Recurrence of primary spontaneous pneumothorax in young adults and children

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INTRODUCTION

Although the pathogenesis of primary spontaneous pneumothorax (PSP) is multifactorial, tall and thin body habitus, male gender and smoking are known risk factors. Most cases of PSP occur in healthy adolescents and young adults, but it is a relatively rare disease entity in children. Better nutritional support has resulted in faster growth rates among children [1]. Concurrently the occurrence of PSP has also been increasing in children.

At the time of the first episode, various therapeutic strategies such as observation, aspiration, closed thoracostomy and surgery can be employed depending on the size of the PSP and the presence of symptoms. However, the ideal approach for treatment of PSP remains controversial. Surgical treatment is associated with a low risk of recurrence, and some authors state that video-assisted thoracic surgery (VATS) should be the standard approach in cases of recurrence and should be considered for treatment at the first episode [2]. With advances in surgical technique and instruments, VATS has become safer and more effective, even in children. Despite these developments, recurrence of PSP is more frequent in adolescents than in young adults after surgical treatment [3].

Others state that non-surgical treatment such as observation, aspiration and closed thoracostomy will suffice for most patients with a first episode of PSP [4–6]. Regardless, the choice of treatment must not depend on the presence of bullous lesions or on whether the PSP is first-time or recurrent, but on the effectiveness of the treatment [7]. The goal of treatment for PSP is to manage the acute episode and prevent recurrence with minimal morbidity.

There has been no research regarding the occurrence and recurrence of PSP in young adults and children. And there is no consensus about the use of surgery for the management of PSP in young adults. Some authors claim that the choice of treatment should depend on the age of the patient [8–10]. Others have recommended that VATS should be the standard approach in cases of primary spontaneous pneumothorax (PSP) in young adults [11].

METHODS

A total of 840 patients were treated for pneumothorax at our hospital from January 2006 to December 2010. Exclusion criteria for this study were age >25 or secondary, traumatic or iatrogenic pneumothorax, and a total of 517 patients were included. Patients were classified into three groups according to age at the first episode of primary spontaneous pneumothorax: Group A: ≤16 years; Group B: 17–18 years and Group C: ≥19 years.

RESULTS: The study group was composed of 470 male and 47 female patients. There were 234 right-sided, 279 left-sided and 4 bilateral primary spontaneous pneumothoraces. Wedge resection by video-assisted thoracic surgery was performed in 285 patients, while 232 were managed by observation or closed thoracostomy. In the wedge resection group, 51 patients experienced recurrence. The recurrence rates after wedge resection were 27.9% in Group A, 16.5% in Group B and 13.2% in Group C (P = 0.038). The recurrence rates after observation or closed thoracostomy were 45.7% in Group A, 51.9% in Group B and 47.7% in Group C (P = 0.764).

CONCLUSIONS: In the present study, postoperative recurrence rates were higher than those in the literature. Intense and long-term follow-up was probably one reason for the relatively high recurrence rate. The recurrence rate after wedge resection in patients aged ≤16 years was higher than that in older patients. There was no difference between the recurrence rates after observation or closed thoracostomy, regardless of age. These results suggest that wedge resection might be delayed in children.

Keywords: Primary spontaneous pneumothorax • Recurrence • Young adult • Children
MATERIALS AND METHODS

From January 2006 to December 2010, 840 patients were treated for pneumothorax at our hospital. Patients who were ≥25 years old or had secondary, traumatic or iatrogenic pneumothorax were excluded. A total of 517 patients were eligible for inclusion in the study. The medical records and operative notes of these patients were reviewed. Most patients presenting with a postoperative recurrence were referred to our institution; for patients who never showed recurrence or who experienced recurrence but were referred to another centre, the follow-up information was obtained via the outpatient clinic or by a telephone survey. The patients were followed up until May 2014.

The patients included in our study were classified into three groups according to age at the first episode of PSP: Group A, ≤16 years; Group B, 17–18 years and Group C, ≥19 years. Group A consisted of 114 patients (22.1%), Group B, 180 patients (34.9%) and Group C, 223 patients (43.2%).

We diagnosed pneumothorax by chest radiography; computed tomography (CT) scan of the chest was performed in all patients. The treatment was based on symptoms and radiological findings and included high-flow oxygen inhalation therapy, closed thoracostomy and wedge resection by VATS. The size of the pneumothorax was quantified by the Light index: the Light index calculates the volume in cubes of the average lung diameter and the average thorax was quantified by the Light index: the Light index calculates the volume in cubes of the average lung diameter and the average thorax diameter. Pneumothorax ≥20% on chest radiographs was treated with oxygen inhalation therapy, closed thoracostomy and included high-flow oxygen inhalation therapy, closed thoracostomy and wedge resection by VATS. After surgery, the chest tube (20 Fr) was connected to an underwater seal drainage bottle. Suction (−10 to −20 cm of H₂O) was applied to the chest drain first and then the suction was disconnected when there was no air leak on coughing or the Valsalva manoeuvre. The chest tube was removed after the air leak had stopped for at least 48 h.

If air leaks persisted for 4 days, bullae or blebs were seen on CT scans, or ipsilateral pneumothorax recurred, wedge resection by VATS was performed. The wedge resection was performed using staplers. After surgery, the chest tube (20 Fr) was connected to an underwater seal drainage bottle. Suction (−10 to −20 cm of H₂O) was applied to the chest drain first and then the suction was disconnected when there was no air leak on coughing or the Valsalva manoeuvre. The chest tube was removed after the air leak had stopped for at least 48 h.

Recurrent pneumothoraces were confirmed by a pleural line on upright posteroanterior chest X-ray.

Patients were further divided into groups according to treatment. The non-surgical group consisted of patients who were treated with supplemental oxygen therapy and closed thoracostomy.

Descriptive statistics are expressed as means ± standard deviation values unless otherwise specified. Continuous variables were compared using Student’s t-test. Categorical variables were compared using the χ² test. Probabilities of recurrent PSP were analysed using the Kaplan–Meier method. A P-value of < 0.05 was considered statistically significant. Statistical analyses were performed using SPSS version 20.0 (SPSS, Chicago, IL, USA).

RESULTS

The study group was composed of 470 male and 47 female patients. There were 234 right-sided PSPs, 279 left-sided PSPs and 4 bilateral PSPs. Wedge resection by VATS was performed in 285 patients. Wedge resections were performed because of persistent air leak or visible bullae on CT scan in 182 patients, and because of recurrent PSP in 103 patients. The resection margin was covered with surgical glue or sheets in 151 patients (53.0%), and mechanical or chemical pleurodesis was performed in 146 patients (51.2%). Furthermore, in 97 patients (34.0%) both coverage and pleurodesis were performed, and in 85 patients (29.8%) neither coverage nor pleurodesis was performed. The non-surgical group consisted of 232 patients; 52 were treated with supplemental oxygen therapy and 180 were treated by closed thoracostomy. In the surgical (wedge resection) group, 51 patients (17.9%) experienced recurrence and in the non-surgical group, 113 patients (48.7%) experienced recurrence.

There were no differences between sides of pneumothorax in all groups (Table 1).

The recurrence rate according to age in the non-surgical group was 45.7% in Group A, 51.9% in Group B and 47.7% in Group C (P = 0.764). The recurrence rates after wedge resection were 27.9% in Group A, 16.5% in Group B and 13.2% in Group C (P = 0.038) (Table 1).

The body mass index (BMI) of Group C in the non-surgical group was higher than that of the other groups, but there were no differences in BMI according to age in the wedge resection group (Table 1) and there was no apparent relationship between BMI and recurrence (Tables 2 and 3). Recurrence was more common in male patients in the wedge resection group (Table 3).

The probabilities of recurrent PSP increased by up to 23.0% after 5 years in the non-surgical group and up to 16.5% after 5 years in the surgical group (P = 0.000) (Fig. 1). Probabilities for recurrent PSP were significantly different according to age in the surgical group (P = 0.022), while there were no significant differences in the probabilities for recurrent PSP according to age in the non-surgical group (P = 0.738) (Fig. 2).
Recurrence rates after surgery for PSP range between 2–14% [8]. However, it appears that recurrence of PSP after surgery is more frequent in children than in adolescents or young adults. The reported recurrence rate in adolescents was significantly higher than in young adults (10.6 vs 3.9%) [7]. In that study, new bullae were found in all cases in the adolescent group but in only 4 cases in the young adult group [7]. Our data were similar, but our study group had a higher rate of recurrence after wedge resection because it included younger patients.

Most recurrences after closed thoracostomy occur within 6 months to 2 years after the initial episode [9–11]. Massongo reported a recurrence rate after observation alone for small PSP of 33.3% in 1 year, while recurrence rates after small-bore catheter treatment and surgery were 15.8 and 0%, respectively, in 1 year, and they proposed that the first episode of PSP could be treated by outpatient management [12]. Lee et al. [5] found that the success rates of aspiration and closed thoracostomy as primary treatments were 78 and 67%, respectively. They concluded that conservative treatment including observation, thoracentesis and thoracostomy could be suitable for most patients with first episode PSP [5]. In our study, there was no difference in probabilities for recurrent PSP according to age (P = 0.738) in the non-surgical group. However, there was a difference in probabilities for recurrent PSP according to age in the surgical group (P = 0.022) (Fig. 2). Lopez et al. [13] recommended non-surgical treatment as the initial management for paediatric patients, because primary VATS resulted in an increased quality-adjusted life expectancy 1 year after treatment compared with the closed thoracostomy group.

Growth rates have been shown to differ in individuals of ages from 13 to 25 years old: for individuals younger than 16 years, growth rates are higher than those in 17- and 18-year olds, and remain steady in individuals over the age of 19 years [1]. Growth during adolescence causes a rapid increase in the vertical dimension of the thorax compared with the horizontal dimension, causing an increase in negative pressure at the apex of the lung, which may lead to formation of subpleural blebs or fluid-filled cysts that can cause PSP upon rupturing [14]. This may also contribute to higher recurrence rates after wedge resection in younger patients. Similarly, the lower prevalence of PSP in adolescent or young adult females might be related to a steadier pattern of growth.

Our data showed that the recurrence rate after non-surgical management was similar among all age groups, but the recurrence rate after surgery was significantly higher in younger patients than in the older groups. We thought that surgery for young patients with PSP could be delayed for some years.

The postoperative recurrence rate in this study was higher than that in the literature. Intense and long-term follow-up was probably one reason for the relatively high recurrence rate. We strictly defined even extremely small postoperative pneumothoraces as recurrence. Since all patients received the follow-up care by clinic visits or telephone consultations more than once a year, we minimized the dropout rate and approached near to the actual recurrence rate.

We had believed that observation and closed thoracostomy were similar because these two treatments did not manipulate the bullae that were the cause of pneumothorax. We focused on the recurrence rates of a non-surgical approach and surgical approach according to age. Indeed, the recurrence rates of observation and closed thoracostomy were different. Fifteen patients (28.8%) experienced recurrence among the 52 patients of the observation group, while 98 patients (54.4%) experienced recurrence among the 180 patients of the closed thoracostomy group in our study.
A number of algorithmic approaches have been proposed and in the majority of them, a more invasive surgical approach is indicated for recurrence or for the presence of persistent air leak [5, 8, 15]. When surgery for pneumothorax is planned, pleurectomy, mechanical abrasion and chemical pleurodesis in addition to ligation of bullae or apical resection might reduce the recurrence rate [16]. With regard to paediatric surgery, wedge resection plus pleurodesis provides not only the shortest length of hospital stay but also the lowest recurrence rates [17]. In our study, an additional procedure, such as coverage is performed routinely but pleurodesis is not performed routinely. Pleurodesis is performed when the underlying lung is emphysematous or unhealthy. In one study, there was a difference between the simple wedge group and the additional procedure group. However, there was no difference between the coverage group and the pleurodesis group [18].

Recurrence was associated with the type, number and distribution of bullae at the first episode, but was not associated with the size of the first PSP [19]. As prolonged air leak and the need for surgery were more common in patients with >50% pneumothorax, surgery should be considered as an immediate option at their first episode of PSP in these patients [20]. Martinez-Ramos et al. did not find an association between the presence or absence of bullae, even on CT scans, and recurrence of PSP. They did not recommend surgery according to the presence of bullae on CT scans [21]. Sahn et al. concluded that the presence of bullae should not guide decision-making regarding prevention of recurrence [15].

However, a CT scan has been shown to be considerably more sensitive than simple chest X-ray for the detection of such bullae, and their presence on the CT scan could represent a greater risk of recurrence after an initial episode of PSP [18, 20]. Additionally, a CT scan provides more detailed information with use in subsequent management [8]. The findings that can be noted on CT scan include the number, size and location of bullae, as well as possibilities of pleural adhesion, pleural fluid accumulation and underlying pulmonary disease [8]. The risk would be not as high when patients are checked by CT scan of low radiation dose. The benefit of a CT scan would outweigh its risk.

In our study, the recurrence rate after wedge resection in children was higher than that of adolescents and young adults. There was no difference between the recurrence rates after observation or closed thoracostomy regardless of age. These results suggest that wedge resection might reasonably be delayed in children.

**Conflict of interest:** none declared.

**REFERENCES**


showed a higher recurrence rate of PNX after surgery in patients aged ≤ 16 years.


eComment. Postoperative recurrence of spontaneous pneumothorax in younger patients: is it a matter of age, lung apex dystrophy or just a difficult air leak valuation through “a hole in a thorax” in video-assisted thoracic surgery?

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We read with great interest the article by Noh et al. [1], analyzing the recurrence of primary spontaneous pneumothorax (PNX) and the efficacy of video-assisted thoracic surgery (VATS) in the treatment of young adults and children. The Authors’ data showed a higher recurrence rate of PNX after surgery in patients aged ≤ 16 years than in older ones. Therefore, they suggested that VATS wedge-resection might be delayed in children.

However, it would be interesting to know how the 85 patients (29.8%) in the study, who received neither pleurodesis nor coverage with surgical glue, were distributed among the three groups (≤16 years, 17-18 years and ≥19 years). While there was no difference between coverage and pleurodesis in terms of PNX recurrence, there would have been a difference if coverage or pleurodesis had not been performed. Furthermore, it would be useful to know if there were dystrophy of lung apex and postoperative air leaks in patients aged ≥16 years and if there were any significant differences between the groups with respect to these risk factors. In fact, early onset of PNX in younger patients could be justified by a greater dystrophy of lung apex, due to a different growth rate in this age group, which could explain a possible prolonged air leak after surgery and consequently, a PNX recurrence. Recently, Imperatori and co-workers [3] in a well-conducted retrospective study, identified prolonged air leakage to be an important risk factor for postoperative recurrence of PNX treated by VATS. The Authors also underlined how air leakage tests are sometimes difficult to interpret during VATS, deceiving surgeon into overlooking leaking bullae [4,5]. With regards to this point, although VATS is considered the standard treatment of primary PNX, several meta-analyses [6,7] comparing the different surgical approaches for treatment of spontaneous PNX showed an increase in PNX recurrence when a video-assisted approach was performed compared with thoracotomy approach. Therefore, the higher recurrence rate of PNX after surgery in younger patients found by Noh and co-workers [1] is probably not strictly an age problem but rather, a matter of lung apex dystrophy, prolonged air leak or difficult air leak valuation in VATS especially in smaller thoracic cavities.

Based on the data reported, we would really appreciate the Authors’ reflections and reaction on the aspects debated.

Conflict of interest: none declared.

References


