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Outcomes of Contralateral Bullae in Primary Spontaneous Pneumothorax

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Background: The management of contralateral bullae incidentally found in radiological studies is controversial, largely due to the unpredictability of the natural course of incidentally found contralateral bullae. This study aimed to identify the factors associated with the contralateral occurrence of primary spontaneous pneumothorax (PSP), and to characterize the outcomes of contralateral bullae incidentally found in radiological studies. ***Methods:*** From January 2005 to December 2008, 285 patients were admitted to our institution for PSP, and the patients underwent follow-up until August 2012. The relationships between the following variables and contralateral pneumothorax occurrence were evaluated: age, sex, smoking history, body mass index, ipsilateral recurrence, ipsilateral bullae size, the number of ipsilateral bullae, contralateral bullae size, and the number of contralateral bullae. ***Results:*** The study group consisted of 233 males and 29 females. The mean age and mean body index of the patients were 23.85± 9.50 years and 19.63±2.50 kg/m^2. Contralateral PSP occurred in 26 patients. The five-year contralateral PSP occurrence- free survival rate was 64.3% in patients in whom contralateral bullae were found. ***Conclusion:*** The occurrence of contralateral PSP was associated with younger age, ipsilateral recurrence, and the presence of contralateral bullae. Contralateral PSP occurrence was more common in young patients and patients with recurrent PSP. Single-stage bilateral surgery should be considered if an operation is needed in young patients, patients with recurrent pneumothorax, and patients with contralateral bullae.

Key words: 1. Pneumothorax
2. Computed tomography

INTRODUCTION

Primary spontaneous pneumothorax (PSP) occurs when blebs or bullae are ruptured in a patient without known pulmonary disease. Young, tall, and lean males, particularly smokers, suffer from PSP. Various therapeutic strategies, such as observation, needle or small catheter aspiration, closed thoracostomy with or without pleurodesis, and surgical strategies such as bullectomy, can be used to treat PSP, depending on the size of the pneumothorax and the presence of symptoms. Surgery may be indicated if the pneumothorax is complicated by persistent air leakage, failure of the lung to re-expand, or hemothorax. Bilateral and tension pneumothorax may also be indications for surgery. These surgical indications for PSP have been securely established; however, they focus on a single side of the lungs.

The management of contralateral bullae incidentally found in radiological studies is controversial, with proposed strategies ranging from simple observation to surgical interventions, such as bullectomy. The main reason for this contro-

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Table 1. Patient characteristics

Characteristic	Value
Sex (male:female)	233:29 (88.9:11.0)
Age (yr)	23.85±9.50
Body mass index (kg/m^2)	19.63±2.50
Smoking	87 (33.2)
Location of lesion (right:left)	136:126 (51.9:48.1)
Presence of contralateral bullae on computed tomography scan	32 (12.2)
Treatment of ipsilateral pneumothorax	
Observation or high-oxygen therapy	7 (2.7)
Closed thoracostomy	70 (26.7)
Bullectomy via video-assisted thoracic surgery	183 (69.9)

Values are presented as number (%) or mean±standard deviation.

versy is the unpredictable natural course of incidentally found contralateral bullae. Moreover, the choice of surgical strategy is based on patient preference, which may reflect economic concerns, such as time away from work and medical cost. The argument against surgery is that most patients do not experience contralateral pneumothorax, and therefore may incur unnecessary surgical risk. No consensus exists regarding the management of contralateral bullae incidentally found in radiological studies. This study attempts to identify the factors associated with the contralateral occurrence of PSP, and to characterize the outcomes of contralateral bullae incidentally found in radiological studies.

METHODS

From January 2005 to December 2008, 285 patients were admitted to our institution for PSP. Chest computed tomography (CT) scans were performed if the air leak persisted for three days, and such patients were considered for surgery to treat PSP. CT scans was performed in 262 patients, and all of those patients were enrolled in this retrospective study. All medical records and operative notes were reviewed. Most patients with postoperative recurrence were referred to our institution, while other patients were referred to another center. In such cases, follow-up information was obtained from the outpatient clinic that the patient attended or via a telephone survey. The patients underwent follow-up until August 2012.

CT scans were performed using a 16-slice multi-detector CT scanner (Somatom Sensation 16; Siemens Medical Solutions, Erlangen, Germany). The images were acquired with a slice thickness of 5 mm.

We reviewed the patients' characteristics, imaging findings, and the natural course of the contralateral bullae. We defined blebs as small (<2 cm) subpleural collections of air contained within the visceral pleura, and bullae were defined as resulting from alveolar wall destruction. In this study, both blebs and bullae were referred to as bullae. The relationships of the following factors with contralateral pneumothorax occurrence were investigated: age, sex, smoking history, body mass index, ipsilateral recurrence, ipsilateral bullae size, the number of ipsilateral bullae, contralateral bullae size, and the number of contralateral bullae. No age criterion was implemented in this study. Patients' age and the number and size of the bullae were treated as continuous variables. Descriptive statistical parameters were expressed as mean±standard deviation, unless otherwise specified. Kaplan-Meier analysis was used to analyze freedom from the occurrence of contralateral pneumothorax. Cox regression analysis was used to evaluate risk factors for the occurrence of contralateral pneumothorax by estimating the corresponding hazard ratios. All p-values <0.05 were considered to indicate statistical significance. Statistical analysis was performed using IBM SPSS ver. 20.0 (IBM Co., Armonk, NY, USA).

RESULTS

The study group consisted of 233 males and 29 females. Their mean age and mean body index were 23.85±9.50 years and 19.63±2.50 kg/m^2, respectively. Eighty-seven patients (33.2%) were smokers.

Bullectomy via video-assisted thoracic surgery (VATS) for PSP was performed in 183 patients. Closed thoracostomy was performed in 72 patients, and seven patients underwent observation with high levels of oxygen. Ipsilateral pneumothorax recurred in 54 of the 262 patients (20.6%) (Table 1). Table 2 presents the size and the number of the bullae. The median interval between the occurrence of pneumothorax and contralateral occurrence was 51.98 months.

Of the 183 patients who underwent bullectomy, ipsilateral pneumothorax recurred in 25 patients (13.7%). Contralateral

Table 2. The size and quantity of bullae

	Ipsilateral bullae	Contralateral bullae
Size (mm)	12.2±9.5	7.1±3.5
Quantity (N)		
1	95	16
2	54	12
3	30	4
4	7	-

Table 3. Clinical courses of pneumothorax

Outcomes	No. (%)
Ipsilateral recurrence	54/262 (20.6)
Ipsilateral recurrence after bullectomy	25/183 (13.7)
Contralateral occurrence	26/262 (9.9)
Contralateral occurrence with bullae	12/32 (37.5)
Contralateral occurrence without bullae	14/230 (6.1)

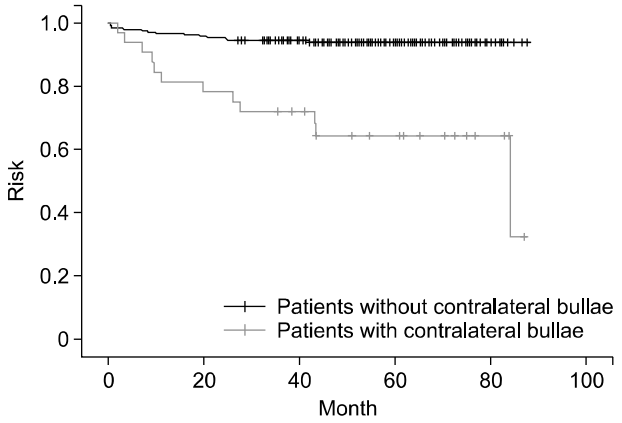

Fig. 1. Freedom from the occurrence of contralateral pneumothorax. The rate of five-year freedom from contralateral occurrence was 64.3% in patients with contralateral bullae. The rate of five-year freedom from contralateral occurrence was 93.8% in patients with no contralateral bullae (p=0.000).

pneumothorax occurred in 26 of the 262 patients (9.9%) (Table 3). Incidentally found contralateral bullae were observed in the CT scans of 32 patients, and the contralateral pneumothorax occurred in 12 of those patients (37.5%) (Table 1).

The rate of five-year freedom from contralateral occurrence was 64.3% among patients with contralateral bullae. In contrast, contralateral pneumothorax occurred in 14 patients with no contralateral bullae (6.1%). The rate of five-year freedom from contralateral pneumothorax occurrence was 93.8% among patients with no contralateral bullae (p=0.000) (Fig. 1).

The occurrence of contralateral pneumothorax was associated with younger age, ipsilateral recurrence, and contralateral bullae (Tables 4, 5). Bullectomy was performed in 19 patients, and closed thoracostomy was performed in seven patients to treat the occurrence of contralateral pneumothorax.

DISUCSSION

PSP occurs in 18–28 per 100,000 males and 1.2–6.0 per 100,000 females [1]. Some patients experience contralateral PSP. The rate of contralateral occurrence has been reported to range from 5% to 15%, and the rate of contralateral occurrence in patients in whom contralateral bullae were found in CT imaging was 26.7% [2-4]. Furthermore, the rate of contralateral occurrence after unilateral operations has been reported to range from 18% to 50% [5]. In this study, contralateral bullae were radiologically found in 12.2% of patients, and the contralateral PSP occurrence rate was 9.9%. In contrast, the rate of contralateral PSP occurrence in the non-bullous patients was 6.5%. Therefore, some authors have argued that in cases of relapse, surgery or pleurodesis is called for in patients without significant contraindications [2].

The treatment of PSP includes observation, needle or small catheter aspiration, closed thoracostomy with or without pleurodesis, and surgical treatments such as bullectomy. After surgical treatment, the recurrence rate has been reported to be $<5\%$ [6]. In this study, we found a high incidence of recurrence, and further studies should be performed to establish strategies for reducing the recurrence rate. If surgical treatment is considered for a patient, a CT scan is essential. CT scans are a very useful diagnostic tool for the proper management of PSP and for preventing recurrence [7]. CT scans demonstrate the number, location, and size of bullae in both affected and unaffected lungs. Moreover, surgical operations were performed based on these findings. CT can help determine the appropriate method of treatment, provide guidance during surgical treatment, and establish the presence of bullae as a possible cause of recurrent pneumothorax [8]. Bulging bullae and bullae without surrounding local fibrosis

Table 4. Effect of patient characteristics on contralateral pneumothorax occurrence using univariate Cox regression

Factor	Hazard ratio (95% confidence interval)	p-value
Age	0.874 (0.793-0.964)	0.007
Sex	0.319 (0.043-2.357)	0.263
Body mass index	0.879 (0.759-1.017)	0.083
Smoking	0.462 (0.174-1.225)	0.121
Lesion location	0.808 (0.372-1.754)	0.590
Presence of ipsilateral bullae	2.284 (0.787-6.628)	0.129
Quantity of ipsilateral bullae	1.140 (0.714-1.820)	0.583
Size of largest ipsilateral bulla	0.965 (0.911-1.021)	0.216
Recurrence of ipsilateral pneumothorax	7.160 (3.244-15.800)	<0.001
Presence of contralateral bullae	6.613 (3.047-14.354)	<0.001
Quantity of contralateral bullae	1.203 (0.504-2.870)	0.677
Size of largest contralateral bulla	0.965 (0.824-1.130)	0.661

Table 5. Effect of patient characteristics on contralateral pneumothorax occurrence using multivariate Cox regression

Factor	Hazard ratio (95% confidence interval)	p-value
Age	0.907 (0.826-0.996)	0.042
Recurrence of ipsilateral pneumothorax	3.812 (1.601-9.077)	0.003
Presence of contralateral bullae	3.882 (1.685-8.943)	0.001

in CT scans have been found to be associated with a high recurrence rate, and the number and size of bullae has been found to be associated with recurrence [9].

In contrast, the presence of bullae in CT scans has been found to have no relation with recurrence [10,11]. Furthermore, the number and size of the bullae have not been found to be associated with recurrence [12]. Similarly, many controversies exist regarding the treatment of PSP. Our study was designed to address these issues.

In a previous study, simultaneous bilateral surgery to treat contralateral bullae incidentally found in CT scans had no additional risk and led to good outcomes [13]. Evidence of the contralateral bullae in CT scans for underweight patients (body mass index <18.5 kg/m^2) is an indication for single-stage bilateral surgery [5]. Single-stage bilateral surgery has been recommended because it involves no additional surgical risk and has been shown to prevent recurrence.

It is likely that bullous lesions are independent risk factors for developing PSP, because PSP occurs even in normal- appearing lungs. It is unclear if an additional bullectomy should be performed in PSP patient [14]. In a previous study, bullous lesions appeared to be related to the occurrence of PSP, but not recurrence [15]. The choice of treatment should not depend on the presence of bullous lesions or presentation with first-time or recurrent spontaneous pneumothorax, but on the effectiveness of the treatment [15]. A previous study did not recommend surgery for PSP, because the presence, size, or number of bullae on CT scans had no effect on the recurrence rate [12]. The presence of bullae is not a significant predictive sign for contralateral pneumothorax [4]. Surgery for pneumothorax may involve some complications, and doubts still exist regarding bilateral surgery [4]. Moreover, the presence of bullae in CT scans has been found to have no predictive value for recurrence [11,12].

VATS has been recommended as the initial treatment of PSP due to its low recurrence rate [16]. However, the spontaneous resolution of air leaks has been observed in the majority of cases of PSP up to 15 days after occurrence [17]. In this study, the overall incidence of contralateral pneumothorax was 10.8%, and while the incidence of contralateral pneumothorax in patients with contralateral bullae was 37.5%. The rate of five-year freedom from contralateral occurrence was 64.3%. In contrast, the rate of five-year freedom from contralateral occurrence in patients with no bullae was 93.3%.

Surgical intervention was considered for incidentally found unruptured bullae, and we incorporated socioeconomic factors into our decision-making process.

The requirements for and timing of surgical interventions for pneumothorax have been investigated recently, but still remain a matter of debate. We suggest that single-stage bilateral surgery should be considered, if an operation is needed in young patients, patients who have experienced recurrent pneumothorax, and patients with contralateral bullae. However, further studies are required to investigate the benefits, risks, and timing of prophylactic treatment.

In conclusion, the contralateral occurrence of PSP is significantly more common in young patients and patients with recurrent PSP. Moreover, patients with contralateral bullae have a significantly higher incidence of PSP. Therefore, single-stage bilateral surgery might be beneficial for young patients, patients with recurrent pneumothorax, and patients with contralateral bullae. Further studies focusing on the benefits, risks, and timing of prophylactic treatment are required.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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