

Analysis and Comparison of the Effect of Preserving Spontaneous Breathing Without Intubation and Endotracheal Intubation with One Lung Ventilation in Single-hole Thoracoscopic Bulla Suture

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Abstract: *Objective:* To explore the situation of patients and the compare the effect between two methods, which are preserving spontaneous breathing without intubation and endotracheal intubation with one lung ventilation in the single-hole thoracoscopic bulla suture. *Method:* 42 patients who received single-hole thoracoscopic pulmonary bullae suture in our hospital from January 2020 to December 2021 were selected as the study subjects, including 19 patients who underwent endotracheal intubation and one lung ventilation as the control group and 23 patients who underwent single-hole thoracoscopic pulmonary bullae suture without intubation as the study group. The relevant indexes, postoperative general conditions, complications and pneumothorax recurrence of the two groups were analyzed and observed. *Results:* In the control group, the scores of anesthesia time (points), resuscitation time (points), surgical visual field score (points), surgical time (points), and surgical bleeding volume (points) were 20.8 ± 4.6 , 19.9 ± 7.9 , 1.7 ± 0.5 , 44.9 ± 7.9 , and 11.4 ± 2.4 respectively. In the study group, the scores of anesthesia time (points), resuscitation time (points), surgical visual field score (points), surgical time (points), and scores of surgical bleeding (points) were 17.9 ± 4.3 , 15.4 ± 3.4 , 1.9 ± 0.4 , 48.4 ± 7.1 , 10.9 ± 2.2 , respectively. There was no statistical difference in surgical visual field score, surgical time and surgical bleeding whereas there was a statistical difference between anesthesia time and resuscitation time. In the control group after operation, VAS score at 6 hours after operation, SaO₂ (%) after operation, PaCO₂ (mmHg) after operation, drainage volume (ML) after operation, feeding time (H) after operation, retention time of thoracic tube after operation (H), WBC (10⁹) on the first day after operation, hospitalization time (d), and total hospitalization cost (RMB 1000) were 2.1 ± 0.7 , 98.2 ± 1.4 , 42.4 ± 4.9 , 139.1 ± 23.1 , 6.9 ± 1.6 , 37.1 ± 5.4 , 7.9 ± 2.1 , 6.6 ± 1.3 , and 2.6 ± 0.3 respectively. As for the study group, the VAS score at 6 hours after operation, SaO₂ (%) after operation, PaCO₂ (mmHg) after operation, drainage volume (ML) after operation, feeding time (H) after operation, retention time of thoracic tube after operation (H), WBC (10⁹) on the first day after operation, hospitalization time (d), and total hospitalization cost (RMB 1000) were 1.9 ± 0.4 , 97.9 ± 1.2 , 42.8 ± 5.1 , 151.8 ± 21.9 , 4.3 ± 1.4 , 15.3 ± 2.6 , 5.2 ± 2.3 , 4.2 ± 1.2 , and 1.8 ± 0.4 respectively. Among them, there were no significant differences in visual analog scale (VAS) score at 6 hours after operation, SaO₂ after operation and PaCO₂ after operation between the two groups, but there were significant differences in other factors. The complication rate of the control group was 36.84%, which was significantly higher

than that of the study group (4.35%), with statistical difference. The recurrence rate of the control group was 21.05%, which was not significantly different from that of the study group (4.35%). *Conclusion:* The single-hole thoracoscopic bullae suture without intubation can reduce the anesthesia time and resuscitation time of patients, reduce the hospitalization cost of patients, reduce the treatment burden, shorten the first feeding time, and reduce the complication rate of patients. Therefore, it is worthy of clinical promotion.

Keywords: Spontaneous breathing; One lung ventilation; Single-hole thoracoscopy

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1. Introduction

Pulmonary bullectomy is a surgical treatment for spontaneous pneumothorax caused by rupture of pulmonary bullae [1]. With the development of endoscopic instruments and the progress of minimally invasive technology, thoracoscopic surgery for spontaneous pneumothorax has become a common surgical method. However, the bullae resection under general anesthesia and endotracheal intubation will cause great damage to the patient, and the patient's recovery time will be prolonged, and it may also cause complications related to endotracheal intubation and the risk of throat pain, nausea and hemoptysis. In addition, the patients with bilateral pulmonary bullae are anesthetized with laryngeal mask intubation and ventilator assisted breathing. The airway pressure of the dilated lung is slightly high, and sometimes the airway pressure is normal, which may cause the rupture of the contralateral pulmonary bullae during the operation, forming pneumothorax or even tension pneumothorax, which may lead to the decrease of blood oxygen saturation and even endanger the patient's life [2]. Therefore, non-intubated autonomous respiratory vein anesthesia is now more commonly used. Compared with conventional thoracoscopic surgery, single-hole thoracoscopic pulmonary bullectomy has less trauma to the patient, less postoperative pain and faster recovery [3,4].

2. Data and methods

2.1. General information

42 patients who received single-hole thoracoscopic pulmonary bullae suture in our hospital from January 2020 to December 2021 were selected as the study subjects, including 19 patients who underwent endotracheal intubation and one lung ventilation as the control group and 23 patients who underwent single-hole thoracoscopic pulmonary bullae suture without intubation with autonomous breathing as the study group. There was no significant difference in the general data of patients and there was no statistical significance

2.2. Methods

- (1) The patients in the control group were monitored by electrocardiography (ECG) without urinary catheterization. After induction of anesthesia with dexmedetomidine, propofol, sufentanil and other drugs, double lumen endotracheal intubation was performed and fiber bronchoscope was positioned. One lung ventilation was performed on the healthy side, continuously using propofol and sufentanil during the operation. The maintenance of analgesia and sedation, surgical incision, surgical resection, postoperative analgesia and reexamination and extubation were the same as those in non-intubated video-assisted thoracic surgery (NIVATS) group.
- (2) Patients in the study group were fasted for 6 hours before operation, and ECG monitoring was performed. The affected side was placed in the superior decubitus position, and 0.375% ropivacaine was used for paravertebral nerve block at the 3-7th intercostal plane of the affected side under the guidance of bedside B-ultrasound. Dexmedetomidine, propofol and sufentanil were used to control the fluid

velocity, monitor the BIS value between 40-60 and do not inhibit respiration. After falling asleep, laryngeal mask was placed to give oxygen, no catheter was inserted, and the fourth intercostal midaxillary incision was made for 4 cm, conventional single-port thoracoscopic operation was performed. After entering the chest, the vagus nerve was blocked with 2% lidocaine 2 mL on the operative side. 2% lidocaine was sprayed on the surface of the lungs for anesthesia, the operation was gentle to prevent cough, the bullae were explored and removed, the pleural cavity was washed with warm normal saline after pleural friction fixation, and one chest drainage tube was placed at the incision site after no air leakage, and the lungs were expanded by pressure ventilation to promote lung recruitment, and the chest was closed. Patient controlled intravenous analgesia with analgesia pump was performed after operation. On the first day after the operation, the chest X-ray was reexamined, and the yellow liquid with a drainage volume of less than 150ml was removed from the chest tube for 24 hours.

2.3. Observation indicators

The related indexes during operation, general conditions after operation, complications and pneumothorax recurrence were analyzed and observed in the two groups.

2.4. Statistical methods

SPSS25.0 software was used for t-test and χ^2 inspection

3. Results

3.1. Analysis and comparison of the relevant indexes of the two groups during operation

In the control group, the scores of anesthesia time (points), resuscitation time (points), surgical visual field score (points), surgical time (points), and surgical bleeding volume (points) were 20.8 ± 4.6 , 19.9 ± 7.9 , 1.7 ± 0.5 , 44.9 ± 7.9 , and 11.4 ± 2.4 respectively. In the study group, the scores of anesthesia time (points), resuscitation time (points), surgical visual field score (points), surgical time (points) The scores of surgical bleeding (points) were 17.9 ± 4.3 , 15.4 ± 3.4 , 1.9 ± 0.4 , 48.4 ± 7.1 , 10.9 ± 2.2 , respectively. There was no statistical difference in surgical visual field score, surgical time and surgical bleeding, but there was a statistical difference between anesthesia time and resuscitation time, as shown in **Table 1**.

Table 1. Analysis and comparison of the relevant indexes of the two groups during operation

Group	Control group (n = 19)	Research group (n=23)	t	P
Anesthesia time (min)	20.8 ± 4.6	17.9 ± 4.3	2.1080	0.0413
Recovery time (min)	19.9 ± 7.9	15.4 ± 3.4	2.4733	0.0177
Surgical visual field score (points)	1.7 ± 0.5	1.9 ± 0.4	1.4408	0.1574
Operation time (min)	44.9 ± 7.9	48.4 ± 7.1	1.5112	0.1386
Surgical blood loss (points)	11.4 ± 2.4	10.9 ± 2.2	0.7036	0.4857

3.2. Analysis and comparison the relevant indexes of the two groups after operation

In the control group after operation, VAS score at 6 hours after operation, SaO₂ (%) after operation, PaCO₂ (mmHg) after operation, drainage volume (ML) after operation, feeding time (H) after operation, retention time of thoracic tube after operation (H), WBC (10⁹) on the first day after operation, hospitalization time (d), and total hospitalization cost (RMB 1000) were 2.1 ± 0.7 , 98.2 ± 1.4 , 42.4 ± 4.9 , 139.1 ± 23.1 , 6.9 ± 1.6 , 37.1 ± 5.4 , 7.9 ± 2.1 , 6.6 ± 1.3 , and 2.6 ± 0.3 respectively. In the study group, VAS score at 6 hours

after operation, SaO₂ (%) after operation, PaCO₂ (mmHg) after operation, drainage volume (ML) after operation, feeding time (H) after operation, retention time of thoracic tube after operation (H), WBC (10⁹) on the first day after operation, hospitalization time (d), and total hospitalization cost (RMB 1000) were 1.9 ± 0.4, 97.9 ± 1.2, 42.8 ± 5.1, 151.8 ± 21.9, 4.3 ± 1.4, 15.3 ± 2.6, 5.2 ± 2.3, 4.2 ± 1.2, and 1.8 ± 0.4 respectively. Among them, there were no significant differences in VAS score at 6 hours after operation, SaO₂ after operation and PaCO₂ after operation, but there were significant differences in other factors, as shown in **Table 2**.

Table 2. Analysis and comparison of the postoperative related indexes of the two groups

Group	Control group (n = 19)	Research group (n = 23)	t	P
VAS score 6 hours after operation	2.1 ± 0.7	1.9 ± 0.4	1.1615	0.2523
Postoperative SaO ₂ (%)	98.2 ± 1.4	97.9 ± 1.2	0.7479	0.4589
Postoperative PaCO ₂ (mmhg)	42.4 ± 4.9	42.8 ± 5.1	0.2575	0.7981
Postoperative drainage volume (ml)	139.1 ± 23.1	151.8 ± 21.9	1.8249	0.0755
Feeding Time (h)	6.9 ± 1.6	4.3 ± 1.4	5.6161	0.0000
Retention time of thoracic tube after operation (h)	37.1 ± 5.4	15.3 ± 2.6	17.1357	0.0000
WBC on the first postoperative day (10 ⁹)	7.9 ± 2.1	5.2 ± 2.3	3.9368	0.0000
Length of hospital stay (d)	6.6 ± 1.3	4.2 ± 1.2	6.2131	0.0000
Total hospitalization expenses (RMB 1000)	2.6 ± 0.3	1.8 ± 0.4	7.1987	0.0000

3.3. Analysis and comparison of the complications and pneumothorax recurrence of the two groups

The complication rate of the control group was 36.84%, which was significantly higher than that of the study group (4.35%), with statistical difference. The recurrence rate of the control group was 21.05%, which was not significantly different from that of the study group (4.35%), as shown in **Table 3**.

Table 3. The complications and pneumothorax recurrence of the two groups were analyzed and compared [n (%)]

Group	Control group (n = 19)	Research group (n = 23)	χ ²	P
Complication	7 (36.84)	1 (4.35)	5.1733	0.0229
Recrudescence	4 (21.05)	1 (4.35)	1.4048	0.2359

4. Discussion

With the development of medical technology and the continuous improvement of quality of life, people have increasing demands for minimally invasive treatment of traditional surgery. Thoracoscopic surgery has become the direction of minimally invasive development of thoracic surgery, and has become the first option of thoracic surgery. The anesthesia technology of thoracic surgery has developed from the general anesthesia under double lumen bronchial intubation in the early stage to nerve block and intrathoracic spinal

anesthesia in recent years, and to the general anesthesia under laryngeal mask without invading the airway in recent years [5-10].

While dual lumen bronchial intubation has many advantages, there are also many complications, such as airway injury during intubation [11-14], catheter cuff displacement during operation, bronchospasm, and so on; The increase of intrapulmonary shunt also leads to hypoxemia; and mechanical ventilation complications, such as hypoxic lung injury, mechanical stretch lung injury, ventilator-related lung injury (vali), non-ventilated side lung injury, ischemia-reperfusion injury, and so on. This effect is more prominent in elderly patients, especially those with obstructive ventilation dysfunction. One lung ventilation also increases the risk of lung infection, lung injury and the need for mechanical ventilation and respiratory support after surgery [15]. During general anesthesia of endotracheal intubation, due to the use of muscle relaxants, opioids, inhaled anesthetics and acetylcholine drugs, the recovery of gastrointestinal function after operation is affected, the time of drinking and eating is prolonged, and nausea, vomiting, choking and abdominal distension often occur. Recent studies have confirmed that some patients will have neuromuscular block after general anesthesia surgery, especially respiratory muscle group, which will further affect the patient's lung function [16].

Compared with the traditional thoracotomy, the self-breathing single-hole thoracoscopic surgery is widely used in clinics because of its advantages such as less trauma, less bleeding, shorter operation time, less complications and faster recovery. The methods and advantages of non-intubated autonomous breathing single-hole thoracoscopic surgery includes: (1) The position pad is placed under the patient's armpit to raise the operation side, which is in line with the position of conventional thoracoscopic surgery and is more conducive to the operation; (2) small trauma cause little damage to the patient, and reduce the pain of the patient; (3) postoperative recovery is fast, promoting the recovery of gastrointestinal function, able to drink and eat after a short period of time, and nausea, vomiting and abdominal distension are rare; (4) since the patient has no tracheal intubation injury, he consciously has no pain in the throat after the operation and does not need muscle relaxants, which promotes the recovery of the patient's ventilator function and sputum discharge function after the operation, reduces the occurrence of lung infection, reduces the perioperative risk of the respiratory tract, and makes the management of the respiratory tract easier; (5) it reduce the number of days in hospital and reduce the cost of patients.

The general anesthesia technique of laryngeal mask with autonomous breathing was retained. For the cases meeting the screening conditions, the anesthesia effect was ideal, the surgeon was also satisfied with the exposure of the surgical field, and the thoracoscopic surgery was successfully completed. This technology not only greatly reduces the interference to the respiratory function, but also avoids the invasive injury of the airway and ventilator-related lung injury, and greatly reduces the surgical trauma of the patient. Besides, laryngeal mask general anesthesia technology not only avoids the stress reaction during endotracheal intubation and the influence on the cilia of respiratory mucosa, but also can perform manual ventilation during operation to improve hypoxemia or hypercapnia when necessary, and can temporarily stop ventilation during important operation steps to obtain a good visual field, which is unique in non-endotracheal intubation anesthesia technology.

5. Conclusion

In conclusion, the single-hole thoracoscopic bullae suture without intubation can reduce the anesthesia time and resuscitation time of patients, reduce the hospitalization cost of patients, reduce the treatment burden, shorten the first feeding time, and reduce the complication rate of patients. Therefore, it is worthy of clinical promotion.

Disclosure statement

The authors declare no conflict of interest.

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