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Early Autologous Blood Pleurodesis, Could It Effectively Control Postoperative Air Leak?

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ABSTRACT

Background: Prolonged air leak (PAL) after pleuropulmonary excisional surgeries is a nightmare for thoracic surgeons, as it worsens the postoperative outcome in terms of both morbidity and mortality.

Objective: This study aimed to investigate the value of the early autologous blood pleurodesis (EABP) in prophylaxis against PAL following pleural decortication and lung resection surgeries.

Patients and methods: We retrospectively reviewed the medical records of 482 patients who underwent pleuropulmonary excisional surgeries in 2 different centers: Cairo, and Beni Suef University Hospitals from January 2020 to February 2025. Patients were divided into 2 groups: group A (the conventional group including 260 patients with no blood pleurodesis) and group B (EABP group including 222 patients where our blood pleurodesis technique was used). Data regarding postoperative PAL, longer need for the intercostal tube (ICT), broncho-pleural fistula (BPF), reoperation, prolonged intensive care unit (ICU), hospital stays, and early mortality were gathered and analyzed.

Results: The EABP had significantly lowered the incidence of PAL (4 vs. 15 patients) with a shorter need for the intercostal tube (7.39 $\pm$ 2.86 vs. 10.5 $\pm$ 2.87), mechanical ventilation time (1.12 ± 0.69 vs. 2.30 ± 089), shorter ICU stay (10.46 $\pm$ 2.88 vs. 13.92 $\pm$ 3.17), and a shorter hospital stay (12.68 $\pm$ 3.26 vs. 13.32 + 3.44). Although not statistically significant, group B showed less incidence of postoperative infected BPF (3 vs. 7) and less need for reoperation (2 vs. 5). There were no early deaths among both groups.

Conclusion: The use of intraoperative early blood patch pleurodesis in patients undergoing pleuropulmonary excisional surgeries significantly guards against PAL and its hustle sequelae.

Keywords: PAL, EABP, BPF, Intercostal tube.

INTRODUCTION

Despite its high occurrence following lung surgeries, postoperative air leak (PAL) remains a difficult condition to handle, as no widely preferred therapy exists. It affects 9-16% of patients and is considered the second most prevalent post-resection problem, behind atrial arrhythmias. As a result, surgeons are constantly looking for novel management strategies to reduce its impact and enhance patient outcomes [(1-2)].

Too many techniques have been suggested to overcome such problem including conservative observation, connecting the draining system to a low suction device [(3)], one-way valve [(4)], slurry pleurodesis with different agents [(5)], induced pneumoperitoneum [(6)], endobronchial sealing [(7)] and bronchial stump covering techniques [(8)] or even reopening for air leak control [(9)].

Talc pleurodesis is the most popular and effective non-surgical approach for PAL management. However, it requires close opposition of both pleurae, which is not feasible in cases of compression lung collapse [(10-11)]. Blood patch pleurodesis, on the other hand, has the advantage of forming a clot that then fills the hole, attaching the surface of the collapsed lung to the interior of the chest wall and closing the source of the air leak [(12)].

Thus, blood pleurodesis is strongly recommended for patients with chronic air leaks, those who are unfit for surgical or bronchoscopic procedures, when talc pleurodesis fails, or where there are significant regions of pleural non-apposition [(13-14)].

In this multi-center study, we were investigating the effect of the early blood pleurodesis at the end of the operation using the patient's own blood over a fashioned piece of the reabsorbable oxidized cellulose/fabric meshwork (surgical—Ethicon US®**).**

PATIENTS AND METHODS

Study design: 482 patients who had pleuropulmonary excisional procedures performed in Cairo, and Beni Suef University hospitals between January 2020 and February 2025 were included in this study. Based on whether we used the EABP or not, the patients were split into two groups: Group A (control group; 260 patients) and group B (SCS group; 222 patients). After surgery, we collected and evaluated data on broncho-pleural fistula (BPF), postoperative PAL, prolonged intensive care unit (ICU) stays, hospital stays, early mortality, and longer intercostal tube (ICT) needs.

Definitions: Prolonged air leak (PAL) is defined by the Society of Thoracic Surgeons as an air leak lasting more than 5 days [(15)]. Prolonged MV (> 24 hours), prolonged ICU stay (> 3 days), prolonged hospital stays (> 14 days), and early postoperative mortality (within 30 days postoperatively) were defined regarding guidelines from the Society of Thoracic Surgeons (STS) [(16)].

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Exclusion criteria: Patients with uncontrolled diabetes, previous radiotherapy, previous ipsilateral thoracotomy, urgent or emergency lung resection (such as massive hemoptysis in tuberculosis patients), systemic steroid-dependent COPD (more than one month prior to admission), and upper respiratory tract infections (such as chronic sinusitis) were not included in our analysis.

Study endpoints:

- **The study's primary endpoints** were the incidence of postoperative prolonged air leak (PAL), Broncho pleural fistula and the need for re-operation to control the air leak.
- **Secondary endpoints** were Prolonged MV time, Prolonged ICU stay, Prolonged Hospital stay and Chest drains time span.

Surgical technique: All of our patients were operated in lateral decubitus, under combined general and regional anesthesia using the conventional thoracotomy incision. Regardless the procedure done, we finalized the procedure with strict hemostasis and aerostasis. Areas with major air-leak as a leaking major air vessel is usually controlled using simple interrupted Ethibond 2/0 stitches perpendicular to the divided bronchus without halting its perfusion.

Leaky raw areas of the lung where tissues usually fail to hold any controlling stitches were covered using a fashioned piece of the reabsorbable oxidized cellulose/fabric meshwork (Surgicel® Ethicon US®). Then 50 to 100 cc of the patient's own blood is injected over the fashioned Surgicel piece that acts as a scaffold for the clotting blood sealing the leaky area.

Before rib approximation, we usually insert 2 chest drains, the drain with smaller caliber is positioned in anterior and apical position for air leak while the other one is positioned in basal and posterior position for any fluid collection. Then wound is closed in layers.

Follow up after hospital discharge: All patients were followed in our patient clinics on a monthly basis for the first three months after discharge, then tri-monthly for the following year. The follow-up procedure comprised wound care, a chest examination, a plain chest X-ray and follow-up C.T. chest for certain pathologies.

Sampling method: With an alpha error of 5%, a 95% confidence level, and 80% power sample, the Medcalc 19 program was used to determine the appropriate sample size population (323 patients) (Equations are provided by **Machin *et al.* [17].**

Ethical approval: The Ethics Committee of Beni Suef Faculty of Medicine authorized this study [No.: FMBSUREC/04032025/Mahmoud]. After receiving all of the information, all participants signed their permissions. The Helsinki Declaration was followed throughout the course of the study.

Statistical analysis

SPSS version 22.0 was used to handle data and conduct statistical analyses. Continuous data were presented as mean ± SD or median with interquartile range, while categorical data were given as percentages. All stated P values are two-sided, with P values ≤ 0.05 indicating statistical significance. All statistical studies were conducted with the assistance of a trained statistician.

RESULTS

A total of 482 patients (170 females) were separated into two groups: Group A (the control group of 260 patients where we did not use EABP) and Group B (which included 222 patients who received the EABP). Our sample's mean age was 56.68 ± 8.57 years. There was no significant difference between the groups in terms of demographic and clinical baseline characteristics ($p > 0.05$) (Table 1).

Table (1): Demographic and preoperative parameters

Preoperative parameter	Group A (260)	Group B (222)	P Value
Age (years)	54.64 ± 7.83	53.84 ± 8.67	P = 0.2878
Female sex (number %)	84 (32.31%)	86 (38.74%)	P = 0.1413
Body Mass index (BMI; Kg/m^2)	26.72 ± 8.5	27.63 ± 6.4	P = 0.1910
Smokers (number %)	124 (47.69%)	106 (47.75%)	P = 0.9895
FEV-1 (%)	63.60 ± 7.05	62.53 ± 8.0	P = 0.1192

FEV-1; Forced Expiratory Volume in 1 second

There were no statistically significant differences between both groups regarding the nature of the procedures performed and the total operative time (**Table 2**).

Table (2): Postoperative parameters

Intra-operative parameter	Group A (260)	Group B (222)	P Value
Procedure done:			
Pleural procedure: (total: 102)	53 (20.38%)	49 (22.07%)	P = 0.6510
Decortication: 82	42 (16.15%)	40 (18.01%)	P = 0.5884
Pleurectomy for MPM: 20	11 (4.23%)	9 (4.05%)	P = 0.9214
Lung resections (total: 380)	207 (79.62%)	173 (77.93%)	P =0.6510
Resection type:			
Wedge resection :35	17 (6.54%)	18 (8.11%)	P = 0.4831
Segmentectomy: 47	22 (8.46%)	25 (11.26%)	P = 0.3021
Lobectomy: 298	168 (64.62%)	130 (58.56%)	P = 0.1727
Lobe resected (total: 298)			
Right Upper Lobectomy: 124	70 (26.92%)	54 (24.32%)	P = 0.5155
Left Upper Lobectomy: 74	44 (16.92%)	30 (13.51%)	P = 0.3011
Right Lower Lobectomy: 52	27 (10.38%)	25 (11.26%)	P = 0.7565
Left Lower Lobectomy: 30	16 (6.15%)	14 (6.31%)	P = 0.9423
Middle lobectomy 10	6 (2.31%)	4 (1.80%)	P = 0.6957
Bi-lobectomy: 8	5 (1.92%)	3 (1.35%)	P = 0.6255
Cause for resection (total: 482)			
Bronchogenic carcinoma: 197	99 (38.07%)	98 (44.14%)	P = 0.1771
Lung abscess: 160	86 (33.08%)	74 (33.33%)	P = 0.9537
Others: 125	62 (23.85%)	63 (28.38%)	P = 0.2585
Operative time (hours)	2.9 ± 0.85	3.02 ± 0.9	P = 0.1334

MPM; Malignant Pleural Mesothelioma.

Primary endpoints: In terms of our main outcomes, the EABP group had considerably lower incidence of postoperative prolonged air leak (P value = 0.0257). The same group showed lower incidence of BPF and need for reoperation. However, the difference was not clinically significant.

Secondary endpoints: A significantly higher proportion of patients in the control group needed longer stays in the critical care unit, mechanical ventilatory support, and underwater seal chest drainage until they met the internationally mandated removal criteria, while taking into account the secondary outcomes. Those patients also needed a longer hospital stay for proper chest rehabilitation and reconditioning (P value <0.05) **(Table 3)**.

Table (3): Postoperative parameters

Post-operative parameter	Group A (260)	Group B (222)	P Value
Primary Endpoints:			
PAL	15 (5.77%)	4 (1.80%)	P = 0.0257
BPF	7 (2.69%)	3 (1.35%)	P = 0.3039
Need for reoperation	5 (1.92%)	2 (0.9%)	P = 0.3510
Secondary Endpoints:			
MV time (prolonged if > 24 hours)	1.12 ± 0.69	2.30 ± 0.89	P < 0.0001
ICU stay (prolonged if > 3 days)	13.92 ± 3.17	10.46 ± 2.88	P < 0.0001
Chest drains time (days)	7.39 ± 2.86	10.5 ± 2.87	P < 0.0001
Hospital stay (prolonged if > 14 days)	13.32 ± 3.44	12.68 ± 3.26	P < 0.0001

PAL; Prolonged Air Leak, BPF; Broncho-Pleural Fistula, MV; Mechanical Ventilation, ICU; Intensive Care Unit.

DISCUSSION

Autologous blood patch pleurodesis was first innovated in 1987 by **Robinson** [18] as a conservative measure for treating prolonged air leak following spontaneous pneumothorax with no need for further surgical intervention in 85% of the cases involved in their report. Then, this method gradually gained a world-wide popularity as a good step preceding the surgical intervention [18].

The effectiveness of ABPP in treating air leaks after spontaneous pneumothorax [19-21], and mild to moderate air leaks after surgery in patients with a large raw region over the lung or low BPF [22-23] has been supported by numerous reports. Data regarding intraoperative blood pleurodesis as a preventative step against postoperative air leaks, however are scarce, particularly in high-risk patients such as those with TB, bronchogenic carcinoma, or those who had prior chemoradiotherapy.

The injected blood over the targeted area acts as a blockade for minor air leaks and initiates an inflammatory reaction within the pleural space with subsequent fibrin deposition that adheres visceral and parietal pleurae, sealing the leaky air vessel or lung surface and preventing further air collection. however, in cases with major air leak or wide raw areas after extensive decortication or large residual space following lung resection, blood pleurodesis may fail even with large amount of the injected blood (250 cc) [24-25].

Thus, we innovated combining covering the targeted area with a fashioned piece of the reabsorbable oxidized cellulose/fabric meshwork (Surgicel® Ethicon US®) to act as a scaffold to hold the clotting injected blood and to accelerate the process of fibrin deposition between the operated lung and the nearby chest wall [26].

In this study, we investigated the safety and efficacy of early autologous blood pleurodesis combined with Surgicel® coverage in the prevention of postoperative air leaks by comparing the outcome of using this technique versus not using it in two groups of patients with similar demographic and preoperative criteria, thereby minimizing bias effects.

In 2009, Ueda *et al.* [27] founded less postoperative air leak on using suture-less pneumostasis using bioabsorbable mesh and glue during major lung resection for malignant causes comparing 2 groups of patients (0% vs 7%, P = .042). In 2013, **Witte *et al.*** [28] proved high efficacy of the Cotton-Derived Oxidized Cellulose in Minimally Invasive Thoracic Surgery including pleural and lung excisional surgeries to minimize postoperative bleeding and air leak.

After reviewing the records of 510 patients who underwent lobectomies by **Campisi *et al.*** [29], they discovered that ABPP significantly reduced the number of days before chest tube removal (8.12 vs 9.30, P = .004), length of hospital stays (10 vs 11 days, P = .045), and need for reoperation (0 vs 4, P = .044). These findings are consistent with our statistical analysis of the identical items, which yielded a P value of < 0.0001.

In their systemic review published in 2024, **Abdalla *et al.*** [23] reported that approximately 73.8% of cases responded to ABPP in 1 to 30 days. This supports the role of ABPP as an effective and safe intervention for managing PAL, particularly after pulmonary resection that also is consistent with our findings. In contrast, in 2023, **Umar *et al.*** [30] found no statistically significant difference between patients obliged to ABPP and those with no pleurodesis regarding time needed for air leak cessation, ICU, and hospital stays.

CONCLUSION

Early autologous blood pleurodesis, which utilizes the patient's own blood applied to a specially designed piece of reabsorbable oxidized cellulose or fabric meshwork, is both safe and effective in reducing hospital stays and facilitating early chest tube removal without causing complications.

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REFERENCES

1. **Dugan K, Laxmanan B, Murgu S *et al.* (2017):** Management of Persistent Air Leaks. Chest, 152 (2): 417-423.
2. **Hoeijmakers F, Hartemink K, Verhagen A *et al.* (2022):** Variation in incidence, prevention and treatment of persistent air leak after lung cancer surgery. European Journal of Cardio-Thoracic Surgery, 61 (1): 110–17.
3. **Mitsui S, Tauchi S, Uchida T *et al.* (2021):** Low suction on digital drainage devices promptly improves post-operative air leaks following lung resection operations: a retrospective study. J Cardiothorac Surg., 16 (1): 105. doi: 10.1186/s13019-021-01485-z.
4. **Gogakos A, Barbetakis N, Lazaridis G *et al.* (2015):** Heimlich valve and pneumothorax. Ann Transl Med., 3 (4): 54. doi: 10.3978/j.issn.2305-5839.2015.03.25.
5. **How C, Tsai T, Kuo S *et al.* (2014):** Chemical pleurodesis for prolonged postoperative air leak in primary spontaneous pneumothorax. J Formos Med Assoc., 113 (5): 284-90.
6. **Pecoraro A, Garbarino G, Peritore V *et al.* (2021):** Early Induction of Bedside Pneumoperitoneum in the Management of Residual Pleural Space and Air Leaks After Pulmonary Resection. World J Surg., 45 (2): 624-630.
7. **Gkegkes I, Mourtarakos S, Gakidis I (2015):** Endobronchial valves in treatment of persistent air leaks: a systematic review of clinical evidence. Med Sci Monit., 21: 432-38.
8. **Lamloum A, Elsharkawy I, Alsisi H *et al.* (2024):** Autologous Reflected Pericardial Flap Coverage of Post-Resection Bronchial Stump; Was it Effective in Preventing Broncho-Pleural Fistula in Children? Egyptian Journal of Hospital Medicine, 95: 1272-1275.
9. **Leivaditis V, Skevis K, Mulita F *et al.* (2024):** Advancements in the Management of Postoperative Air

Leak following Thoracic Surgery: From Traditional Practices to Innovative Therapies. Medicina (Kaunas), 60 (5): 802. doi: 10.3390/medicina60050802.

10. **Hallifax R, Yousuf A, Jones H *et al.* (2017):** Effectiveness of chemical pleurodesis in spontaneous pneumothorax recurrence prevention: a systematic review. Thorax, 72 (12): 1121–31.
11. **Shafiq M, Banka R, Bain P *et al.* (2022):** Autologous blood patch for persistent air leak following secondary spontaneous pneumothorax: a systematic review. J Bronchol Interv Pulmonol., 30 (1): 70-75.
12. **Manley K, Coonar A, Wells F *et al.* (2012):** Blood patch for persistent air leak: a review of the current literature. Curr Opin Pulm Med., 18: 333-38.
13. **Huseynov M (2020):** A first case report of neonatal persistent pneumothorax treated with an autologous blood patch. Türk Pediatri Arşivi., 55: 438–40.
14. **Pruitt L, Kastenberg Z, Fenton S *et al.* (2021):** Early use of autologous blood patch pleurodesis in children is successful in resolving persistent air leaks. J Pediatr Surg., 56: 629–31.
15. **Seder C, Basu S, Ramsay T *et al.* (2019):** A Prolonged Air Leak Score for Lung Cancer Resection: An Analysis of the Society of Thoracic Surgeons General Thoracic Surgery Database. Ann Thorac Surg., 108 (5): 1478-1483.
16. **Rotar E, Beller J, Smolkin M *et al.* (2022):** Prediction of Prolonged Intensive Care Unit Length of Stay Following Cardiac Surgery. Semin Thorac Cardiovasc Surg., 34 (1): 172-179.
17. **Machin D, Campbell M, Tan S *et al.* (2009):** Sample Size Tables for Clinical Studies, Third Edition. Pp: 263. DOI:10.1002/9781444300710.ch3
18. **Robinson C (1987):** Autologous blood for pleurodesis in recurrent and chronic spontaneous pneumothorax. Can J Surg., 30: 428-429.
19. **Shakir S, Choo-Kang B, Ross C *et al.* (2023):** Autologous Blood Patch Pleurodesis for Secondary Spontaneous Pneumothorax: A Narrative Review, a Retrospective Case Series and State of Play in the UK. Pulm Ther., 9 (1): 165-172.
20. **Patail H, Patail H (2023):** Autologous blood-patch pleurodesis for persistent air leak in an AIDS patient with pneumothorax. Proc (Bayl Univ Med Cent), 36 (2): 263-265.
21. **Skaarup S, Laursen C, Hallifax R *et al.* (2024):** National survey on management of spontaneous pneumothorax from emergency department to specialised treatment: room for improvement. Eur Clin Respir J., 11 (1): 2307648.
22. **Karampinis I, Galata C, Arani A *et al.* (2021):** Autologous blood pleurodesis for the treatment of postoperative air leaks. A systematic review and meta-analysis. Thorac Cancer, 12 (20): 2648-2654.
23. **Abdalla B, Kakamad F, Hassan M *et al.* (2024):** Role of autologous blood patch pleurodesis for management of prolonged pulmonary air leak: A systematic review. Lung India, 41 (6): 447-454.
24. **Akçıl A, Hatipoğlu M, Cansever L *et al.* (2019):** Blood pleurodesis for air leak after pulmonary resection. Current Thoracic Surgery, 4 (2): 63-69.
25. **Apilioğulları B, Dumanlı A, Ceran S (2020):** Application of autologous blood patch in patients with non-expanded lungs and persistent air leak. Turkish Journal of Thoracic and Cardiovascular Surgery, 28 (3): 521-26.
26. **Gondé H, Le Gac C, Gillibert A *et al.* (2019):** Feedback on the use of three surgical sealants for preventing prolonged air leak after robot-assisted anatomical lung resection. J Thorac Dis., 11 (7): 2705-2714.
27. **Ueda K, Tanaka T, Li T *et al.* (2010):** Sutureless pneumostasis using bioabsorbable mesh and glue during major lung resection for cancer: who are the best candidates? J Thorac Cardiovasc Surg., 139 (3): 600-605.
28. **Witte B, Kroeber S, Hillebrand H *et al.* (2013):** Cotton-Derived Oxidized Cellulose in Minimally Invasive Thoracic Surgery: A Clinicopathological Study. Innovations, 8(4):296-301.
29. **Campisi A, Dell'Amore A, Gabryel P *et al.* (2022):** Autologous Blood Patch Pleurodesis: A Large Retrospective Multicenter Cohort Study. Ann Thorac Surg., 114 (1): 273-279.
30. **Umar Z, Nassar M, Ashfaq S *et al.* (2023):** The Efficacy and Safety of Autologous Blood Patch for Persistent Air Leaks: A Systematic Review and Meta-Analysis. Cureus, 15 (3): e36466. doi: 10.7759/cureus.36466.