A Comparison of Success of Autologous Blood Patching in Sealing of Bronchopleural Fistula of Primary and Secondary Spontaneous Onset.

Thapa B, Sapkota R, Sayami P

Department of Cardio-Thoracic Vascular Surgery, Manmohan Cardio-Thoracic Vascular and Transplant center, Institute of Medicine Tribhuvan University

Correspondence: Dr. Bibhusal Thapa

Email: thapabibhusal@yahoo.com

Abstract

Introduction: Autologous Blood patching (ABP)has been usedto treat bronchopleural fistula in spontaneous pneumothoraxwith varying success. We evaluatedthe safety and efficacy of ABP when used in patients with primary (PSP) versus secondary (SSP) spontaneous pneumothorax.

Methods: All patients with spontaneous pneumothorax with no evidence of pleural infection and in whom the air leak did not subside despite 48 hours of conservative management were included. A CT scan was done to categorize if there was underlying lung disease and classify patients into primary and secondary spontaneous categories. These patients underwent blood patching in one to three episodes in 50ml aliquots. Comparisons of the demographic profile, smoking status, success rate and complications in these two groups were done.

Results: Between July 2012 and January 2014, 76 patients underwent ABP. The overall success rate of ABP was 58%. There were 29 patients who were classified as PSP and 47 with SSP. There was no difference in the sex distribution but patients with PSP were younger (P= 0.00), were more likely to present earlier (P=0.04) and had higher rates of residual pneumothorax (P= 0.05) after chest tube insertion. The success rates in the two groups were similar (P=0.76).The rate of complications was low and not different in the two types (P=0.58).

Conclusion: ABP has modest success in sealing air leak of spontaneous onset. We found the success and complication rates in the two types of spontaneous pneumothoracesto be equivalent.

Key words:air leak, autologous blood patching, pneumothorax.

Introduction

Spontaneous pneumothoraces are common Thoracic Surgical problems. They can follow rupture of bullae in patients who have Chronic Obstructive pulmonary Disease (COPD) i.e. Secondary spontaneous pneumothorax (SSP). They can also result from rupture of subpleural blebs in young patients with otherwise normal lungs i.e. Primary spontaneous pneumothorax (PSP).[1]When spontaneous pneumothorax is complicated by a broncho-pleural fistula (BPF) and a resultant persistent/prolonged air leak (PAL), it is often a difficult problem to manage.A variety of methods like conservative management consisting of prolonged drainage with use of negative suction and physiotherapy, trial of pleurodesis and also Heimlich valves have been used.[2,3] Although these methods have been employed with some success, none have seen to be universally effective or even entirely safe. Failure of conservative methods often necessitate surgery or prolonged tube drainage. Also, there remains the risk of recurrence and significant morbidity.

The use of autologous blood instilled through the chest tube in an attempt to close air leaks was first described by Robinson in 1987.[4] Since then it has been used to close BPF of various etiologies.[5-8]Past series have reported varying degrees of success in spontaneous pneumothoraces but there has been no comparison of the success of the procedure in PSP versus SSP.[9-11]Patients with SSP usually have associated co-morbidities and are more likely to be unfit for surgery compared to patients with PSP.[12]These patients would therefore benefit more from a less invasive and less morbid option like ABP. We conducted this prospective study to evaluate if theefficacy of ABP was different between patients with SSP and PSP.

Methods

This study was conducted prospectively in the Thoracic Surgery Unit of the Department of Cardio-thoracic and Vascular Surgery of the Manmohan Cardio-thoracic Vascular and Transplant Center, Institute of Medicine, Tribhuvan University. Ethical clearance was obtained from the Institutional Review Board of the Institution of Medicine prior to initiation of the study. Informed consent was taken from each patient prior to enrollment. The inclusion and exclusion criteria were as follows.

Inclusion criteria

All patients with spontaneous pneumothorax (on Chest X-ray) and BPF which persists after 48 hrs of conservative treatment. (chest tube insertion and suction of -20 cm of water)

Show no evidence of pleural infection.

Exclusion Criteria

Evidence of pleural infection- frank pus or positive pleural fluid cultures.

Anemic patients with hemoglobin level <10gm%

Secondary pneumothoraces and BPFs (e.g. post-lung resection, post traumatic, iatrogenic- post central venous catheter insertion)

Patients who have had attempts at pleurodesis before presenting to our center.

As a preparation for possible operative treatment the patient was investigated with a High resolution CT scan (HRCT).

Procedure of ABP

Prior to the initiation of the procedure, the patient was explained in detail about the procedure. They were also taught to report immediately any shortness of breath (SOB) or sudden swelling of the body (surgical emphysema). Initially, the chest tube and drainage system were modified. Using an aseptic technique, a three way a 3/8-inch connector with a luer-lock side port was inserted between the pleural drain and the tubing leading to the underwater seal. This device not only connected the chest tube to the drainage system but also provided an extra port with a cap which was used to introduce the blood into the chest in a sterile fashion without having to make a needle stick hole in the chest tube itself or having to even temporarily disconnect the tube from the drainage pipe which has been described by others.[8] The drainage tube itself was also lengthened with the addition of another two meter tubing. This was done to allow adequate length for the tube be looped over an Intravenous (IV) stand. The patient was put off suction.

Fifty milliliter of blood was drawn from the cubital vein of the patient in a 60ml syringe which was not heparinized. The drainage tube distal to the three-way connection was briefly clamped using an artery clamp. The blood was then immediately and quickly injected through the port. This was followed by 30ml of sterile Normal Saline. This was done to avoid clogging of the blood in the tube. The port was then closed. The drainage tube was looped on top of an IV stand placed by the patient's bed. The artery clamp was then released. This allowed the blood to enter and stay in the thoracic cavity. Looping the drainage tube allowed us to avoid having to clamp the tube which could have increased possibility of tension pneumothorax and surgical emphysema. The patient was then asked to change positions every 15 minutes to ensure a uniform distribution of the film of blood on the entire pleural surface. No pre-emptive analgesia or sedation was used.

The patient was then watched closely for SOB, onset of surgical emphysema and evidence of infection (like change in color of chest tube fluid, fever, rising counts). If the patient developed SOB or surgical emphysema, the tube was immediately checked for function. If it was found to be blocked, attempts were made to de-clog with normal saline. If this was unsuccessful, the chest tube was replaced and the further procedure was abandoned. If a subsequent X-ray done at this time showed that the lung had fallen back, the patient was re-initiated on negative suction. If the patient showed any features suggestive of infection, the pleural fluid was collected for bacteriological assessment. If found positive, they were treated with antibiotics and no further attempts at ABP were made.

The patient was evaluated at 12, 24 and 48 hours for the cessation of air leak. If at any of the assessments, there was no bubbling of air in the underwater seal drain system on deep inspiration and on forceful coughing, a repeat chest X-ray was done. If this chest X-ray showed a fully expanded lung and no evidence of loculated collection,

the tube was left for a further 24 hours to allow some pleurodesis and then removed. If the air leak was found to be persistent at 48 hours of the instillation of blood, the patient was reassessed for re-instillation. In the absence of subsequent development of any of the exclusion criteria, the procedure was repeated. The procedure was repeated a maximum of two times making a total of maximum three attempts at blood patching. If the patient was found to still have persistent air leak at 48 hours after the third instillation of blood, the procedure was deemed to have failed. Patients who failed three attempts at blood patching were subjected to either continued conservative management or surgical treatment depending on their physiological status, CT scan findings and patient preference.

Data Collection

Data collection was done with the help of a structured Performa.The data was collected by the investigator and residents working in the Thoracic Surgical Unit during the period of study. The demographic data in terms of the age, sex, address, smoking status, type of spontaneous pneumothorax (SSP Vs PSP), high resolution CT scan (HRCT) findings, and time from onset of pneumothorax to first episode of ABP were recorded. The success/failure of ABP, if successful the number of attempts needed and the number and complications encountered were also recorded.

Data Analysis

Data was entered and analyzed in SPSS version 20. Mean ± SD was calculated for age, duration of leak before ABP and size of pneumothorax. Frequency and percentage were calculated for gender, smoking status and outcome variable i.e. success rate of ABP (Yes/No). Effect modifier was controlled through stratification of age, gender, duration of leak before ABP, size of pneumothorax and smoking status to see the effect of these on outcome outcome variables. Post stratification, difference in success rates were compared using Chi square test taking $P \leq 0.05$ as significant.

Results

Of 106 patients admitted with pneumothorax between July 2012 and January 2014, thirty patients were excluded (18 were secondary- trauma, iatrogenic: in 10 there was resolution of pneumothorax and air leak with conservative managementtwo had evidence of pleural infection at presentation) Seventy-six patients who met the inclusion criteria were included in the study.

The demographic data of the included patients were as presented in Table 1. The radiological findings of these patients were as detailed in Table 2. Based on the HRCT findings, forty seven patients were classified as SSP and 29 as PSP.

ABP was successful in sealing the broncho-pleural fistula and ceasing the air leak in 44 patients (57.9%). The number of attempts required and the success rates at Among patients in whom ABP was successful, in 21 patients (27.6%) the air leak ceased after the first episode of instillation. Among patients who required a second attempt, the procedure was successful in twelve patients (12/55 = 21.8%). The third attempt was successful in eleven patients (11/43 = 25%). (Table 3)

We compared the patients with PSP and SSP. The age of patients with PSP was 8-44 years (24.4± 8.2 years) while the age of those with SSP was 25-80 years (59.2±10.9 years). While all patients with SSP except a 25 year old man with ILD had history of smoking (10-50 pack years, mean = 24.3±12.6 pack years), only seven patients with PSP had history of smoking. The duration of air leak prior to ABP was shorter in PSP when compared to SSP.

ABP was slightly more successful among patients with SSP, (28/47 i.e. 59%) than among patients with PSP (16/29 i.e. 55%). However this did not reach statistical significance with a P value of 0.70. (Table 4) Amongst patients with PSP, success was attained in the first attempt in 11/29 (37%) in second attempt in 3/18 (16%) and 2/15(13%) in the third. Similarly, amongst the patients with SSP, the first attempt was successful in 10/47 (21.2%), in second attempt in 9/37(24%) and in third attempt in 9/28 (32%).

Incidence of complications was low. There were a total of seven complications. (Table 5) There was no difference in the rate of complication rates between patients with PSP and SSP.

Table 1: Demographic data of patients.

Number of patients(N)	**76**
Age	18-80 years (mean =45.9 ± 19.9)
Sex ratio (M:F)	4:1
Address	Inside Kathmandu Valley = 27 Outside Kathmandu Valley =49
Smoking history	Never smokers = 24 Current/past smokers = 52 with 3-50 (mean =23.1± 12.0 pack years) history
Duration between onset of pneumothorax and first attempt of ABP	2-20 (mean =7.5 ± 4.3 days) For patients who came from within Kathmandu = 7.1± 4.9 days For patients being referred from outside Kathmandu = 7.8 ± 4.1 days

Table 2: Radiological findings:

CXR findings after chest tube insertion and suction	Full expansion = 13 ≤ 20% residual pneumothorax =37 ≥ 20% residual pneumothorax = 26
High resolution CT scan findings	Normal =9 Apical blebs only = 19 (10 on right, 9 left), Bullae = multiple bullae on HRCT in 44 patients (19 on the right, five on the left, 20 had bilateral bullae). Hyperinflated emphysematous lung, no bullae = 1 ILD=2 HRCT not done = 1

Table 3: Success rates of ABP

Overall success rate observed	44/76 = 57.9%
Success rates according to number of attempts	First attempt = 21/76(27.6%) Second attempt = 12/55 (21.8%) Third attempt = 11/43 (25%)

Table 4.Comparison of PSP and SSP.

Particulars	Primary Pneumothorax	Secondary Pneumothorax	P-value
Number	29	47	
Age(years)			.000
≤ 40	28	2	
≥41	1	45	
Sex			.951
Male	23	37	
Female	6	10	
Smoking			.000
Yes	7	45	
No	22	2	
Duration of air leak before ABP(hours)			.045
≤5	16	15	
>5	13	32	
Residual pneumothorax			.005
Yes	1	14	
No	28	33	
Success			.706
Yes	16	28	
No	13	19	
Complication			.584
Yes	2	5	
No	27	42	

Table 5.List of complications.

Complication	Frequency
Empyema	3
Surgical emphysema	1
Expansion of pneumothorax	1
Recurrence	2

Discussion

Spontaneous pneumothoraces can usually be treated with various procedures ranging from conservative management to needle aspiration and tube thoracostomy; persistence of the air leak and recurrences are often troublesome and difficult to treat. Persistent air leak is suggestive of development of bronchpleural fistulas which are known to be associated with significant morbidity like empyema, surgical emphysema and need for prolonged chest tube drainage. Prolonged chest tube, trial of pleurodesis and use of Heimlich valves have been routine strategies used with varying degrees of success. Failure of these non/less invasive methods often necessitates surgery. Although surgery has high success rate, an older population with higher rates of co-morbidities can often make surgery less favoured option in patients with SSP. ABP which provides a less invasive and less morbid option would therefore be expected to be more advantageous in this population.

In our series we found that ABP was able to cause cessation of BPF due to spontaneous pneumothorax in 58% when it was applied up to three times. This is significantly lower when compared to most previous reports. Robinson when he first described the technique in 1987, reported a successful outcome in 21 of his 25 patients giving a 85% success rate.[5] In 1998, Cagirici et al.[13] reported in a prospective cohort study with 32 patients with spontaneous pneumothorax and PAL a success rate of 84%. Chambers et al.[14] 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 spontaneous pneumothorax.

Comparing our results with most published series, it is obvious that in our experience ABP has not shown the efficacy reported in previous reports. Although our results may seem eccentric and out of place at first glance, it is possible to explain when we look more closely to the specific aspects of our methodology and the nature of previous reports. Almost all previous reports are severely limited by their small sample size. Therefore, the true success rate of this procedure would be difficult to decipher based solely on small scale studies. Athough the review by Chambers et al.[13] has shown very high success figures but is faulted by the lack of inclusion of some recent papers which have reported very modest results like that of Ando et al.[15] reported who have reported successful results in only 6/10 patients with inflated lungs and only 4/7 patients with deflated lungs. More recently Karengaliset al.[12] in 2010 reported their experience with 15 patients in whom they managed to close air leak in only 4 (27%) within 24 hrs of the instillation.

The fact that we used only 50 ml of blood for each instillation unlike some other authors like Jones et al.[16]and Cao et al.[17]may have affected our results. We did this to minimize the possibility of infectious complications.

The age of patients with PSP was 8-44 years (24.4± 8.2 years) and that of those with SSP was 25-80 years (59.2±10.9 years). This is in adherence to the general age range reported for the respective problems. While all patients (save one patient with ILD) with SSP had history of smoking (10-50 pack years, mean = 24.3±12.6 pack years), only seven patients with PSP had history of smoking. This demonstrates the association of cigarette smoking in the pathogenesis of secondary spontaneous pneumothorax.

Although similar comparisons have not been done in previous series, we found no difference in the success rates of ABP when used for PSP Vs SSP. This indicates that it may worthwhile trying ABP in PAL of any aetiology before considering surgery. One interesting finding that emerged during the analysis of success rate of ABP in PSP and SSP was that subsequent (second and third) attempts of ABP were more likely to be successful in patients with SSP than PSP. Although this finding cannot easily be explained, it probably signifies that persisting with attempts of ABP may be more beneficial in SSP patients who unlike PSP patients are often not medically fit for operative interventions.

Our rates of complications in general and infectious complications in particular were lower than in reported literature.[13,18-20] No difference was noted in complication rates between SSP and PSP even though patients with SSP would have been expected to have higher rates due to commoner co-morbidities.

Conclusion

ABP is moderately successful in sealing PAL of spontaneous onset. There is no significant difference in success rates in primary and secondary spontaneous pneumothoraces. Given its low complication rates, it can be considered a

safe alternative before embarking to surgery in all patients with BPF of spontaneous onset.

Conflict of interest: None declared.

References

1. Rice TW, Kirby TTJ. Prolonged air leak. Chest SurgClin North Am. 1992; 2: 803-11
2. Almassi GH, Haasler GB. Chemical pleurodesis in the presence of persistent air leak. Ann Thorac Surg. 2001; 72: 1716-9.
3. Baumann MH, Strange C. The clinician's perspective on pneumothorax management. Chest. 1997; 112: 822-8.
4. Videm V, Pillgram-Larsen J, Ellingsen O, Andersen G, Ovrum E. Spontaneous Pneumothorax in Chronic Obstructive pulmonary disease: complications, treatment and recurrences. Eur J Respir Dis, 1987; 71: 365-71
5. Robinson CL. Autologous blood pleurodesis in recurrent and spontaneous pneumothorax. Can J Surg. 1987; 30: 428-9.
6. Dumire R, Crabbe MM, Mappin FG, Fontelle LJ. Autologous ' blood patch' pleurodesis for persistent pulmonary air leak . Chest. 1992; 101: 64-6.
7. Rivas de Andres JJ, Blanco S, De la Torre M. Post Surgicalpleurodesis with autologous blood in patients with persistent air leak. Ann Thorac Surg. 2000; 70: 270-2.
8. Lang-Lazdunski L, Coonar AS. A prospective study of autologous 'blood patch' pleurodesis for persistent air leak after pulmonary resection. Eur J CardiothoracSurg 2004; 26: 897-900.
9. Özpolat B. Autologous blood patch pleurodesis in the management of prolonged air leak. ThoracCardiov Surg. 2010; 58: 52-8.
10. Oliveira FH, Cataneo DC, Ruiz RL Jr, Cataneo AJ. Persistent pleuropulmonary air leak treated with autologous blood: results from a university hospital and review of literature. Resp. 2010; 79(4): 302-6.
11. Athanassiadi K, Bagaev E, Haverich A. Autologous blood pleurodesis for persistent air leak. ThoracCardiovasc Surg. 2009 Dec; 57(8): 476-9.
12. Videm V, Pillgram-Larsen J, Ellingsen O, Andersen G, Ovrum E. Spontaneous Pneumothorax in Chronic Obstructive pulmonary disease: complications, treatment and recurrences. Eur J Respir Dis, 1987; 71: 365-71
13. Karangelis D, Tagarakis GI, Daskalopoulos M, Skoumis G, Desimonas N, Saleptsis V et al. Intrapleural instillation of autologous blood for persistent air leak in spontaneous pneumothorax- is it as effective as it is safe? J Cardiothorac Surg. 2010 Aug 17; 5: 61-5.
14. Cagirici U, Sahin B, Cakan A, Kayabas H, Buduneli T. Autologous blood patch pleurodesis in spontaneous pneumothorax with persistent air leak. ScandCardiovasc J. 1998; 32: 75–8.
15. Chambers A, RoutledgeT.Bille A, Scarci M. Is blood pleurodesis effective for determining the cessation of persistent air leak? Inter CardiovascThorac Surg. 2010; 11: 468-72.
16. Ando M, Yamamoto M, Kitagawa C, Kumazawa A, Sato M, Shima K. Autologous blood-patch pleurodesis for secondary spontaneous pneumothorax with persistent air leak. Respir Med. 1999; 93: 432–4.
17. Jones NC, Curry P, Kirk AJ. An alternative to drain clamping for blood pleurodesis. Eur J Cardiothorac Surg. 2005; 27: 935-9.
18. Cao G, Kang J, Wang F, Wang H. Intrapleural instillation of Autologous blood for persistent air leak in spontaneous Pneumothorax in patients with advanced Chronic Obstructive Pulmonary Disease. Ann Thorac Surg. 2012; 93: 1652-7.
19. Shackcloth MJ, Poullis M, Jackson M, Soorae A, Page RD. Intrapleural instillation of autologous blood in the treatment of prolonged air leakafter lobectomy: a prospective randomized controlled trial. Ann Thorac Surg. 2006;82: 1052-6.
20. Droghetti A, Schiavini A, Muriana P, Comel A, De Donno G, Beccaria M. Autologous blood patch in persistent air leaks after pulmonary resection.J ThoracCardiovasc Surg. 2006;132:556–9.