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An Exploration of the Treatment of Spontaneous Progressive Hemopneumothorax in Young People

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Abstract: *Objective:* To explore an effective treatment for spontaneous progressive hemopneumothorax in young people. *Methods:* Thirty-four young patients with spontaneous progressive hemopneumothorax from January 2018 to December 2019 were selected to be included in the control group for retrospective analysis; from January 2020 to December 2021, 69 young patients with spontaneous progressive hemopneumothorax were selected to be included in the study group. The control group was treated with double-port thoracoscopic bullectomy, whereas the study group was treated with single-port thoracoscopic bullectomy. The intraoperative blood loss, operation time, tube retention time, VAS score, postoperative air leakage, and 1-year recurrence of the patients in the two groups were observed and analyzed. *Results:* The perioperative conditions of the patients in the study group, including intraoperative bleeding loss, operation time, tube retention time, and VAS scores, were 15.12 ± 1.36, 54.69 ± 18.78, 2.14 ± 0.98, and 3.25 ± 0.14, respectively. The perioperative conditions of the patients in the control group, including intraoperative bleeding loss, operation time, tube retention time, and VAS scores, were 22.69 ± 2.01, 55.36 ± 19.01, 4.21 ± 1.01, and 5.36 ± 0.45, respectively; other than the operation time, the differences in intraoperative blood loss, tube retention time, and VAS scores between the two groups were statistically significant ($p < 0.05$); after the surgery, two patients in the study group had postoperative air leakage, accounting for 2.90% and another two patients had recurrence one year after the surgery, accounting for 2.90%; on the other hand, three patients in the control group had postoperative air leakage, accounting for 8.82%, and two patients had recurrence one year after the surgery, accounting for 5.88%. However, χ^2 test showed that $p > 0.05$. *Conclusion:* Treatment of spontaneous progressive hemopneumothorax in young people is better with single-port thoracoscopic bullectomy than with two-port thoracoscopic bullectomy, which effectively reduces intraoperative bleeding. The pain level is significantly better with single-port thoracoscopic bullectomy than with two-port thoracoscopic bullectomy, and the prognosis of patients is good with a low probability of recurrence for both, single- and two-port thoracoscopic bullectomy.

Keywords: Spontaneous progressive hemopneumothorax; Single-port thoracoscopic pulmonary bulla resection; Double-port thoracoscopic pulmonary bulla resection

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1. Introduction

In 1819, the concept of spontaneous pneumothorax was originally proposed by Laënnec, who defined it as when air enters between the chest wall and the lung of the human body without the influence of exogenous factors and is then stored in the pleural cavity. Spontaneous pneumothorax can be diagnosed by imaging. At the same time, clinical signs and symptoms can be used as the standard for diagnosing spontaneous pneumothorax. After the proposal of this concept, the research on spontaneous pneumothorax has been further developed, dividing it into spontaneous pneumothorax and secondary pneumothorax. According to current research results, primary spontaneous pneumothorax (PSP) mainly occurs in young or middle-aged people. Healthy young people who are thin and tall without any underlying lung diseases have the highest incidence rate of primary spontaneous pneumothorax. The diagnostic criteria of PSP are obvious, and its symptoms are simple to identify. In treating this condition, no matter what treatment method is used, its mortality is low, but the possibility of postoperative recurrence of PSP is high. Experimental data have shown that in most patients with PSP, recurrent pneumothorax occurs within 1 year after surgery; hence, all current treatments for PSP must ensure good therapeutic effect, control the postoperative recurrence rate, eliminate the etiology, and promote lung revascularization [1-7].

Although there are various ways to treat primary spontaneous pneumothorax, there is controversy in the treatment effect. Each treatment method has certain advantages and prominent treatment effect. Therefore, this study used the single- and two-port thoracoscopic bullectomy as the basis to treat the condition and analyzed the treatment effects of the two methods, so as to identify the best treatment for primary spontaneous pneumothorax, which would solve the problem of treating young people affected by primary spontaneous pneumothorax.

2. Methods

2.1. Study population

Thirty-four young patients with spontaneous progressive hemopneumothorax from January 2018 to December 2019 were selected to be included in the control group for retrospective analysis. The average age of the patients was 29.63 ± 2.96. Since January 1, 2021, the hospital has upgraded its technology for treating spontaneous progressive hemopneumothorax. From January 2020 to December 2021, 69 young patients with spontaneous progressive hemopneumothorax were selected to be included in the study group. The average age of the patients was 31.23 ± 3.01. There were no statistical differences in the general data of the patients between the two groups. The clinical data of all the patients involved in the study were complete and met the clinical criteria of spontaneous progressive hemopneumothorax.

2.2. Study design

In the control group, two-port thoracoscopic bullectomy was used, the operation room was arranged before surgery, and the family members of the patients had also signed the surgical consent form. The experimental group, on the other hand, underwent single-port thoracoscopic bullectomy, and similar to the control group, the operating room was arranged before surgery, and the family members of the patients had signed the surgical consent form.

2.3. Outcomes

The intraoperative blood loss, operation time, tube retention time, VAS score, postoperative air leakage, and 1-year recurrence were observed and analyzed.

2.4. Statistical analysis

SPSS 25.0 was used to analyze the data. The count and measurement data were expressed in n/% and $\bar{x} \pm s$, respectively. Chi-square (χ^2) test and t-test were performed, and $p < 0.05$ was considered as statistically significant.

3. Results

3.1. Intraoperative blood loss, operation time, tube retention time, and VAS score

The perioperative conditions of the patients in the study group, including intraoperative blood loss, operation time, tube retention time, and VAS score, were 15.12 ± 1.36, 54.69 ± 18.78, 2.14 ± 0.98, and 3.25

± 0.14, respectively. On the other hand, the perioperative conditions of the patients in the control group, including intraoperative blood loss, operation time, tube retention time, and VAS score, were 22.69 ± 2.01, 55.36 ± 19.01, 4.21 ± 1.01, and 5.36 ± 0.45, respectively. Except for the operation time, the differences in intraoperative blood loss, tube retention time, and VAS score were statistically significant ($p < 0.05$) between the two groups, as shown in **Table 1**.

Table 1. Comparison of intraoperative blooding loss, operation time, tube retention time, and VAS score between the two groups

Group	**Intraoperative blood loss (ml)**	**Operation time (min)**	**Retention time (days)**	**VAS score**
Study group (n = 99)	15.12 ± 1.36	54.69 ± 18.78	2.14 ± 0.98	3.25 ± 0.14
Control group (n =34)	22.69 ± 2.01	55.36 ± 19.01	4.21 ± 1.01	5.36 ± 0.45
t	31.3626	0.1696	9.9798	35.7461
p	0.0000	0.8657	0.0000	0.0000

3.2. Postoperative conditions

After the surgery, the number of patients with postoperative air leakage in the study group was 2, accounting for 2.90%, and the number of patients with recurrence one year after surgery was also 2, accounting for 2.90%; the number of patients with postoperative air leakage in the control group was 3, accounting for 8.82%, and the number of patients with recurrence one year after surgery was 2, accounting for 5.88%. χ^2 test showed that $p > 0.05$, indicating that the difference was not statistically significant (**Table 2**).

Table 2. Comparison of postoperative conditions between the two groups

Group	**Postoperative air leakage**	**Recurrence one year after surgery**
Study group (n = 99)	2 (2.90)	2 (2.90)
Control group (n =34)	3 (8.82)	2 (5.88)
χ^2	0.5262	0.0379
p	0.4682	0.8456

4. Discussion

Spontaneous pneumothorax is one of the common conditions seen in thoracic surgery. This condition usually occurs in young people, although there are more elderly patients with pneumothorax. With the maturity of rapid rehabilitation and the accumulation of minimally invasive surgical techniques in recent years, lung surgery has entered the era of minimally invasive surgery represented by thoracoscopy [8]. At present, the approaches of thoracoscopic bullectomy include the classic 3-4-hole VATS, two-hole VATS, and single-hole VATS [9,10]. In particular, the single-port video-assisted thoracic surgery [11], which represents the latest minimally invasive surgery, adopts the technology of a single hole incision (3-5 cm), with soft opening and complete endoscopic resection. It has reached maturity in most conventional lung surgeries and can even be used for sleeve resection and other difficult surgeries [12-14]. Many thoracic surgeons are now opting for thoracoscopy to treat spontaneous pneumothorax. According to several studies [12,15], thoracoscopic surgery should be the first choice for treating spontaneous pneumothorax, and many clinicians are now believing that single-port and three-port VATS have similar surgical effects in the treatment of SP [9-16].

Pneumothorax refers to the abnormal accumulation of gas in the pleural cavity. The pleural cavity is a potential closed space with negative pressure under physiological conditions. Its pressure is lower than the normal atmospheric pressure outside the body in most phases of the respiratory cycle. Air may enter the pleural cavity through three ways: (1) traumatic pneumothorax (including trauma, iatrogenic, and other means), where the chest wall (skin, muscle, and/or ribs) and parietal pleura are damaged, creating a direct connection between the pleural cavity and outside the chest; (2) a communication between the pleural cavity and some organs within the body, which are originally connected to outside the body, such as trachea, bronchus, lung tissue, esophagus, and even gastrointestinal tract; the most common cause is the rupture of pulmonary bullae on the pleural surface; (3) infected pleural cavity with gas-producing microorganisms. Pneumothorax can be divided into spontaneous pneumothorax and traumatic pneumothorax. The former can be further divided into primary spontaneous pneumothorax, secondary spontaneous pneumothorax (SSP), and other types of spontaneous pneumothorax according to whether it is associated with known lung diseases or lung tissue abnormalities. The latter can be further divided into iatrogenic and non-iatrogenic pneumothorax.

Primary spontaneous pneumothorax is usually caused by the rupture of subpleural blebs and pulmonary bullae. These patients generally do not have any underlying lung diseases. However, it often occurs in young, thin, and tall men. Studies have found that smoking is closely related to primary spontaneous pneumothorax [2,3]. The risk of pneumothorax increases with smoking. Other related risk factors include cocaine use, family history of pneumothorax, and surrounding atmospheric environment [4-6]. Secondary spontaneous pneumothorax often occurs in patients with underlying lung diseases. Some of the common ones include chronic obstructive pulmonary disease, cystic fibrosis, lung cancer (primary or metastatic), pulmonary tuberculosis, pneumoconiosis, and intrathoracic endometriosis [16-18]. Among them, chronic obstructive pulmonary disease is more common, accounting for about 70% of the cases.

At present, there are many methods of treatment for spontaneous pneumothorax, including conservative oxygen therapy, thoracocentesis extraction, closed thoracic drainage, bullectomy and repair, pleural fixation, and other methods [12-15]. The management plan will be different with varying volumes of pneumothorax [16], which is one of the important bases for deciding whether to carry out closed drainage or surgery [19].

In clinical practice, chest radiography is a convenient and rapid method for qualitative and quantitative diagnosis of pneumothorax. Chest radiograph may be an upright posterior-anterior position examination or a supine anterior-posterior position examination. At present, the commonly used methods to measure the degree of lung compression in cases of pneumothorax from chest X-ray films include the line segment method, area method, volume method, parallel pleural spacing method, and three-line method.

In conclusion, using single-port thoracoscopic bullectomy is better than two-port thoracoscopic bullectomy in treating spontaneous progressive hemopneumothorax in young people, since it effectively reduces intraoperative bleeding. The pain level is also significantly better with single-port thoracoscopic bullectomy than with two-port thoracoscopic bullectomy. However, the prognosis of patients is good with a low probability of recurrence for both single- and two-port thoracoscopic bullectomy.

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The authors declare no conflict of interest.

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