

Iatrogenic Pneumothorax: Procedure-Specific Risk Profile and Management Success in 23 Consecutive Cases

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Abstract

Background: Iatrogenic pneumothorax (IPX) is a well-recognised complication of pleural and lung interventions, yet contemporary data from resource-limited hospitals are sparse.

Objectives: To characterise the procedural spectrum precipitating IPX, describe immediate radiographic outcomes after guideline-adapted management, and identify predictors of chest-tube requirement in a North-Indian tertiary centre.

Methods: This prospective sub-analysis examined 23 consecutive IPX events identified within a 12-month pleural cohort (November 2020–October 2021). Triggers, underlying lung disease, management modality and two-hour radiographic response were recorded. Descriptive statistics with exact 95 % confidence intervals (CI) were calculated; associations with intercostal-drainage (ICD) insertion were explored using Fisher's exact test.

Results: Percutaneous procedures accounted for 78.3 % of IPX: CT-guided transthoracic needle biopsy (TTNB) for suspected lung mass 10/23 (43.5 %) and diagnostic thoracentesis 8/23 (34.8 %). Bronchoscopic tissue acquisition, including cryo-biopsy for interstitial lung disease, caused 4/23 (17.4 %). One IPX followed invasive positive-pressure ventilation. ICD was inserted in 15/23 (65.2 %); needle aspiration + oxygen succeeded in 6/23 (26.1 %); oxygen alone sufficed in 2/23 (8.7 %). Two-hour full re-expansion was achieved in 17/23 (73.9 %). Procedure-related subcutaneous emphysema occurred in 7/23 (30.4 %); no deaths were recorded. Structural lung disease (COPD/ILD) independently predicted ICD requirement ($p = 0.04$).

Conclusions: TTNB and thoracentesis dominate IPX aetiology in this setting. Small-bore ICD secures rapid lung re-expansion with low morbidity; pre-procedural risk stratification—particularly in COPD/ILD—could further curtail chest-tube utilisation.

Keywords: iatrogenic pneumothorax; transthoracic biopsy; thoracentesis; intercostal drainage; complications.

INTRODUCTION

Iatrogenic pneumothorax (IPX) occurs when diagnostic or therapeutic interventions disrupt pleural integrity, introducing air into the pleural space (1). Incidence varies widely by procedure: ≤ 1 % after diagnostic thoracentesis, 5–25 % following transthoracic needle biopsy (TTNB) and up to 30 % after trans-bronchial lung biopsy in emphysematous lungs (2). Although most IPX remain small and resolve without invasive treatment, up to one-third require intercostal drainage (ICD), prolonging hospital stay and healthcare cost (3).

Risk is modulated by lesion depth, needle diameter, operator experience and baseline parenchymal fragility, especially emphysema and fibrotic interstitial lung disease (ILD) (2).

Preventive strategies such as real-time ultrasound guidance, rapid patient repositioning, blood-patch sealing or saline-instillation have shown promise but remain inconsistently adopted in resource-constrained settings (4). Guidelines from the American College of Chest Physicians recommend immediate post-procedure imaging and reserve chest-tube placement for large or symptomatic IPX or those with ongoing air-leak (5). However, these recommendations derive largely from high-income cohorts with routine CT capability and portable Heimlich valves—conditions not universally available.

Local data are essential to benchmark complication rates, refine consent discussions and tailor preventive measures. We therefore undertook a prospective sub-analysis of 23

consecutive IPX events captured during a 12-month pleural disease study at a North-Indian tertiary hospital. Our aims were to (i) delineate procedure-specific triggers, (ii) describe immediate radiographic outcome after BTS-adapted management, and (iii) explore clinical factors associated with chest-tube requirement. Findings may inform pragmatic risk-mitigation protocols for similar resource-limited environments.

MATERIALS AND METHODS

Study Design and Population

This prospective observational sub-study was nested within a broader pneumothorax cohort at Indira Gandhi Medical College & Hospital, Shimla. All adult patients (≥ 18 y) who developed radiographically confirmed IPX within 24 h of an invasive thoracic procedure were included. Spontaneous, post-traumatic and post-operative cases were excluded.

Data Collection

Pre-designed case-report forms captured demographic data, indication for procedure, imaging guidance, needle calibre, underlying lung disease (COPD, ILD, normal), size of pneumothorax (Light index) and symptoms. Management modality (ICD, needle aspiration + oxygen, oxygen alone), two-hour erect chest X-ray outcome (full / partial / no re-expansion) and early complications were prospectively

recorded. All biopsies used 18- or 20-G cutting needles; thoracenteses employed 18-G trocar cannulae.

Outcome Definitions

- **Primary outcome:** two-hour full lung re-expansion on chest radiograph.
- **Chest-tube requirement:** insertion of small-bore (14 F) ICD during index admission.

Statistical analysis

Categorical variables are n (%) with exact 95 % CI; continuous variables are median (IQR). Fisher's exact test assessed associations with ICD requirement. Analyses used SPSS v26; $p < 0.05$ deemed significant.

RESULTS

Baseline characteristics and procedural triggers

Twenty-three IPX events (mean age 58 ± 12 y; 74 % male) were analysed. Table 1 summarises procedure types. Percutaneous interventions precipitated 18/23 (78.3 %) IPX—TTNB for suspected malignancy was most frequent (10/23, 43.5 %), followed by diagnostic thoracentesis (8/23, 34.8 %). Bronchoscopic lung biopsy (including two cryo-biopsies) accounted for 4/23 (17.4 %); one case followed invasive positive-pressure ventilation (IPPV) during surgery (4.3 %).

Table 1. Procedure-specific triggers of iatrogenic pneumothorax (N = 23)

Trigger	n	% (95 % CI)
CT-guided TTNB	10	43.5 (23–66)
Diagnostic thoracentesis	8	34.8 (17–57)
Trans-bronchial (forceps \pm cryo) biopsy	4	17.4 (5–39)
Invasive positive-pressure ventilation	1	4.3 (0–22)

Management Modalities and Immediate Outcome

Management strategy and radiographic response are detailed in Table 2. ICD was placed in 15/23 (65.2 %); needle aspiration + oxygen succeeded in 6/23 (26.1 %); oxygen

alone sufficed in 2/23 (8.7 %). Overall, two-hour full re-expansion reached 73.9 %. Patients with COPD/ILD were more likely to require ICD (12/14 vs 3/9 with normal parenchyma; $p = 0.04$).

Table 2. Initial management and two-hour radiographic outcome

Modality	n (%)	Full	Partial	None
ICD	15 (65.2)	10	4	1
Needle aspiration + oxygen	6 (26.1)	5	1	0
Oxygen alone	2 (8.7)	2	0	0
Total	23	17 (73.9 %)	5 (21.7 %)	1 (4.3 %)

Early Complications

Procedure-related subcutaneous emphysema developed in 7/23 (30.4 %); all resolved within

48 h. No tension IPX, re-expansion pulmonary oedema or deaths occurred within 30 days.

Discussion

In this resource-limited tertiary centre, 78 % of iatrogenic pneumothoraces followed percutaneous procedures—principally CT-guided TTNB and diagnostic thoracentesis—mirroring global registry data where TTNB contributes up to 50 % of IPX (2). The chest-tube insertion rate (65 %) exceeds the 20–40 % range reported from high-income hospitals (3), likely reflecting deeper lesions, larger biopsy needles and prevalent COPD/ILD, which independently predicted ICD need in our cohort. Ultrasound guidance for thoracentesis and post-biopsy preventive manoeuvres such as normal-saline track sealing can halve clinically significant IPX (4); incorporating these inexpensive techniques may reduce drain burden.

Early radiographic success with small-bore ICD (67 % full expansion) confirms prior studies favouring pigtail catheters for procedural pneumothorax (5). Needle aspiration achieved definitive expansion in 83 % of selected cases, supporting current ACCP guidance to attempt conservative measures when feasible (5). Subcutaneous emphysema was the sole complication (30 %), aligning with meta-analytic estimates (6) and causing no morbidity. Limitations include single-centre scope, small sample size and absence of long-term follow-up; nonetheless, prospective capture and uniform imaging strengthen internal validity. Future multicentre work should evaluate saline-track sealing and blood-patch approaches in COPD/ILD to further mitigate IPX.

CONCLUSION

Transthoracic needle biopsy and thoracentesis are the predominant triggers of iatrogenic pneumothorax in this low-resource setting. Small-bore intercostal drainage provides rapid re-expansion, but judicious patient selection, ultrasound guidance and simple post-biopsy sealing techniques—especially in COPD/ILD—could meaningfully reduce chest-tube utilisation and hospital stay.

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