

Original Article

Ruptured Pulmonary Hydatid Cysts: Surgical Challenges and Clinical Outcomes.

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Abstract

Objectives: Rupture of pulmonary hydatid cysts is an uncommon but serious complication with notable morbidity. Data on iatrogenic rupture remain limited, particularly in endemic regions. This study evaluated the clinical characteristics, management, and outcomes of patients with ruptured pulmonary hydatid cysts.

Methods: A retrospective study was conducted at the Thoracic Surgery Department of Services Hospital, Lahore, Pakistan, including 36 patients with iatrogenic or spontaneous cyst rupture from January 2021 to June 2025. Demographic, clinical, radiologic, surgical, and postoperative data were analyzed using descriptive and correlation statistics.

Results: The mean age was 34.3 ± 11.2 years; 24 (66.7%) were male. Chest pain (94.4%) was the most frequent symptom, followed by cough (41.7%) and hemoptysis (22.2%). Rupture was iatrogenic in 22 (61.1%) and spontaneous in 14 (38.9%) cases. Post-rupture complications included respiratory distress (77.8%) and anaphylaxis (38.9%). Surgical procedures included cystotomy with capitonnage in 17 (47.2%), lobectomy in 11 (30.6%), and cystotomy with decortication in 8 (22.2%). Larger or multiple cysts were significantly associated with lobectomy ($p = 0.008$). Postoperative complications occurred in 11.1% of patients, mean hospital stay was 5.9 ± 1.6 days, and mortality was nil.

Conclusion: Rupture of pulmonary hydatid cysts, especially iatrogenic rupture, is a rare but preventable event. Early diagnosis and prompt surgical management ensure excellent outcomes. Larger or multiple cysts significantly increase the need for lobectomy. This study provides valuable data from an endemic region to guide prevention and management strategies.

Keywords: Pulmonary hydatid cyst; rupture; iatrogenic; thoracic surgery; lobectomy; capitonnage

INTRODUCTION

Hydatid disease, caused by the larval stage of *Echinococcus granulosus* and less commonly *E. multilocularis*, remains a major public health concern in endemic regions, particularly in areas where livestock farming and close human-dog contact are common. The liver is most frequently affected, followed by the lungs, which account for 25–40% of cases (1). Pulmonary hydatid cysts often remain asymptomatic until they attain sufficient size to cause compression or rupture. Cyst rupture, whether spontaneous, traumatic, or iatrogenic, may result in severe and potentially life-threatening complications. These include acute release of antigenic fluid leading to anaphylaxis and shock, and secondary complications such as pneumothorax, hydropneumothorax, empyema, bronchopleural fistula, and infection of the residual cavity (2, 3).

A particular concern is iatrogenic rupture during diagnostic interventions. In high-burden areas such as Pakistan, pulmonary hydatid cysts are sometimes misdiagnosed as simple cysts, abscesses, or neoplastic lesions. Physicians may proceed with needle aspiration or fine-needle biopsy for diagnostic confirmation, which can precipitate catastrophic outcomes, including rupture, anaphylaxis, shock, and empyema (4–6). While sporadic case reports have documented anaphylaxis during puncture of hydatid cysts (7, 8), systematic reporting of iatrogenic pulmonary hydatid cyst rupture remains scarce. The radiological images of a ruptured hydatid cyst are shown in **figure 1**.

Local data on pulmonary hydatid disease management exist, including a large series from Peshawar where 14.1% of 580 patients presented with ruptured cysts, though iatrogenic causes were not specifically addressed (9). More recently, our own department has contributed to the surgical literature

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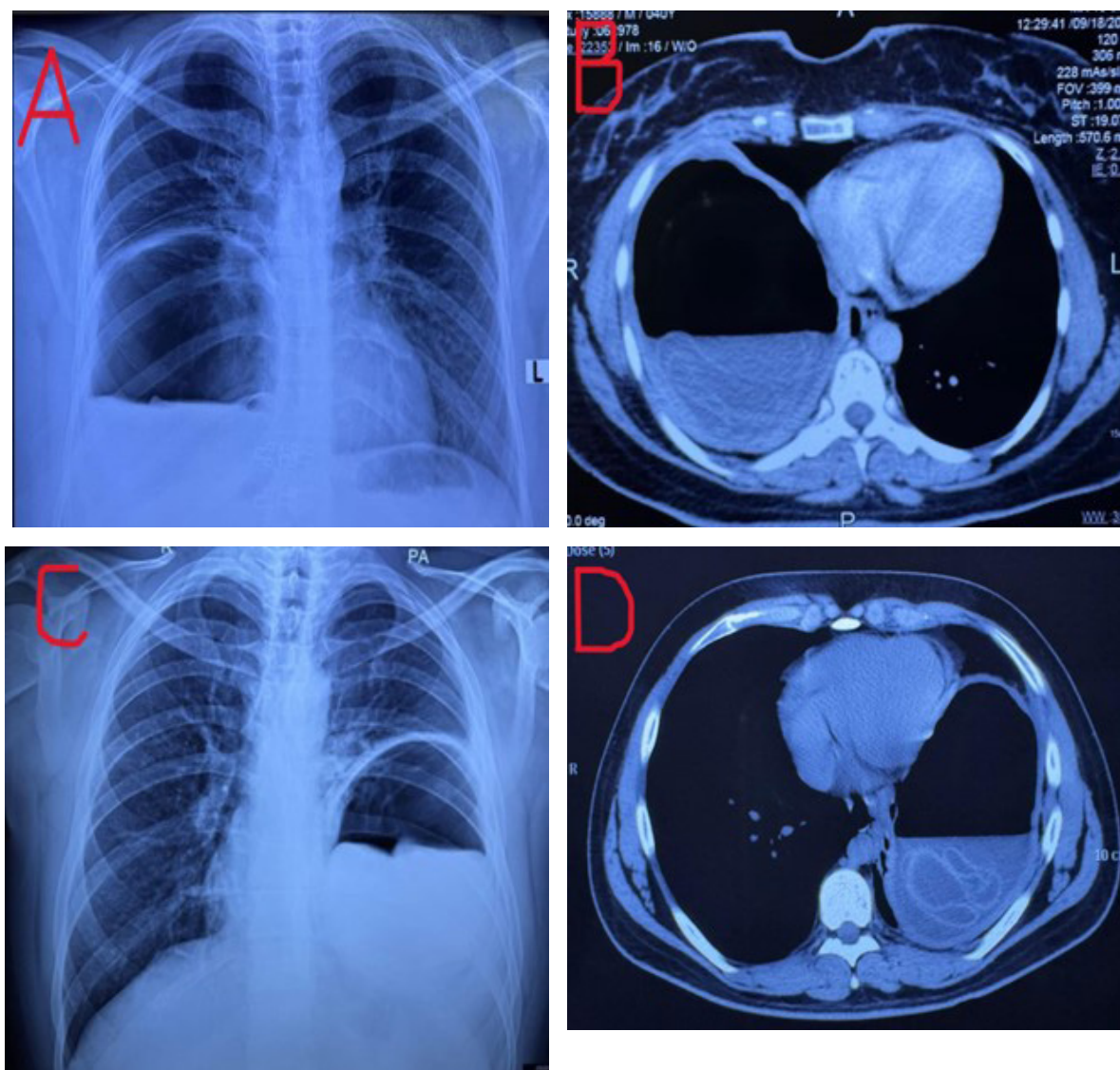
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by evaluating the role of capitonnage following cystotomy in pulmonary hydatid disease (10, 11). However, to date, there are no published local case series focusing specifically on iatrogenic ruptures following aspiration or misdirected diagnostic interventions.

In this study, we present a case series of patients with iatrogenic rupture of pulmonary hydatid cysts, many of whom developed anaphylaxis, shock, and empyema. By reporting our experience, we aim to highlight this preventable complication, describe its clinical course and management, and provide recommendations for physicians practicing in endemic regions.

Figure 1. (A); Chest X-ray of patient with ruptured right pulmonary hydatid cyst showing air fluid level (B); Axial CT-Scan of the patient “A” showing air fluid level and water lilly sign (C); Chest X-ray of another patient with ruptured left pulmonary hydatid cyst (D): axial CT scan of patient “C” showing floating membranes “water-lilly sign” with air fluid level typical of ruptured hydatid cyst.



MATERIALS AND METHODS

Study Design and Setting

This retrospective case series was conducted at the Department of Thoracic Surgery, Services Institute of Medical Sciences (SIMS), Services Hospital, Lahore, Pakistan, a tertiary care referral center located in an endemic region for hydatid disease. The study was approved by the institutional review board of Services Institute of Medical Sciences (SIMS), Services Hospital, Lahore, with reference number IRB/2025/1535/SIMS issued on 11.02.2025, and patient confidentiality was maintained throughout.

Study Period

Medical records of all patients admitted and surgically managed for ruptured pulmonary hydatid cysts between January 2021 and June 2025 were reviewed.

Patient Selection

A total of 36 patients with ruptured pulmonary hydatid cysts were included. Both iatrogenic and spontaneous ruptures were analyzed.

Inclusion criteria were:

- Radiological, intraoperative, or histopathological confirmation of pulmonary hydatid cyst.
- Documentation of cyst rupture—either iatrogenic (post-procedural) or spontaneous.
- Availability of complete clinical, operative, and postoperative data.
- Exclusion criteria were:
- Extrapulmonary hydatid cysts without lung involvement.
- Incomplete records or missing follow-up data.

Data Collection

Data were collected from patient files, operative notes, and discharge summaries using a standardized proforma.

Variables recorded included:

- Demographics: age, sex, and comorbidities.
- Epidemiological factors: residence (urban/rural), exposure to livestock.
- Clinical presentation: symptoms at rupture (chest pain, cough, hemoptysis, dyspnea, fever, etc.) and post-rupture complications (anaphylaxis, shock, respiratory distress, empyema, hydropneumothorax).
- Radiologic findings: location (right/left lung), cyst number (single or multiple), and cyst size (cm).
- Rupture etiology: spontaneous or iatrogenic (needle aspiration, fine-needle biopsy, or other interventions).
- Surgical management: cystotomy with capitonnage,

lobectomy, or combined procedures (cystotomy with decortication).

- Postoperative course: complications, length of hospital stay, and recovery outcomes.
- Albendazole therapy: all patients received albendazole 10–15 mg/kg/day for three cycles of 28 days each postoperatively.

Management Protocol

All patients were managed according to standardized institutional protocols. Initial stabilization and timing of surgery were determined by the patient's hemodynamic and clinical status.

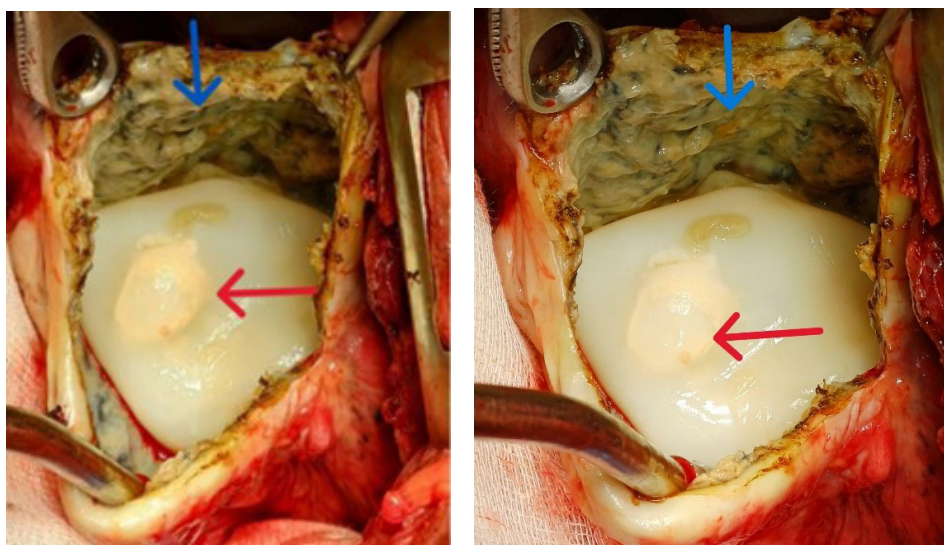
Patients presenting with anaphylaxis or hemodynamic instability were given immediate resuscitative management, including administration of adrenaline, corticosteroids, and antihistamines, along with fluid resuscitation and airway support as needed. These patients were prioritized for urgent surgical intervention once clinically stabilized. In contrast, hemodynamically stable patients without acute complications were managed electively. Intra operative images of ruptured hydatid cyst with infected cyst wall is shown in **Figure 2**.

Surgical management was individualized according to intraoperative findings:

- Cystotomy with capitonnage was the preferred procedure for sterilized and non-infected small ruptured cysts.
- Lobectomy was performed for large, multiple, or complicated cysts with destroyed parenchyma.
- Cystotomy with decortication was undertaken in cases associated with empyema or thickened pleura.

Postoperatively, all patients received albendazole therapy for three cycles of 28 days each, separated by 14-day drug-free intervals, and were followed clinically and radiologically for recurrence.

Figure 2. (A), (B); Intra-operative picture of ruptured hydatid cyst after cystotomy with Red Arrow pointing towards daughter cyst and Blue Arrow pointing towards the infected wall of hydatid cyst invading into the pulmonary parenchyma.



Data Analysis

Data were analyzed using IBM SPSS Statistics. Continuous variables were expressed as mean $\pm$ standard deviation (SD) or median (interquartile range, IQR) as appropriate. Categorical variables were summarized as frequencies and percentages.

Associations between categorical variables (e.g., cyst characteristics, type of surgical procedure, and postoperative outcomes) were tested using the Chi-square or Fisher's exact test. Correlations between continuous variables (e.g., cyst size and length of hospital stay) were evaluated using Spearman's correlation coefficient. A p-value < 0.05 was considered statistically significant.

Ethical Consideration

This retrospective study was conducted following the ethical standards of the institutional and national research committees and with adherence to the Declaration of Helsinki. Since the study involved analysis of existing medical records, no direct patient contact or intervention was required. Patient confidentiality was strictly maintained by anonymizing all identifiable information before analysis. No

personal identifiers were used in data handling or reporting. As this was a retrospective review, the requirement for informed consent was waived by the ethics committee. The study posed minimal risk to participants, and all data were used solely for research purposes.

RESULTS

A total of 36 patients with iatrogenic rupture of pulmonary hydatid cyst were included in the study. The mean age of the cohort was 34.31 ± 11.21 years (range: 18–60 years). There were 24 males (66.7%) and 12 females (33.3%). The majority of patients were from rural areas (23/36, 63.9%), while 13/36 (36.1%) were from urban regions.

Exposure to livestock, considered a potential risk factor for hydatid disease, was present in 24 (66.7%) patients. Regarding comorbidities, 3 (8.3%) patients had diabetes mellitus, 4 (11.1%) had hypertension, and 29 (80.6%) had no associated comorbidity.

The median length of hospital stay was 5 days (mean 5.91 ± 1.63 days, range: 4–10 days; $n = 35$). The demographic data is shown in **Table 1**:

Table 1. Baseline Characteristics of Patients with Ruptured Pulmonary Hydatid Cyst

Variable	Division	n(%) or Mean $\pm$ SD (Range)
Total patients		36 (100%)
Age (years)		34.31 ± 11.21 (18–60)
Gender	Male	24 (66.7%)
	Female	12 (33.3%)
Residence	Rural	23 (63.9%)
	Urban	13 (36.1%)
Exposure to Livestock		24 (66.7%)
Co morbidities	Diabetes Mellitus	3 (8.3%)
	Hypertension	4 (11.1%)
	No Comorbidity	29 (80.6%)
Length of hospital stay (days)		5.91 ± 1.63 (4–10)

Among the 36 patients included in the study, chest pain was the most frequent presenting symptom, reported by 34 patients (94.4%), followed by cough in 15 (41.7%), hemoptysis in 8 (22.2%), dyspnea in 5 (13.9%), and fever in 4 (11.1%). Many patients experienced overlapping or multiple presenting symptoms at the time of admission.

A total of 22 patients (61.1%) developed iatrogenic rupture of a pulmonary hydatid cyst following an interventional procedure involving the lungs. These included needle aspiration, fine-needle biopsy, or other procedures performed for a suspected misdiagnosis (such as simple cyst, lung abscess, or lung mass). The remaining 14 patients (38.9%) presented with spontaneous rupture of the hydatid cyst. The data is categorized in **Graph 1** below:

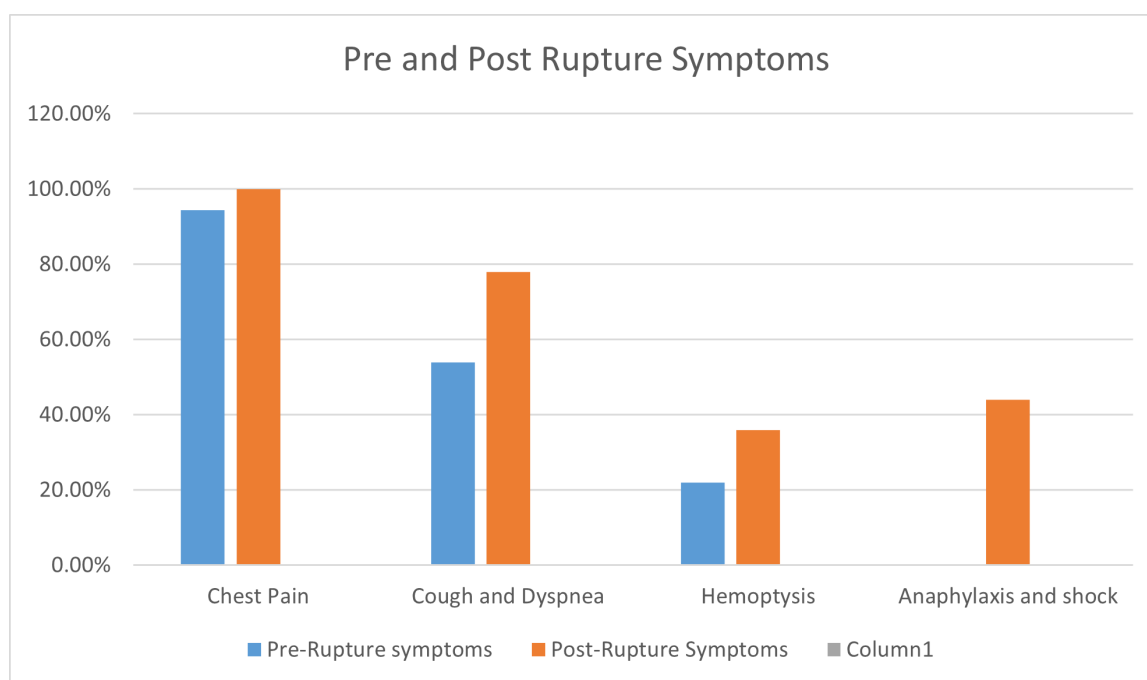
At the time of rupture, all patients (100%) experienced severe chest pain (VAS > 5), accompanied by respiratory distress in 28 (77.8%), anaphylaxis in 14 (38.9%), and shock in 2 (5.6%).

Radiologically, hydropneumothorax was the most common finding, observed in 31 patients (86.1%), whereas empyema thoracis developed in 5 (13.9%) patients.

Regarding the anatomical distribution, 20 patients (55.6%) had the cyst located in the right lung, while 16 (44.4%) had it in the left lung. Single cysts were present in 29 (80.6%) patients, whereas multiple cysts were observed in 7 (19.4%) patients.

All patients underwent surgical management following the rupture of the pulmonary hydatid cyst. The most commonly performed procedure was cystotomy with capitonnage in 17 patients (47.2%), followed by lobectomy in 11 patients (30.6%), and combined cystotomy with capitonnage and decortication in 8 patients (22.2%).

Graph 1. Frequency of Presenting Symptoms in Pre and Post rupture of Hydatid Cyst Bar chart illustrating the frequency (%) of presenting symptoms among patients with rupture of pulmonary hydatid cyst.



Albendazole therapy was administered to all patients postoperatively, consisting of three cycles, each of 28 days' duration, as part of the standard antiparasitic regimen.

Postoperative complications were infrequent. The most commonly reported specific complication was wound infection, observed in 4 patients (11.1%), while 32 patients (88.9%) experienced no postoperative complication.

Overall, 33 patients (91.7%) had a smooth postoperative recovery, whereas 3 patients (8.3%) required prolonged chest tube drainage lasting more than 14 days. Post-operative outcomes are shown in **Table 2**:

Table 2. Surgical Management and Postoperative Outcomes

	Variable	N (%) Or Description
Surgical Procedure	Cystotomy with capitonnage	17 (47.2%)
	Lobectomy	11 (30.6%)
	Cystotomy with capitonnage and decortication	8 (22.2%)
Post-Operative Complications	Wound Infection	4 (11.1%)
	No Post-operative Complication	32 (88.9%)
Post-Operative Recovery	Uneventful recovery	33 (91.7%)
	Prolonged Chest tube >14 days	3 (8.3%)

Correlations and Associations

Correlation and association analyses were performed to investigate the relationships between demographic, clinical, and surgical variables in patients with iatrogenic rupture of pulmonary hydatid cysts.

A weak positive correlation was observed between patient age and length of hospital stay (Spearman's rho = 0.277, p = 0.1125). Although this relationship did not reach statistical significance, the trend suggests that older patients tended to have slightly longer postoperative hospital stays (mean = 5.9 ± 1.6 days).

No significant association was found between the type of surgical procedure performed (cystotomy ± capitonnage, lobectomy, or cystotomy + decortication) and the occurrence of postoperative complications (p = 0.44), indicating that outcomes were comparable across the different surgical techniques used.

However, there was a statistically significant association between the type of diagnostic intervention leading to cyst rupture (e.g., fine-needle aspiration, needle biopsy, or thoracentesis) and the severity of immediate post-rupture complications ($\chi^2 = 12.47$, p = 0.0013). Specifically, patients who underwent needle aspiration or biopsy showed a markedly higher incidence of severe respiratory distress (81.8%) and anaphylactic reactions (54.5%) compared to those with spontaneous rupture (42.8% and 14.2%, respectively).

Similarly, clinical status at the time of rupture (stable vs. hemodynamically unstable) was significantly associated with outcome at discharge ($\chi^2 = 8.26$, $p = 0.0166$). Patients presenting with hemodynamic instability had a higher rate of prolonged chest tube duration (> 14 days) and delayed recovery (33.3%) compared to those who were stable at rupture (3.4%). These correlations are shown in **Table 3** below:

There was no statistically significant association between cyst location (right vs. left lung) and postoperative complications ($p = 0.30$), suggesting that laterality did not influence short-term outcomes.

Table 3. Correlation and Association Analysis

Variable Pair	Statistical Test	Correlation / Chi-Square (X^2)	P-Value	Interpretation
Age Vs. Hospital Stay	Spearman's rho	0.277	0.112	Weak positive correlation; not significant
Surgical Procedure Vs. Postoperative Complications	Chi-square	-	0.44	No significant association
Diagnostic Intervention Vs. Immediate Complications	Chi-square	12.47	0.0013	Significant association; more severe complications after invasive interventions
Clinical Status At Rupture Vs. Outcome At Discharge	Chi-square	8.26	0.0166	Significant association; unstable patients had prolonged recovery
Cyst Location Vs. Postoperative Complications	Chi-square	-	0.30	No significant association

Association between Cyst Characteristics and Surgical Management

Analysis of cyst characteristics demonstrated a clear relationship between cyst size and the type of surgical procedure performed. Patients undergoing lobectomy tended to have significantly larger cysts compared to those managed with cystotomy and capitonnage.

The mean cyst diameter among lobectomy cases was 9.4 ± 2.1 cm, compared to 6.8 ± 1.9 cm in the cystotomy-capitonnage group ($p = 0.008$, t-test).

Similarly, the presence of multiple cysts was more frequently associated with lobectomy (5 of 7 patients with multiple cysts; 71.4%) than in those with a single cyst (6 of 29 patients; 20.7%), showing a statistically significant association between cyst multiplicity and the need for lobectomy ($p = 0.028$). This association is shown in **Table 4** below:

These findings indicate that larger or multiple hydatid cysts tend to require more extensive surgical resection, often necessitating lobectomy, whereas smaller, solitary cysts are more amenable to conservative procedures such as cystotomy with capitonnage.

Table 4. Cyst Size and Surgical Procedure

Cyst Characteristics	Cystotomy ± Capitonnage (N=17)	Lobectomy (N=11)	Cystotomy + Decortication (N=8)	P-Value
Mean Cyst Diameter (Cm)	6.8 ± 1.9	9.4 ± 2.1	7.6 ± 1.8	0.008*
Mean Cyst Diameter (Cm)	2 (11.8%)	5 (45.5%)	0 (0%)	0.028*
Right Lung Involvement, N (%)	9 (52.9%)	7 (63.6%)	4 (50.0%)	0.78
Postoperative Complication, N (%)	1 (5.9%)	2 (18.2%)	1 (12.5%)	0.41

*Statistically significant ($p < 0.05$). Larger cysts and multiple cysts were significantly associated with the need for lobectomy.

DISCUSSION

Rupture of pulmonary hydatid cysts is an uncommon but critical complication that leads to acute clinical presentations and influences surgical decision-making. In our series of 36 patients with ruptured pulmonary hydatid cysts, key findings clarify the patterns of presentation, complications, surgical management, and outcomes in this rare scenario.

In all cases, chest pain was the predominant presenting symptom, reported by 94.4% of patients, while respiratory distress (77.8%), anaphylaxis (38.9%), and even shock (5.6%) occurred following cyst rupture. Hydropneumothorax (86.1%) and empyema thoracis (13.9%) were common radiologic/pleural complications. These findings are consistent with case series of ruptured pulmonary hydatid cysts in children, where hydropneumothorax and air-fluid levels are frequent radiographic signs, and severe symptoms are common [12].

More than 60% of ruptures in our cohort were iatrogenic, due to diagnostic or therapeutic lung interventions such as needle aspiration or biopsy, suggesting these procedures pose a high risk when hydatid cysts are misidentified. Published literature supports increased morbidity in ruptured versus non-ruptured pulmonary cysts and emphasizes that iatrogenic causes can precipitate severe immediate complications [13,14]. A strong association emerged between cyst characteristics and surgical procedure: larger or multiple cysts were more often managed with lobectomy, while solitary, smaller cysts received lung-preserving surgeries (cystotomy with capitonnage, with or without decortication). This corresponds to findings in ruptured cyst case series: e.g., in a pediatric series of 63 children with 68 ruptured lung hydatid cysts, the resection rate (i.e., lobectomy or higher) was 22.1%, and cystotomy plus capitonnage was used in about 38% [12]. A series from Turkey reported that in 76 pleural-ruptured pulmonary hydatid cases, even though spontaneous ruptures were common, parenchyma-preserving procedures were preferred, and lobectomy was reserved for cases with destroyed lung tissue or large cysts [15].

Length of hospital stay in our patients averaged 5.9 ± 1.6 days (median 5), and while there was a weak positive correlation with age ($p = 0.277$, $p = 0.1125$), it was not statistically significant. This aligns with reports that ruptured cases tend to have longer stays than intact cyst cases, but that age per se is less predictive than the severity of rupture, complications, and procedure type [12, 15].

Postoperative morbidity in our series was relatively low: wound infection in ~11.1% of patients, and 88.9% with no complications. Smooth recovery occurred in 91.7%, while 8.3% required prolonged chest tube duration beyond 14 days. In the children's ruptured-cyst series (63 children), morbidity was ~25.4%, including prolonged air leak, empyema, bronchopleural fistula, and pneumonia; mortality was 4.7% [12]. In the Turkish pleural rupture series, morbidity was reported in 39.4% of patients, with hospital stays averaging 12.3 ± 2.9 days [15]. Thus, our outcomes suggest that even among ruptured cases, rigorous management can limit morbidity.

Strength of our study lies in its exclusive focus on ruptured pulmonary hydatid cysts—which, being rare, are less represented in many hydatid cyst series—and in quantification of associations: cyst burden (size and multiplicity) correlated clearly with need for more extensive surgical resection (lobectomy), unlike some series where data on rupture status and cyst size were mixed [12, 13].

Limitations

This single-center retrospective study included a relatively small sample size ($n = 36$), which may limit the generalizability of the findings. In many iatrogenic rupture cases, pre-

rupture imaging and procedural details were unavailable from referring centers. Variations in surgical expertise and intraoperative decisions may have influenced outcomes, and long-term follow-up data were incomplete. Despite these limitations, this remains one of the few focused analyses of iatrogenic and spontaneous rupture of pulmonary hydatid cysts, offering meaningful clinical insights into this rare complication.

CONCLUSION

Ruptured pulmonary hydatid cysts, especially those ruptured iatrogenically, lead to pronounced clinical symptoms and higher risk of immediate complications. Cyst size and multiplicity strongly determine surgical approach; lung-preserving procedures are effective when feasible, but lobectomy becomes necessary in large or multiple cysts. Our data contribute rare but essential benchmarks for morbidity, procedure selection, and outcomes in ruptured pulmonary hydatid cysts under local settings.

Place of Study

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Conflict of interest statement

The authors declare that they have no conflicts of interest related to this case report.

Data availability statement

All data are included in this article; further details are available from the corresponding author upon reasonable request.

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