

## ORIGINAL ARTICLE

# A Prospective Study of Pleurodesis by Autologous 'Blood Patch' Mixed with Tranexemic Acid in the Management of Persistent Air Leak

Ankan Kumar Paul<sup>1</sup>, Hossain Al Mahmud<sup>2</sup>, Serajus Salekin<sup>3</sup>, Mohammed Kamrul Hasan<sup>4</sup>, Md. Kamrul Alam<sup>5</sup>, Osman Goni<sup>6</sup>, Debasish Das<sup>7</sup>, S.M. Shafiqul Alam<sup>8</sup>

### Abstract:

**Objective:** To evaluate the efficacy and risks of autologous 'blood patch' pleurodesis in patients with persistent air leak. **Method:** All patients with persistent air leak following recurrent pneumothorax, secondary spontaneous pneumothorax and pulmonary surgery, admitted in our institute between January 2018 to December 2018 were treated with 20 mL of autologous blood through chest drain tube mixed with 10 ml Tranexemic acid, starting from 6<sup>th</sup> day of persistent air leak and followed up closely. Sample size was 25. **Results:** This procedure showed 96% success rate with 84% patients recovered from persistent air leak within 12 hours and another 12% within 24 hours. No significant adverse effects were seen except 8% transient fever and 4% pleural effusion which recovered conservatively. Early discharge and early restoration of working life was achieved in all patients at a very low cost. **Conclusion:** In our experience a single injection of 20 ml of blood mixed with tranexemic acid is sufficient to seal persistent air leaks in less than 24 hours. As it is a cost effective procedure, it is very much suitable for our country and should be practiced more widely.

**Key Words:** Persistent air leak, Autologous blood patch, Pleurodesis.

[Chest Heart J. 2019; 43(1) : 22-27]

DOI: <http://dx.doi.org/10.33316/chab.j.v43i1.2019596>

### Introduction:

Pneumothorax is a common problem for thoracic surgeons which may occur spontaneously or after thoracic surgery. Spontaneous pneumothorax can occur primarily or may be due to a secondary cause. Primary spontaneous pneumothorax (PSP) occurs in persons without coexisting pulmonary disease, usually from rupture of a pulmonary bleb,

while secondary spontaneous pneumothorax (SSP) is associated with underlying pathology, such as chronic obstructive pulmonary disease (COPD), bullous emphysema, pulmonary tuberculosis (PTB), interstitial lung disease (ILD), bronchogenic carcinoma etc. Spontaneous pneumothorax following clinical cure of a previous episode is referred to as recurrent.<sup>1,2</sup>

1. Resident, Cardiovascular and Thoracic Surgery, NICVD
2. Registrar, Dept of Thoracic Surgery, DMCH
3. Assistant Professor, Dept. of Thoracic Surgery, DMCH
4. Junior consultant, 250 bed Chest and TB Hospital, Shyamoli, Dhaka
5. Professor, Dept. of Thoracic Surgery, DMCH
6. Assistant Professor, Dept. of Cardiovascular and Thoracic Surgery, NICVD
7. Indoor Medical Officer, Dept. of Thoracic Surgery, DMCH
8. Associate Professor, Dept. of anaesthesiology, DMCH

**Correspondence to:** Dr. Ankan Kumar Paul, Resident, Cardiovascular and thoracic surgery, NICVD, Dhaka, E-mail: [ankankumar64@gmail.com](mailto:ankankumar64@gmail.com), Mobile: 01717402587

**Submission on:** 12 January 2019

**Accepted for Publication:** 22 January 2019

Available at <http://www.chabjournal.org>

Persistent air leakage is defined as air leakage more than 5 to 7 days after intercostal drainage, which are more common with secondary pneumothorax than with primary pneumothorax.<sup>3-5</sup> They are also seen after lung surgery or trauma. Video assisted thoracoscopy (VATS) has been advocated in the management of patients with PSP and SSP who suffer from persistent air leakage. For those in whom operation is not feasible chemical pleurodesis is a fair option.<sup>6</sup>

Pleurodesis is a procedure to achieve symphysis between the two layers of pleura to prevent recurrent pleural effusion or recurrent pneumothorax.<sup>7-9</sup> This can be done by both chemical and surgical means. The principal is to induce inflammation and fibrosis causing the symphysis between the two layers of pleura.<sup>10</sup> Chemical pleurodesis has been widely applied for stopping air-leak or for preventing pneumothorax recurrence. It can be applied through the intercostal drainage tube, medical thoracoscopy, or during the operation. A variety of sclerosant agents are used clinically including tetracycline and derivatives (doxycycline or minocycline), talc,

bleomycin, autologous blood patch, iodopovidone, picibanil, silver nitrate, and quinacrine, of which most commonly used agent was talc followed by tetracycline derivatives and bleomycin.<sup>11</sup>

In this study we are aiming to see the efficacy of autologous blood patch, applied through intercostal drain tube, as a agent of pleurodesis in patients with persistent air leak for several reasons. We added tranexemic acid with autologous blood due to its antifibrinolytic action.

### Material and Methods:

#### Patient Selection:

The study was done in Dept. of Thoracic Surgery, Dhaka Medical College Hospital (DMCH), Dhaka, Bangladesh between January 2018 and June 2019. Total 25 patients with persistent air leak after 6 days of introducing intercostals chest drain tube who were already admitted in DMCH were taken. These patients developed persistent air leak either after recurrent pneumothorax, SPS and post operative. Pleurodesis was done in radiologically expanded lungs but persistent air leak for at least 6 days, despite a properly placed chest tube. Written

informed consent of each patient was taken. Patients were examined prospectively in terms of timing and success rate of pleurodesis, cessation of air leak, timing of tube removal, recurrence of pneumothorax, hospital length of stay (LOS), procedure related complications, and additional interventions required. After discharge follow up was done at 1 month, 3 months and 6 months.

### Study Type:

It is an interventional study.

### Pleurodesis Technique:

20 cc of blood is drawn from the patient's median cubital or cephalic vein, and injected directly into the chest drain aseptically, without applying any analgesics or sedation. 10cc tranexemic acid was injected into the tube afterwards and the tube was flushed with 10cc normal saline in order to inhibit clotting inside the drain and ensuring all the blood is kept in the thoracic cavity.<sup>12</sup> Tranexemic acid was used so that clotted blood can seal the air leakage site and it remain sealed. It may also cause the fibrin in tissue to retain its original structure by antifibrinolytic effect so that healing is fastened. In order to achieve continuous air drainage but keep the injected blood in the thorax, the chest tube line is elevated 40-50 cm above the patient and kept unclamped for 2 hours. During this period, the patient was asked to change his position in bed every 15 minutes, to attain homogenous distribution of blood within the pleural cavity. Neither antibiotic prophylaxis nor negative suction was applied to any patient.<sup>13,14</sup>

### Results:

Total 25 patients were taken out of which 72% were male and 28% were female. The mean age was 59.2 years (Table I). 24% patients presented with recurrent pneumothorax, 44% had SSP out of which 28% had COPD, 8% had H/O PTB and 8% was suffering from ILD. Remaining 28% patients developed persistent air leak after lung surgery, 20% lobectomy and 8% decortication (Table II).

In 68% patients involved side was right and rest developed it in left side (Table III). Most of the bronco-pleural fistulas 64% were of medium size. 28% were small and rest were of large size (Table

IV). Pleurodesis was done after certainty that air leak was present for at least 6 days (44%). We waited a few more days in patients with small fistula with a hope that it will cease eventually but when it persisted for 8 days we went for pleurodesis. In 12% patients pleurodesis was done at 11<sup>th</sup> day (Table V).

**Table-I**  
*Age and sex distribution*

Total Patients (n)	25	
Sex	Male	18 (72%)
	Female	7 (28%)
Age (years)	Range	32-76
	Mean	59.2 ± 9.7 SD

**Table-II**  
*Aetiology*

Recurrent Pneumothorax	6 (24%)	
Secondary Spontaneous Pneumothorax (SSP)	11 (44%)	
	COPD	7 (28%)
	H/O PTB	2 (8%)
	ILD	2 (8%)
After Thoracic Surgery	7 (28%)	
	Lobectomy	5 (20%)
	Decortication	2 (8%)
Previous H/O Pleurodesis	1 (4%)	

**Table-III**  
*Side involved*

Rt Side	17 (68%)
Left Side	8 (32%)

**Table-IV**  
*Size of Fistula*

Severity of air leak	
Large (continuous air leak)	2 (8%)
Medium (air leak during talking)	16 (64%)
Small (air leak during coughing)	7 (28%)

**Table-V**

*Duration of air leak before pleurodesis*

Duration of air leak before Pleurodesis (days)	
6	11 (44%)
7	7 (28%)
8	4 (16%)
11	3 (12%)

After pleurodesis patients were followed up closely and it was seen that in 84% patients air leak ceased within 12 hours. In 12% patients it ceased between 12-24 hours and persistence of air leak remained in 4% of patients even after 72 hours, so repeat pleurodesis needed for them and it was done after 72 hours of first one. After repeatation air leak stopped within 12 hours (Table VI). Tubes were removed the following day of stoppage of air leak in all patients (Table VII). Follow up was done closely in all patients during and after pleurodesis, in the period of hospital stay and at 1, 3 and 6 months after discharge. Complications were very less as only 8% patients developed transient fever and 4% developed pleural effusion which was treated conservatively. No pain, irritation, empyema chest tube obstruction or recurrence was found (Table VIII)

**Table-VI**

*Timing of cessation of air leak after pleurodesis*  
*Efficacy of Blood Patch Pleurodesis*

Air leak cessation in <12 hours	21 (84%)
	[p value <0.001]
Air leak cessation in <24 hours	3 (12%)
Persistent air leak after 72 hours	1 (4%) Repeat pleurodesis was done and leak stopped within 12 hours of repeatation.

**Table-VII**

*Timing of tube removal after pleurodesis*

Tube removal	
After 24 hours	21 (84%)
After 48 hours	3 (12%)
Couldn't be removed after 1 <sup>st</sup> pleurodesis	1 (4%) removed after 24 hours of repeat pleurodesis

**Table-VIII**  
*Complications*

Complications	
Pain, Irritation	0 (0%)
Fever	2 (8%)
Pleural effusion	1 (4%)
Empyema	0 (0%)
Chest tube obstruction	0 (0%)

### Discussion:

Persistent air leak (PAL) remain one of the most common complication in modern thoracic surgery.<sup>15</sup> PAL is a complication which can occur after PSP, SSP and also lung surgery. There are numerous diseases in the etiology of SSP. The most frequent factor seen is COPD, and it is responsible approximately in 70% of all patients.<sup>16,17</sup> Other diseases contributing to it includes PTB, ILD, malignancy etc. Trauma is also an important cause in our country. In our study most patients presented with SSP were COPD cases (63.6%). Another important entity is PSP which usually occur in tall, slender, young, male, smoker. Recurrence is also quite common among them. Rice and Kirby have reported a 15.2% rate of air leak persisting more than 7 days after pulmonary lobectomy in a series of 197 consecutive patients,<sup>18</sup> and others and we have reported a 14.8% rate in 182 patients treated by VATS wedge resection for spontaneous pneumothorax.<sup>19</sup> In our study we found SSP (44%), recurrent primary pneumothorax (24%) and post surgical cases (28%). 4% of patients had previous history of chemical pleurodesis.

Many techniques have been tried for the treatment of persistent air leaks but non proved to be superior than the others. Some of the procedures applied by surgeons are; a drain *in situ* and a Heimlich valve, more aggressive approaches such as intrapleural chemical agents (pleurodesis) or even primary repair by re-operation and injection of fibrin glue.<sup>20</sup> Every procedures have some merits and demerits. Spontaneous recovery following drain tube placement usually requires a lot of time and increases patient morbidity and mortality by increasing the chance of empyema, prolonged pain and immobility. Most of the sclerosing agents used for pleurodesis are not well accepted, since they can cause systemic reactions and severe pain.

Moreover, in the presence of a large air leak or bronchopleural fistula, chemical pleurodesis involves

a risk of reflux of the agent into bronchial segments.<sup>2</sup> Surgical repair or re-thoracotomy is also problematic specially in patients with poor condition. So we preferred to go for autologous blood patch pleurodesis (ABPP) as it has been shown as a cheap, painless method with good success rate.

In 1987, Robinson<sup>13</sup> first reported using patch pleurodesis with autologous blood to treat SSP with PAL, and he obtained an 85% success rate in a series of 25 patients receiving 1 to 3 instillations of 20 mL of blood mixed with 10ml tranexemic acid into the pleural cavity. ABPP has since been used to treat persistent postoperative air leak after pneumonectomy.<sup>21</sup> As summarized by Chambers and associates,<sup>22</sup> the overall success rates from 43 studies were 92.7% from patients having undergone pulmonary procedures and 91.7% of patients with pneumothorax. Several prospective studies (including 2 randomized controlled trials) showed unanimously that ABPP had superior outcomes, such as shorter sealing time, higher success rate, and fewer complications for PAL, when compared with conservative treatment.<sup>22-24</sup> Furthermore this bedside surgical procedure is easy to perform, inexpensive, and painless.<sup>22,25</sup> Our success rate was 96% as air leak ceased in 84% patients within 12 hours and another 12% patients within 24 hours. Drain was removed the next day and patients were discharged. Only in 1 patient air leak didn't stop within 72 hours, so we had to re-inject blood after 72 hours and this time air leak stopped within 24 hours. Only 2 patients developed transient fever and one patient developed pleural effusion which resolved with conservative treatment. Obstruction of the catheter is an important problem which occurs during autologous blood pleurodesis which may even cause tension pneumothorax.<sup>12</sup> But that didn't happen in our study probably due to flashing the tube with 10mL normal saline after installation of blood.

Autologous blood pleurodesis is believed to work by multiple mechanisms. Immediate cessation of air leak after instillation takes place because of direct mechanical action of the fibrin due to a blood patch effect or direct sealing of the leak with hematoma or coagulated blood. The presence of

blood in the cavity induces adhesions between the visceral and parietal pleural layers, due to inflammation of pleural surfaces.<sup>26</sup> Cessation of air leakage within 24 hours in most of the cases in our study supports the first mechanism. In our experience 20 ml of blood have been sufficient in all patients, whereas in most series 50–250 ml have been necessary to seal the air leak.<sup>27,28</sup> We didn't use more than 20 mL as we thought it may act as a medium for colonization which may cause empyema thoracis.<sup>2</sup> No empyema occurred to any of the patients of our study. We added 10 ml of tranexemic acid with blood to keep the blood in clotted condition so that it can remain as a patch and seal the fistula with the clot. As tranexemic acid is anti-fibrinolytic fibrin in tissue may remain in its original state with the use of it and it may enhance healing. This was our view to use tranexemic acid and our results were excellent and more research in the use of tranexemic acid should be carried out to see its role in healing. The timing of pleurodesis is still controversial.<sup>23,28</sup> Some authors propose the use of autologous blood pleurodesis on the 9th day of continuing air leak while other reports recommend initiating treatment on the 5th day.<sup>23,27</sup> In our study patients with continuing air leak for six days were selected for autologous blood patch pleurodesis as per definition. We believed that early intervention can prevent the chance of empyema and reduce the pain and immobility which in turn reduce the morbidity and mortality to give the patient a chance of early discharge and better quality of life as recovery will be quick.

For a country like us where cost is a major issue in the treatment of the patient, it is an excellent method in the treatment of persistent air leak as the cost is almost zero. Moreover early recovery means less hospital stay and less chance of infection which is also contributing in reducing the expenditure of the patient.

Small sample size and only 6 month follow-up are the main limitations of our study. So Large prospective trials are further needed to signify the importance and efficacy of this procedure.

#### **Conclusion:**

ABPP is a simple bedside procedure for the treatment of PAL in PSP, SSP and post surgical

patients. It is highly efficacious as success rate is 96% in 24 hour, cost effective and side effects and complications are almost negligible. It is a blessing for a country like ours where cost is a important factor in treatment of the patients as by using only 50 mL of patients own blood we can treat and discharge the patient at earliest possible time.

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