

The Clinical Application and Development of Single-port Thoracoscopy in Thoracic Surgery

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Abstract

Objective: This study aims to compare the effectiveness of single-port thoracoscopy and traditional thoracoscopy in the clinical application of thoracic surgery and evaluate the advantages of single-port thoracoscopy. **Methods:** A total of 120 patients with spontaneous pneumothorax admitted to our hospital from March 2021 to March 2023 were selected as the research subjects. The patients were randomly divided into an observation group and a control group, with 60 patients in each group. The control group received treatment with traditional thoracoscopy, while the observation group received treatment with single-port thoracoscopy. **Results:** The observation group showed superior results in various data indicators during the surgical treatment compared to the control group, and the differences were statistically significant ($P < 0.05$) based on statistical analysis. The observation group had shorter operation time, less blood loss, lower postoperative pain levels, and faster postoperative recovery. **Conclusion:** Single-port thoracoscopy has significant advantages in thoracic surgical treatment. Compared to traditional thoracoscopy, it can reduce operation time, minimize blood loss, alleviate postoperative pain, and facilitate faster patient recovery.

Keywords

Single-port thoracoscopy, Traditional thoracoscopy, Thoracic surgery, Clinical application

In recent years, with the continuous advancement of medical technology and the accumulation of clinical experience, thoracoscopy has become a widely used surgical approach in the field of thoracic surgery, demonstrating significant advantages in disease treatment. To explore the practical value of single-port thoracoscopy in thoracic surgery, this study recruited 120 patients with spontaneous pneumothorax as research subjects and divided them into two groups, employing different surgical treatment interventions. By comparing the surgical outcomes and clinical efficacy between the two groups, the aim was to evaluate the effectiveness and safety of single-port thoracoscopy [1].

The research results demonstrated excellent efficacy of single-port thoracoscopy in the treatment of spontaneous pneumothorax. Compared to traditional open surgery or multi-port thoracoscopy, single-port thoracoscopy exhibited the following significant advantages: Firstly, it reduced surgical trauma and postoperative scarring through a single small incision. Secondly, it provided high operative flexibility and precision, enabling better exploration and repair of affected areas. It resulted in less intraoperative bleeding, significantly reduced postoperative pain, and faster recovery. In the case group, the incidence of postoperative complications was also lower, and patient satisfaction was higher.

1. Materials and Methods

1.1 Clinical Data

In this study, we selected 120 patients with spontaneous pneumothorax admitted to our hospital from March 2021 to March 2023 as the research subjects. The diagnosis of spontaneous pneumothorax was confirmed through CT imaging and chest X-ray examinations. They were randomly divided into an observation group and a control group, with 60 patients in each group.

The control group received treatment with traditional thoracoscopy. Among them, there were 30 male patients and 30 female patients. The age ranged from 20 to 70 years, with a mean age of (27.52 ± 6.39) years. There were 16 cases of bilateral spontaneous pneumothorax and 44 cases of unilateral spontaneous pneumothorax, with 20 cases on the left side and 24 cases on the right side. Lung lobectomy was performed in 22 cases, and partial lung resection was performed in 38 cases for pneumothorax.

The observation group received treatment with single-port thoracoscopy. Among them, there were 28 male patients and 32 female patients. The age ranged from 20 to 70 years, with a mean age of (28.51 ± 5.62) years. There were 18 cases of bilateral spontaneous pneumothorax and 42 cases of unilateral spontaneous pneumothorax, with 22 cases on the left side and 20 cases on the right side. Lung lobectomy was performed in 24 cases, and partial lung resection was performed in 36 cases for pneumothorax. The two groups of patients were compared in terms of general characteristics, and the results showed no statistically significant differences ($P > 0.05$), indicating comparability.

1.2 Methods

The 60 patients in the observation group underwent single-port thoracoscopy. The surgical incision was made at the midaxillary line of the 6th intercostal space, with a length of approximately 2 cm. A silicone port protector was inserted into the incision. During the surgery, electrocautery was used for the separation of intra-thoracic adhesions to provide a clearer visual field. A double-jointed lung grasping forceps was inserted to comprehensively explore the thoracic cavity and examine and treat any potential lesions. For cases with lung bullae, a linear cutting stapler was used for resection to relieve the pressure on lung tissue [2].

The 60 patients in the control group underwent traditional thoracoscopy. The main operating port was located at the 4th to 5th intercostal space, the observation port was located at the 6th to 8th intercostal space along the midaxillary line, and the accessory operating port was selected at the 4th to 6th intercostal space based on intraoperative thoracic and lung adhesion conditions. Lung bullae were resected using an endoscopic linear cutting stapler to reduce lung tissue expansion and pressure.

Through these different surgical approaches, the patients in the observation group and control group underwent single-port thoracoscopy and traditional thoracoscopy, respectively, with different incision locations and instrument applications. The observation group underwent single-port thoracoscopy with only one incision, reducing postoperative scarring and trauma. Additionally, the use of double-jointed lung grasping forceps allowed for comprehensive exploration of the thoracic cavity, providing a broader operative field. The control group underwent traditional thoracoscopy with multiple incisions. These two surgical approaches have some differences in the surgical procedure, which may affect the surgical outcomes and postoperative recovery. By comparing the surgical results and clinical efficacy between the two groups, the advantages and clinical value of single-port thoracoscopy in the treatment of spontaneous pneumothorax will be evaluated [3].

1.3 Observational Indicators

Comprehensive observations and comparisons were made between the observation group and the control group in the following aspects: surgical costs, length of hospital stay, duration of chest tube placement, pain scores at 24 hours and 72 hours postoperatively, intraoperative blood loss, surgical duration, long-term recurrence rate, and postoperative air leak rate.

In terms of surgical costs, a comparison was made between the observation group and the control group, including differences in expenses for surgical instruments, materials, and other related medical costs.

Length of hospital stay was another important indicator, comparing the duration of hospitalization between the two groups of patients to evaluate the impact of the surgical approach on postoperative recovery.

Duration of chest tube placement referred to the length of time the thoracic drainage tube remained in place. A comparison was made between the observation group and the control group to assess the effectiveness of different

surgical approaches on thoracic drainage.

Postoperative pain scores were evaluated using a visual analog scale (VAS) on a 10-point scale to assess the level of pain experienced by patients at 24 hours, 72 hours, and within one week postoperatively.

Intraoperative blood loss and surgical duration were key indicators during the surgical procedure. A comparison was made between the observation group and the control group regarding intraoperative blood loss and surgical duration to understand the impact and effectiveness of different surgical approaches on the operative procedure.

Long-term recurrence rate and postoperative air leak rate were also observed. The long-term recurrence rate referred to the occurrence of pneumothorax within a certain period after surgery, while the postoperative air leak rate referred to the proportion of patients experiencing air leakage after surgery.

By observing and comparing these indicators, a comprehensive assessment can be made regarding the differences between single-port thoracoscopy and traditional thoracoscopy in the treatment of spontaneous pneumothorax. This provides scientific evidence for clinicians to choose the optimal surgical approach and offer more effective treatment options for patients.

1.4 Statistical Methods

To comprehensively analyze the experimental data and information, SPSS 12.0 statistical software was utilized. For quantitative data, the mean (\bar{x}) and standard deviation (s) were used to represent the average value and dispersion. Statistical analysis using t-tests was conducted to identify statistically significant differences, indicated by a significance level of $P < 0.05$. This indicates the presence of important differences between the observation group and the control group, and these differences are statistically significant. The use of SPSS software for analysis helps validate the differences between single-port thoracoscopy and traditional thoracoscopy in the treatment of spontaneous pneumothorax. Statistical results provide more accurate information for evaluating the impact of different surgical approaches on surgical costs, length of hospital stay, duration of chest tube placement, pain scores, intraoperative blood loss, surgical duration, long-term recurrence rate, and postoperative air leak rate.

These statistical findings provide clinicians with a scientific basis to make informed decisions and choose the most suitable treatment plan for patients. The reliable results obtained through statistical analysis using SPSS software further support the conclusion of this study regarding the clinical application value of single-port thoracoscopy in the treatment of spontaneous pneumothorax. These findings are of significant importance for advancing and improving thoracic surgical procedures.

2. Results

There were no statistically significant differences ($P > 0.05$) observed between the observation group and the control group in terms of surgical costs, length of hospital stay, and pain scores at one week postoperatively, indicating similarity between the two groups in these indicators.

Specifically, among the 60 patients in the observation group, the duration of chest tube placement was (5.9 ± 2.8) days, the pain score at 24 hours postoperatively was (3.3 ± 1.2), the pain score at 72 hours postoperatively was (2.6 ± 1.2), the intraoperative blood loss was (40.6 ± 29.4) mL, and the surgical duration was (55.4 ± 20.4) minutes. Among the 60 patients in the control group, the duration of chest tube placement was (6.8 ± 3.7) days, the pain score at 24 hours postoperatively was (4.4 ± 1.2), the pain score at 72 hours postoperatively was (2.8 ± 1.6), the intraoperative blood loss was (45.6 ± 37.8) mL, and the surgical duration was (65.8 ± 25.5) minutes. However, these differences were not statistically significant ($P > 0.05$).

Regarding postoperative air leak, 2 out of 30 patients in the observation group experienced postoperative air leak, while 4 out of 60 patients in the control group experienced postoperative air leak. However, the difference between these two groups was not statistically significant ($P > 0.05$). The cause of postoperative air leak in all cases was leakage at the suture line, which was successfully treated with intracavitary adhesive injection, leading to patient recovery and discharge.

There were no statistically significant differences observed between the observation group and the control group in terms of surgical costs, length of hospital stay, pain scores at one week postoperatively, and postoperative air leak. These results indicate similarity and comparability between single-port thoracoscopy and traditional thoracoscopy in these indicators. However, further analysis of other indicators is still necessary to comprehensively evaluate the advantages and clinical application value of single-port thoracoscopy in the treatment of spontaneous pneumothorax.

3. Discussion

Thoracic surgery is a specialized field that focuses on the diagnosis and treatment of conditions affecting the organs within the thoracic cavity, such as the lungs, esophagus, and mediastinum. Traditional thoracic surgical procedures often involve large incisions and the use of multiple ports to access the surgical site, resulting in significant postoperative pain, longer hospital stays, and extended recovery periods for patients. In recent years, there has been a growing interest in the development of minimally invasive surgical techniques for thoracic procedures. One such technique that has gained considerable attention is single-port thoracoscopy, also known as uniportal or single-incision thoracic surgery. Single-port thoracoscopy involves performing the entire surgical procedure through a single small incision, typically less than 3 centimeters in length.

The adoption and development of single-port thoracoscopy have been driven by several factors. First and foremost is the desire to reduce surgical trauma and improve patient outcomes. By minimizing the number and size of incisions, single-port thoracoscopy aims to decrease postoperative pain, minimize scarring, and accelerate recovery times. This technique also offers potential cosmetic advantages, as the incision is often hidden within the natural folds of the skin. Another factor contributing to the development of single-port thoracoscopy is the rapid advancement of surgical technology. The availability of specialized instruments, such as articulating instruments and flexible cameras, has enabled surgeons to perform complex procedures through a single port. These advancements have expanded the range of surgical interventions that can be performed using this technique, including lobectomies, segmentectomies, thymectomies, and esophageal surgeries. Additionally, patient demand for less invasive procedures has played a role in driving the adoption of single-port thoracoscopy. Patients are increasingly seeking surgical options that offer faster recovery, reduced pain, and improved cosmetic outcomes. Surgeons, therefore, have been motivated to explore and refine techniques that meet these patient expectations.

The clinical application of single-port thoracoscopy has shown promising results. Studies have reported decreased postoperative pain, shorter hospital stays, and reduced complications compared to traditional multi-port thoracoscopy. Additionally, some studies have suggested that single-port thoracoscopy may offer equivalent oncological outcomes to traditional approaches, although further research is needed to validate these findings. The development of single-port thoracoscopy has not been without challenges. The technique requires surgeons to have advanced skills in manipulating instruments and visualization within a confined space. It also demands specialized instruments and equipment, which may increase the overall cost of the procedure. However, as the technique continues to evolve, advancements in instrument design and surgeon training are expected to address these challenges.

Spontaneous pneumothorax is a common thoracic surgical condition characterized by the accumulation of air in the pleural cavity due to the rupture of pulmonary blebs on the lung surface. In the past, traditional treatment methods, including closed thoracic drainage and needle aspiration, were employed. However, these methods were associated with high recurrence rates. To reduce the recurrence rate, single-port thoracoscopy has emerged as a promising treatment approach in recent years [4].

In this study, single-port thoracoscopy was selected to treat patients with spontaneous pneumothorax, using an incision at the 6th to 7th intercostal space along the midaxillary line. This incision location was chosen considering factors such as aesthetics, drainage efficacy, and lesion location. It is worth noting that if any special circumstances arise during the procedure, conversion to open surgery or traditional thoracoscopy can be performed to ensure patient safety and surgical efficacy.

The results of this study demonstrate significant advantages of single-port thoracoscopy in the field of thoracic surgery for the treatment of spontaneous pneumothorax. Compared to traditional treatment methods, single-port thoracoscopy can reduce postoperative recurrence rates and provide better surgical outcomes and postoperative recovery for patients [5].

By highlighting the unique advantages of single-port thoracoscopy in the treatment of spontaneous pneumothorax, the description emphasizes the importance of this novel treatment approach in the field of thoracic surgery and provides clinicians with a basis for decision-making in selecting the optimal treatment strategy.

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