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Research Article

Secondary Spontaneous Pneumothorax in a High-TB-Burden Region: Incidence, Aetiology and Short-term Outcomes

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Abstract
Background: Secondary spontaneous pneumothorax (SSP) produces greater morbidity and recurrence than primary disease. Contemporary data from tuberculosis (TB)–endemic regions are sparse.
Objectives: (i) Quantify SSP incidence among consecutive pneumothorax presentations in a North-Indian tertiary centre; (ii) delineate the current aetiological spectrum; (iii) describe two-hour radiographic response and early complications after guideline-adapted management; and (iv) identify 12-month recurrence predictors.
Methods: Adults with radiologically confirmed pneumothorax were enrolled prospectively. SSP was defined as pneumothorax with underlying lung disease. Management followed British Thoracic Society (BTS-2023) algorithms. Primary outcome was full lung re-expansion two hours post-intervention; secondary outcomes were early complications and recurrence at 12 months. Predictors of recurrence were examined with multivariate Cox analysis.
Results: Of 111 pneumothoraces, 75 (67.6 %) were SSP (median age 62 y; M:F = 6.3:1). TB—active 21.3 % plus post-TB sequelae 22.7 %—superseded COPD (40 %) as the leading cause. Heavy smoking index ≥ 300 pack-year-equivalents occurred in 50.7 % of SSP versus 11 % of non-SSP ($p < 0.001$). Intercostal drainage (ICD) was required in 94.7 % of SSP; two-hour full re-expansion reached 61.3 %. Sub-cutaneous emphysema (57 %) predominated among early complications. Twelve-month recurrence was 14.7 %; underlying TB (HR 2.1, 95 %CI 1.1–4.3) and persistent air-leak > 5 days (HR 3.4, 1.4–7.9) were independent predictors.
Conclusions: In high-TB settings, TB now rivals COPD as the principal driver of SSP. Prompt small-bore ICD ensures rapid re-expansion, yet appreciable early recurrence supports first-episode pleurodesis and intensified smoking-cessation strategies.

Keywords: secondary spontaneous pneumothorax; tuberculosis; COPD; intercostal drainage; India.

INTRODUCTION

Spontaneous pneumothorax results from the entry of air into the pleural space without antecedent trauma. When it occurs in previously normal lungs it is classified as primary, whereas secondary spontaneous pneumothorax (SSP) implies an underlying pulmonary disorder (1). SSP carries a four-fold greater in-hospital mortality and longer admission compared with primary spontaneous pneumothorax (PSP) (2). In high-income countries, chronic obstructive pulmonary disease (COPD) accounts for nearly 70 % of SSP (2). However, India remains the global epicentre of tuberculosis (TB) with ~2.95 million new cases reported in 2023 (3). Active infection, residual bullae and fibrocavitation weaken pleural integrity and predispose to rupture (4).

Retrospective Indian case series from Chandigarh and Hyderabad suggested TB equals or exceeds COPD as the leading SSP aetiology (5, 6), but those studies were limited by small size, potential selection bias and pre-DOTS treatment era. International guidelines now emphasise ambulatory needle aspiration for stable SSP (7). Whether such resource-intensive pathways are feasible or effective in TB-endemic, low- and middle-income settings is uncertain. Furthermore, predictors of early radiographic success and one-year recurrence remain ill-defined in populations where TB co-exists with heavy tobacco exposure.

We therefore conducted a prospective cohort study at a North-Indian tertiary hospital to: (i) quantify the incidence of SSP among all pneumothorax presentations; (ii) detail the contemporary aetiological spectrum with

emphasis on TB; (iii) evaluate two-hour radiographic response and early complications after BTS-adapted management; and (iv) identify clinical predictors of 12-month recurrence. These data aim to guide context-appropriate treatment algorithms and preventive strategies in high-TB-burden regions.

MATERIALS AND METHODS

Study design and setting

Prospective observational cohort at Indira Gandhi Medical College & Hospital, Shimla.

Participants

All consecutive adults (≥ 18 y) with chest-radiograph-confirmed pneumothorax were screened. Exclusions: traumatic or post-operative pneumothorax, previous ipsilateral pleurodesis.

Definitions

- **SSP:** pneumothorax in a patient with documented lung disease (clinical, radiological or microbiological).
- **Underlying TB:** active TB requiring therapy, or post-TB structural sequelae in previously treated patients.
- **Smoking Index (SI):** cigarettes (or bidis)/day × years; heavy SI ≥ 300 pack-year-equivalents.
- **Primary Outcome:** full lung re-expansion two hours after initial intervention on erect chest radiograph.
- **Recurrence:** new ipsilateral or contralateral pneumothorax ≥ 30 days after complete radiographic resolution.

Management Protocol

Treatment followed BTS-2023 pleural guidelines (7) with pragmatic adaptations: oxygen 4–6 L min^{-1} for all; 14 F small-bore ICD preferred; 16-G needle aspiration reserved for PSP < 2 cm or SSP < 1 cm in minimally symptomatic patients. Continuous suction (−15 cmH_2O) commenced if lung expansion < 50 % at two hours.

Data Collection and Follow-Up

Pre-designed case-report forms captured demographics, comorbidities, pneumothorax size (Light index), aetiology, intervention, two-hour outcome, complications, hospital stay and recurrence. Follow-up visits: two weeks, three months, 12 months; defaulters contacted telephonically.

Statistical Analysis

SPSS v26.0. Continuous variables: median (IQR); Mann-Whitney U test. Categorical variables: n (%) compared with χ^2 or Fisher's exact. Variables with $p < 0.10$ on univariate analysis entered multivariate Cox proportional-hazards modelling for recurrence. Significance: $p < 0.05$ (two-tailed).

RESULTS

Baseline Profile and Incidence

Of 117 pneumothorax presentations, six (traumatic) were excluded; 111 episodes remained. SSP comprised 75/111 (67.6 %). SSP patients were older (median 62 y vs 45 y in PSP, $p < 0.001$) and predominantly male (86.7 %). Heavy SI ≥ 300 was recorded in 38/75 SSP (50.7 %) versus 1/36 PSP (2.8 %) ($p < 0.001$).

Table 1. Underlying lung disease among 75 SSP episodes

Disease category	n	% of SSP
COPD	30	40.0
Active tuberculosis	16	21.3
Post-TB sequelae	17	22.7
COVID-19 pneumonia	5	6.7
Interstitial lung disease	2	2.7
Non-COVID bacterial pneumonia	2	2.7
Lung mass	2	2.7
Pneumoconiosis	1	1.3

Table 2. Initial treatment and two-hour radiographic response (SSP only)

Intervention	n (%)	Full expansion	Partial expansion	No expansion
ICD	71 (94.7)	44	25	2
Needle aspiration + O_2	1 (1.3)	1	0	0
Oxygen alone	3 (4.0)	1	2	0
Total	75	**46 (61.3 %)**	**27 (36.0 %)**	**2 (2.7 %)**

Sub-cutaneous emphysema occurred in 43/75 SSP (57 %); traumatic ICD insertion in 5 (6.7 %). Median ICD dwell-time 4 days; median hospital stay 5 days.

Recurrence

At 12 months, 11/75 SSP (14.7 %) recurred (8 ipsilateral, 3 contralateral). Cox modelling identified underlying TB (HR 2.1, 95 %CI 1.1–4.3; p = 0.03) and persistent air-leak > 5 days (HR 3.4, 1.4–7.9; p = 0.01) as independent predictors.

DISCUSSION

This prospective cohort confirms that tuberculosis—active plus residual—has overtaken COPD as the predominant cause of SSP in a high-TB-burden Indian region, accounting for 44 % of cases (Table 1). The figure aligns with earlier Indian series reporting 42–56 % TB-SSP (5, 6) and contrasts sharply with < 10 % in Western populations (2). Nearly 95 % of SSP required intercostal drainage, reflecting late presentation, large defects and limited outpatient suction; by comparison, UK audits report ICD use in only 35–50 % (7). Nevertheless, small-bore ICD achieved full re-expansion within two hours in ~61 % of SSP—comparable to pooled success in recent meta-analysis (8). Heavy smoking acted synergistically with TB, underscoring the need for robust tobacco-control measures. Twelve-month recurrence (14.7 %) and its association with TB suggest that first-episode talc pleurodesis, currently recommended for COPD-SSP, should be extended to TB-SSP in endemic zones. Collectively, these findings support adaptation—not wholesale adoption—of Western ambulatory pathways in TB-rich, resource-limited settings.

CONCLUSION

In this North-Indian tertiary-care cohort, tuberculosis has surpassed COPD as the principal driver of secondary spontaneous pneumothorax. Prompt small-bore intercostal drainage delivers rapid re-expansion with acceptable morbidity, yet a 15 % one-year recurrence—predominantly in TB-associated disease—justifies consideration of definitive pleurodesis at first presentation and aggressive smoking-cessation initiatives. Randomised, resource-appropriate trials comparing ambulatory aspiration with ICD are urgently required for TB-endemic regions.

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