ARTIGO ORIGINAL ORIGINAL ARTICLE

DEFINITIVE TREATMENT OF PRIMARY SPONTANEOUS PNEUMOTHORAX: A 10-YEAR EXPERIENCE

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Abstract

Objectives: *Primary spontaneous pneumothorax (PSP) is defined as a pneumothorax without obvious underlying lung disease. Definitive treatment should be offered to patients with recurrent or persistent PSP. The aim of this study was to compare the effectiveness of medical pleurodesis (MP) with video assisted thoracic surgery (VATS) on definitive treatment of PSP.*

Methods: *10 years' retrospective study of PSP patients that underwent VATS or MP. Baseline characteristics, perioperative and follow-up data were compared.*

Results: *A total of 133 patients were included (MP=54; VATS=79). Baseline characteristics were similar between groups, with a male predominance (MP 83.6 vs VATS 85.5%) with a mean age of 24.78 and 25.81 years old, respectively. Post interventional length of hospital stay was similar (MP 4.94 vs VATS 4.47 days, p=0.20), but chest tube duration was longer in the VATS group (MP 2.94 vs VATS 3.56 days, p=0.03). The overall complications rate was low with no statistically significant difference between groups (MP 5/54 vs VATS 7/79, p=1.00). Regarding the follow-up, MP had a significant higher PSP recurrence rate (MP 11.1% vs VATS 1.3%, p=0.042), most occurring over the first two years.*

Conclusion: *Despite both MP and VATS are safe methods with short hospital stay and few complications associated, the results of this study show that VATS had a significantly lower rate of recurrences. Overall, VATS should be offered as the first line treatment to patients with PSP.*

INTRODUCTION

Primary spontaneous pneumothorax (PSP), which is defined as a pneumothorax without obvious underlying lung disease, most commonly occurs in young (between 15-34 years old), tall, lean males.[1,2] This form of presentation has an incidence of 18-28 and 1-6 per 100,000 cases each year for men and women, respectively.[1] Furthermore, the recurrence rate is reported to range between 17% and 54% in the first year following the first episode.[3]

The precise pathogenesis behind PSP is not completely understood. However, blebs and bullae can be visualized ipsilaterally or bilaterally in almost all patients during surgery, medical thoracoscopy or CT scans. These changes visible on the visceral pleura have been called emphysema-like changes (ELCs), which are also recognized as a specific entity and it is generally believed that pneumothorax results from the rupture of ELCs.[3]

Although the management of persistent or recurrent PSP continues to be debated, it is consensual that it must include firstly, evacuation of air and secondly, prevention of recurrences by ways of medical pleurodesis (MP) or surgical approach. The medical pleurodesis is based on instilling a chemical irritant (usually talc) to achieve a pleural symphysis. The surgical approach includes more complex procedures such as resection of bullae or blebs, partial pleurectomy or mechanical abrasion and instillation of sclerosing agents to close the pleural space and prevent relapses.[1,2,4]

The aim of this study was to analyze the reality of PSP treatment at a tertiary center and to compare the effectiveness of talc poudrage under medical thoracoscopy with video assisted thoracic surgery (VATS).

METHODS

This was a retrospective single center study, in the period between January, 2008 and December, 2018. All the patients hospitalized with the diagnosis of PSP who underwent definite treatment for PSP (MP or VATS) were screened. The patients were admitted via emergency

department, either directly or referred by other hospitals.

Indications for definitive treatment were the following: recurrence of PSP, persisting air leak (>3–5 days), bilateral pneumothorax and professionals at risk (aircraft personnel, divers). Exclusion criteria included patients with evidence of lung disease, other secondary causes of pneumothorax and patients that had already been submitted to pneumothorax definitive treatment.

Simple talc poudrage was performed via single-port medical thoracoscopy under general anesthesia.Thoracoscopy was carried out in the lateral decubitus position. A 7-mm trocar was inserted into the fourth or fifth intercostal space in midaxillary line and a 0º optical telescope was inserted and connected to a video camera and monitor. The visceral pleura was carefully inspected using supplemental air insufflation when necessary. Sterile asbestos-free talc (2-4 g) was insufflated particularly to the apex. At the end of the procedure a chest drain (24 French gauge) was inserted through the sixth intercostal space in the midaxillary line and connected to underwater seal suction.

The standard surgical approach consisted of three port video-assisted intervention with lung exclusion, either by double lumen intubation or CO_2 inflation and general anesthesia. The procedure always included partial pleurectomy (PP). PP generally started at the level of the anterior incision using blunt dissection. The dissection is carried out until the edge of intercostal muscles posterior and one centimeter lateral of the internal thoracic artery to avoid damage to these structures. In the apex of the pleural cavity, the pleura is carefully dissected sparing the region of the subclavian artery and vein, again to avoid harm to these structures. Lung tissue with evidence of abnormalities, fistulae or blebs was resected. In the end one chest tube was inserted and connected to a water seal system.

For both groups, criteria for drain removal included the absence of clinical signs of air leak; less than 200cc of serous fluid drainage in the last 24 hours; and complete/acceptable lung expansion.

Clinical records were retrieved and analyzed. All available clinical (medical and nursing) records were reviewed for any mention of procedural or other medical complications. Outpatient files were also reviewed, in order to identify any readmissions or pneumothorax recurrences.

The primary outcome of the study was to compare the recurrence rate of PSP after MP or VATS intervention. Secondary outcomes included: baseline characteristics (age, gender, smoking status, and comorbid conditions) and perioperative data (complications secondary to intervention, post-interventional duration of chest drainage and length of hospital stay).

Categorical variables were presented as counts and percentages, and quantitative variables as means and standard deviation (SD). For group comparison, the chi-square test or Fisher's exact test for categorical variables were used. Student's T (parametric) or Mann-Whitney (nonparametric) tests were used for continuous variables.

Table 1 **Baseline characteristics of patients.**

Variables	MP group (n=54)	VATS group (n=79)	*p* value
Gender, male, n (%)	46 (83.6)	71 (85.5)	0.811
Age, mean (SD), years	24.7 (5.31)	25.8 (7.85)	0.401
Weight, mean (SD), kilograms	66.2 (10.03)	64.1 (10.55)	0.538
Height, mean (SD), meters	1.74 (0.08)	1.80 (0.06)	0.04
Risk factors			
Tobacco smoking, n (%)	24 (44.4)	57 (72.2)	0.02
Cannabis smoking, n (%)	2 (3.7)	11 (13.9)	0.07
Pre-existing conditions n (%)			0.44
Asthma	18,2%	22.9%	0.532
Rhinitis	9,1%	22.9%	0.041
Others	5 (9.3)	6 (7.6)	
Number of PSP events prior to definitive treatment n, (%)			0.018
0	24 (44.4)	32 (40.5)	
1	25 (46.3)	32 (40.5)	
2	3 (5.6)	9 (11.4)	
3 or more	2 (3.7)	6 (7.6)	
Time between the last and present PSP, mean (SD), months	11.7 (23.32)	16.2 (27.39)	0.419

Table 2 **Perioperative characteristics.**

Variables	MP group (n=54)	VATS group (n=79)	*p* value
Intervened side, right, n(%)	33 (61.1)	44 (55.7)	0.594
Indication			
Recurrence of PSP (ipsilateral)	24 (44.4)	10 (12.7)	-
Recurrence of PSP (contralateral)	5 (9.3)	35 (44.3)	-
Persisting air leak (>3–5 days)	24 (44.4)	33 (41.7)	-
First episode in professionals at risk	1 (1.9)	1 (1.3)	-
Complications, total, n(%)	5 (9.2)	7 (8.9)	1.0
Delayed lung expansion	1 (1.9)	3 (3.8)	0.646
Haemothorax	0	3 (3.8)	0.271
Nosocomial pneumonia	2 (3.7)	1 (1.3)	0.158
Other nosocomial infections	2 (3.7)	0	0.566
Post interventional chest tube duration, mean (SD), days	2.94 (1.188)	3.56 (2.105)	0.033
Post interventional length of hospital stay, mean (SD), days	4.94 (2.609)	4.47 (2.846)	0.271

Subsequently, a multivariate analysis of the selected variables was performed. A p value of <0.05 was considered significant. Statistical analysis was performed with Statistical Package for the Social Sciences (SPSS) 25. The study was approved by the Research Ethics Committee of *Centro Hospitalar Universitário Lisboa Norte*.

RESULTS

Between January, 2008 to December, 2018 a total of 133 patients with PSP underwent definitive treatment: 54 patients were submitted to MP and 79 underwent VATS. In the surgical group, most cases included PP with bleb resection and talc poudrage (n=75); only 2 cases were submitted to PP alone (n=2) and 2 cases of PP associated to bleb resection (n=2).

Patients' demographics are summarized in table 1. Most of the patients were young male patients (MP 83.6 vs VATS 85.5%, p=0.811) with an average age of 24.7 and 25.8 years old, respectively. Tobacco (MP 44.4 vs VATS 72.2%, p=0.02) and cannabis smoking (MP 3.7 vs VATS 13.9%, p=0.07) were more prevalent among the surgical group. Asthma was the most frequent comorbid condition in both groups (MP 18.5 vs VATS 22.8%, p=0.66), followed by chronic rhinitis (MP 9.3 vs VATS 22.8%, p=0.06). Marfan syndrome was also found in both groups (MP n=1 vs VATS n=3). Other comorbid diseases included: Rendu-Osler-Weber syndrome (n=1), epilepsy (n=1) and systemic lupus erythematosus (n=1) in MP group; Ehlen Danlos syndrome (n=1), hepatitis C (n=1) and alpha 1 antitrypsin deficiency (n=1) in the VATS group.

Perioperative data is described in Table 2. The most frequent intervened side was the right side in both groups (p=0.594). A significant higher post interventional chest tube duration was found in patients undergoing VATS (MP 2.94 vs VATS 3.56 days, p=0.03). However, there were no significant differences in post interventional length of hospital stay (MP 4.94 vs VATS 4.47 days, p=0.271).

During the postoperative course, the overall complication rate was low and there was no statistically significant difference between groups (MP 5/54 vs VATS 7/79, p=1.0). Delayed lung expansion was found in 1.9% of MP group and 3.8% in VATS group (p=0.646); the mean of chest drain duration was 5 and 10 days, respectively. Haemothorax only occurred in the VATS group in three (3.8%) patients, two needing re-intervention for significant bleeding.

Nosocomial pneumonia was found in two patients in MP group (with one case complicated with pleural effusion and bacteremia with Serratia marcescens isolation)

Table 3 **Pneumothorax recurrence.**

Variables	MP group (n=54)	VATS group (n=79)	*p* value
Recurrence rate, n(%)	6 (11.1)	1 (1.3)	0.042
Follow-up duration, mean (SD), years	6.57 (2.457)	6.47 (2.846)	0.832

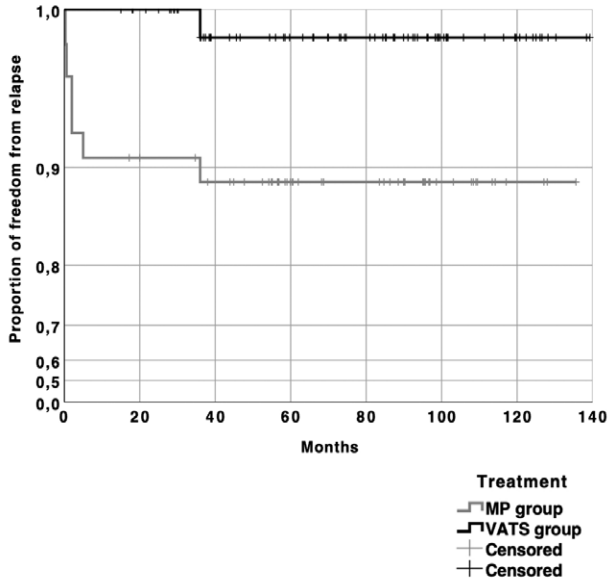

Figure 1 *Freedom from pneumothorax recurrence.*

and one case in the VATS group with no microbiological agent isolated. Other nosocomial infections were found in the MP group and included infection with no identified focus (n=1) and phlebitis associated to bacteremia to *Staphylococcus aureus* (n=1).

Regarding pneumothorax recurrence, a significant difference occurred between the groups: the MP group had 6 recurrences opposed to only one from the surgical group (MP 11.1% vs VATS 1.3%, p=0.042), as shown in table 3. Most recurrences occurred over the first two years (Fig 1). Median follow-up period was 6.57 (SD 2.457) years in the MP and 6.47 (SD 2.846) years in the VATS group.

DISCUSSION

The demographic characteristics present in this study were similar from those reported in the literature, with a predominance of young, tall, thin and male patients, in both groups.[4-9]

Asthma and chronic rhinitis were the most frequent underlying conditions. Although some studies categorized asthma to be a secondary cause of pneumothorax, in this study asthmatic patients were included, as there was no evidence of parenchymal pulmonary disease on CT scans, excepted for the presence of ELCs as the remaining cases of the study. The relationship between asthma and pneumothorax is not yet established. Also, no significant difference was found between groups regarding asthma prevalence. As asthma is a common disorder, pneumothorax and asthma can be coincidentally related rather than causally.[10] Further studies are needed to clarify this matter.

A large proportion of patients were active tobacco smokers. It is known that tobacco smoking is the most important risk factor of PSP.[3,9] Cannabis smoke shares common pathological processes and an overlapping spectrum of lung disease with tobacco smoking; nevertheless, cannabis has been demonstrated to be particularly associated with bullous disease.[11-13]

The main finding of our study is related to recurrence rates. Patients with PSP submitted to MP have a significantly higher recurrence rate comparing to surgery. These results are in line with previous studies that have already demonstrated recurrence rates around 5-7% for simple talc poudrage under medical thoracoscopy[14-17] and 1-2% for surgical treatment of lung lesions and pleurectomy.[18,19]

Although surgical treatment with VATS is the recommended first line for the definitive treatment of PSP in international guidelines[1,4], direct comparative trials are lacking. In clinical practice, a large proportion of patients are still submitted to MP. Talc poudrage under thoracoscopy is a a safe, cheap and very efficient agent for achieving pleurodesis with a fast recovery of the patients.[18] However, these arguments are surpassed by higher recurrence rates. The MP can be an acceptable approach for pneumothorax prevention in patients who wish to avoid surgery and for patients who present increased surgical risk (eg, bleeding diathesis).[4]

The lower rate of pneumothorax recurrence after surgery may be explained by the additional benefit of techniques such as pleurectomy, bullectomy and/or lung apex excision, associated to pleurodesis, in the prevention of further episodes.

All surgical interventions were video-assisted. In fact, VATS is associated with reduced complication rates and morbidity, short hospital stays and fast recovery. With these obvious and recognized advantages, thoracotomy is no longer acceptable for these procedures. The use of VATS, can explain the almost similar post-operative results between the two groups in terms of complications, and hospital stay. However, a significant difference was observed in chest tube duration in favor of MP.

Complications were minor and, even though two cases of pneumonia were observed in the MP group, a direct relation to the technique could not be established. No case of severe ARDS was reported.

This study has the inherent limitations of its retrospective nature. Information regarding patient refusal of surgery was not obtained but, it is also possible that MP was offered as an alternative procedure.

In conclusion, despite both talc poudrage under medical thoracoscopy and VATS are safe methods with short hospital stay and few complications associated, the results of this study show that surgical intervention had a significantly lower rate of recurrences. Overall, VATS should be offered as the first line treatment to patients with PSP.[1,4] In patients that are either too frail or who present increased surgical risk (eg, bleeding diathesis)and in situations where thoracic surgery is inaccessible, medical pleurodesis may be appropriate.[1,4]

REFERENCES

1. MacDuff A, Arnold A, Harvey J. Management of spontaneous pneumothorax: British Thoracic Society pleural disease guideline 2010. Thorax 2010; 65: Suppl. 2, ii18–ii31.
2. How CH, Hsu HH, Chen JS. Chemical pleurodesis for spontaneous pneumothorax. Journal of the Formosan Medical Association (2013) 112, 749e755
3. Tschopp JM, Bintcliffe O, Astoul P, Canalis E, Driesen P, Janssen J, et al. ERS task force statement: diagnosis and treatment of primary spontaneous pneumothorax. Eur Respir J 2015; 46: 321–335
4. Baumann MH, Strange C, Heffner JE, et al. Management of spontaneous pneumothorax: an American College of Chest Physicians Delphi consensus statement. Chest 2001; 119: 590–602.
5. Kelly AM, Clooney M. Deviation from published guidelines in the management of primary spontaneous pneumothorax in Australia. Intern Med J 2008; 38: 64–67.
6. Smit HJ, Chatrou M, Postmus PE. The impact of spontaneous pneumothorax, and its treatment, on the smoking behaviour of young adult smokers. Respir Med 1998; 92: 1132–1136.
7. Marquette CH, Marx A, Leroy S, et al. Simplified stepwise management of primary spontaneous pneumothorax: a pilot study. Eur Respir J 2006; 27: 470–476.
8. Gupta D, Hansell A, Nichols T, et al. Epidemiology of pneumothorax in England. Thorax 2000; 55: 666–671.
9. Bense L, Eklund G, Wiman LG. Smoking and the increased risk of contracting spontaneous pneumothorax. Chest 1987; 92: 1009–1012
10. Porpodis K, Zarogoulidis P, Spyratos D, Domvri K, Kioumis I, Angelis N, Konoglou M, et al. Pneumothorax and asthma. J Thorac Dis 2014;6(S1):S152-S161.
11. Beshay M, Kaiser H, Niedhart D, et al. Emphysema and secondary pneumothorax in young adults smoking cannabis. Eur J CardiothoracSurg 2007; 32: 834–838.
12. Johnson MK, Smith RP, Morrison D, et al. Large lung bullae in marijuana smokers. Thorax 2000; 55: 340–342.
13. Wu TC, Tashkin DP, Djahed B, et al. Pulmonary hazards of smoking marijuana as compared with tobacco. N Engl J Med 1988; 318: 347–351.
14. Gyorik S, Erni S, Studler U, Hodek-Wuerz R, Tamm M, Chhajed PN. Long-term follow-up of thoracoscopic talc pleurodesis for primary spontaneous pneumothorax. Eur Respir J 2007; 29: 757–760
15. Tschopp JM, Boutin C, Astoul P, et al. Talcage by medical thoracoscopy for primary spontaneous pneumothorax is more cost-effective than drainage: a randomised study. Eur Respir J 2002; 20: 1003–1009.
16. el Khawand C, Marchandise FX, Mayne A, et al. Pneumothorax spontane. Resultats du talcage pleural sous thoracoscopie [Spontaneous pneumothorax. Results of pleural talc therapy using thoracoscopy]. Rev Mal Respir 1995; 12: 275–281.
17. Boutin C, Viallat JR, Aelony Y. Practical Thoracoscopy. Heidelberg, Springer, 1991.
18. Cardillo G, Carleo F, Giunti R, Carbone L, Mariotta S, Salvadori L, Petrella L, Martelli M.Videothoracoscopic talc poudrage in primary spontaneous pneumothorax: A single-institution experience in 861 cases. J Thorac Cardiovasc Surg 2006;131:322-328
19. Ayed AK. Suction versus water seal after thoracoscopy for primary spontaneous pneumothorax: prospective randomized study. Ann ThoracSurg 2003; 75: 1593–1596.