

Application of Bronchial Blockers in Thoracic Surgery

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How to cite this paper: Liu, Y.J., Dan, H.W., Zhang, L., Wang, Y.F. and Zhang, M. (2025) Application of Bronchial Blockers in Thoracic Surgery. *Journal of Biosciences and Medicines*, 13, 285-291. <https://doi.org/10.4236/jbm.2025.1310024>

Received: March 16, 2025

Accepted: October 21, 2025

Published: October 24, 2025

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Abstract

Background: Thoracic surgery requires lung isolation techniques, which are typically achieved using a double-lumen bronchial tube or a single-lumen tube combined with a bronchial blocker. Double-lumen bronchial tubes have a larger diameter and may cause more significant intubation-related trauma. In contrast, bronchial blockers cause less trauma and are better tolerated by patients. This study compares the two lung isolation techniques to explore their advantages and disadvantages in lung isolation surgery. **Methods:** In this study, both the double-lumen bronchial tube group and the bronchial blocker group underwent surgery under general anesthesia combined with paravertebral block. Intubation time, quality of lung collapse, and postoperative complications such as hoarseness and sore throat were observed. Statistical analysis was performed using SPSS 20.0, with a P-value < 0.05 considered statistically significant. **Results:** The bronchial blocker group demonstrated shorter intubation and positioning times compared to the double-lumen bronchial tube group. The success rate of intubation was higher in the bronchial blocker group, while the incidence of postoperative hoarseness and sore throat was lower. No difference was observed in the quality of lung collapse between the two groups. **Conclusion:** For single-lung isolation, bronchial blockers achieve ideal lung isolation effects comparable to double-lumen tubes, with a higher success rate of intubation, less trauma to the glottis and throat, and significantly improved patient comfort.

Keywords

Single-Lung Isolation, Double-Lumen Bronchial Tubes, Bronchial Blockers

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1. Introduction

In order to provide a better surgical field and operating space and avoid cross-infection of both lungs during thoracic surgery, lung isolation technology is often used to implement single-lung ventilation [1]. Both double-lumen endobronchial tubes (DLT) and bronchial blockers (BB) can achieve lung isolation [2] [3]. In the past, DLT was often chosen. Because DLT is thick and has an angled front end, the intubation damage is greater, and complications such as throat discomfort and sore throat are more likely to occur after extubation, affecting the patient's comfort and satisfaction [4]. What's more, it is often difficult to choose a suitable model of DLT when encountering children or smaller patients [5]. If the patient has a difficult airway, the intubation failure rate is higher. When using a BB for lung isolation, a 7.5# single-lumen endotracheal tube (ET) commonly used in general anesthesia is often used, and the lung isolation effect can be achieved by placing the BB into the surgical side bronchus [6]. Therefore, the damage is smaller, the patient's tolerance is better, and it is more in line with the concept of accelerated recovery in modern surgery. This report compares the two technologies in terms of intubation time, bronchoscopic positioning time, lung collapse quality, postoperative hoarseness and sore throat, and other complications, and the advantages, disadvantages, and indications of the two technologies based on previous research.

2. Materials and Methods

2.1. General Information

Choose 60 cases of thoracic surgery patients in our hospital (thoracoscopic lobectomy, radical treatment of lung cancer), average age (52.6 ± 5.3) years old; average body mass index (BMI) (22.1 ± 2.5) kg/m²; ASA II-III level, Mallampati grade 1 - 2, they were randomly divided into a traditional double-lumen tube group (DLT group) and a bronchial blocker group (BB group), with 30 patients in each group. To minimize variations in the techniques of the various anesthesiologists, we designated an associate chief physician as the sole anesthesiologist for the study.

2.2. Anesthesia Method

After entering the room, the patient routinely underwent an electrocardiogram, blood oxygen saturation, arterial puncture pressure measurement, and end-tidal carbon dioxide monitoring. The anesthetic methods, drug selection, and ventilation parameters were the same in the two groups. General anesthesia was chosen, and an ultrasound-guided thoracic paravertebral nerve block was performed. Anesthesia-inducing drugs included: remimazolam 0.2 mg/kg, sufentanil 0.2 - 0.4 µg/kg, rocuronium 0.6 - 1 mg/kg, and propofol 2 - 3 mg/kg; after induction, a visual laryngoscope was used to assist endotracheal intubation.

Intubation method in the DLT group: the front end of the DLT is bent upward and inserted into the glottis. After the bronchial cuff passes the glottis, the tube core is pulled out and rotated toward the main ventilation lung side, and continues

to be inserted until obvious resistance appears and the intubation operation is stopped. Then use the fibrescope to adjust the position of the double-chamber bronchial catheter, with the blue bronchial cuff edge visible at the contralateral carina as the appropriate position. When using the left double-lumen tube, ensure that the fiberoptic bronchoscope can observe the openings of the left upper and lower bronchus; when intubating the right double-lumen bronchus, adjust the side hole of the right catheter lumen to ensure that it is aligned with the opening of the right upper lobe of the lung.

The BB group used ET combined with BB, the operation method: lubricate the BB cuff with paraffin cotton balls, and insert the 7.5# ET using a video laryngoscope. Then, put the BB into the ET, use the fiberoptic bronchoscope to adjust the Tampa angle, and insert the BB into the surgical bronchus. After sealing the sleeve and inflation, the edge of the cuff can be seen (**Figure 1**). Fix the endotracheal tube (**Figure 2**).

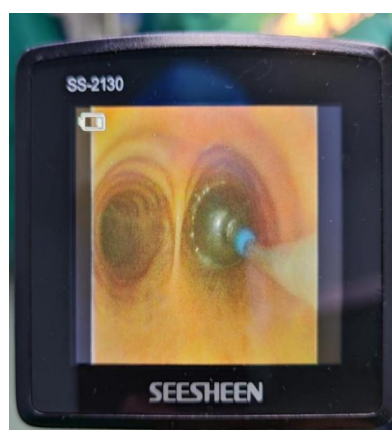


Figure 1. Bronchoscopic-guided bronchial blockers were placed.



Figure 2. Diagram of a bronchial blocker in the supine position.

Both groups of patients were given mechanical ventilation after intubation, and the ventilator parameters were as follows: the tidal volume of one-lung ventilation was maintained at 4 - 6 mL/kg, the respiratory rate was maintained at 14 - 16

times/min, the pure oxygen flow was 2 L/min, and the inspiration-expiration ratio was 1:2. After the body is positioned, the thoracic (4/7) space is selected for ultrasound-guided paravertebral nerve block (the local anesthetic is 0.33% ropivacaine 30 ml, 15 ml at each point). Anesthesia maintenance options: Dexmedetomidine 0.5 µg/kg/min, propofol 4 - 6 mg/kg by pump, remifentanyl 0.01 - 0.02 µg/kg/min by pump, sufentanyl 5 - 10 µg intravenous injection before lung inflation, stop propofol 15 min before the end of the operation, stop sufentanyl at the end of skin suture, and add muscle relaxants as needed. Prepare the vasoactive drug norepinephrine and pump it if necessary to maintain blood pressure fluctuation within 20%. After the operation, transfer to the anesthesia recovery room or the chest surgery ward without a companion. One day later, the patient was checked for any post-anesthetic complications such as hoarseness and sore throat.

2.3. Observation Indicators

The observation indicators include: intubation time (Time from laryngoscope insertion to completion of intubation); bronchoscopic positioning time (Time from intubation to completion of bronchial alignment); intubation success rate; the quality of lung collapse for patients with good intubation alignment, which was compared and evaluated with reference to the Campos standard, was divided into three levels: excellent (the lung on the occluded side is completely collapsed and the surgical field is fully exposed), good (there is still gas residual in the lung on the occluded side, but there is no ventilation, the surgical field exposure is acceptable, and there is no obvious impact on the operation), and poor (the lung on the occluded side is not collapsed enough, the surgical field exposure is insufficient and the operation is limited); postoperative complications such as hoarseness and sore throat.

2.4. Statistical Methods

SPSS 20.0 statistical software was used for data analysis. The measurement data were expressed as mean ± standard deviation, and the independent sample t-test was used for inter-group comparison. The count data were expressed as the number of cases or percentage (constituent ratio), and the chi-square test was used for inter-group comparison. $P < 0.05$ was considered statistically significant.

3. Results

1) Comparison of relevant time indicators between the two groups: the intubation time and positioning time of the BB group were shorter than those of the DLT group, with statistically significant differences ($P < 0.05$); the intubation success rate of the BB group was higher than that of the DLT group, with statistically significant differences ($P < 0.05$). See **Table 1**.

2) Comparison of collapsed lung mass between the two groups: there was no significant difference in collapsed lung mass between the two groups ($P > 0.05$). See **Table 2**.

3) Comparison of postoperative hoarseness and sore throat between the two groups: the incidence of hoarseness and sore throat was lower in the control group than in the reference group, with a statistically significant difference ($P < 0.05$). See **Table 3**.

Table 1. Comparison of relevant time indicators between the two groups (mean \pm SD).

Group	N	Intubation time (s)	Positioning time (s)	Success rate of intubation (%)
DLT	30	135.6 \pm 19.3	70.8 \pm 12.3	28 (93.3)
BB	30	88.3 \pm 15.1	62.3 \pm 10.2	30 (100)
t/χ^2		10.57	2.914	Fisher
P		0.000	0.005	0.0237

Table 2. Comparison of lung collapse mass between the two groups.

Group	N	Excellent	Good	Poor
DLT	28	26	2	
BB	30	27	3	
χ^2		Fisher	Fisher	
P		0.9999	0.9999	

Table 3. Comparison of hoarseness and sore throat between the two groups.

Group	N	Hoarseness	Sore throat
DLT	28	7	10
BB	30	1	3
χ^2		2.01	2.03
P		0.044	0.042

4. Discussion

The corresponding outer diameters of 35[#]/37[#]/39[#] DLTs are 11.7 mm/12.3 mm/13.0 mm; the outer diameters of 7.5[#]/8.0[#] single-lumen tubes are 10 mm/10.7 mm. When DLT is used for lung isolation, female patients are mostly treated with 35[#]/37[#], and male patients are mostly treated with 37[#]/39[#]; when BB is combined with ET for lung isolation, a 7.5[#] single-lumen endotracheal tube is usually sufficient [7]. DLT is thicker than ET, and the front end of DLT is angled. DLT intubation requires adjusting the angle and rotating the lumen, which causes greater damage to the throat and glottis. But in the BB group, the ET tube is fixed after intubation and only the BB needs to be adjusted, which will not cause secondary damage to the glottis and pharynx. Therefore, the time of intubation and bronchoscopic align-

ment was longer in the DLT group, and the incidence of postoperative hoarseness and sore throat was lower in the BB group. Furthermore, the front end of DLT is angled and relatively rigid. Even if the bronchial end is inserted into the bronchus after passing through the glottis, there is often great resistance, which may damage the tracheal mucosa or even prevent it from entering the bronchus, leading to intubation failure. In the DLT group, intubation failed in 2 patients because the front end of the catheter could not enter the bronchus, and the situation was remedied successfully after replacing the 7.5# single-lumen tube with a BB. For patients who were successfully intubated, both groups were able to achieve satisfactory lung collapse effects.

Through previous research and observation, when performing lung isolation, in terms of the selection of airway tools, thoracic surgery should fully understand the surgical site before surgery. CT-based evaluation and measurement of the distances between the carina and the ostia of the left and right upper lobe bronchi. When using BB, the distance between the left/right upper lobe opening and the carina should be greater than 5 mm to stabilize the BB cuff and implement lung isolation. Since the opening of the right upper lobe varies greatly and its position is not fixed, it is difficult to align the opening of the right upper lobe. Therefore, when DLT must be selected, the left DLT is often chosen. The advantages, disadvantages, and indications of the two methods are summarized as follows:

1) The distance from the opening of the left/right upper lobe to the carina in adults is usually 3 - 5 cm/1 - 3 cm. Therefore, there is no difference in the effect of lung isolation between the BB and the DLT in patients with normal anatomy, but the BB causes less damage and is therefore more recommended.

2) When the opening of the right upper lobe is at the level of the carina or less than 5 mm away from the carina, if right lung surgery is performed, in order to achieve an ideal isolation effect, a BB cannot be used, and only left DLT can be used. For left lung surgery, both options are available.

3) For patients undergoing lung lavage or patients with traumatic wet lung, empyema, or hemothorax who need complete isolation of the healthy lung from the affected lung, only DLT can be used.

4) For children or smaller adults (less than 150 cm tall), there are often no suitable DLT. A single-lumen endotracheal tube with an ID less than 7.0# can be used for intubation, and a BB can be inserted through the endotracheal tube to perform single-lung ventilation. Or choose a suitable model of laryngeal mask combined with BB to perform lung isolation. The specific method for the patient is to insert the laryngeal mask and fix it, then insert the BB through the laryngeal mask, and finally place the BB into the surgical side bronchi.

5) If the patient is an adult with a difficult airway, a single-lumen tube or laryngeal mask is inserted with the help of a video laryngoscope or fiberoptic bronchoscope, and a BB is placed to implement lung isolation.

However, this study also has limitations. For example, this is a small-sample, single-center study, and multi-center and large-sample studies can be further carried out in the future.

Therefore, when performing lung isolation, both BB and DLT can achieve the same lung isolation effect, but BB has a higher intubation success rate. Moreover, it causes less damage to the glottis and larynx, and the patient's comfort is significantly improved. For children or smaller adults and patients with difficult airways, BB is an additional option. Therefore, it has a higher use value.

Funding

This work was supported by grants from the Yichang City Medical and Health Research Project (A24-2-002 to M.Z.).

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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