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Outcomes of hydropneumothorax among pulmonary tuberculosis patients: a prospective observational study from a tertiary care center in north India

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Abstract

Hydropneumothorax is an uncommon but serious complication of pulmonary tuberculosis (PTB), often resulting from the rupture of a tuberculous cavity into the pleural space with bronchopleural fistula formation. Early diagnosis and optimal management are crucial to improving outcomes. A descriptive study was conducted over 18 months in 50 microbiologically confirmed PTB patients presenting with pneumothorax or hydropneumothorax at a tertiary care hospital in Punjab, India. Demographic, clinical, radiological, and microbiological data were recorded. Lung expansion was quantified using Light's Index at serial intervals up to 8 weeks. Statistical analysis was performed using Chi-square/Fisher exact tests; $p<0.05$ was considered significant. The mean age was 34.48±11.69 years, and 82% were male. All patients presented with breathlessness, 96% with chest pain, 68% with fever, and 62% with cough. New TB cases comprised 82%, recurrent 8%, and loss-to-follow-up 10%. The mean lung expansion time was 2.92±2.16 weeks. Significant associations were found between drainage status and lung expansion ($p=0.01$) and between type of TB and lung expansion ($p=0.04$). Complete radiological expansion was achieved in 76% of patients within 8 weeks. Surgical referral to the Cardiothoracic and Vascular Surgery Department was required in 24%.

Hydropneumothorax in PTB predominantly affects young adult males and often requires prolonged drainage. Early intercostal tube drainage significantly improves lung expansion outcomes, particularly in new TB cases.

Key words: hydropneumothorax, pulmonary tuberculosis, India.

Introduction

Tuberculosis (TB) remains a significant public health challenge in India, accounting for nearly one-quarter of the global TB burden and continuing to be a leading cause of morbidity and mortality despite advances in diagnosis and treatment [1]. Pulmonary tuberculosis (PTB) may be complicated by various pleural manifestations, most commonly tuberculous pleural effusion, while more severe complications such as pneumothorax and hydropneumothorax occur less frequently but are associated with substantial clinical deterioration [2,3]. Hydropneumothorax—defined as the simultaneous presence of air and fluid in the pleural cavity—most often arises from a bronchopleural fistula (BPF) secondary to advanced cavitary disease, although it may also result from rupture of subpleural cavities into the pleural space [4,5].This condition presents a unique therapeutic challenge, as patients frequently exhibit persistent air leaks, prolonged lung collapse, and a high risk of developing chronic sequelae such as a non-expanding lung or pleural fibrosis if not managed promptly [5,6]. In addition, the clinical presentation can be misleading, with symptoms overlapping those of other pleural pathologies, necessitating a high index of suspicion and prompt imaging for accurate diagnosis [3,7]. Management strategies typically include intercostal drainage (ICD), antimicrobial therapy, and, in selected cases, surgical intervention to close BPF or decorticate the pleura [4,6].

Despite its clinical relevance, the current literature on TB-associated hydropneumothorax is sparse, consisting predominantly of small retrospective series and isolated case reports, leaving many aspects of its natural history and prognostic determinants poorly defined [2,4,6,7]. The present study was therefore undertaken to evaluate the clinical profile, management approaches, and outcomes in PTB patients with hydropneumothorax, and to identify factors influencing successful lung re-expansion.

Materials and Methods

Study design and setting

A descriptive prospective study was conducted in the Department of Pulmonary Medicine, Guru Gobind Singh Medical College & Hospital, Faridkot, over 18 months with sample size 50.

Inclusion criteria

- Age >18 years
- Microbiologically confirmed PTB with pneumothorax or hydropneumothorax

- New and previously treated drug-sensitive TB cases

Exclusion criteria

- Drug-resistant TB
- Pregnancy
- Chronic obstructive pulmonary disease or interstitial lung disease
- Encysted pneumothorax/hydropneumothorax
-Hydropneumothorax with transudative pleural effusion

Management protocol

All patients underwent ATT as per national guidelines. Intercostal drainage tube (ICDT) insertion was performed for air/fluid evacuation in all patients. Bronchopleural fistula closure was monitored clinically and radiologicallywith sequential chest X-RAY at 1,2,4,6 and 8 weeks followup. Patients with persistent bronchopleural fistula or persistent drainage after 8 weeks of ICDT insertion were referred to CTVS department for surgical closure of bronchopleural fistula.

Measurement of lung expansion

Complete lung expansion used for 100% improvement and incompelete/un-expended lung who fail to achieve 100% improvement after 8 weeks of ICDT insertion.

Lung expansion was quantified using Light's Index:

$PNX\% = 100 \times [1 - \{L^3 / H^3\}]$.

L = average lung diameter, H = hemithorax diameter (Figure 1).

Data analysis

Data were analyzed using SPSS v25. Categorical variables were compared with Chi-square or Fisher's exact test; $p<0.05$ was considered statistically significant.

Ethics approval

The study was approved by the Institutional Ethics Committee of Guru Gobind Singh Medical College & Hospital, Faridkot (Approval No: BFUHS/2K25p-TH/3782). Written informed consent was obtained from all participants.

Results

Baseline characteristics

A total of 50 microbiologically confirmed PTB patients with pneumothorax or hydropneumothorax were enrolled. The mean age was 34.48 ± 11.69 years, ranging from 18 to 72 years. Most were 21–30 years old (38%), followed by 31–40 years (28%). Males comprised 82% of the cohort.

Occupationally, labourers (52%) were the most common group, followed by farmers (20%), housewives (10%), and students (10%) (Table 1).

All patients presented with breathlessness (100%), most had chest pain (96%), and a large proportion reported fever (68%) and cough (62%). The mean duration of symptoms before presentation was 20.94 ± 18.51 days.

Comorbidities were present in 40% of patients, most commonly viral infections (22%), followed by diabetes, hypertension, and chronic liver disease.

TB category and treatment status

At presentation, 82% were new TB cases, 8% recurrent, and 10% loss-to-follow-up. Seventeen patients (34%) were on ATT at presentation.

Primary outcomes – lung expansion

Complete lung expansion within 8 weeks occurred in 38 patients (76%), with a mean expansion time of 2.92 ± 2.16 weeks. Twelve patients (24%) failed to achieve full expansion by 8 weeks (Table 2).

Among total 27 cases of hydropneumothorax, we observed that 10 patients didn't experience lung expansion after 8 weeks follow up which is more than those patients who had pneumothorax, 2 out of 23 experienced no lung expansion (Table 3).

We observed In our study that there is significant association between type of TB and lung expansion ($p = 0.04$), with new cases showing better outcomes than the recurrent or loss-to-follow-up cases (Table 4).

In our study, it was observed that out of 50, only 12 (24%) of the patients required referral to surgery department for surgical management. While majority of them didn't require any surgery i.e. 38 (76%). Thus, the referral rate came out to be 24% (Table 5).

Discussion

Hydropneumothorax is an important complication in pulmonary tuberculosis (TB) and can adversely affect clinical outcomes if not managed promptly. The present study assessed lung expansion outcomes, broncho-pleural fistula closure, and surgical referral rates in 50 patients with pneumothorax or hydropneumothorax associated with pulmonary TB.

Age and gender trends

The majority of patients were in the 21–30-year age group (38%), with a mean age of 34.48 ± 11.69 years. Males predominated (82%), reflecting the higher TB prevalence in men, consistent with national and global epidemiology.

Occupational and socioeconomic factors

Labourers (52%) and farmers (20%) formed the largest occupational groups, indicating potential links with low socioeconomic status, occupational exposure, and higher TB risk, due to financial necessity, resumed physically demanding work soon after tube thoracostomy, potentially impairing recovery. Additionally, poor nutritional status-common among low-income TB patients-compromises immune function and delays tissue repair, contributing to prolonged healing and delayed lung expansion. This interplay of medical pathology with socio-economic pressures underscores the need for comprehensive management, including early intervention, nutritional rehabilitation, and patient counselling on adequate rest during recovery,similar to findings by Chaudhuri et al. [8], Mohan et al. [9], and Sehgal et al.[10].

Significant clinical associations

A key finding was the statistically significant association between hydropneumothorax and delayed or incomplete lung expansion ($p = 0.01$). Among 27 hydropneumothorax cases, 10 (37%) showed no expansion after 8 weeks, compared to only 2 (9%) among 23 pneumothorax cases. Fluid accumulation in hydropneumothorax likely impedes re-expansion, consistent with prior reports by Gupta et al. and Qureshi et al. [11,12].

Similarly, type of TB significantly influenced lung expansion ($p = 0.04$), with new TB cases achieving better recovery than recurrent or lost-to-follow-up cases. This aligns with studies by Menzies et al. [13], Baghaei et al. [14], Gupta et al. [11], and Patel et al. [15], which reported better outcomes in new TB cases due to early treatment and lower drug resistance rates.

Treatment outcomes

After 8 weeks, complete lung expansion occurred in 76% of patients, with a mean intercostal drainage tube (ICD) duration of 20.44 ± 15.12 days. The surgical referral rate was 24%, aligning with Souza et al. [16], who reported a 23.7% referral rate, and lower than the 88% reported by Shamaei et al. [17].

Non-significant associations

No statistically significant associations were found between lung expansion and comorbidities ($p = 0.55$), duration of symptoms ($p > 0.05$), or ongoing anti-tubercular treatment at presentation ($p > 0.05$). Although conditions such as diabetes and HIV were present in 40% of patients, they did not significantly alter short-term expansion outcomes, in agreement with Chaudhuri et al. [8], Mohan et al. [9], Kumar et al. [18], and Verma et al. [19].

These findings highlight that hydropneumothorax and recurrent TB are strong predictors of delayed or incomplete lung expansion in TB-related pleural disease. Early recognition and targeted management—especially in high-risk groups—may improve recovery rates.

Most PTB patients with hydropneumothorax achieve lung expansion within 6-8 weeks on ATT with ICD drainage.Thus, early surgical referral is unnecessary for tubercular hydropneumothorax, waiting up to 6-8 weeks is justified.

Early return to laborious work and poor nutrition among low-income TB patients impaired recovery, delaying lung expansion. These findings highlight the need for nutritional support, rest counseling, and comprehensive management during treatment.

Primary care physicians, alongside pulmonologists, play a vital role in post-discharge follow-up to monitor lung function, detect recurrence, and facilitate rehabilitation.

From a clinical perspective:

- Early drainage improves outcomes.
- Close monitoring of recurrent/LFU cases is essential.
- Surgical intervention should be considered within 6–8 weeks for non-expanding lungs.

Limitations include the single-centre design, small sample size, and short follow-up.

Conclusions

ICD insertion with an underwater seal, combined with prompt anti-tubercular therapy, is highly effective in managing tubercular pneumothorax and hydropneumothorax, resulting in excellent lung re-expansion and favorable outcomes. Early intervention, adherence to treatment protocols,

and vigilant follow-up are essential to prevent recurrence. Strengthening early detection, improving access to care, and raising public awareness—especially among high-risk groups—can substantially reduce TB-related complications. Larger multicentric studies are warranted to validate and refine these findings.

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Table 1. Distribution of patients according to occupation.

Occupation	Frequency (n)	Percentage (%)
Driver	2	4.0
Farmer	10	20.0
Housewife	5	10.0
Labour	26	52.0
Plumber	1	2.0
Student	5	10.0
Unemployed	1	2.0
Total	50	100

Table 2. Duration of lung expansion.

Duration of lung expansion	Frequency (n)	Percentage (%)
1 week	13	26
2 weeks	10	20
4 weeks	10	20
6 weeks	4	8
8 weeks	1	2
Not recovered at 8 weeks	12	24
Mean±SD	2.92± 2.16	
Median	2	
Minimum	1 week	
Maximum	8 weeks	

Table 3. Association between drainage and lung expansion.

Variable	Lung expansion			p
Drainage	Yes	No	Total	
Yes	17	10	27	0.01
No	21	2	23	
Total	38	12	50	

Table 4. Relation of expansion of lung with type of PTB.

Variable	Lung expansion			p
Type of TB	Yes	No	Total	
New	34	7	41	
Loss to follow up	2	3	5	0.04
Recurrent	2	2	4	
Total	38	12	50	

Table 5. Distribution of patients according to referral for surgery.

Referral for surgery	Frequency (n)	Percentage (%)
Yes	12	24.0
No	38	76.0
Total	50	100.0

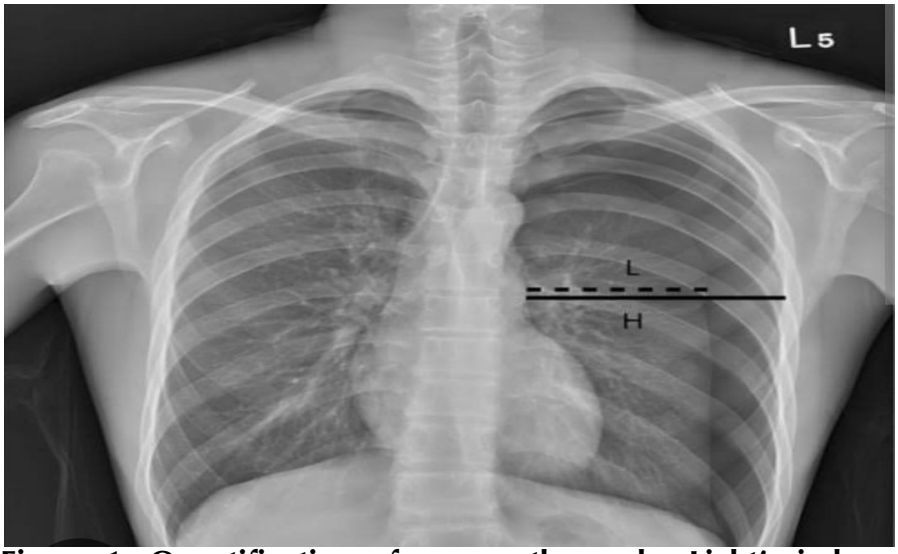

Figure 1. Quantification of pneumothorax by Light's index. L, average lung diameter; H, hemithorax diameter.