

Targeted Thoracoscopic Autologous Blood Patch for Persistent Air Leak in Secondary Spontaneous Pneumothorax: A Case Report

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ABSTRACT

Persistent air leak (PAL) is a challenging complication of secondary spontaneous pneumothorax (SSP), particularly in patients with advanced structural lung disease who are poor surgical candidates. We report a case of successful thoracoscopically guided autologous blood patching for PAL in an elderly patient with SSP. A 78-year-old man with smoking-related chronic lung disease presented with a left-sided SSP and a continuous, high-grade air leak (Cerfolio grade IV) that persisted despite prolonged chest drainage. Surgical repair was considered high risk and was declined by the patient. Flexible bronchoscopy with sequential balloon occlusion localized the dominant air leak to the basal segments of the left lower lobe. Medical thoracoscopy was subsequently performed and demonstrated a focal visceral pleural defect corresponding to the suspected leak site. Fifty milliliters of freshly drawn autologous blood was applied directly over the defect under thoracoscopic visualization. The air leak decreased substantially within 24 hours, from Cerfolio grade IV to grade I, with complete radiographic lung re-expansion. The chest tube was removed after 48 hours, and the patient was discharged in stable condition. At 1-month follow-up, he remained asymptomatic without clinical or radiographic evidence of recurrence. Thoracoscopically guided direct autologous blood patching may represent a simple, targeted, and pragmatic salvage option for PAL in selected patients with SSP, particularly when surgery is contraindicated or declined and bronchoscopic occlusion alone is insufficient. Further experience is required to establish its safety, reproducibility, and role among available PAL management strategies.

Keywords: Autologous blood patch, Case report, Medical thoracoscopy, Persistent air leak, Pleural intervention, Secondary spontaneous pneumothorax.

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INTRODUCTION

Persistent air leak (PAL) is a frequent and clinically significant complication of secondary spontaneous pneumothorax (SSP), particularly in patients with underlying chronic lung disease.^{1,2} Persistent air leak is commonly considered as an air leak that persists for several days; many sources use a threshold of >5–7 days to label an air leak as “persistent/prolonged,” while some guidance—particularly for SSP—recommends early thoracic surgical discussion if an air leak persists or the lung fails to re-expand, including discussion at approximately 48 hours in SSP.^{1,2} Prolonged air leak is associated with extended chest tube duration, increased morbidity, higher healthcare utilization, and delayed recovery.^{1,3}

Surgical repair remains the definitive treatment for refractory PAL and typically involves resection of blebs or bullae with pleural symphysis.^{1,3} However, advanced age, comorbid illness, frailty, and patient refusal frequently preclude operative management.³ In such settings, interventional pulmonology-based alternatives assume greater importance. Bronchoscopic strategies, including balloon occlusion testing and endobronchial valve/spigot or glue placement, have expanded the therapeutic armamentarium but are limited by collateral ventilation, incomplete fissures, distal air leaks, and restricted availability of specialized devices.^{4,5}

Pleural-based approaches, including chemical pleurodesis and autologous blood patch pleurodesis, are commonly employed when surgery is not feasible.^{3,5} Autologous blood pleurodesis has demonstrated encouraging success rates in observational studies and systematic reviews, with air leak cessation reported in most

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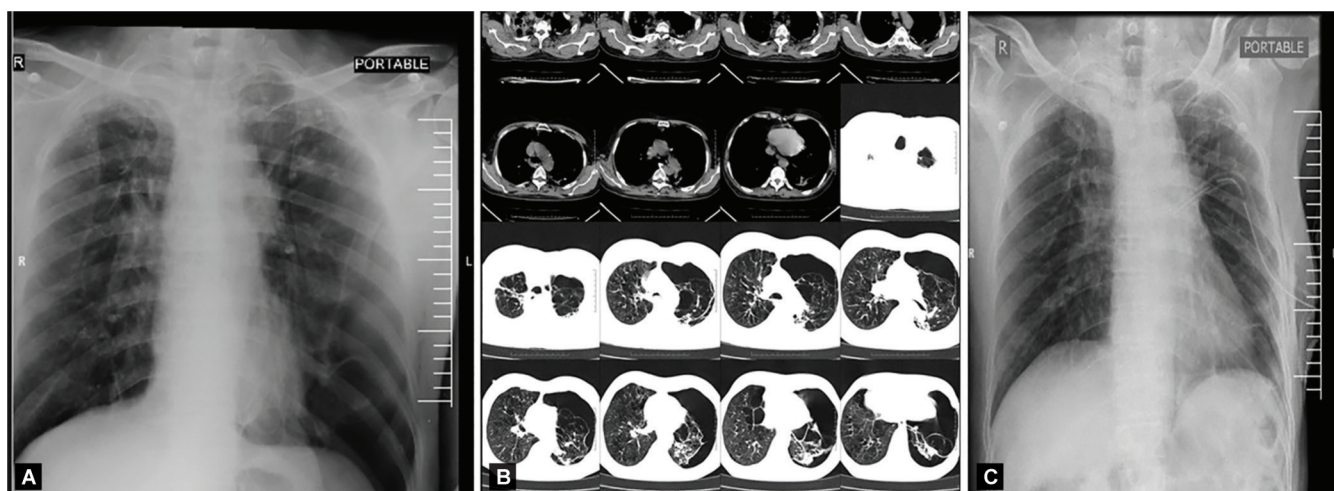
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patients within 24–72 hours.^{5,6} Nevertheless, this technique is usually performed without direct visualization of the pleural defect, and outcomes may be influenced by variability in blood volume, distribution, and pleural apposition.^{5,6}

Medical thoracoscopy provides direct access to the pleural space, enabling visual identification of focal pleural defects and targeted therapeutic intervention.⁷ Despite its established role in



Figs 1A to C: (A) Chest radiograph at presentation demonstrating a left-sided SSP with partial lung collapse; (B) Computed tomography of the thorax revealing bilateral bullous lung disease with emphysematous changes, consistent with SSP and predisposing to persistent air leak; (C) Chest radiograph following intercostal chest drain insertion showing partial lung re-expansion with residual pneumothorax, correlating with a continuous high-grade air leak (Cerfolio grade IV)

pleural disease, thoracoscopic autologous blood patching for PAL has been infrequently described, and its position within current management algorithms remains undefined.⁷

We report the feasibility of a targeted, thoracoscopically guided autologous blood patch applied directly to a visually identified visceral pleural defect in a patient with SSP and continuous air leak who was a poor surgical candidate.

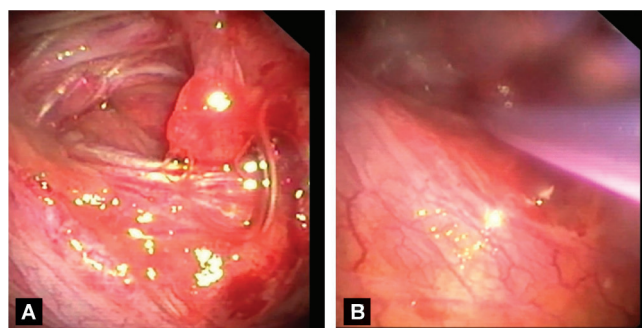
CASE PRESENTATION

A 78-year-old male farmer with a smoking history exceeding 40 pack-years presented with acute-onset left-sided chest pain, progressive dyspnea, and cough following physical exertion. Initial evaluation confirmed a left-sided SSP, for which an intercostal chest drain was inserted (Fig. 1A). Computed tomography of the thorax revealed bilateral bullous lung disease, supporting the diagnosis of SSP (Fig. 1B).

Following tube thoracostomy, the patient experienced symptomatic improvement; however, there was continuous air leak through the chest drain. Air leak severity was assessed using the bedside underwater seal system and categorized using the Cerfolio leak pattern classification as grade IV (continuous bubbling during both inspiration and expiration). Serial chest radiographs demonstrated incomplete resolution of the pneumothorax despite appropriate drain position and function. After 1 week of continuous drainage, the air leak persisted (Fig. 1C).

Thoracic surgical consultation was obtained. In view of the patient's advanced age, significant comorbidities, and high anticipated operative risk, surgical intervention was considered unfavorable. After detailed discussion, the patient and family declined operative management, prompting consideration of alternative interventional strategies.

Flexible bronchoscopy was performed to localize the source of the air leak. Sequential balloon occlusion was performed using a balloon catheter passed through the working channel of the flexible bronchoscope. Occlusion was maintained for several respiratory cycles while observing changes in bubbling in the underwater seal chamber; the most pronounced reduction occurred when

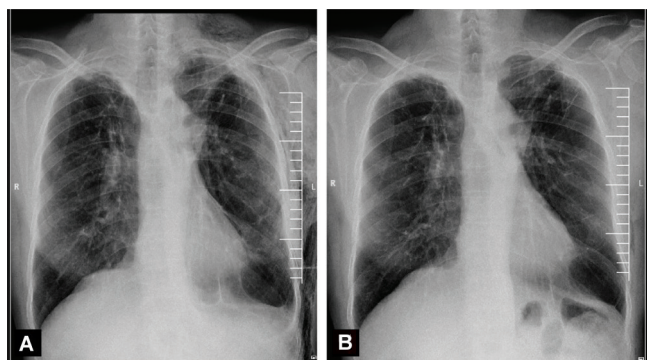


Figs 2A and B: (A) Thoracoscopic view of the visceral pleura demonstrating a focal pleural defect with active air leakage identified during medical thoracoscopy; (B) Thoracoscopic instillation of autologous blood directly over the identified pleural defect using a feeding catheter, illustrating targeted blood patch application

occluding the left lower lobe lateral basal segment (LB9), suggesting this as the dominant contributor. Balloon occlusion of the LB9 segment led to a reduction, but not cessation, of the air leak. Localization was performed without using fluoroscopy and airway or pleural contrast instillation. Objective assessment of collateral ventilation and fissural completeness using the CHARTIS system could not be performed due to unavailability.

Given the persistence of a high-grade air leak, absence of surgical options, and limitations of bronchoscopic therapy, a medical thoracoscopic approach was planned to allow direct pleural visualization and targeted intervention.

Medical thoracoscopy was performed with the patient in a right lateral decubitus position, using a single-port approach. Port placement was guided by identification of a safe access site and standard positioning principles under real-time ultrasound guidance. Single-port medical thoracoscopy was performed, which revealed a focal pleural defect with active air leakage on the visceral pleura (Fig. 2). Under thoracoscopic guidance, an autologous blood patch was performed by instilling approximately 2 aliquots of 25 mL each (total 50 mL) of freshly drawn autologous



Figs 3A and B: (A) Postprocedure chest radiograph showing complete lung re-expansion with no residual pneumothorax following thoracoscopic autologous blood patching; (B) Follow-up chest radiograph after 4 weeks

blood directly onto the identified pleural defect using a 6 Fr infant feeding catheter (length 50 cm), to maximize local coverage while minimizing dispersion. A small blood volume was considered, as it was applied directly over the visualized defect.

Adjunctive ice-cold saline, 500 mg tranexamic acid, and 1 mL botropase were applied locally (as routinely used for intraluminal bleeds during bronchoscopic procedures), followed by tamponade with scope over the defect for 3–4 minutes to promote local clot stabilization. A new 24 Fr intercostal drain was positioned to ensure optimal pleural apposition.

Within 24 hours of the procedure, there was a marked reduction in air leak from Cerfolio grade IV to grade I. Follow-up chest radiography demonstrated complete lung re-expansion without residual pneumothorax (Fig. 3A). Mild subcutaneous emphysema was noted but remained clinically insignificant and required no intervention. The chest drain was removed after 48 hours.

The patient remained clinically stable and was discharged shortly thereafter. At 1-month follow-up, he was asymptomatic, with no radiographic evidence of recurrent pneumothorax (Fig. 3B).

DISCUSSION

Persistent air leak in SSP represents a complex therapeutic challenge, particularly when definitive surgical management is not feasible.^{1,2} In elderly patients with underlying structural lung disease, prolonged air leak is common and frequently refractory to conservative chest tube drainage alone. Current management algorithms emphasize early identification of patients unlikely to respond to conservative measures, as delayed intervention is associated with prolonged hospitalization and increased morbidity.^{1–3}

Surgical repair remains the gold standard for refractory PAL, offering high success rates through resection of blebs or bullae combined with pleural symphysis.^{1,3} However, real-world practice often necessitates alternative approaches, as advanced age, comorbidities, frailty, or patient preference may preclude surgery.³ In such scenarios, interventional pulmonology-based strategies assume a vital role. Bronchoscopic interventions may be considered when surgery is not feasible, particularly after localization of the dominant leaking segment.^{4,5} Options reported include one-way valves, silicone spigots, and occlusive strategies using sealants, coils,

occluder devices, or covered airway stents. Indian experience has described bronchoscopic device closure using endobronchial coils with sealant, ductal occluder devices, and covered self-expandable metallic stents and customized silicone stents, with successful closure reported in most cases in that series.⁸ They are particularly useful when a proximal airway source can be reliably localized. Nevertheless, their effectiveness may be limited by collateral ventilation, incomplete fissures, distal pleural defects, and restricted access to specialized devices, all of which may compromise durable air leak control.^{4,5}

Autologous blood patch pleurodesis has emerged as a pragmatic, low-cost option for PAL, most often administered through an indwelling chest drain. Several observational studies and a systematic review have reported high rates of air leak cessation, often within 24–72 hours, with an acceptable safety profile.⁶ However, the technique is typically performed without direct visualization of the pleural defect, and reported methodologies vary with respect to blood volume, clamping protocols, patient positioning, and adjunctive measures. These factors may influence both efficacy and reproducibility, particularly in patients with focal visceral pleural defects.^{5,6}

Medical thoracoscopy provides a unique advantage by allowing direct visualization of the pleural cavity and visceral pleural surface.⁷ In the present case, thoracoscopic inspection enabled precise identification of a focal pleural defect responsible for the persistent, high-grade air leak. Targeted delivery of autologous blood directly over the defect, rather than blind instillation through a chest tube, may facilitate immediate sealing of the leak, optimize clot localization, and enhance pleural apposition. The rapid reduction in air leak severity observed in this patient supports the potential utility of this targeted approach.

Reports describing thoracoscopic autologous blood patching remain limited, confined to small case series and isolated reports.^{7,9} A recent case series and systematic review examining thoracoscopic blood patch instillation suggested favorable outcomes in selected patients, although heterogeneity in technique and patient selection precludes definitive conclusions.⁷ Importantly, thoracoscopic autologous blood patch (ABP) should not be viewed as a replacement for surgery or established bronchoscopic therapies, but rather as a salvage strategy in carefully selected patients where other options are unavailable, contraindicated, or declined.^{3–5,7}

This case illustrates several practical considerations relevant to interventional practice. First, thoracoscopic ABP may be particularly suited for patients with peripheral, focal pleural defects identified under direct visualization. Second, the procedure can be cost-effective and performed using readily available equipment without the need for specialized bronchoscopic devices. Third, rapid air leak control may facilitate early chest tube removal and discharge, reducing hospital length of stay in a vulnerable patient population compared to large volume blood instillation through chest tube.^{6,7}

Limitations

The limitations of this report are inherent to its single-patient design. Objective digital air leak quantification and assessment of collateral ventilation were not available, and the index case reports only a 1-month follow-up. Additionally, standardized protocols for thoracoscopic blood volume, adjunctive agents, and

post-procedure management remain undefined. Given the use of supportive local measures and the single-patient design, the independent contribution of each step cannot be determined. Even though our patient did not have any adverse events – fever, chest pain, hemoptysis, and respiratory failure – these are ones that need to be considered. Larger prospective studies are required to better delineate patient selection criteria, procedural standardization, and comparative effectiveness relative to other interventional modalities for the management of PAL.

CONCLUSION

Thoracoscopically guided autologous blood patching may be considered a useful salvage option in carefully selected non-surgical candidates for PAL in SSP.^{5,7} Direct pleural visualization allows precise localization and targeted treatment of focal pleural defects, potentially enabling rapid air leak control and early chest tube removal (Fig. 3B). While this approach should not replace established surgical or bronchoscopic therapies, it may be feasible in only selected patients within a tertiary interventional pulmonology setting.^{3-5,7} Further prospective and comparative studies are needed to define standardized techniques and optimal patient selection.

Clinical Significance

Targeted thoracoscopic autologous blood patching may be a feasible salvage option for persistent air leak in selected patients with secondary spontaneous pneumothorax who are unsuitable for or decline surgery. Direct visualization of the pleural defect allows precise application of autologous blood and may facilitate rapid air leak control and earlier chest tube removal.

DECLARATIONS

Ethical Approval

Ethics committee approval was not required for this single-patient case report in accordance with institutional policy. Written informed consent was obtained from the patient for publication of clinical details and accompanying images.

Data Availability Declaration

All relevant clinical data supporting the findings of this case report are included within the article. Additional details are available from the corresponding author upon reasonable request, subject to patient confidentiality.

Artificial Intelligence (AI) Disclosure

Generative AI tools were used for language editing and formatting assistance. All clinical information, scientific content, interpretation, references, and the final manuscript were reviewed and verified by the authors.

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AUTHORS' CONTRIBUTION

Avinash Anil Nair contributed to the conception of the report, clinical management, and manuscript preparation.

Rennis Davis Kizhakkepeedika clinically managed and performed the procedure, supervised the work and critically revised the manuscript.

Ajaykumar Kurumpelil Karunakaran and Akhila Joboy contributed to clinical management and critical revision of the manuscript.

All authors reviewed and approved the final manuscript.

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