

# Use of autologous blood patch for prolonged air leak in spontaneous pneumothoraces in the adolescent population

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## ABSTRACT

Instillation of an autologous blood patch for prolonged air leak (PAL) in chest tube system has been studied and determined to be a safe and effective treatment plan for adults. The current recommended treatment guidelines for a PAL in adolescent secondary to a spontaneous pneumothorax are surgical intervention. This paper serves as documentation of two case reports with successful treatment of PALs with autologous blood patch in two adolescent patients.

**KEY WORDS:** Autologous blood patch, blood patch, prolonged air leak, pneumothorax

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## INTRODUCTION

A pneumothorax occurs when alveolar air somehow moves through the parietal pleura and into the pleural space, resulting in equalization of air pressure that collapses a portion of the lung. This can occur in a myriad of ways, including spontaneously via rupture of a pulmonary bleb, or secondarily due to increased alveolar pressure from underlying pulmonary disease, among others.<sup>[1]</sup> Occasionally, these pneumothoraces may persist or recur despite typical management. Should the leak persist for over 5–7 days, it is termed a prolonged air leak (PAL).<sup>[2]</sup>

While most patients see the resolution of their PAL with conservative management,<sup>[2]</sup> other patients require more aggressive intervention. Current guidelines in the treatment of PAL are primarily surgical. The American College of Chest Physicians published guidelines in 2001 that recommended patients be observed with a chest tube for 4 days, after which surgery should be consulted for further management.<sup>[3]</sup> Similarly, the British Thoracic Society published guidelines in 2003 that recommend the

managing physician seek early thoracic surgical opinion within 3–5 days for patients with PAL.<sup>[4]</sup>

For patients who are not surgical candidates or who have had a failure of surgical management, pleurodesis with a variety of substances is another option, including talc, tetracycline, chemotherapeutic agents, and autologous blood.<sup>[1,2,5]</sup> Here, we present two adolescent patients who benefited from autologous blood patch pleurodesis.

## CASE REPORTS

### Case 1

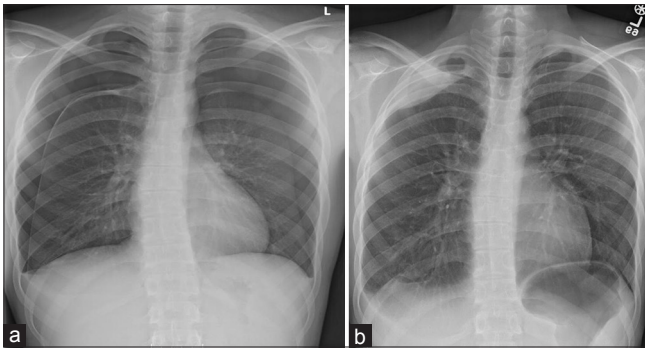
A 16-year-old male with no medical history presented to the emergency department with a right-sided spontaneous pneumothorax [Figure 1a]. A 24 French chest tube was placed by pediatric surgery. Patient chest tube system revealed a significant air leak for 2 days. The patient underwent video-assisted thoracoscopic surgery (VATS). During the procedure, a resection of right upper lobe bleb and right parietal pleurectomy were performed. Patient

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**Figure 1:** (a) Right-sided pneumothorax in the first patient. (b) Postprocedure chest X-ray revealing resolution

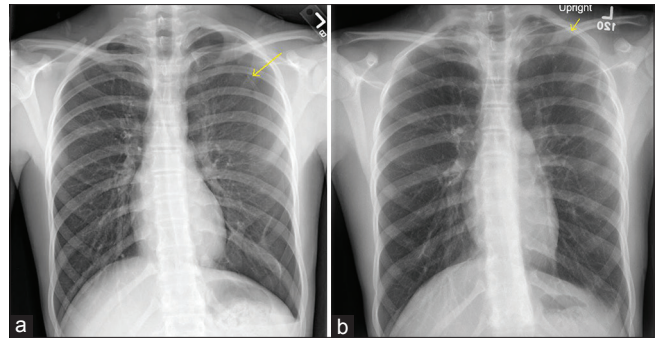
discharged home 5 days later without chest tube. Five months later, the patient presented to the emergency department with bilateral pneumothoraces, for which bilateral chest tubes were placed. Computed tomography of the chest revealed bilateral sub centimeter blebs with pectus excavatum.

The patient underwent thoracotomy with lysis of adhesions and redo-pleurodesis on the right side and left thoracoscopic resection of left upper lobe bleb and mechanical pleurodesis the following day. Left chest tube was removed on postoperative day 3, whereas right-sided chest tube remained due to air leak. Due to prolonged air leak for 25 days, the patient was evaluated by interventional pulmonology for endobronchial valve placement. However, the valve was unable to be placed as source of leak was not identified. The patient underwent intrapleural autologous blood patch installation 26 days after his initial surgery with no air leak postprocedure [Figure 1b]. Chest tube was removed the following day after procedure and patient was discharged home 2 days later.

### Case 2

A 14-year-old male with no significant past medical history presented to his primary care physician with a cough and mild chest pain was found to have left-sided spontaneous pneumothorax [Figure 2a]. Patient's pneumothorax did not fully re-expand after chest tube placement, and patient subsequently underwent left-sided VATS with parietal pleurectomy for pleurodesis as well as apical blebectomy. Intraoperative findings were consistent with blebs and chronic adhesions. Postsurgery patient noted to have an air leak that persisted for 6 days. The patient underwent instillation of autologous blood patch, but lung after procedure had limited expansion laterally with persistence of the air leak.

Four days later, the patient underwent a second instillation of autologous blood patch. Chest tube was removed 2 days later. Computed tomography of the chest revealed bi-apical blebs. Patient discharged home from hospital. Small and stable residual left-sided pneumothorax was seen on 1 and 3 weeks' follow-up chest imaging studies [Figure 2b], but resolved by week four and the patient had complete reexpansion of the left lung



**Figure 2:** (a) Left-sided pneumothorax in the second patient. (b) Postprocedure chest X-ray with improved pneumothorax

Approximately 4 months later, the patient was again admitted for spontaneous pneumothorax, this time of the right lung. The patient was observed overnight with high-flow oxygen by nasal cannula and then discharged in the morning after clinical and radiological improvement was noted. It is to be noted that second pneumothorax was on the contralateral side.

### Procedure

In each case, 2 mL/kg (average 120 ml) of venous blood was withdrawn from antecubital vein and then administered as a bolus through chest tube with the patient in Trendelenburg position. Chest tubes were elevated above the chest for 4 h using standard intravenous stand and the patient kept in Trendelenburg position. Chest tube was elevated so that the blood does not drain out right after instillation. The tubes could not be clamped due to concern for tension. After 4 h, the chest tube was allowed to drain underwater seal, and the patient stayed in a flat position in bed for another 24 h. Chest tubes were removed on the following day if no air leak is present and imaging confirms resolution or stability of the pneumothorax and patients discharged home. The procedure can be repeated 2–4 days later with no adverse events.

### DISCUSSION

Air leaks in both adolescent were successful eliminated after instillation of autologous blood patch.

Due to the low incidence of pneumothorax,<sup>[6]</sup> and subsequent PAL, in children and adolescents, there are currently no guidelines specifying management of PALs in pediatric populations. As such, adolescents are typically managed similarly to adults, first conservatively, then with surgery. In adolescents and children, surgical intervention is most likely required for full resolution in patients with PALs lasting over 5 days.<sup>[7]</sup> In patients who fail surgical intervention or who are poor candidates for surgery, pleurodesis is typically the next option. Recurrence rates after pleurodesis are 9%–16%, depending on the substance used.<sup>[4,8]</sup> Talc pleurodesis can be highly effective,<sup>[9]</sup> but has also be associated with significant side effects such as acute respiratory distress syndrome.<sup>[10]</sup> Minocycline has

also been studied as an effective method in the treatment of PAL.<sup>[11]</sup>

Autologous blood patch pleurodesis was first discussed in 1987 by Robinson<sup>[12]</sup> and has since been shown at least as effective as other forms of pleurodesis, with a success rate of 92%–93% in patients with PAL following pulmonary resection or spontaneous pneumothorax.<sup>[13]</sup> As in the two presented patients, blood pleurodesis is typically performed by extracting a small volume of blood from the patient and then injecting it into the pleural space through the chest tube.<sup>[14]</sup> There is some controversy as to the exact volume of blood required for effective pleurodesis that requires further research,<sup>[15]</sup> but volumes starting at 50 mL and going up to 200 mL have been used.<sup>[16]</sup> Most patients only require one treatment for PAL resolution, but therapy can be repeated as needed,<sup>[14,17]</sup> similar to chemical pleurodesis. Optimal timing for the procedure has also not been determined.<sup>[14]</sup>

Although referred to as pleurodesis, there is evidence that blood pleurodesis works through a patch effect where coagulated blood seals the air leak, instead of an inflammatory effect similar to chemical or mechanical pleurodesis, or possibly a combination of both.<sup>[17-19]</sup> This may have implications as to its side effect profile and should be further investigated.

Currently, autologous blood patch pleurodesis has been associated with some but not many side effects, including empyema and fever.<sup>[16,17]</sup> While the low numbers of reported toxicities is promising, there is not enough data currently to compare rates of toxicities between blood pleurodesis and other forms of pleurodesis. Interestingly, there was notable decline in pulmonary function tests in patients receiving talc and tetracycline pleurodesis compared to patients who received autologous blood pleurodesis.<sup>[14]</sup> This, combined with known toxicities of chemical pleurodesis,<sup>[10]</sup> suggests autologous blood patch pleurodesis may be safer than other forms of chemical pleurodesis. Further research here is needed to draw more definitive conclusions.

Unfortunately, most studies performed on autologous blood patch pleurodesis are in adult populations,<sup>[2]</sup> with limited generalizability to a pediatric population. Publications on blood patch pleurodesis in children and adolescents have been limited to case reports. Lillegard *et al.* presented a case series on eight children who successfully received autologous blood patch pleurodesis, with only one patient having a recurrence of their PAL.<sup>[20]</sup> A report from Japan by Tatewaki *et al.* presented a 3-month-old with hypoplastic left heart syndrome successfully treated with blood patch pleurodesis for postsurgical bilateral pneumothoraces.<sup>[21]</sup>

Although anecdotal, these cases, along with the two presented here, suggest that autologous blood patch pleurodesis is effective and safe in adolescents and children, including infants. Due to the decreased risk of recurrent pneumothorax in patients older than 40 years,<sup>[1]</sup>

pediatric patients stand to benefit more from possible preventive therapies. Blood pleurodesis also offers an economic advantage, as there is no extra cost of materials for chemical pleurodesis or operating room costs for surgical therapy.<sup>[22]</sup> For these reasons, autologous blood patch pleurodesis has significant potential in the treatment for PAL in pediatric populations and should be investigated further.

## CONCLUSIONS

Autologous blood patch appears to be a safe and effective treatment option for PAL in adolescents. Autologous blood patch offers an inexpensive, easy to perform the technique and avoids the use of toxic chemicals for pleurodesis in pediatric patients. The use of autologous blood patch for pleurodesis should be considered in the pediatric population for prolonged air leak.

### Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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### Conflicts of interest

There are no conflicts of interest.

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