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Cystic hydatid disease of the liver and lungs in Peruvian children: Clinical and surgical profile and associated factors in 219 cases (2014-2023)

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ABSTRACT

Introduction. Cystic echinococcosis is a major zoonotic disease from a public health perspective, with a high prevalence in rural areas of Peru. We analyzed the clinical characteristics and surgical treatment of hepatic and pulmonary cases in children from 2014 to 2023.

Population and methods. This was a retrospective, cross-sectional study of 219 children diagnosed through imaging. The study evaluated sociodemographic variables (sex, rural origin, educational level, and parental occupation), clinical variables (symptoms, cyst location), surgical variables, and complications. Descriptive analysis, Pearson's chi-square test, and multivariate logistic regression were performed to assess location, independent predictive factors, and complications.

Results. The disease predominantly affected males from rural or marginal urban areas. The most common symptoms were cough, abdominal pain, chest pain, and weight loss. In most cases, surgery was elective, with a short mean hospital stay and zero mortality. Complications were rare, such as biliary fistulas/liver abscesses and pneumothorax, with a higher risk in cases involving multiple cysts. Pulmonary involvement was associated with rural origin and contact with dogs. Contact with dogs, herding, and low socioeconomic status were identified as predictors of cystic echinococcosis; concurrent pulmonary and hepatic cysts and a diagnostic delay of >90 days were identified as predictors of complications.

Conclusion. The disease is linked to rural poverty and zoonotic exposures (dogs, grazing), with clinical profiles that vary depending on the location of the cysts and higher morbidity in cases involving both the lungs and liver, with a predominance of pulmonary cysts. Zoonotic and social determinants are more significant than classic demographic factors. Surgical treatment combined with albendazole proved highly effective.

Keywords: *cystic echinococcosis; hepatic hydatid disease; pulmonary hydatid disease.*

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INTRODUCTION

Cystic echinococcosis, caused by the larval form of *Echinococcus granulosus*, remains a public health challenge in rural areas of South America, particularly in Peru, where traditional livestock-raising practices and socioeconomic vulnerability contribute to its transmission to children.[1,2] In Huancayo, the incidence remains high; few studies have detailed the epidemiological factors and clinical profile in the pediatric population, which hinders preventive and therapeutic interventions tailored to the local context.[3,4]

Treatment in children places a significant burden on the healthcare system: diagnostic tests, antiparasitic medications, surgeries, and postoperative care, all of which entail high costs.[5,6] In the central highlands of Peru, it is still unclear what the best surgical strategy is for these patients, considering the size and location of the cysts, the child's condition, and the health risks.[4,7] Treatment decisions must be tailored to the specific characteristics of the cyst and the patient; surgery is essential in complicated cases, supplemented with perioperative albendazole.[8,9]

The experience gained in different healthcare settings can provide practical lessons applicable to other countries in the Southern Cone with comparable rural conditions, such as Argentine Patagonia or Uruguay's livestock-raising northern areas, where cystic echinococcosis maintains rates of 10-30 per 100 000 inhabitants in pastoral regions, which are characterized by a scarcity of healthcare facilities and intense exposure to dogs.[10]

This study analyzes the clinical characteristics and surgical treatment of hepatic and pulmonary cystic echinococcosis in children treated at the Ramiro Prialé Prialé National Hospital in Huancayo (2014-2023), to identify local patterns to inform clinical protocols and control strategies.

POPULATION AND METHODS

Study design and data sources

The study was conducted among patients treated from January 2014 to December 2023 at a national hospital in Huancayo, Peru. It employed a quantitative, analytical, retrospective, and cross-sectional design; medical records were reviewed for 219 children (ages 2-16) with a diagnosis confirmed by ultrasound, radiology, and CT scans, classified according to the WHO-IWGE.[11]

Through a literature review, data were collected on sociodemographic characteristics (age, sex, place of origin, contact with dogs/livestock, parental education and occupation, unsafe drinking water, access to health care, health education), clinical characteristics (duration of illness, cyst size/location, chest pain, cough, fever, abdominal pain, hepatomegaly, weight loss), diagnostic methods, treatment, outcomes, and risk factors (exposure to animals).[12,13]

Regarding ethical considerations, the National Code of Scientific Integrity and the regulations of Universidad Continental were followed, ensuring anonymity and complete confidentiality. The researchers handled the data with strict confidentiality. The Ethics Committee of Universidad Continental approved the protocol on March 15, 2025 (No.o 045-2025-UC-CIEI), and the administration of the Ramiro Prialé Prialé National Hospital authorized access to medical records for data collection (letter No. 089-2025-DG-HNRPP).

Statistical analysis

Using data from medical records, a descriptive analysis (means, standard deviations) was conducted; Pearson's chi-square test was used for bivariate associations, and binary logistic regression was used for sociodemographic, epidemiological, and clinical factors associated with dichotomous outcomes: cystic location (lung, liver, both) and complications (yes/no). The following variables were included as independent variables: age, sex, area of residence, place of origin, parental education level, contact with dogs, herding, duration of illness, and treatment modality (surgical/non-surgical). Odds ratios (OR) with confidence intervals (95%CI) are reported.

RESULTS

Table 1 summarizes findings from 219 children (ages 2-16) with confirmed cystic echinococcosis, including cyst location, demographic profile, surgical technique, and complications. The mean age was 10.8 ± 3.2 years, with most children (59.8%) coming from rural (52.1%) or marginal urban (28.8%) areas. Most parents had not completed secondary school (83.5% of fathers, 77.6% of mothers) and worked in mining (58.0%) or agriculture (62.0%), in a low socioeconomic context (61.6%).

Pulmonary cysts were the most common finding (55.3%), followed by liver involvement (29.7%) and concurrent lung-liver involvement (15.0%). The most common symptoms identified in the population were chest pain (66.7%), cough (67.1%), fever (64.8%), abdominal pain (69.9%),

Table 1. Cyst location and its relationship with the demographic profile, the surgical technique, and complications (n = 219)

Characteristic	Frequency n (%)	Hepatic n = 65 (29.7%)	Pulmonary n = 121 (55.3%)	Both n = 33 (16.1%)
Sociodemographic				
Average age (years)	10.8 ± 3.2	11.2 ± 2.9	10.5 ± 3.4	10.9 ± 3.0
Male sex	131 (59.8)	40 (61.5)	72 (59.5)	19 (57.6)
Rural background	114 (52.1)	36 (55.4)	62 (51.2)	16 (48.5)
Urban-marginal background	63 (28.8)	18 (27.7)	36 (29.8)	9 (27.3)
Parents with incomplete high school education	178 (81.3)	53 (81.5)	99 (81.8)	26 (78.8)
Occupation: mining/agriculture	135 (61.6)	41 (63.1)	74 (61.2)	20 (60.6)
Symptoms/signs				
Chest pain	146 (66.7)	32 (49.2)	92 (76.0)	22 (66.7)
Cough	147 (67.1)	35 (53.8)	95 (78.5)	17 (51.5)
Fever	42 (64.8)	38 (58.5)	85 (70.2)	19 (57.6)
Abdominal pain	53 (69.9)	52 (80.0)	72 (59.5)	29 (87.9)
Weight loss	184 (84.0)	52 (80.0)	104 (86.0)	28 (84.8)
Surgical techniques				
Elective surgery	205 (93.6)	61 (93.8)	114 (94.2)	30 (90.9)
Pericystectomy	85 (38.8)	32 (49.2)	41 (33.9)	12 (36.4)
Enucleation + suturing	62 (28.3)	15 (23.1)	38 (31.4)	9 (27.3)
Simple drainage	41 (18.7)	12 (18.5)	24 (19.8)	5 (15.2)
Segmental resection	31 (14.2)	6 (9.2)	18 (14.9)	7 (21.2)
Laparotomy approach for hepatic echinococcosis	65 (29.7)	65 (100)	18 (14.9)	28 (84.8)
Thoracotomy	121 (55.3)	-	121 (100)	25 (75.8)
Results				
Average length of stay (days)	6.7	7.1	6.4	7.2
Mortality	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Complications:	40 (18.4)	16 (24.6)	18 (14.9)	6 (18.2)
Biliary fistula/abscess	10 (4.6)	8 (12.3)	1 (0.8)	1 (3.0)
Surgical site infection	12 (5.5)	4 (6.2)	7 (5.8)	1 (3.0)
Pneumothorax/effusion	9 (4.1)	0 (0.0)	8 (6.6)	1 (3.0)

hepatomegaly (40.6%), and weight loss (84.0%). The diagnosis was incidental in 66.2% of cases (chest X-ray 72.1%, ultrasound 56.2%, positron emission tomography 89.0%): the children were referred for suspected conditions such as tuberculosis, pneumonia, asthma, hepatitis, or liver tumors; 94.1% underwent surgery plus albendazole; 93.6% of these procedures were elective, and 58.4% were performed using conventional techniques (open surgery). Other surgical techniques included enucleation plus padding (28.3%) and segmental resection (14.2%). The median hospital stay was 6.7 days, with no deaths. Complications were reported in 18.4% of cases (abscesses/fistulas: 4.6%).

Multivariate logistic regression (*Table 2*) for predictors of location and, complications, was associated with rural origin (OR 2.14; 95%CI 1.42–3.22; $p = 0.001$), dogs (OR 2.91; 95%CI 1.85–4.57; $p < 0.001$), and incomplete paternal education (OR 1.81; 95%CI 1.12–2.92; $p = 0.015$). Environmental exposure and the paternal

Table 2. Multivariate logistic regression analysis for predictors of location, and complications (n = 219)

Model	Variable	OR	95%CI	*p*-value
1. Cyst location (pulmonary vs. hepatic/both)	Rural origin	2.14	1.28-3.58	0.004
	Contact with dogs	2.91	1.45-5.84	0.003
	Incomplete parental education	1.81	1.05-3.11	0.032
2. Perioperative complications (yes/no)	Simultaneous pulmonary and hepatic cysts	2.87	1.42-5.81	0.003
	Duration of the illness >90 days	2.25	1.12-4.52	0.023
	Absence of postoperative albendazole	1.95	0.92-4.13	0.082

education gap emerge as key factors in pediatric echinococcosis. On the other hand, multiple cysts and diagnostic delay predict morbidity and recurrence, while socioepidemiological factors determine pulmonary localization.

Table 3 shows logistic regression results for factors associated with the presence of cystic echinococcosis (adjusted bivariate analysis); only ORs >2 and p <0.05 were considered independent predictors. Direct zoonotic exposures take precedence over classic demographic factors in endemic settings. Contact with dogs (OR 3.2) was observed to triple the risk due to their role as definitive hosts; they shed eggs in their feces, which contaminate rural areas. Grazing (OR 2.5) was associated with exposure to zoonotic cycles in contaminated pastures. Poverty (OR 2.8) was also a significant factor, particularly due to poor hygiene combined with overcrowding of dogs, which perpetuates transmission. Factors found to be non-significant (p >0.05) include sex, age, urban residence, maternal education, and access to drinking water. The results confirm the predominance of zoonotic and social factors over demographic factors.

Multivariate regression analysis of predictors of perioperative complications (*Table 4*) revealed that concurrent hepatopulmonary cysts increase the risk 2.87-fold (p = 0.003) due to protoscolex dissemination; a delay in care of >90 days increases the risk of complications (OR 2.25; p = 0.023) (persistent inflammation); the absence of postoperative albendazole also tends to increase the risk (OR 1.95; p = 0.082); patients without it have double the odds.

DISCUSSION

The results confirm the concentration of cystic echinococcosis among children in rural areas, where limited parental education and occupations in mining or agriculture expose them to active zoonotic cycles, consistent with previous reports from the Andean region.[12-14] This sociodemographic distribution explains the high frequency of pulmonary cases (55.3%), associated with rural origin (OR 2.14) and contact with dogs (OR 2.91). It highlights how practices such as herding perpetuate the transmission of disease in communities with inadequate health education.[15-18]

Peru's inadequate rural health infrastructure exacerbates this vulnerability. According to data from the National Institute of Statistics and Informatics (INEI, by its Spanish acronym) and sectoral analyses, more 94.0% of Peru's districts are rural (approximately 1,823 out of 1,938), of which 700 lack health facilities classified as category I-3 or higher (with outpatient services and basic clinical laboratory services); this affects 1.5 million residents and limits the

Table 3. Factors associated with the presence of cystic echinococcosis (logistic regression analysis, n = 219)

Factor	OR (95%CI)	*p*-value
Significant risk factors		
Contact with dogs	3.2 (2.0-5.1)	<0.001
Livestock grazing	2.5 (1.6-4.0)	0.002
Low socioeconomic status	2.8 (1.7-4.5)	<0.001
Factors with no significant risk		
Male gender	1.2 (0.8-1.8)	0.312
Age >10 years	1.1 (0.7-1.7)	0.645
Urban origin	0.9 (0.6-1.4)	0.721
Completed maternal education	1.0 (0.6-1.6)	0.982
Access to drinking water	0.8 (0.5-1.3)	0.389

Table 4. Multivariate logistic regression: predictors of perioperative complications (n = 219)

Variable	OR	95%CI	p-value
Concurrent pulmonary and hepatic cysts (vs. single)	2.87	1.42-5.81	0.003
Duration of the illness >90 days	2.25	1.12-4.52	0.023
Absence of postoperative albendazole	1.95	0.92-4.13	0.082

capacity to treat endemic diseases such as cystic echinococcosis.[19,20] In Junín (Huancayo), with 518 health posts (5.7% of the national total), 142 primary care centers (4.9%), and only 28 hospital-based care centers, health coverage is insufficient despite exceeding the national average for water and sanitation. Extreme poverty and low rural per capita income exacerbate diagnostic delays (>90 days, OR 2.25 for complications),[21] fragmenting care and overburdening higher-level care facilities.

Clinically, the symptoms and the pulmonary/hepatic predominance are consistent with pediatric series from endemic areas, where incidental radiographic findings (72.1%) highlight the need for active screening in high-risk areas with limited access.[18] Combined surgical treatment proved effective with pericystectomy, although complications increased in cases with concurrent cysts (OR 2.87), a finding that calls into question conservative approaches in complex cases with geographic barriers.[13,19]

The regression models identified key predictors such as zoonotic exposures for pulmonary involvement and diagnostic delays (>90 days) for complications.[14] These findings extend previous observations to the local context and support the use of albendazole as an adjunctive treatment (OR 2.85 in the absence of treatment).[6] In Junín (Huancayo), the prevalence of cystic echinococcosis reaches 14-34 per 100 000 in livestock-raising areas, with pilot control programs (2015-2021) limited by poor infrastructure (lack of slaughterhouses and safe drinking water), thereby perpetuating rural disparities.[22]

The combination therapy resulted in short hospital stays (6.7 days) and zero mortality, despite complications from biliary fistulas (12.3%) and pneumothorax (6.6%), which were twice as common in cases with delays (OR 2.25; p = 0.023).[5] The absence of albendazole in perioperative treatment showed marginal protection (OR 1.95; *p* = 0.082), indicating the efficacy of the combined surgical-albendazole treatment, consistent with the Peruvian series.[6] On the other hand, compared with Lima,[7] Huancayo exhibits a higher incidence of pulmonary involvement: 121 cases (55.3% of the total); and exclusive hepatic involvement: 65 cases (29.7% of the total), with a clear difference between pulmonary and hepatic cases (55.3% vs. 29.7%; that is, 1.9 times higher), attributable to altitude and intensive grazing in underserved districts.[8]

Concurrent pulmonary and hepatic cysts emerge as a key predictor of surgical complications, which are exacerbated by diagnostic delays exceeding 90 days. However, the pericystectomy-albendazole regimen ensures short hospital stays and a complete absence of mortality. Furthermore, the predominance of zoonotic and social determinants over classic demographic factors is confirmed.

These findings highlight concurrent pulmonary and hepatic cysts as predictors of morbidity and rural factors—including the presence of dogs—as determinants of pulmonary tropism.[8] Limitations inherent in retrospective studies (clinical registries) suggest caution in making generalizations, although the sample size (219) and multivariate adjustments strengthen the internal validity. Prospective studies could evaluate targeted preventive interventions, incorporating investment in rural infrastructure to address gaps reported by the INEI.[23] In Huancayo, pediatric cystic echinococcosis is prevalent in rural settings, where children exposed to dogs and grazing—whose parents have limited education and work in agriculture and mining—predominantly develop pulmonary cysts. These findings call for comprehensive actions such as intensive veterinary control, targeted community education, and strengthening of rural health infrastructure to interrupt the zoonotic cycle that overwhelms hospital services in endemic regions.

CONCLUSION

The disease is linked to rural poverty and zoonotic exposures (dogs, grazing), with clinical profiles that vary depending on the location of the cysts and higher morbidity in cases involving both the lungs and liver, with a predominance of pulmonary cysts. Zoonotic and social determinants are more significant than classic demographic factors. Surgical treatment combined with albendazole proved highly effective. ■

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