

# THE BLOOD-PATCH TECHNIQUE FOR PERSISTENT AIRLEAKS

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Persistent airleaks are sometimes troublesome for patients with spontaneous pneumothorax or patients after lung surgery. Prolonged airleaks are undesirable because they prolong the duration of chest tube drainage with associated pain and risk of infection and they also prolong hospitalization. Numerous methods have been employed to manage persistent air leak including prolonged chest tube drainage, surgical repair, chemical pleurodesis (via the infusion of sclerosing agents such as doxycycline or talc). Recently, several reports have been published which suggest that autologous blood patch pleurodesis may be the most effective treatment. This article will review the current literature regarding autologous blood patch pleurodesis.

Robinson (1) first described autologous blood patch pleurodesis in 1987. He treated 25 patients with chronic spontaneous pneumothorax and reported that after one to three applications of autologous blood via the chest drain, the chronic airleak stopped in 21 of the 25 patients. Dumire et al. (2) first described the successful use of autologous blood patch pleurodesis for persistent airleak after lung resection in 1992.

## **Mechanism of Action**

The mechanism of action of the autologous blood patch pleurodesis is unknown. We were unable to produce pleurodesis in normal rabbits without airleaks by the injection of autologous blood and feel that pleurodesis is certainly not the primary mechanism of action. It is possible that the air leak is directly sealed by the formation of a clot and subsequently the fibrogenic activity of the blood creates a pleurodesis via pleural irritation and inflammation (3).

## **Efficacy of Autologous Blood**

Autologous blood pleurodesis appears to be efficacious for persistent airleaks associated with pneumothorax and with those occurring after lung resection. Chambers et al. (4) in 2010 reviewed 10 studies and reported that the technique was effective in 92.7% of 133 patients with persistent air leaks post lung resection and in 91.7% of 109 patients with persistent air leaks complicating pneumothorax.

There has been one randomized study concerning the use of the autologous blood patch technique. Shackcloth et al. (5) randomized 20 patients with persistent airleaks following lobectomy to an autologous blood patch group or a prolonged chest tube drainage group. The study group received 120 mL autologous blood into their apical chest drain on the fifth postoperative day, and again on days 7 and 9 if the air leak persisted. The control group was continuously treated by tube thoracostomy alone, but if the air leak was still present on the 10<sup>th</sup> postoperative day, they were treated with the intrapleural instillation of blood. After instillation of blood, the air leak ceased by the next day in 58.6% of the treatments. The median length of air leak was 5 days in the study group and 11 days in the control group ( $p < 0.001$ ). The time to chest drain removal (median 6.5 days versus 12 days) and hospital discharge (median 8 days versus 13.5 days) were both significantly ( $p < 0.001$ ) shorter in the study group (5). This study demonstrates the efficacy of the blood patch technique.

It appears that the autologous blood patch technique is superior to traditional pleurodesis with a tetracycline derivative or talc. In a non randomized study, Cobanoglu et al. (6) treated 20 patients with blood patch pleurodesis, 19 patients with aerosolized talc

pleurodesis and 11 patients with tetracycline. They reported that the success rate with the three different treatments was 75%, 84.2% and 63.6% respectively (6). The duration of the persistent airleak was significantly shorter in the blood patch pleurodesis group. The mean hours for the cessation of the air leak was 27 hours in the autologous blood group, 51 hours in the talc group and 64 hours in the tetracycline group (6). Even though the success rate with aerosolized talc was higher than that with the autologous blood patch technique, thoracoscopy is certainly more invasive and more expensive than is the autologous blood patch technique. Interestingly, there was a significant decline in PFT ( $p < 0.05$ ) in patients treated with talc when compared to tetracycline and ABPP, and VC/FVC/FEV1 were notably reduced in patients who had received tetracycline pleurodesis when compared to ABPP (6).

Aihara et al. (7) retrospectively reviewed 59 occurrences of pneumothorax in 34 patients with interstitial lung disease over a 12 year period. The persistent airleak stopped in 72.7% (16 episodes) after the application of ABPP and in 78.6% (11 episodes) after chemical pleurodesis with minocycline or OK432 through the chest tubes. The results in the two treatment groups did not differ significantly (7). Recurrence rates were comparable with each therapy ( $p = 0.99$ ) (50% (8 episodes) following blood pleurodesis and in 45.5% (5 episodes) following chemical pleurodesis). The patients undergoing ABPP did not develop any respiratory complications, however respiratory complications occurred in 14.3% (2 patients) of those undergoing chemical pleurodesis. Since the complication rate is less with the blood patch technique and since the results are comparable, it appears that the blood patch technique is the procedure of choice in patients with interstitial lung disease and spontaneous pneumothorax.

It appears that blood patch pleurodesis is also effective in patients with pneumothorax secondary to the adult respiratory distress syndrome (ARDS). Martinez-Escobar et al. (8) treated 27 such patients with autologous blood patch pleurodesis and compared the results with those of 27 patients treated with tube thoracostomy alone. Treatment was initiated when the air leak had been present for 24 hours. Cessation of air leak for the blood pleurodesis group was significantly shorter (2 days) when compared with controls (10 days) ( $p < 0.01$ ). The use of ABPP was also found to significantly reduce weaning time from ventilation by 11 days and ICU stay by 9 days ( $p < 0.01$ ). Finally, mortality rates were lower in the ABPP group (Odds Ratio: 0.6).

Use of the autologous blood patch technique also appears to be effective for patients with spontaneous pneumothorax secondary to advanced chronic obstructive pulmonary disease. Cao et al. (9) applied the autologous blood patch technique to 44 patients with secondary spontaneous pneumothorax due to severe or very severe chronic obstructive pulmonary disease who had a persistent air leak on the 7<sup>th</sup> day after intercostal tube drainage. The 44 patients were assigned to 4 different groups with 11 patients in each group. Groups A, B, and C were given increasing doses of autologous blood (0.5 mL/kg, 1 mL/kg and 2 mL/kg while group D was given 1 mL/kg normal saline (9). The procedure was repeated if the air leak persisted on postoperative days 9 and 11. Patients in group D crossed over and received autologous blood as in group B if the air leak was still present on the 13<sup>th</sup> day. The success rate (82%) was significantly higher in groups B and C than in group A (27%) or group D (9%) (9).

#### **Optimum Strategy for Successful Autologous Blood Patch Pleurodesis**

There is debate in the literature concerning the optimum strategy for successful autologous blood patch pleurodesis. The first question is the optimal quantity of blood. It has been suggested that larger volumes of blood should be avoided because blood is an ideal culture medium and larger volumes might lead to a higher incidence of infection (10). However, Jones et al. (11) describe poor efficacy with 50-60 mL as do Cao et al. (9). Therefore, it appears that 100-120 mL blood is probably the ideal quantity to use (3).

A second question is whether the chest tube should be clamped after the blood is injected. If a patient has a large air leak, there is always the danger of the development of a tension pneumothorax if the tube is clamped (12). A generally accepted measure is to hook the chest tube over a drip stand so that autologous blood remains in the pleural cavity, but air is still permitted to escape thus reducing the risk of developing a tension pneumothorax.

A third question is when the autologous blood patch technique should be applied. The initial application has been anywhere from 5 to 9 days after the air leak develops. We believe that the autologous blood patch technique is likely to be effective within the first few days of the development of the air leak and recommend that it be applied relatively early (3-5 days) although there are no studies on its application as early as three days.

### Complications

The main complication of the autologous blood patch technique is fever and empyema does occasionally occur. Cagirici et al. (13) reported three cases of empyema (9%) but most series report no cases of empyema. The role of prophylactic antibiotics has not been studied but due to the low incidence of pleural infection, they are not recommended at the present time. However, it is quite important to obtain the autologous blood in a sterile fashion. There is some evidence that patients with a persistent airleak from a spontaneous pneumothorax have a lower incidence of recurrence pneumothorax than if they are treated with only tube thoracostomy (3).

### Conclusion

The application of the autologous blood patch technique for persistent air leak with either spontaneous pneumothorax or after thoracic surgery is more effective than tube thoracostomy in causing the air leak to cease. The technique is also effective in patients with persistent air leaks who are receiving mechanical ventilation. It is cheap, simple, well tolerated and readily available with minimal side effects and a broad range of applications. Its use should become routine in the management of patients with persistent air leaks who are not going to be approached surgically.

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