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Original Article

Clinical and Epidemiological Characteristics of Surgically Treated Human Cystic Echinococcosis in Northeastern Iran: A Nine-Year Retrospective Study (2017–2025)

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Abstract

Background: Cystic echinococcosis (CE) is a neglected zoonosis endemic in livestock-raising regions, including Iran. Regional data from northeastern Iran are limited. This study described demographic, clinical, and surgical characteristics of histopathologically confirmed CE cases treated at a referral hospital in Sabzevar over nine years.

Methods: This retrospective study included patients undergoing CE surgery at Shahid Dr. Beheshti Hospital, Sabzevar, Iran, from March 2017 to March 2025. Only histopathologically confirmed cases were included. Demographic, clinical, surgical, and outcome data were extracted from medical records and analyzed using descriptive statistics and exploratory univariable analyses in SPSS.

Results: Among 59 patients, mean age was 44.7 ± 19.1 years (range: 3–80), and 64.4% were female. Most patients were urban residents (55.9%). Hepatic involvement occurred in 96.6%, while isolated extrahepatic disease accounted for 3.4%. Abdominal pain was the most common presentation (88.1%), and 45.8% reported direct dog contact. Cyst excision, with or without drainage, was the predominant procedure (44.1%). Perioperative albendazole use was recorded in seven patients (11.9%); timing, duration, and adherence were inadequately documented. Postoperative complications and recurrence were recorded in 13.6% and 15.3%, respectively. Mean postoperative hospital stay was 2.73 days. CE operations represented 0.26% of general surgical procedures, declining from 0.96% in 2017 to 0.06% in 2025.

Conclusion: This study describes surgically treated CE in Sabzevar. The declining proportion of CE operations does not indicate changes in population-level incidence or transmission. Improved surveillance and One Health approaches are needed to clarify regional burden and support control efforts.

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Introduction

Cystic echinococcosis (CE), commonly known as hydatid disease, is a chronic zoonotic infection caused by the larval stage of *Echinococcus granulosus* sensu lato (1). The disease remains an important public health problem in endemic regions where livestock husbandry and close contact among humans, dogs, and domestic animals facilitate transmission (2). Dogs and other canids act as definitive hosts, whereas livestock and other herbivores serve as intermediate hosts; humans become accidental intermediate hosts through ingestion of eggs shed in canine feces (1,2).

The parasite most commonly establishes cysts in the liver and lungs, and the slow growth of these cysts may result in prolonged asymptomatic infection before diagnosis (3–7). CE remains widely distributed across the Middle East, Central Asia, North Africa, South America, and parts of Europe (4,8,9).

Iran is an endemic country with substantial geographic variation in CE occurrence, and previous studies have reported associations with rural residence, livestock exposure, and contact with dogs (10–15). However, contemporary epidemiological data from northeastern Iran remain limited. Sabzevar County, in western Khorasan Razavi Province, is characterized by agricultural activity and small-ruminant farming, which may support maintenance of the Echinococcus life cycle (2,16). A previous retrospective study of surgically treated hydatid disease in Sabzevar during 2012–2016 demonstrated ongoing CE in the region (17). However, updated data on the demographic, clinical, and surgical characteristics of CE are lacking.

Therefore, this study aimed to describe the demographic characteristics, clinical manifestations, organ distribution, and surgical outcomes of histopathologically confirmed CE cases treated at the main referral hospital in Sabzevar from 2017 to 2025.

Methods

Study Area

The study was conducted in Sabzevar County, western Khorasan Razavi Province, northeastern Iran. The area has a semi-arid climate and substantial agricultural and livestock activity, particularly small-ruminant farming. Shahid Dr. Beheshti Hospital, affiliated with Sabzevar University of Medical Sciences, was the only hospital in Sabzevar providing surgical treatment for cystic echinococcosis (CE) and served as the main referral center for patients from Sabzevar and surrounding areas (Fig. 1).

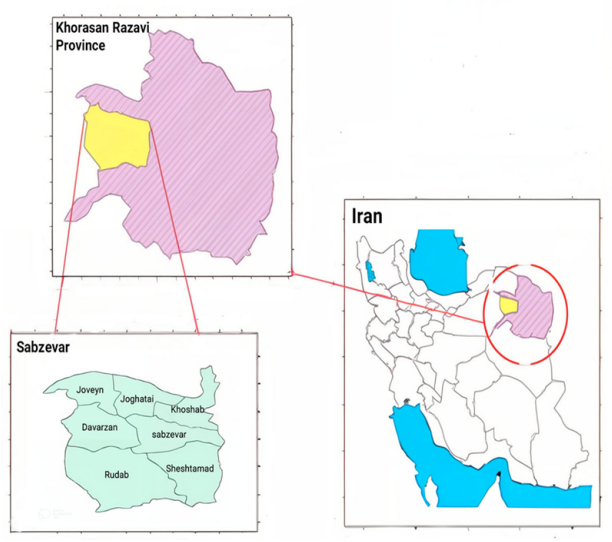


Fig. 1: Geographic location of Sabzevar County, Khorasan Razavi Province, northeastern Iran

Design and Study Population

A retrospective hospital-based study was conducted among patients who underwent surgical treatment for CE at Shahid Dr. Beheshti Hospital between Mar 2017 and Mar 2025. Cases were identified from surgical and operating-room registries, pathology records, and the hospital information system. Only patients with histopathologically confirmed CE were included. Histopathological confirmation was based on characteristic hydatid cyst structures, including laminated membranes, germinal layers, and/or protoscolices. Patients with incomplete medical records or without histopathological confirmation were excluded. The final cohort comprised 59 unique patients.

Four patients had a documented history of previous CE-related surgery, considered prior surgical history and was not counted as an additional study case. Because of the retrospective design, independent verification that all consecutive cases had been captured was not possible. WHO-IWGE CE1–CE5 staging was not retrospectively assigned because the historical imaging records did not consistently contain sufficient standardized information for reliable cyst-stage classification.

Data Collection

Data were retrospectively extracted from medical records using a standardized data collection form. Variables included age, sex, residence, animal exposure, clinical manifestations, organ involvement, cyst number and size, available imaging findings, surgical procedure, perioperative albendazole use, operative time, postoperative complications, length of hospital stay, mortality, and documented recurrence. Recurrence was defined as physician-documented CE recurrence after surgery. Because standardized imaging criteria and fixed follow-up intervals were unavailable, true recurrence could not be reliably distinguished from residual or persistent cysts or newly developed cysts. Missing data were not imputed, and denominators therefore varied according to the availability of information. Exposure variables such as livestock contact, slaughtering practices, and vegetable consumption were incompletely documented and were not available for reliable analysis. Similarly, hepatic lobe or segment, calcification, daughter cysts, and biliary communication were inconsistently reported and were not analyzed across the full cohort.

Statistical Analysis

Data were analyzed using SPSS ver. 24.0 (IBM Corp., Armonk, NY, USA). Continuous variables were summarized as mean ± standard deviation, and categorical variables as frequencies and percentages. Associations were assessed using the chi-square or Fisher's exact test, with odds ratios (ORs) and 95% confidence intervals (CIs). Multivariable logistic regression was not performed because of the small number of outcome events.

Ethical Considerations

The study protocol was approved by the Ethics Committee of Sabzevar University of Medical Sciences (Approval No. IR.MEDSAB.REC.1403.150). Owing to the retrospective nature of the study and the use of anonymized patient records, the requirement for informed consent was waived by the ethics committee.

Results

Demographic and Epidemiological Characteristics

Overall, 59 histopathologically confirmed CE patients who underwent surgery at Shahid Dr. Beheshti Hospital in Sabzevar were included. The demographic and epidemiological characteristics of the study population are summarized in Table 1.

Clinical and Diagnostic Findings

The liver was the predominant organ involved, either as an isolated site or in combination with other organs, whereas isolated extrahepatic disease was uncommon (Table 2). Among the extrahepatic sites, the spleen, kidney, and pancreas were each involved in two cases, while the lung, gallbladder, peritoneum, and soft tissue of the right thigh were each involved in one case. Cyst size ranged from 7 × 7 to 191 × 156 mm; other imaging characteristics were inconsistently documented.

Abdominal pain was the predominant clinical presentation. Other manifestations included nausea/vomiting, fever and chills, and nonspecific symptoms such as altered consciousness, cough, epigastric bulging, flank pain, and palpable mass. Some cysts were discovered incidentally during abdominal ultrasonography in asymptomatic patients (Table 2). Additional animal exposures recorded in medical files included contact with sheep (n=3) and cats (n=4).

Table 1: Demographic characteristics of the CE patients at Shahid Dr. Beheshti Hospital, Sabzevar

Variable	Category	n (%) or Mean ± SD
Age (yr)	Mean ± SD	44.7 ± 19.1
	Median (range)	45 (3–80)
Age group	< 15 yr	5 (8.5)
	15–60 yr	38 (64.4)
	> 60 yr	16 (27.1)
Sex	Female	38 (64.4)
	Male	21 (35.6)
Residence	Urban	33 (55.9)
	Rural	25 (42.4)
	Unrecorded	1 (1.7)
Education level	Illiterate	21 (35.6)
	Primary	9 (15.3)
	Middle school	8 (13.6)
	Diploma	8 (13.6)
	University	1 (1.7)
	Student (age < 18)	4 (6.8)
	Not recorded	8 (13.6)
Occupation	Housewife	32 (54.2)
	Self-employed / Worker	15 (25.4)
	Farmer / Livestock keeper	6 (10.2)
	Student	4 (6.8)
	Retired	1 (1.7)
	Not recorded	1 (1.7)

Table 2: Clinical and paraclinical characteristics of the CE patients at Shahid Dr. Beheshti Hospital, Sabzevar

Variable	Category	n (%)
Organ involvement	Liver only	44 (74.6)
	Liver + other organs	13 (22.0)
	Extrahepatic only	2 (3.4)
Cyst count	1	35 (59.3)
	2	11 (18.6)
	≥3 or multiple	9 (15.3)
	Not recorded	4 (6.8)
Clinical symptoms	Abdominal pain	52 (88.1)
	Nausea / Vomiting	10 (16.9)
	Fever / Chills	3 (5.1)
	Incidental (asymptomatic)	4 (6.8)
	Other symptoms	9 (15.3)
Contact with dogs history	Yes	27 (45.8)
	No	32 (54.2)

Surgical Management and Outcomes

All patients underwent preoperative imaging, most commonly ultrasonography combined with CT. Serological testing was not systematically documented. Perioperative albendazole use was recorded in seven patients (11.9%); however, the timing of administration, treatment duration, and adherence were inconsistently documented. The distribution of surgical procedures and postoperative outcomes is presented in Table 3. Four patients had a documented history of previous CE-related surgery before the index procedure.

Table 3: Surgical characteristics and outcomes of the CE patients at Shahid Dr. Beheshti Hospital, Sabzevar

Variable	Category	n (%) or Mean (range)
Surgical procedure	Excision ± drainage	26 (44.1)
	Hepatectomy / Lobectomy	8 (13.6)
	Laparotomy + drainage/aspiration	7 (11.9)
	Other / Combined	11 (18.6)
	Not reported	5 (8.5)
Operative time	Mean (range)	1h 35m (30m – 4h 30m)
Postoperative complications	Any complication	8 (13.6)
	Surgical site infection	5 (8.5)
	Other	3 (5.1)
Postoperative hospital stay (days)	Mean (range)	2.73 (1–9)
Early postoperative mortality	Yes	2 (3.4)
	No	57 (96.6)
Recurrence*	Yes	9 (15.3)
	No	50 (84.7)

*Recurrence was identified from physician documentation in the hospital record; standardized imaging criteria and fixed follow-up intervals were unavailable, and true recurrence could not be reliably distinguished from residual or persistent cysts or newly developed cysts

Documented postoperative complications included surgical-site infection, localized numbness, persistent wound discharge, and prolonged incisional pain. The causes of early postoperative mortality were sepsis associated with surgical-site infection and liver failure.

Recurrence was identified through physician documentation in the hospital records. Because follow-up was heterogeneous and standardized imaging criteria and fixed follow-up intervals were unavailable, true recurrence could not be reliably distinguished from residual or persistent cysts or newly developed cysts. Exploratory univariable analyses did not identify statistically significant associations with either recurrence or postoperative complications (Supplementary Tables 1 and 2) (Not published). Multivariable modelling was not performed because of the small number of recurrence events.

Proportion of CE Surgeries Among General Surgical Procedures

The annual numbers of CE surgeries and their proportions among all general surgical procedures during 2017–2025 are presented in Table 4.

Table 4: Annual number of CE surgeries and their proportion among general surgical procedures at Shahid Dr. Beheshti Hospital, Sabzevar

Year	CE Surgeries (n)	Total General Surgeries (n)	Percentage of Total Surgeries
2017	10	1,042	0.96
2018	10	2,750	0.36
2019	5	2,439	0.20
2020	8	2,214	0.36
2021	6	2,282	0.26
2022	7	2,260	0.31
2023	6	3,111	0.19
2024	5	3,728	0.13
2025	2	3,275	0.06
Total	59	23,101	0.26

Discussion

The present study provides an updated epidemiological profile of surgically treated CE in Sabzevar, northeastern Iran, based on raw patient-level data over a 9-year period. Several findings merit emphasis. The demographic pattern—female predominance (64.4%) and a mean age of 45 yr—is consistent with the existing Iranian and international literature (11,14,15). The chronic, slow-growing nature of hydatid cysts accounts for the diagnostic peak in middle adulthood, while the higher proportion of women likely reflects gender-specific domestic exposures such as food preparation and vegetable handling, though differential healthcare-seeking behavior cannot be excluded (5,13).

A key finding was the predominance of urban residents (55.9%) over rural dwellers. The high rate of illiteracy (35.6%) underscores the need for pictorial and community-based health education rather than written materials (2). The predominance of urban over rural residents in this surgically treated cohort warrants separate consideration. Although CE is traditionally associated with rural and pastoral communities, transmission can also occur in urban and peri-urban settings through indirect environmental exposure to contaminated dog feces and through continued interactions with livestock and domestic dogs. In Sabzevar, ongoing agricultural activity, small-ruminant husbandry, and possible peri-urban animal keeping may contribute to transmission beyond strictly rural settings. In addition, referral patterns and access to hospital-based surgical care may have influenced the observed distribution of residence in this hospital-based cohort. Therefore, the higher proportion of urban residents should not be interpreted as evidence of a higher risk of CE among urban populations without population-based denominator data.

Compared with the previous regional study conducted in Khorasan Razavi Province during 2011–2014, the present study provides a more recent profile of surgically treated CE. In the earlier study, 54.9% of patients were female, 40.3% were from rural areas, 39.2% were aged 21–40 yr, abdominal pain was reported in 42.3%, liver involvement in 59.4%, and multiple-organ involvement in 8.4% of cases. In the present cohort, female patients accounted for 64.4%, rural residents for 42.4%, abdominal pain for 88.1%, hepatic involvement for 96.6%, and concomitant liver and extrahepatic involvement for 22.0%. These differences should be interpreted cautiously because the earlier study and the present study differed in case ascertainment, in-

clusion criteria, referral patterns, and study setting (11).

Hepatic involvement was documented in 96.6% of patients, substantially higher than the 81.4% initially reported and entirely consistent with the portal venous filtration of *Echinococcus* oncospheres (1,5). Abdominal pain was the dominant symptom (88.1%), while incidental asymptomatic detection occurred in only 6.8% of cases. The fact that all patients underwent surgery, including those with incidentally discovered cysts, raises the question of whether surgical management was uniformly indicated or whether non-surgical options—albendazole monotherapy or watchful waiting for inactive cysts—were underutilized (5,18).

According to the WHO recommendations, treatment of CE should be individualized according to cyst stage, location, size, and the presence of complications rather than routinely relying on surgery (5). For selected uncomplicated hepatic cysts, percutaneous treatment, particularly PAIR (puncture, aspiration, injection, and re-aspiration), may be considered when appropriate expertise and facilities are available. Albendazole is recommended as a medical treatment in selected active cysts and may be used as an adjunct to surgical or percutaneous treatment when indicated. In contrast, uncomplicated inactive cysts are generally managed with a "watch-and-wait" strategy based on periodic imaging, with surgery avoided unless complications develop. Surgery remains an important treatment option for complicated cysts and for selected cysts in which percutaneous or medical management is inappropriate. Therefore, the high proportion of surgically treated patients in the present cohort should be interpreted in the context of the absence of standardized WHO-IWGE staging in the historical records, which prevents assessment of whether less invasive or non-surgical approaches would have been appropriate for individual patients (5,19,20). The WHO-IWGE CE1–CE5 classification provides a standardized framework for distinguishing active, transitional, and inactive cysts and is important for treatment selection (5). Because cyst stage was not systematically recorded in the historical records, it was not possible to determine retrospectively whether individual lesions were active, transitional, or inactive, and therefore whether surgery was appropriate for each patient. The absence of standardized cyst staging also limits interpretation of recurrence and comparison of treatment strategies across patients.

A documented history of contact with dogs was present in 45.8% of patients; however, dog exposure should not be considered an isolated proxy for CE risk because transmission is influenced by broader demographic, occupational, environmental, and behavioral factors (2,16,19). At the population level, sustainable CE control requires coordinated interventions targeting the dog–livestock transmission cycle, including treatment of infected dogs and vaccination of livestock where feasible (21).

In the present cohort, information on residence, education, occupation, and contact with other animals was available, but the small sample size and incomplete documentation limited meaningful assessment of their independent associations with disease occurrence or recurrence. In particular, information on livestock exposure was sparse, while slaughtering practices and vegetable consumption were not systematically recorded. Therefore, the present findings should be interpreted as a description of documented exposures among surgically treated patients rather than a comprehensive analysis of CE risk factors. Because the study lacked a non-CE control group, the observed exposure patterns cannot be interpreted as risk factors for acquiring CE or as evidence of causal associations.

The absence of systematic serological testing should a be interpreted in the context of the retrospective, surgically focused design of this study. Serology is supportive rather than de-

finitive for the diagnosis of CE and may have limited sensitivity, particularly for some cyst locations and disease stages. Therefore, the lack of uniformly available serological results reflects the absence of a standardized serological protocol in the historical records rather than a deliberate exclusion of serology from patient evaluation (5).

Postoperative complications occurred in 13.6% of patients, predominantly surgical site infections, a rate comparable to other regional series (7,12). The mean postoperative hospital stays of 2.73 d is notably short and likely reflects institutional and economic pressures rather than accelerated recovery. Two postoperative deaths (3.4%) underline the non-trivial risks of surgery for advanced CE. The documented recurrence rate of 15.3% should be interpreted with caution because recurrence was identified solely from physician documentation, without standardized imaging criteria or fixed follow-up intervals. The available records did not permit reliable differentiation between true recurrence, residual or persistent cysts, and newly developed cysts. Therefore, the reported 15.3% represents documented post-treatment recurrence rather than a definitive estimate of true recurrence.

The available records did not reliably distinguish preoperative from postoperative administration, and information on treatment duration and adherence was inconsistent. According to current WHO guidance, albendazole is generally administered for 1–7 d before surgery and continued for 1–3 months after the procedure, although the duration may be modified according to cyst characteristics and clinical circumstances. For larger hepatic cysts, a shorter preoperative course may be used because of concern about cyst perforation. Therefore, the low proportion of documented albendazole use in this retrospective cohort should not be interpreted as definitive evidence that patients did not receive perioperative treatment; rather, it highlights an important limitation in the completeness of the historical medical records (22).

A notable feature of this study is the quantitative comparison of CE surgical procedures with total general surgical activity at the study hospital. CE procedures accounted for 0.26% of all general surgical procedures over the 9-year study period. The observed decline in the number of CE surgical procedures, from 10 cases in 2017 to 2 cases in 2025, should be interpreted cautiously. Because this study included only histopathologically confirmed patients who underwent surgery at a single referral hospital, the observed trend reflects changes in hospital-based surgical activity rather than changes in population-level CE incidence or transmission. The decline may have been influenced by changes in referral patterns, healthcare access, diagnostic practices, treatment selection, or the availability of non-surgical management; however, these factors could not be evaluated directly in the present study. Therefore, the observed reduction in surgical procedures should not be interpreted as evidence of declining community transmission or improved prevention at the population level.

Study Limitations

This study is limited by its retrospective, single-center design and inclusion of only surgically treated cases, which may restrict generalizability. Livestock exposure and other behavioral variables were incompletely documented. The absence of standardized WHO-IWGE CE1–CE5 staging in the historical records further limited assessment of cyst activity, appropriateness of surgical indications, and interpretation of recurrence and treatment selection. Incomplete and heterogeneous historical imaging documentation also limited assessment of cyst location by hepatic lobe or segment, calcification, daughter cysts, and biliary communication. Key clinical variables were incompletely recorded, and variable follow-up may have led to underestimation of recurrence. Although Shahid Dr. Beheshti Hospital is the only hospital in Sabzevar performing

surgical treatment for CE, patients referred to tertiary centers outside Sabzevar, including Mashhad, may not have been captured in the present dataset. Therefore, the study should be interpreted as a hospital-based surgical series rather than a complete population-based registry of all surgically treated CE cases in the region.

Conclusion

This nine-year review describes the epidemiological and clinical characteristics of surgically treated CE in Sabzevar, with a decline in the number of CE surgical procedures observed at the study hospital over time. CE surgeries represented 0.26% of all general surgical procedures during the study period. However, this hospital-based trend should not be interpreted as evidence of changes in population-level CE incidence or transmission. Improved surveillance and integrated One Health approaches are needed to better characterize the regional burden and support disease control.

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Conflict of Interest

The authors declare that they have no competing interests.

Data Availability

The datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request.

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