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ORIGINAL ARTICLE

Pulmonary hydatid disease in an endemic setting: clinical presentation and outcomes

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ABSTRACT

Background: Pulmonary hydatid disease, caused by *Echinococcus* spp., particularly *Echinococcus granulosus*, remains endemic in North Africa. Despite advances in imaging and surgical management, it continues to pose diagnostic challenges due to its nonspecific clinical presentation and the high frequency of complicated forms, largely related to persistent zoonotic transmission in endemic areas. **Objective and Methods:** This multicenter observational study included 25–27 patients from Algiers, Tipaza, and Constantine. It aimed to analyze the epidemiological, clinical, radiological, and therapeutic characteristics of pulmonary hydatid cysts. **Results:** The mean age was 36.8 years (range: 14–70), with a balanced sex distribution (13 men and 12 women). Urban residence predominated (64%) and was significantly associated with older age ($p = 0.023$). Occupational exposure was uncommon (16%) and occurred mainly in men ($p < 0.01$). Complicated cysts accounted for 68% of cases, predominantly due to rupture. ELISA serology was positive in 60% of patients and was associated with a shorter duration of symptoms ($p = 0.024$) and a higher rate of complicated disease ($p = 0.028$). Surgical management was performed in 23 out of 25 patients, mainly using lung-sparing procedures. Postoperative complications occurred in 17% of cases, including one death. **Conclusion:** Pulmonary hydatid disease frequently presents in complicated forms despite access to healthcare, highlighting persistent diagnostic delays and the need for improved preventive strategies in endemic regions.

Keywords: pulmonary hydatid cyst, echinococcosis, computed tomography, serology, Surgery.

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1. INTRODUCTION

Hydatid disease (echinococcosis) is a zoonosis caused by Echinococcus spp., mainly E. granulosus, with cystic (CE) and alveolar (AE) forms (1,2). Humans are accidental hosts infected via ingestion of parasite eggs, leading to larval development mainly in the liver and lungs (2). The disease is endemic in livestock regions, particularly North Africa, with an estimated incidence in Algeria of 15–50/100,000, likely underestimated (3,4). The liver is the most frequent site (55%), followed by the lungs (28%) (5). Pulmonary hydatid cysts are often asymptomatic or nonspecific; diagnosis relies on chest CT, supported by serology and confirmed histologically (6,7). Surgery remains the mainstay of treatment, with albendazole used selectively (4). Improved understanding is needed to optimize management in endemic settings.

2. MATERIALS AND METHODS

We conducted a multicenter descriptive study in tertiary centers in Algiers, Tipaza, and Constantine (Algeria), including PHC patients confirmed by ELISA and/or histopathology. Of 27 patients, 25 were analyzed after excluding incomplete cases. Two patients were excluded due to incomplete datasets: One patient lacked preoperative CT imaging and surgical operative details, preventing classification of cyst morphology and severity. A second patient had missing ELISA serology and incomplete operative records, making inclusion in comparative analyses impossible. Data were collected using a standardized form covering clinical, imaging (X-ray, CT), laboratory (eosinophilia, serology), and treatment variables. Cysts were classified as intact, complicated, or ruptured. Serology was performed using ELISA with Echinococcus granulosus antigens (8). Statistical analysis was conducted using R (v4.3.2); data are presented as mean (SD), median (range), or frequencies, with $p < 0.05$ considered significant.

3. RESULTS

Demographic characteristics (Table 1)

Twenty-five patients were included (13 men [52%], 12 women [48%]; mean age 36.8 ± 11.9 years), with similar ages between sexes ($p = 0.85$). Most patients were urban (64%), while rural patients were older (44.7 ± 12.4 vs 32.4 ± 9.4; $p = 0.023$). Occupational exposure was reported in 16%, predominantly in men (75%), whereas women predominated among unemployed patients (90%; $p < 0.01$). Toxic exposure was absent in 68%; among exposed patients, five were current smokers (all men). Comorbidities were infrequent (≤8%), and no family history was reported.

Table 1. Clinical characteristics, imaging severity, and surgical outcomes of PHC (n = 25 / 23).

Category	Variable	Findings	p-value
Population	Patients	25 (surgery: 23)	-
Age (years)	Mean (SD)	36.8 ± 11.9	0.27-0.63
Sex	Male / Female	13 / 12	1.00
Residence	Urban / Rural	64% / 36%	0.023
Occupation	Non-exposed / Unemployed / Exposed	44% / 40% / 16%	0.33-0.089
Toxic habits	Present / Absent	32% / 68%	0.39
Medical history	Comorbidity present	36%	0.39
Symptoms	Chest pain / Hemoptysis / Cough / Incidental	20% / 16% / 28% / 12%	0.014
Physical exam	Normal / Abnormal	80% / 20%	0.57
Imaging severity	Complicated PHC	68%	0.014
	Ruptured / hydro-PTX / multiple	36% / 12% / 8%	-
Location	Right / Left / Bilateral	56% / 36% / 8%	1.00
Lobe	Lower / Upper / Middle	52% / 28% / 12%	0.49
Cyst number	Single / Multiple	76% / 24%	-
Serology	Positive / Negative	60% / 40%	0.028
Eosinophilia	Present	28%	-
Extra-pulmonary HC	Present	16%	-
Surgery (n=23)	Cystectomy / Pericystectomy / Atypical / Lobectomy	48% / 35% / 13% / 4%	0.041
Post-op complications	Yes / No	17% / 83%	0.041
Mortality	Death	4%	-

***HC** : Hydatid Cyst; PHC : Pulmonary Hydatid Cyst; Hydro-PTX: Hydro-Pneumothorax ; SD : Standard Deviation.*

Clinical presentation (Table 1)

Mean symptom duration was 17.5 ± 27.3 days (0–90), with no correlation with age (r = −0.075; p = 0.73) or toxic habits (p = 0.49). Chest pain was most frequent (20%), followed by hemoptysis and dry cough (16% each). Incidental diagnosis occurred in 12%. Physical examination was normal in 80%, with pleural effusion (12%) and consolidation (8%).

Imaging findings (Tables 1 and 2)

Complicated PHCs were present in 68% (17/25) versus 32% (8/25), mainly due to rupture (36%), followed by flaccid cysts and hydropneumothorax (12% each) and multiple ruptures (8%); cyst size ranged from 1.5-17 cm. Respiratory symptoms were significantly more frequent in complicated forms (p = 0.014), while age was not associated (p = 0.27) (figures 1, 2 and 3).

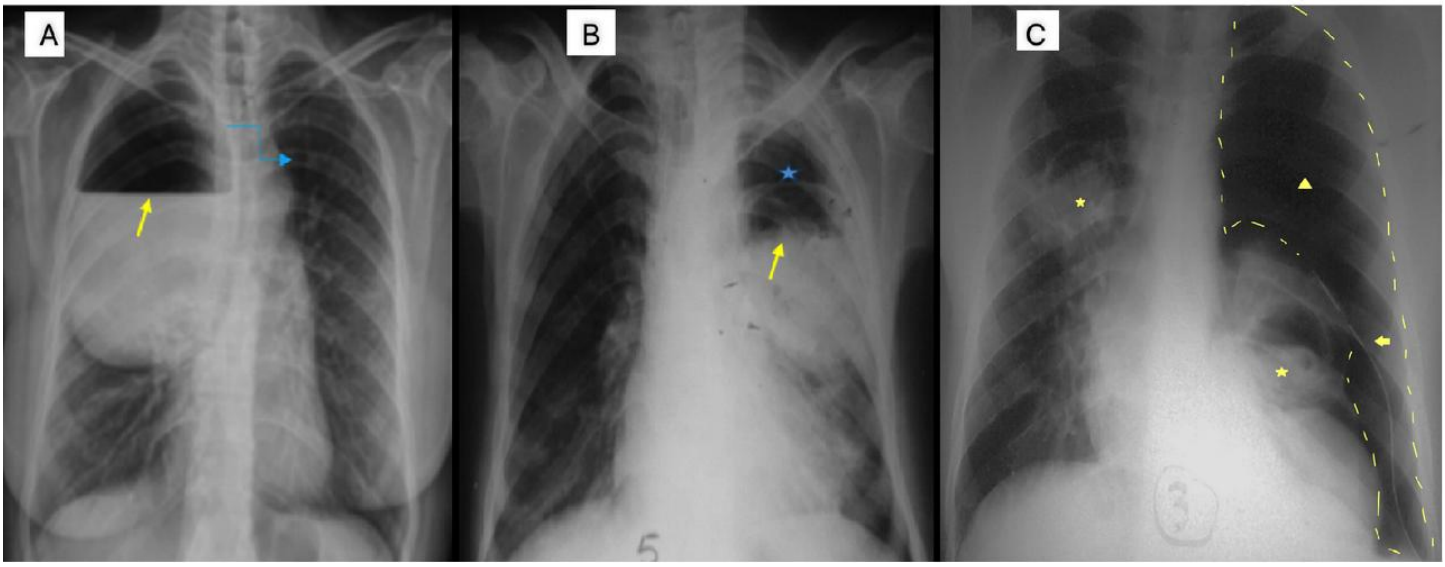

Figure 1. Chest radiographs of ruptured pulmonary hydatid cysts. (A) Large right upper lesion (~15 cm) with mixed density, air–fluid level (yellow arrow) and mediastinal shift (blue arrow), consistent with ruptured PHC. **(B)** Left mid-lung lesion (~8 cm) with mixed density and air–fluid level (yellow arrow), consistent with ruptured PHC. **(C)** Left hydropneumothorax with collapsed lung (yellow dashed line), mediastinal apposition (yellow triangle), pleural drain (yellow arrow), and intrapulmonary lesion (yellow star), with additional right basal 3 cm air–fluid lesion, consistent with bilateral ruptured PHCs. *PHC, Pulmonary Hydatid Cyst.*

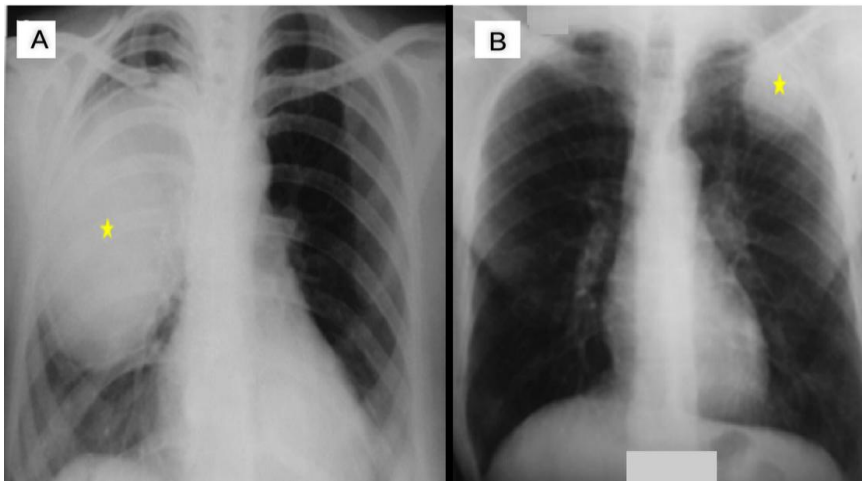

Figure 2. Chest radiographs of uncomplicated pulmonary hydatid cysts. (A) Right (~17 cm) and (B) left (~3 cm) homogeneous well-circumscribed masses (yellow star), consistent with uncomplicated PHCs. *PHC, Pulmonary Hydatid Cys.*

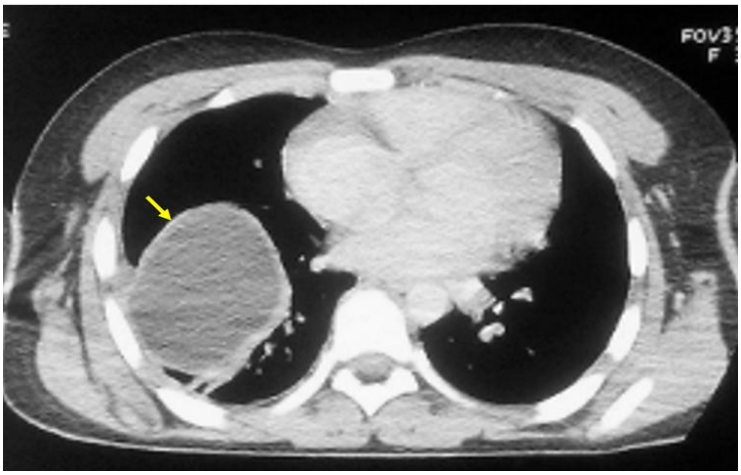

Figure 3. Thoracic CT (mediastinal window) of uncomplicated right PHC. Well-defined homogeneous fluid-density lesion (6 cm) in the right lower lobe (yellow arrow), consistent with an uncomplicated PHC. *CT, computed tomography; PHC, pulmonary hydatid cyst*.

Lesions were predominantly right-sided (56%) versus left (36%) and bilateral (8%). All left-sided and bilateral cysts were symptomatic, whereas most right-sided lesions were asymptomatic (p = 0.43). Lower lobes were most affected (52%), followed by upper (28%), middle (12%), and multiple lobes (8%). Single cysts predominated (76%), with 16% having two and 8% multiple cysts; solitary lesions were typical in unilateral disease, whereas massive cysts occurred only in bilateral cases.

Extra-pulmonary cysts occurred in 16%: hepatic (8%), ovarian (4%), renal (4%, Figure 4); 88% of complicated PHCs had no extra-pulmonary involvement. No associations with age (p = 0.24) or occupation (p = 0.48).

Table 2. Clinical and surgical characteristics of uncomplicated vs complicated PHC (n = 25).

Variable	Uncomplicated (n = 8)	Complicated (n = 17)	p-value
Age, mean (SD)	32.2 (12.4)	39.0 (11.4)	0.27
Sex (Male)	50%	53%	1.00
Exposure profile			0.33
Non-exposed / unemployed / exposed	25% / 62% / 13%	53% / 29% / 18%	
Toxic habits (present)	38%	29%	0.39
Medical history (present)	38%	35%	0.39
Clinical presentation			**0.014**
Chest pain / hemoptysis / cough / incidental	25% / 0% / 75% / 75%	18% / 24% / 41% / 0%	
Physical exam abnormal	13%	24%	0.57
Radiological distribution			0.49
Right / Left / Bilateral	62% / 38% / 0%	53% / 35% / 12%	
Lower lobe predominance	75%	41%	
Extra-pulmonary HC	25%	12%	0.38
Serology positive	25%	76%	**0.028**
Surgery performed (n=23)			0.20
Conservative (cystectomy/pericystectomy)	75%	73%	
Resection (atypical/lobectomy)	25%	27%	
Postoperative complications (n=23)	12%	29%	**<0.01**

HC : Hydatid Cyst ; SD : Standard Deviation

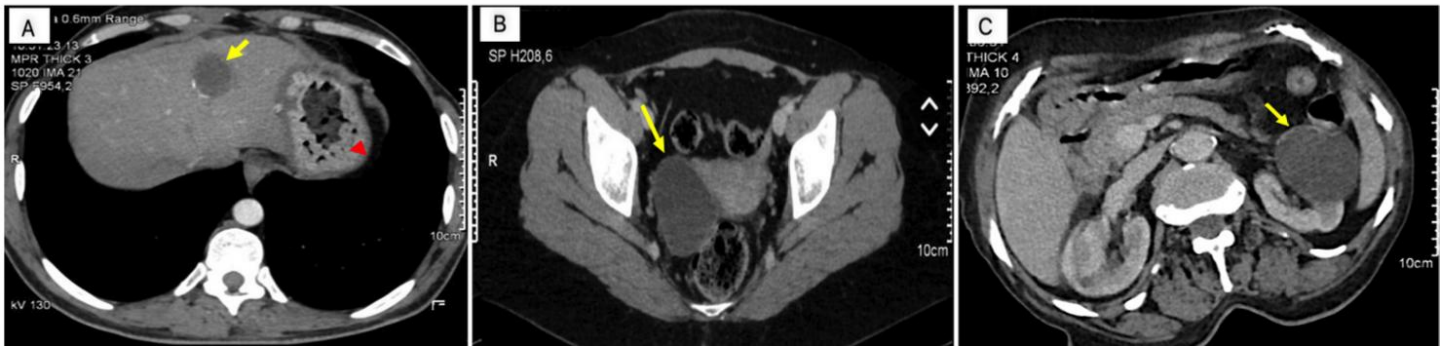

Figure 4. Abdominopelvic CT showing extrathoracic hydatid cysts. (A) Liver (25 × 30 mm), (B) ovary (46 × 64 mm), and (C) kidney (50 mm) cysts (yellow arrow); ovarian and renal lesions confirmed as HC. Gastric adenocarcinoma also noted (red triangle). CT, Computed Tomography; HC, Hydatid Cyst.

Biological and histopathological findings (Table 1)

Eosinophilia was present in 28% (7/25). ELISA was positive in 60% (15/25) and negative in 40%. Seropositive patients were older (40.2 ± 10.6 vs 31.8 ± 12.5; p = 0.071) and had shorter symptom duration (6.6 ± 13.5 vs 32.8 ± 34.7 days; p = 0.024). Seropositivity was associated with complicated cysts (13/15 vs 2/15; p = 0.028) and imaging features such as in situ rupture (47% vs 20%) and intrapleural cysts (13% vs 0%; p = 0.047). No association was found with cyst number, extrapulmonary involvement, residence, toxic habits, or comorbidities. Preoperative diagnosis was occasionally achieved via bronchoscopy or drain obstruction in hydatid pneumothorax (Figure 5).

Figure 5. Bronchoscopic removal of hydatid membranes. Laminated membranes retrieved by bronchoscopy, consistent with endobronchial rupture of a pulmonary hydatid cyst. *Abbreviation: HC, Hydatid Cyst.*

Therapeutic management (Tables 1 and 2**)**

Surgery was performed in 92%: cystectomy (48%), peri cystectomy (35%), atypical resection (13%), and lobectomy (4%). Outcomes were favorable in 83%, with complications in 17%, including one death (4.3%). Complications were associated with older age and complicated cysts (p < 0.01), and absent after cystectomy (p = 0.041).

4. DISCUSSION

In this cohort of 25 patients with PHC, sex distribution was nearly balanced (Table 1), contrasting with earlier reports of marked male predominance (9,10), but consistent with more recent Algerian data suggesting increased female involvement and possible female predominance in adult populations (11,12). This variability highlights the heterogeneity of sex-related patterns across endemic regions.

The mean age (36.8 ± 11.9 years) aligns with the peak incidence in young adults reported in Iranian and Algerian studies (11,12), with no sex-related differences. Although pulmonary involvement is classically more frequent in children, clinically apparent disease peaks in young adulthood, whereas pediatric cases tend to present with larger and more complicated cysts (11,14).

The predominance of urban residence (64%) contrasts with traditional rural patterns (9), but supports an epidemiological shift toward urban and peri-urban settings (14). This likely reflects evolving socio-environmental conditions, including urbanization, uncontrolled dog populations, and informal livestock practices, suggesting that classical rural–urban distinctions are becoming less relevant for transmission dynamics.

Occupational data indicate a transition from traditional risk profiles. Most patients were unemployed or had no identifiable occupational exposure (32% and 44%), while only 16% reported high-risk occupations (Table 1). This aligns with Mahmoudi et al. (5), highlighting domestic and environmental exposure as the main drivers of infection. High-risk occupations were predominantly male (75%), whereas absence of occupational exposure was mainly observed in women (90%), suggesting gender-related exposure patterns, likely occupational in men and domestic in women (15). Overall, occupational exposure appears less determinant than previously assumed.

Smoking was infrequent and unrelated to disease occurrence. The low prevalence of comorbidities (36%) supports exposure-driven risk rather than host-related factors (16). The absence of familial history likely reflects under-ascertainment; however, case–control studies report up to a threefold increased risk among relatives (16,17), supporting systematic household assessment and targeted screening in high-risk families.

The short mean duration of symptoms (17.5 days) (Table 1) contrasts with the typically indolent course of echinococcosis (18), likely reflecting a high proportion of symptomatic and complicated cysts.

Clinically, chest pain was the most frequent symptom (20%), followed by hemoptysis and dry cough (16% each) (Table 1), with lower frequencies than previously reported (19,20). Incidental detection (12%) was comparable (19), supporting that pulmonary hydatid disease often remains asymptomatic until complications occur (21). Vomica was rare (8%) (22), hemoptysis less frequent than in pediatric cohorts (23), and absence of hydatid expectoration may reflect earlier-stage disease (24).

Despite 68% complicated forms, including rupture (36%), physical examination was frequently normal, consistent with its limited sensitivity (21). The complication rate is comparable to previous reports (25,26), likely reflecting delayed diagnosis. The significant association between symptoms and complications ($p = 0.014$) supports this interpretation and aligns with Özdemir et al. (13).

CT imaging enabled accurate characterization, with typical features of rupture such as hydropneumothorax and multiple cysts (27). Lesions predominantly involved the right lung (56%) and lower lobes (52%) (Table 1), consistent with previous studies (7,26). Bilateral involvement was uncommon (8%), lower than reported in some series. Pediatric variations further highlight anatomical heterogeneity (28,29).

Biologically, eosinophilia was present in 28%, confirming its limited diagnostic value (30,31). Serology was positive in 60% (Table 1), consistent with reported sensitivities (32,33), and significantly associated with complicated forms ($p = 0.028$) (Table 2), supporting enhanced humoral response following cyst rupture, although findings remain inconsistent (29,33). Negative serology does not exclude diagnosis (34).

Therapeutically, surgery remains the cornerstone of management. In our cohort, 92% underwent surgery, predominantly conservative procedures (Table 1, 2), in line with recommendations favouring parenchymal preservation (21,30). The low rate of anatomical resection reflects a lung-sparing strategy. Medical therapy remains reserved for selected cases (35,36).

Postoperative morbidity (17%) was higher than in some series (37), likely due to the high proportion of complicated cysts. Complications were associated with more extensive surgical procedures ($p = 0.041$), supporting conservative approaches. Mortality (4.3%) slightly exceeded published averages (36,38), but this finding is purely descriptive given the very small number of events (one death among 23 operated patients). It should therefore be interpreted with caution due to the limited sample size and does not allow inferential conclusions. Rather, it likely reflects the severity and advanced nature of complicated cases in this cohort, rather than an epidemiological estimate of surgical mortality in pulmonary hydatid disease.

Finally, pulmonary hydatid disease in this cohort predominantly affected urban residents, reflecting peri-urban livestock practices and uncontrolled dog populations. Men were overrepresented in occupational exposure, whereas domestic transmission predominated in women. Patients were young adults, presenting mainly with chest pain, hemoptysis, and chronic cough, symptoms significantly associated with complications ($p = 0.014$). Despite 68% complicated cysts, physical examination was often normal and serology variable, underscoring diagnostic challenges. Conservative surgery remained essential to preserve lung parenchyma and limit morbidity. The main limitation was the single-center design and limited sample size, which may affect generalizability.

5. CONCLUSION

Pulmonary hydatid cysts showed near-equal sex distribution and predominance in urban residents across three Algerian cities, suggesting a shift in exposure toward previously low-risk populations. Despite access to care, most cases were complicated, with symptoms associated with rupture and significant postoperative morbidity, highlighting diagnostic and therapeutic challenges. These findings emphasize the need for early detection, optimized surgical management, and strengthened prevention strategies. Pulmonary echinococcosis remains a persistent public health concern in Algeria and North Africa, including urban settings.

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Ethics Approval and Consent to Participate: The study was approved by the ethics committees of the participating institutions and conducted in accordance with the Declaration of Helsinki. Given the retrospective nature of the study, the requirement for individual informed consent was waived where applicable.

Data Sharing Statement: De-identified participant data are available from the corresponding author upon reasonable request for academic purposes, subject to approval of a scientifically sound proposal.

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