

Evaluation of the Diagnostic Performance of the Indirect Hemagglutination Test in the Differential Diagnosis of Cystic Echinococcosis: Single Center Experience

Kistik Ekinokokkoz Ayırıcı Tanısında İndirekt Hemaglütinasyon Testinin Tanısal Performansının Değerlendirilmesi: Tek Merkez Deneyimi

Özlem Ulusan Bağcı, Gülay Akarsu

Ankara University Faculty of Medicine, Department of Parasitology, Ankara, Türkiye

Abstract

Objectives: The purpose of this study is to reveal the epidemiological data of cystic echinococcosis (CE) patients who applied to our hospital and to determine the diagnostic performance of the indirect hemagglutination test (IHAT).

Materials and Methods: The patients whose serum samples were routinely sent to Ankara University İbni Sina Research and Application Hospital, Central Laboratory for CE IHAT between 01.01.2023 and 01.09.2024 were evaluated. The patient's IHAT results were interpreted with clinical and laboratory findings and radiological imaging results. In the evaluation of the IHAT, the serological titer, which is 1/320 and above, is declared positive, and 1/80 and 1/160 are declared as suspicious.

Results: Serology results of 636 patients were evaluated. The positivity rate was found to be 5.97%. The age group of 0-19 had the greatest positivity percentage (19%). Age-group differences in CE seropositivity were statistically significant ($p=0.011$). The patient group with cystic lesions apparent in radiological imaging had the greatest seropositivity rate (11.9%). The seropositivity rate of IHAT in patients with CE-specific findings identified on radiological imaging was calculated as 39.6% when the threshold value was taken as 1/80. The seronegativity rate was found to be 95.7% in patients with no cysts detected on radiological imaging.

Conclusion: The positivity rate of IHAT was found to be low in patients with CE lesions identified on radiological imaging. Therefore, it is thought that it would be beneficial to utilize a second serological test together with IHAT to increase analytical sensitivity in routine laboratory tests.

Keywords: Cystic echinococcosis, indirect hemagglutination test, seropositivity rates, radiological imaging

Öz

Amaç: Çalışmamızın amacı hastanemize başvuran hastaların kistik ekinokokkoz (KE) epidemiyolojik verilerini ortaya koymak ve indirekt hemaglütinasyon testinin (IHAT) tanısal performansını değerlendirmektir.

Gereç ve Yöntem: Çalışma kapsamında 01.01.2023 ile 01.09.2024 tarihleri arasında KE IHAT istemi ile Ankara Üniversitesi İbni Sina Araştırma ve Uygulama Hastanesi Merkez Laboratuvarı'na rutin olarak serum örnekleri gönderilen hastalar değerlendirildi. Hastaların IHAT sonuçları, klinik ve laboratuvar bulguları ve radyolojik görüntüleme sonuçlarıyla birlikte değerlendirildi. Antikor titresi 1/320 ve üzerindeki değerler pozitif, 1/80 ve 1/160 ise şüpheli olarak belirtildi.

Bulgular: Altı yüz otuz altı hastanın seroloji sonuçları değerlendirildi. Pozitiflik oranı %5,97 olarak belirlendi. 0-19 yaş grubu en yüksek pozitiflik yüzdesine (%19) sahipti. Yaş gruplarının seropozitiflik oranları istatistiksel olarak anlamlı derecede farklı bulundu ($p=0,011$). Radyolojik görüntülemelerde kistik lezyonları görülen hasta grubu en yüksek seropozitiflik oranına (%11,9) sahipti. Radyolojik görüntülemelerde KE açısından spesifik bulguları olan

Address for Correspondence/Yazışma Adresi: Assoc. Prof. Özlem Ulusan Bağcı
Ankara University Faculty of Medicine, Department of Parasitology, Ankara, Türkiye
E-mail: oubagci@ankara.edu.tr ORCID ID: orcid.org/0000-0002-9695-5703

Received/Geliş Tarihi: 23.12.2024 Accepted/Kabul Tarihi: 03.03.2025 Publication Date/Yayınlanma Tarihi: 21.03.2025

Cite this article as/Atf: Ulusan Bağcı Ö, Akarsu G. Evaluation of the diagnostic performance of the indirect hemagglutination test in the differential diagnosis of cystic echinococcosis: single center experience. J Ankara Univ Fac Med. 2025;78(1):69-75



hastalarda IHAT'ın seropozitiflik oranı eşik değeri 1/80 olarak alındığında %39,6 olarak hesaplandı. Radyolojik görüntülemelerde kist saptanmayan hastalarda ise seronegatiflik oranı %95,7 olarak tespit edildi.

Sonuç: Radyolojik görüntülemelerde KE lezyonları tanımlanan hastalarda IHAT'ın pozitiflik oranı düşük bulunmuştur. Bu nedenle rutin laboratuvar testlerinde analitik duyarlılığı artırmak için IHAT ile birlikte ikinci bir serolojik testin kullanılmasının faydalı olacağı düşünülmektedir.

Anahtar Kelimeler: Kistik ekinokokkoz, indirekt hemagglütinasyon testi, seropozitiflik oranları, radyolojik görüntüleme

Introduction

Echinococcus granulosus is a zoonotic parasite that is the causative agent of cystic echinococcosis (CE). Whereas dogs are the parasite's definitive hosts, herbivorous animals, including sheep, cattle, and camels, are intermediate hosts. Humans are accidental intermediate hosts, and transmission to intermediate hosts occurs via ingestion of eggs excreted in infected dog feces through improperly washed contaminated food or hands (1). It is one of the 20 neglected tropical diseases declared by the World Health Organization (WHO). This cestode infection is widespread worldwide, but is particularly prominent in South America, Australia, China, Russia, northern and eastern Africa, and Mediterranean countries. There are more than one million people suffering from echinococcosis in the world, and 19,300 people die due to this disease every year (2,3). Cystic lesions formed during CE are the larval stages of the parasite and most commonly seen in the liver. The second most frequently involved site is the lungs, followed by the spleen, kidneys, eyes, heart, brain, and bones. Lung involvement is more prominent in children than in adults (3).

According to several reports, 3-5% of the liver cysts in the general population are detected by ultrasonography (USG) and 15-18% of them by computed tomography (CT). Liver cysts may be caused by a number of factors besides CE. It is important to carry out the appropriate diagnostic tests to make the differential diagnosis in liver cystic disease of various etiology, such as infection, inflammation, neoplasm, congenital, and trauma (4). CE is diagnosed by using a combination of serological tests and radiological imaging methods. Imaging techniques are useful in both the diagnosis and classification of the cysts. Based on imaging characteristics, the WHO informal working group on echinococcosis (WHO-IWGE) has classified cysts into five groups: active cysts are CE1 and CE2; transitional cysts are CE3 (a and b), and inactive cysts are CE4 and CE5 (5). Serological tests are required to confirm the radiological diagnosis when pathognomonic features, including membrane separation, daughter vesicle presence, and cyst wall calcification, couldn't be detected (6). The immunofluorescent antibody test (IFAT), indirect hemagglutination test (IHAT), and enzyme-linked immunosorbent assay (ELISA) can all be applied for serological diagnosis (7). In serological tests, false negativity may be observed in early-stage and late-stage cysts, cysts

located outside the liver, and false positivity may occur due to cross-reactions (8-10). For this reason, it is very important to use radiology and serology in combination to support each other in the diagnosis of echinococcosis.

Our study's objectives are to put forth the epidemiological data of CE patients who applied to our hospital and to determine the diagnostic performance of the IHAT method.

Materials and Methods

In our study, patients whose serum samples were routinely sent to Ankara University İbni Sina Research and Application Hospital, Central Laboratory for CE IHAT between 01.01.2023 and 01.09.2024 were evaluated retrospectively. The patients were categorized into five groups based on age ranges, such as 0-19, 20-39, 40-59, 60-79, and 80 and above. The patient's IHAT results were interpreted together with clinical and other laboratory findings, radiological imaging results, and the reasons for the IHAT request, such as differential diagnosis of a simple cyst, confirmation of CE diagnosis, treatment evaluation, and follow-up. A single sample from each patient was evaluated, and in the case of repeated samples, the first positive sample, if any, was included in the study. Serological test results, laboratory findings, sociodemographic and clinical information, and radiological imaging results of the patients were accessed through the hospital information management system. The classification of the cysts was also documented if available in the radiological imaging report. Early cysts were defined as CE1, CE2, and Gharbi type 1 and 3 cysts; transitional cysts were defined as CE3 and Gharbi type 2 cysts; and late cysts were defined as CE4, CE5, and Gharbi type 4 cysts.

Echinococcus granulosus antibodies in serum were manually detected using a commercial kit (Hydatidose, Fumouze laboratoires, France) in order to diagnose CE. The IHA test was performed in six wells for one serum sample in our laboratory, ranging from 1/80 to 1/2500. If the sera was positive at 1/2500, it was reported as >1/1280. Values of 1/320 and higher were recorded as positive, according to the manufacturer's recommendations, and a positive serological test supported the diagnosis of CE. Titers of 1/80 and 1/160 were considered suspicious, and a test repeat is advised two to three weeks later with the same method, or better, in combination with a different serological test.

The study was approved by the Human Research Ethics Committee of Ankara University (date: 07.10.2024, decision number: İ08-650-24).

Statistical Analysis

The IBM SPSS 24.0 package (SPSS Inc., Chicago, IL, USA) was used for statistical analysis. Descriptive statistics were shown as frequency and percentage (%) for categorical variables and for quantitative variables, mean ± standard deviation if they fit a normal distribution or as median ± minimum-maximum values if they did not fit a normal distribution. The Kolmogorov-Smirnov test was used for normality distribution. The Student's t-test and Mann-Whitney U test were utilized to compare quantitative data between independent groups, and the Chi-square and Fisher's exact tests were used to compare qualitative data.

Results

Serology results of 636 patients between the specified dates were evaluated retrospectively. The average age of women was 54.7±15.3, the average age of men was 52.2±17.2, and there was no statistically significant difference between the average ages of the two groups (p=0.061). The antibody titer of 38 patients was found to be 1/320 and above, and the positivity rate was found to be 5.97%. The serology results of 17 (2.67%) patients were 1/80, and those of 11 (1.73%) patients were 1/160. The seropositivity rate among women was 5.4%, and it was 6.9% among men. The difference between the seropositivity rates according to gender was not statistically significant (p=0.417). The median age of the patients with positive serologic results for CE was 46.5 (6-85) years, whereas those with negative CE serology had a median age of 56 (1-89) years. The difference between the median ages was statistically significant (p=0.003).

Patients were categorized into five groups based on age ranges. The age group of 0-19 had the greatest positivity percentage (19%). Patients aged 80 and above (11.8%) and those aged 20-39 (8.5%) followed the 0-19 age group (Table 1). Age-group differences in CE seropositivity were statistically significant (p=0.011). The patients of whom, in the 0-19 age group, two of the patients had only lung cysts, while one patient had a liver and lung cyst and one had only a kidney cyst.

Analysis of the causes of the requests for CE IHAT revealed that cystic lesions on radiological imaging accounted for the majority of test requests (497/636, 78.1%). In 64 (10.1%) of the patients for whom serological testing was requested, radiological imaging showed nodular lesions, fatty liver, metastatic lesions, etc., but no cystic lesions. Besides, 17 patients (2.7%) were investigated for CE serology because of eosinophilia. The anamnesis of the remaining 58 individuals

(9.1%) did not include any information on why the test was requested. Evaluation of IHAT results according to the reason for requesting the test was demonstrated in Table 2. In this section, where IHAT values were compared with radiological and clinical findings, those with IHAT serological test results of 1/80 and 1/160 were evaluated as seropositive unless 1/320 wasn't stated as a threshold. The patient group with cystic lesions apparent in radiological imaging had the greatest seropositivity rate (11.9%). The eosinophilia group did not demonstrate any seropositivity, and the difference among groups based on the reason for the test request was found to be statistically significant (p=0.032) (Table 2).

Moreover, the seropositivity rate was found to be 39.6% in patients with lesions specifically identified as CE in radiological imaging by observing findings such as double-wall appearance or presence of daughter vesicles. This rate was statistically significantly higher than the rate in the group of patients who had no specific findings of CE (p<0.001).

There were 61 patients whose IHAT results were negative even though CE-specific lesions were identified in their radiological imaging. Of the cysts belonging to these patients, 52 (85.3%) were found in the liver, five (9.8%) in other organs (heart, bone, muscle, brain, spleen, etc.), three (5.9%) in the liver and the kidney, and one (2%) in the liver and the lung. Of these individuals, 47 had previously received CE diagnosis, and 18 of them had undergone at least one of PAIR, surgical, and medical interventions. Furthermore, 35 of these patients had cyst staging performed using radiological imaging; nine (25.7%) had early-stage cysts, six (17.1%) had transition-stage cysts, and 20 (57.1%) had late-stage cysts.

CE radiological staging was performed in 17 of 27 patients that had CE-specific findings in the radiological reports and with CE serology test results of 1/320 and above. Of the patients,

Table 1: Evaluation of serology test results according to age groups

Age (year)		Negative	1/320- >1/1280	Total
0-19	n	17	4	21
	%	81.0	19.0	100
20-39	n	85	8	93
	%	91.4	8.6	100
40-59	n	263	18	281
	%	93.6	6.4	100
60-79	n	218	6	224
	%	97.3	2.7	100
80 and above	n	15	2	17
	%	88.2	11.8	100
Total	n	598	38	636
	%	94.0	6.0	100

five (29.4%) had early-stage cysts, six (35.3%) had transitional stage cysts, and six (35.3%) had late-stage cysts. Staging was performed in nine of 13 patients whose serological test results were found to be 1/80 and 1/160, and CE-specific findings were present in radiology. Of the patients, six (66.7%) had early-stage cysts, while three (33.3%) had late-stage cysts (Table 3).

Patients with cystic lesions in the isolated lung and the lung and bone combined had the highest CE IHAT positivity rate (100%) when the serological test findings were analyzed based on the organ involvement in radiological imaging. The involvement of the liver and lung came next, at 85.7% (Table 4). Of the 38 patients whose CE serology was found at 1/320 and

Table 2: Evaluation of serology test results according to the reason for requesting the test

The reason for test request	The antibody titer							Total n (%)
	Negative n (%)	1/80 n (%)	1/160 n (%)	1/320 n (%)	1/640 n (%)	1/1280 n (%)	>1/1280 n (%)	
No cyst in the radiological imaging	63 (98.4)	1 (1.6)	0	0	0	0	0	64 (100.0)
Presence of cyst in the radiological imaging	438 (88.1)	14 (2.8)	9 (1.8)	10 (2.0)	10 (2.0)	5 (1.0)	11 (2.2)	497 (100.0)
Specific findings for CE	61 (60.4)	6 (5.9)	7 (6.9)	9 (8.9)	6 (5.9)	3 (3)	9 (8.9)	101 (100.0)
No specific finding for CE	377 (95.2)	8 (2)	2 (0.5)	1 (0.3)	4 (1)	2 (0.5)	2 (0.5)	396 (100.0)
Eosinophilia	17 (100.0)	0	0	0	0	0	0	17 (100.0)
Other reason	52 (89.7)	2 (3.4)	2 (3.4)	2 (3.4)	0	0	0	58 (100.0)
Total	570 (89.6)	17 (2.7)	11 (1.7)	12 (1.9)	10 (1.6)	5 (0.8)	11 (1.7)	636 (100.0)

CE: Cystic echinococcosis

Table 3: Evaluation of the stage of the cysts in comparison with the results of the serological test

Patients that had CE-specific findings	Stage	The result of IHAT		
		Negative n (%)	1/80-1/160 n (%)	1/320- >1/1280 n (%)
	Early	9 (25.7)	6 (66.7)	5 (29.4)
	Transitional	6 (17.1)	0	6 (35.3)
	Late	20 (57.1)	3 (33.3)	6 (35.3)
	Total	35 (100)	9 (100)	17 (100)

IHAT: Indirect hemagglutination test, CE: Cystic echinococcosis

Table 4: Evaluation of serology test results according to organ involvement in radiological imaging

Organ involvement	The antibody titer								Total n (%)
	Negative n (%)	1/80 n (%)	1/160 n (%)	1/320 n (%)	1/640 n (%)	1/1280 n (%)	>1/1280 n (%)	1/320- >1/1280 n (%)	
No involvement	124 (94.7)	3 (2.3)	2 (1.5)	2 (1.5)	0	0	0	2 (1.5)	131 (100)
Liver	332 (88.5)	13 (3.5)	7 (1.9)	9 (2.4)	7 (1.9)	3 (0.8)	4 (1.1)	23 (6.1)	375 (100)
Lung	0	0	0	0	0	0	2 (100)	2 (100)	2 (100)
Kidney	28 (93.3)	0	1 (3.3)	0	1 (3.3)	0	0	1 (3.3)	30 (100)
Spleen	15 (93.8)	1 (6.3)	0	0	0	0	0	0	16 (100)
Bone	3 (60)	0	0	0	2 (40)	0	0	2 (40)	5 (100)
Liver + lung	1 (14.3)	0	0	1 (14.3)	0	1 (14.3)	4 (57.1)	6 (85.7)	7 (100)
Liver + kidney	36 (97.4)	0	1 (2.6)	0	0	0	0	0	37 (100)
Liver + spleen	3 (75)	0	0	0	0	1 (25)	0	1 (25)	4 (100)
Lung + bone	0	0	0	0	0	0	1 (100)	1 (100)	1 (100)
Heart, pancreas, gall bladder, muscle, brain and other multiorgan involvement	28 (100)	0	0	0	0	0	0	0	28 (100)
Total	570 (89.6)	17 (2.7)	11 (1.7)	12 (1.9)	10 (1.6)	5 (0.8)	11 (1.7)	38 (6)	636 (100)

higher, isolated liver involvement occurred in 60.5% of cases, followed by liver plus lung involvement in 15.8% of cases and isolated lung involvement in 5.3% of cases. Table 5 shows the location of the cysts in 38 patients with positive CE serology results.

Organ	n (%)
Liver	23 (60.5)
Liver + lung	6 (15.8)
Lung	2 (5.3)
Liver + spleen	1 (2.6)
Liver + bone	1 (2.6)
Lung + bone	1 (2.6)
Bone	1 (2.6)
Kidney	1 (2.6)
No involvement	2 (5.3)
Total	38 (100)

Discussion

Türkiye is among the endemic countries in terms of CE. Studies on echinococcosis prevalence in the population are mainly based on field studies using USG as a radiological imaging technique and/or serological tests. Besides, there are also retrospective studies that report the serological results of serum samples sent to the laboratory with the request of echinococcosis serology. The later studies are expected to report higher prevalence as the sera investigated belong to prediagnosed or suspected to have CE. In studies based on serological tests, different results were obtained depending on the geographical location of the study, the patient population selected, and the sensitivity of the method(s) used. In Türkiye, seropositivity rates in studies carried out by routine hospital

laboratory findings were reported between 9.5 and 34.6% (11-18). The information about the serological studies conducted in Türkiye is given in Table 6. In our study, the CE IHAT positivity rate was found to be 5.97%, which is quite low compared to the seropositivity percentages reported in the literature. It is thought that the positivity rate may be low due to the fact that our hospital is located in Ankara, the capital of Türkiye, and patients mostly reside in urban residential areas. Diagnosis and follow-up of uncomplicated patients is possible at nearby local medical centers. Since it is a university hospital, more complicated cases that need multidisciplinary management are admitted to our hospital.

In most studies in the literature, it is stated that the percentage of CE seropositivity is higher among women (11-13,15). There are also studies, although few in number, that declare it may be more common among men (14). However, in our study, no statistically significant difference was found between the seropositivity percentages in men and women ($p=0.417$). A small number of studies have also been reported in the literature suggesting that the prevalence of echinococcosis serology is similar in men and women (16-18).

CE is more common in adults and is generally seen between the ages of 20-59 (11,13,14,16,19). However, it can also be detected at an early age, especially in children coming from endemic areas (20,21). Although the incubation period of the disease generally varies between 5 and 15 years, it can also be as low as one year (19,21). When the seropositivity was evaluated according to the age groups in our study, contrary to general findings in the literature, it was observed that IHAT positivity was highest in the 0-19 age group, followed by patients aged 80 and over (Table 1).

It is stated in the literature that 67% of CE is located in the lungs in children (19,22). Consistent with this, in our study, of the four patients with CE serology titer 1/320 and above in the 0-19 age group, lung was involved in two, liver and lung in one, and kidney in one. Therefore, it is important to consider the

The number serum samples	The positivity rate (%)	The age group with the highest positivity ratio	The test method	City	Time interval	References
2009	9.5	31-45	IHAT	Erzurum	2009-2013	11
3446	32	-	ELISA	Aydın	2005-2017	12
1543	21.6	21-40	IHAT	Konya	2015-2020	13
531	14.1	20-39	IHAT	İzmir	2020-2021	14
1811	28.6	50+	IHAT	Gaziantep	2015-2022	15
454	18	31-50	ELISA, IHAT	Samsun	2005-2011	16
511	34.6	-	IFAT, IHAT	Kars	-	17
938	15.2	41-65	IHAT	Konya	2014-2018	18

IHAT: Indirect hemagglutination test, ELISA: Enzyme-linked immunosorbent assay, IFAT: Immunofluorescent antibody test

possibility of involvement in organs other than the liver when diagnosing echinococcosis, especially in young patients, and to use extensive radiological imaging to evaluate this possibility.

In adults, the liver is accounted for 60-70% of cysts, the lungs for 10-30%, and the spleen, kidney, muscle, heart, bone, brain, ovarium, and pancreas for less than 10% of the cases (3). In our study, 60.5% of patients with an IHAT antibody titer of 1/320 and higher had just liver cysts, 15.8% had liver and lung cysts, 5.3% had lung cysts, and 2.6% had kidney cysts. In 81.6% of patients, liver involvement was noted. There was multiple organ involvement in 23.7% of cases (Table 5). Compared to the studies published in the literature, our analysis revealed a greater level of extra-hepatic organ involvement (14,18).

IHAT is used as the routine serological test in the diagnosis of CE at our laboratory. Serological tests were thought to be most useful in the patient group who was reported to have cysts in the radiological imaging, but specific features for the CE disease couldn't be identified. In addition, it was determined that the patients who were reported to have cysts only in the lung and lung and bone had the highest CE IHAT positivity rate with 100%, followed by the patients with cysts in the lung and liver with 85.7% (Table 4). The common feature of these three patient groups was the lung involvement, suggesting that echinococcosis should be investigated serologically in the differential diagnosis of patients that have lung cysts detected in radiological imaging.

In our study, the serological results of the patients and, if available, USG, CT, and magnetic resonance imaging reports were evaluated together. The seropositivity rate of the patients with CE-specific lesions identified on radiological imaging was calculated as 26.7% with IHAT. Furthermore, the negativity rate of IHAT was found to be 98% in the patients having no cystic lesions in radiological imaging methods. When the threshold value of the test was taken as 1/80, the positivity rate increased to 39.6, and the negativity rate was calculated as 95.7%. The concordance between radiological imaging methods and IHAT significantly increased when the threshold value was set at 1/80 (Table 2). Six patients with antibody titers of 1/80 and seven patients with antibody titers of 1/160 had cysts with CE-specific findings in their imaging. This situation demonstrated that 1/80 and 1/60 antibody titers might likewise be significant and should be reported. The kit insert states that while values of 1/320 and higher are accepted as diagnostically significant, results of 1/80 and 1/160 should also be documented and assessed in conjunction with radiological and clinical findings (14).

The seropositivity rate of the patients with CE-specific lesions in the radiological imaging method was found to be low. To improve the analytical sensitivity of the serological method, it would be advantageous to combine IHAT with at least one of

the other serological tests. The National Microbiology Standards Guide recommends using at least two of IHAT, IFAT, and ELISA tests for screening, then Western Blot for confirmation (23).

However, since performing multiple serological tests increases the cost per patient, many centers can only use a single screening test, as seen from other studies conducted in our country (11-15,18).

Of the 61 individuals with specific CE features on radiological imaging and negative serological test results, 47 had previously been diagnosed as CE. Cyst staging was performed in 35 of the patients, and 29 of them had cysts in the early or late stage (Table 3). Serological tests may give false negative results in early and late-stage cysts (7). Of the patients with CE-specific findings but negative serological test results, two patients' surgically removed cyst contents were reported to be hemangiomas, and one patients' pathology was found to be negative for echinococcosis. This demonstrates that there may also be errors in radiological imaging reports. Alveolar echinococcosis (AE) was suspected on radiological imaging of the two patients; however, no further testing had been performed to confirm. Although it is not specific for AE, the IHAT kit used for echinococcosis may produce positive results with a reduced probability. For the diagnosis of AE, specific serological tests for Em2 and Em18 should be applied (24,25). Eighteen of the patients had undergone previous surgical and/or medical treatment. All these reasons could have lowered the sensitivity of IHAT in these patients. Nevertheless, it should not be forgotten that serological tests should only be used as diagnostic aids in the diagnosis of echinococcosis.

Study Limitations

The study's limitations include retrospective design, single-center experience, and restriction of the clinical findings to the data recorded in the hospital information management system.

Conclusion

To our knowledge, this is the first study in which IHAT results were evaluated in comparison with radiological imaging findings in a center in Ankara.

The IHAT positivity rate between 01.01.2023 and 01.09.2024 in our university hospital was found to be 5.97%, which is lower compared to studies conducted in other regions. The positivity rate of IHAT was found to be low in comparison with radiological imaging methods. Reasons for a negative serological test despite having specific findings for CE included patients' having previously received surgical or medical treatment, having AE, and having early or late-stage cysts. It is thought that it would be useful to utilize a second serological test together with IHAT to aid diagnosis in patients with cysts on radiological imaging.

Ethics

Ethics Committee Approval: The study was approved by the Human Research Ethics Committee of Ankara University (date: 07.10.2024, decision number: İ08-650-24).

Informed Consent: Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Footnotes

Authorship Contributions

Concept: Ö.U.B., G.A., Design: Ö.U.B., Data Collection and/or Processing: Ö.U.B., Analysis and/or Interpretation: Ö.U.B., G.A., Literature Search: Ö.U.B., Writing: Ö.U.B., G.A.

Conflict of Interest: There is no potential conflict of interest to declare.

Financial Disclosure: This study received no financial support.

References

- Torgerson PR, Robertson LJ, Enemark HL, et al. Source attribution of human echinococcosis: a systematic review and meta-analysis. *PLoS Negl Trop Dis*. 2020;14:e0008382.
- Hogea MO, Ciomaga BF, Muntean MM, et al. Cystic Echinococcosis in the Early 2020s: a review. *Trop Med Infect Dis*. 2024;9:36.
- World Health Organization. Echinococcosis. Available from: <https://www.who.int/news-room/fact-sheets/detail/echinococcosis>. Accessed on 10 November, 2024.
- Morar R, Feldman C. Pulmonary echinococcosis. *Eur Respir J*. 2003;21:1069-1077.
- Alshaikhli A, Al-Hillan A. Liver Cystic Disease. [Updated 2023 Apr 24]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK567739/>
- Brunetti E, Kern P, Vuitton DA; Writing Panel for the WHO-IWGE. Expert consensus for the diagnosis and treatment of cystic and alveolar echinococcosis in humans. *Acta Trop*. 2010;114:1-16.
- Devi M, Venumadhav T, Sukanya B, et al. Role of imaging in diagnosis, predicting biological activity and in treatment plan of hydatid disease. *Open J. Intern. Med*. 2018;8:177-195.
- Manzano-Román R, Sánchez-Ovejero C, Hernández-González A, et al. Serological diagnosis and follow-up of human cystic echinococcosis: a new hope for the future? *Biomed Res Int*. 2015;2015:428205.
- Derbel F, Zidi MK, Mtimet A, et al. Hydatid cyst of the pancreas: a report on seven cases. *Arab J Gastroenterol*. 2010;11:219-22.
- Vola A, Manciuilli T, De Silvestri A, et al. Diagnostic performances of commercial ELISA, indirect hemagglutination, and western blot in differentiation of hepatic echinococcal and non-echinococcal lesions: a retrospective analysis of data from a single referral centre. *Am J Trop Med Hyg*. 2019;101:1345-1349.
- Siles-Lucas M, Uchiumi L, Tamarozzi F. 'No cyst, no echinococcosis': a scoping review update on the diagnosis of cystic echinococcosis after the issue of the WHO-IWGE Expert Consensus and current perspectives. *Curr Opin Infect Dis*. 2023;36:333-340.
- Yılmaz A, Uslu H, Aktaş F. 2009-2013 yılları arasında Erzurum Bölge Hastanesindeki kistik ekinokokkozis şüpheli hastaların indirekt hemagglütinasyon (İHA) metoduyla değerlendirilmesi. *Gümüşhane Üniversitesi Sağlık Bilimleri Dergisi*. 2016;5:23- 32.
- Ertabaklar H, Yıldız İ, Malatyalı E, et al. Retrospective analysis of cystic echinococcosis results in Aydın Adnan Menderes University Training and Research Hospital Parasitology Laboratory between 2005 and 2017. *Türkiye Parazitoloj Derg*. 2019;43:118-122.
- Başer S, Ismayıl A, Maçın S. Evaluation of the seropositivity of patients with cystic echinococcosis in Konya, Turkey. *J Contemp Med*. 2021;11:139-141.
- Ulusan Bağcı Ö, Pektaş B, Aksoy Gökmen A, et al. Use of indirect hemagglutination test in the diagnosis of cystic echinococcosis: two years of retrospective laboratory experience. *Türk Mikrobiyol Cem Derg*. 2022; 52: 223-231.
- Özkeklikçi A, Cirit OS. Investigation of the prevalence of cystic echinococcosis in Gaziantep-Türkiye by ELI.H.A Echinococcus ELITech between 2015-2022. *Trakya Univ J Nat Sci*. 2024;25:91-96.
- Karadağ A, Yanık K, Ünal N, et al. Kistik ekinokokkozis şüphesi ile 2005-2011 yılları arasında Ondokuz Mayıs Üniversitesi Tıp Fakültesi Parazitoloji Laboratuvarına gönderilen örneklerin değerlendirilmesi. *Türkiye Parazitoloj Derg*. 2013;37:28-31.
- Karaman U, Mıman O, Kara M, et al. Kars bölgesinde hidatik kist prevalansı [Hydatid cyst prevalence in the region of Kars.]. *Türkiye Parazitoloj Derg*. 2005;29:238-240.
- Taşbent FE, Yağcı B, Kadiyoran C, et al. Comparative evaluation of the efficacy of indirect hemagglutination test and radiological methods in the pre-diagnosis of cystic echinococcosis. *Türkiye Parazitoloj Derg*. 2021;45:22-27.
- Vázquez-Pérez Á, Santos-Pérez JL. Cystic echinococcosis in a Moroccan boy: a silent and neglected disease among refugee and migrant children. *BMJ Case Rep*. 2022;15:e246399.
- Lees EA, Ives A, Fowler D, et al. Pulmonary cystic echinococcosis in a child presenting in the United Kingdom with fever and chest pain: a brief report and discussion on management. *Pediatr Infect Dis J*. 2023;42:e343-e345.
- Kern P, Da Silva AM, Akhan O, et al. The echinococcoses: diagnosis, clinical management and burden of disease. *Adv Parasitol*. 2017;96:259-369.
- Balci AE, Eren N, Eren Ş, et al. Ruptured hydatid cysts of the lung in children: clinical review and results of surgery. *Ann Thorac Surg*. 2002;74:889-892.
- Ulusal Mikrobiyoloji Standartları. Bulaşıcı Hastalıklar Laboratuvar Tanı Rehberi. Cilt 3. T.C. Sağlık Bakanlığı Türkiye Halk Sağlığı Kurumu Başkanlığı Mikrobiyoloji Referans Laboratuvarları Daire Başkanlığı; 2014; Ankara.
- Sako Y, Nakao M, Nakaya K, et al. Alveolar echinococcosis: characterization of diagnostic antigen Em18 and serological evaluation of recombinant Em18. *J Clin Microbiol*. 2002;40:2760-2765.
- Gottstein B, Tschudi K, Eckert J, et al. Em2-ELISA for the follow-up of alveolar echinococcosis after complete surgical resection of liver lesions. *Trans R Soc Trop Med Hyg*. 1989;83:389-393.