years. However, the age at diagnosis does not necessarily reflect the timing of infection or the onset of symptoms. The predominance of hepatic involvement observed in our study may be explained by the anatomical and physiological role of the liver as the first filter in the portal circulation, where parasites entering the bloodstream after intestinal absorption are most likely to be trapped.

In a study evaluating 57 pediatric hydatid cyst cases (20), abdominal pain was reported as the most common presenting complaint, followed by cough, nausea, vomiting, fever, and dyspnea. Another study analyzing 100 cases of hepatic hydatid cysts (30) found that fever, hepatomegaly, and abdominal pain were the most frequent symptoms. In pediatric patients with pulmonary involvement (19), cough, chest pain, and fever were reported as the predominant symptoms. Similarly, studies evaluating 38 pulmonary cystic echinococcosis cases (31), as well as other studies including 41 (16), 50 (15), and 376 (18) patients, have consistently reported cough, fever, and abdominal pain as the most common presenting complaints.

In the present study, the most frequent presenting symptom was abdominal pain, followed by cough and fever. Differences reported in the literature may be explained by variations in the localization of cyst involvement. Patients with hepatic cysts tend to present with abdominal pain, whereas pulmonary cysts are more commonly associated with cough. Although abdominal pain was more frequently observed among patients with hepatic cysts in our study, no statistically significant association was detected between cyst localization and presenting symptoms ($p>0.05$). This finding may be related to the relatively small sample size and suggests that clinical manifestations may overlap depending on multiple factors.

In line with our findings, varying rates of IHA positivity at the time of diagnosis have been reported in the literature, including 86.7% (18), 48% (32), 54.8% (16) and 58% (11). In our study, IHA positivity was 77.5%, and 15% of the patients were diagnosed incidentally during investigations performed for unrelated conditions. Although serological tests such as IHA are frequently used in the diagnostic evaluation of cystic echinococcosis, their sensitivity may vary depending on several factors. The host immune response may differ according to cyst location, stage, and integrity. In our study, some patients had negative IHA results despite radiologically compatible findings. Possible explanations for seronegativity include early-stage infection, intact cysts that do not induce a strong immune response, or variability in individual immune responses. Therefore, serological results should be interpreted together with clinical findings and imaging studies in the diagnostic evaluation of cystic echinococcosis.

CONCLUSION

The findings of this study highlight the importance of integrating clinical, serological, and imaging findings in the diagnostic evaluation of cystic echinococcosis in pediatric patients. Given the variable diagnostic sensitivity of the IHA, negative serological results should not exclude the disease, and further diagnostic evaluation may be required. Imaging modalities play a crucial role in identifying the localization of cysts and supporting the diagnostic process.

The relatively small sample size represents a limitation of the present study and may have influenced the statistical significance of some analyses. Nevertheless, the findings provide useful clinical and serological insights into pediatric cystic echinococcosis and emphasize the need for larger and prospective studies to better clarify the relationship between cyst characteristics and clinical manifestations.

*Ethics

Ethics Committee Approval: This study was approved by the Sivas Cumhuriyet University Ethics Committee with decision number 2024-12/06, dated December 19, 2024.

Informed Consent: Retrospective study.

*Authorship Contributions

Surgical and Medical Practices: L.C., Concept: K.F.T., L.C., M.H., Design: K.F.T., L.C., Data Collection or Processing: K.F.T., M.H., Analysis or Interpretation: K.F.T., L.C., M.H., Literature Search: K.F.T., Writing: K.F.T., L.C., M.H.

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