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Optical Laryngeal Mask in Combination with Bronchial Blocker Reducing the Incidence of Sore Throat After Video Assisted Pneumonectomy

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【**Abstract**】**Objective:** To investigate the utilization of SafeLM optical laryngeal mask in combination with bronchial blocker in video-assisted pneumonectomy. **Methods:** Patients who underwent video-assisted pneumonectomy under general anesthesia with SafeLM laryngeal mask from January to September 2021 were respectively analyzed (SafeLM group). Age(±3 years),sex and surgical position matched patients who underwent the same surgery using double-lumen tube (DLT) were selected as controls (DLT group). The incidence of sore throat, hoarseness, intubation time, changes of blood pressure and heart rate after intubation, successful rate of one-lung ventilation, degree of lung collapse and incidence of hypoxia during surgery were compared between the two groups. **Results**: A total of 40 patients were enrolled in this study, with 20 patients in each group. There were no significant differences in the gender, age, BM, ASA classification, type of surgery, duration of anesthesia or surgery between the 2 groups (all p >0. 05). The incidence of sore throat in the SafeLM group was significantly lower than that in the DLT group (10% vs. 45%, P<0.01). Less patients in SafeLM group had an increase of 15% in heart rate or blood pressure than DLT group (10% vs. 40%. P<0. O5); but the intubation time in the SafeLM group was significantly longer than that in the DLT group ([9.9±3.7] min vs. [4.7±1.7] min, P< 0.01). There were no significant differences in the incidence of hoarseness, incidence of successful one-lung ventilation or degree of lung colla pse between thetwo groups (all P >0. 05). **Conclusions:** SafeLM laryngeal mask can be effectively used in general anesthesia for video-assisted pneumonectomy in combination with bronchial blocker. It can reduce the incidence of postoperative sore throat and changes in heart rate and blood pressure after intubation.

【**Key Words**】Optical laryngeal mask; Bronchial blocker; One-lung ventilation; Double lumen tube; Video-assisted pneumonectomy

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Single-lung ventilation (OLV) is the main method for intraoperative ventilation management in thoracoscopic lung resection surgeries, providing an ideal surgical field. Currently, the "gold standard" method for OLV in clinical practice remains the double-lumen endotracheal tube, which isolates the left and right lungs through the double-lumen endotracheal tube and achieves the desired OLV effect [1]. However, due to the relatively thick and hard outer diameter of the double-lumen endotracheal tube, the incidence of postoperative sore throat and hoarseness is higher [2-3].

In addition to the double-lumen endotracheal tube, some clinicians have applied bronchial occluders combined with single-lumen endotracheal tubes to achieve OLV. However, compared with the double-lumen endotracheal tube, the single-lumen endotracheal tube does not have an advantage in reducing the incidence of postoperative sore throat and hoarseness [4].

Some physicians have also combined laryngeal masks and bronchial occluders for thoracic surgeries. The results showed that the laryngeal mask could not reduce the incidence of sore throat after tracheal intubation compared with the single-lumen endotracheal tube [5]. SafeLM visual laryngeal mask is a new type of visual laryngeal mask with adjustable front camera angle. It can better ensure a good laryngeal mask positioning under visual conditions, but its application in thoracic surgeries still lacks clinical data support. This study aims to preliminarily evaluate the application of SafeLM visual laryngeal mask combined with bronchial occluders in thoracoscopic-assisted lung resection surgeries through a paired cohort study, providing data reference for further randomized controlled clinical studies and clinical applications.

1 Objects and Methods

1.1 Sample size calculation: The sample size was calculated using the PASS 11.0 statistical software. According to the literature [6], the proportion of patients with post-thoracic surgery sore throat treated with a single-lumen endotracheal tube combined with a bronchial blocker was 26%, while the proportion treated with a laryngeal mask combined with a bronchial blocker was only 5%, while the rate for those using a laryngeal mask combined with a bronchial blocker was only 5%. The incidence of postoperative sore throat after using a double-lumen endotracheal tube will be significantly higher than that of a single-lumen endotracheal tube. Based on the preliminary follow-up results, it is estimated to be around 40%. Assuming $\alpha = 0.05$ and $\beta = 0.2$, the sample size required to detect the above differences in each group is 20 cases.

1.2 Subjects A total of 20 patients undergoing elective thoracoscopic pneumonectomy under laryngeal mask combined with bronchial occluder anesthesia in the First Affiliated Hospital of Naval Medical University from January to September 2021 were collected (SafeLM group), and selected for dual-lumen endotracheal intubation at the same time Twenty patients undergoing thoracoscopic pneumonectomy under tube anesthesia were used as matched pairs

Control (DLT group), two groups of patients with gender, surgical side, age (±3 years). Inclusion criteria: ① 18-64 years old; ② ASA grade I or II; ③ Patients who completed wedge resection, lobectomy, or segmentectomy under the assistance of thoracoscopy. Exclusion criteria: ① Pregnant or lactating women; ② Obese patients (BMI ≥ 28 kg/m2); ③ Patients with metastatic tumors; ④ Patients with severe functional disorders of organs such as heart, lung, liver, and kidney; ⑤ Patients with abnormal airway anatomy and unable to establish OLV.

1.3 Method The patient was routinely prohibited from eating and drinking before the operation. After entering the operating room, peripheral veins and radial artery channels were established, and electrocardiogram, percutaneous arterial oxygen saturation (SpO2), non-invasive blood pressure and invasive blood pressure were monitored. Before induction, 5 mL/kg of fluid was administered for volume expansion. Anesthesia induction: midazolam 0.03 mg/kg, propofol 1.5-2.5 mg/kg, rocuronium 0.6 mg/kg, sufentanil 0.5 μg/kg. Anesthesia maintenance: propofol 4-8 mg/kg, remifentanil 0.2 μg/(kg.min), cisatracurium 0.05 mg/h. 3 minutes after anesthesia induction, SafeLM visual laryngeal mask or DLT was inserted, and the bronchial occluder was placed under the guidance of a fiberoptic bronchoscope (Figure 1) after laryngeal mask insertion. After induction, paravertebral nerve block (T3 - T6) was performed under ultrasound guidance with 0.375% ropivacaine 10 mL. During the operation, the patient's vital signs were closely observed, and heart rate or blood pressure fluctuations were maintained within ±30% of the baseline value. Postoperatively, nalbuphine 0.03 mg/(kg·h) + flubiprofen ester 150 mg were given for patient-controlled analgesia. This study was approved by the hospital's ethics committee (approval number: CHEC2021-092).

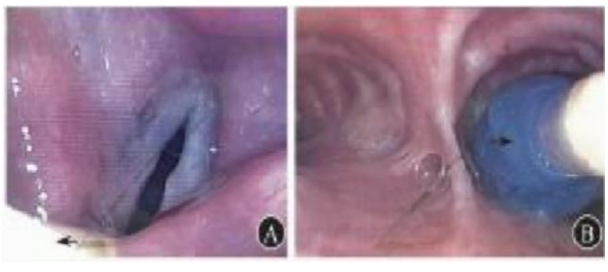

Figure 1 Fiberoptic bronchoscope guidance of the occluder via a SafeLM visual laryngeal mask

1.4 Observation indicators Record the general information of the patients, including gender composition, age, BMI, ASA classification, type of surgery, operation time, and anesthesia time. Primary outcome: Use the throat pain recorded in the postoperative follow-up form as the primary observation indicator, and calculate the required sample size based on the incidence of postoperative throat pain. Postoperative sore throat is defined as the new discomfort in the throat that occurs after surgery. Secondary outcomes: Postoperative hoarseness (defined as new onset of voice change after surgery), intubation time (refer to the anesthesia record sheet, starting from 3 minutes after the end of anesthesia induction until the bronchial blocker or double-lumen tracheal tube maintains the ideal state), fluctuations in heart rate or blood pressure before and after intubation, success rate of OLV, degree of lung collapse (evaluated by the surgeon 5 minutes after single-lung ventilation, with 0 indicating complete lung expansion and 100 indicating the maximum degree of lung collapse), and intraoperative hypoxemia (SpO2 < 90%).

1.5 Statistical processing It was conducted using SPSS 20.0 statistical software. The measurement data with a normal distribution were expressed as mean ± standard deviation, and the comparison between groups was performed using t-test; the measurement data without a normal distribution were expressed as median (M) and the 25th and 75th percentiles (p25, p75), and the comparison between groups was conducted using rank sum test. The count data were expressed as frequency (n) and percentage (%), and the comparison was performed using chi-square test. A difference was considered statistically significant when $P< 0.05$.

2 Results

2.1 General situation All patients completed the anesthesia as per the established protocol without any mid-process change in the intubation method. For patients using laryngeal masks, no cases of laryngeal mask displacement requiring adjustment occurred during the operation. There were 10 male and 10 female patients in each group; the surgical sites were the left lung in 12 cases and the right lung in 8 cases. There were no statistically significant differences in the gender composition, age, BMI, ASA classification composition, surgical type, anesthesia time, and operation time between the two groups (all P values > 0.05). See Table 1.

2.2 The observation indicators of anesthesiology It showed that the incidence of postoperative sore throat in the DLT group was significantly higher than that in the SafeLM group (P< 0.01), and the intubation time in the SafeLM group was significantly longer than that in the DLT group (P< 0.01). The incidence of an increase in heart rate or blood pressure by more than 15% after the insertion of a laryngeal mask or catheter in the SafeLM group was significantly lower than that in the DLT group (P < 0.05). There were no statistically significant differences in the incidence of postoperative hoarseness, the success rate of OLV, the assessment of lung collapse degree by the surgeon, and the incidence of intraoperative hypoxemia between the two groups (all P values > 0.05). See Table 2.

Table 1 Comparison of general conditions between the two groups of patients

Group	Year (mean±s)	BMI (mean±s, kg/m^2)	ASA Grade Ⅰ or Ⅱ (n/n)	Type of Surgery(n)			Surgery time (mean±s, min)	Anesthesia time (mean±s, min)
				Wedge resection	Segmentectomy	Lobectomy		
DLT	51. 4±7.6	23. 0±1.8	10/10	8	7	5	94. 5±33. 6	127. 5±33. 5
SafeLM	50. 8±8.1	22. 4±1.4	9/11	6	8	6	110. 3±37. 1	142. 0±33. 2

Table 2 Comparison of Anesthesiological Observation Indicators between the Two Groups of Patients

Group	Postoperative sore throat(n)	Postoperative hoarseness(n)	Insertion time (mean±s, min)	Increase in blood pressure or heart rate > 15% after catheterization [n(%)]	OLV success rate [n(%)]	Collapsed lung (mean±s, score)	Intraoperative hypoxemia [n(%)]
DLT	9(45)	2(10)	4. 7±1.7	8(40)	20(100)	89. 0±7.9	3(15)
SafeLM	2(10)	0	9. 9±3.7	2(10)	20(100)	87. 5±7.9	4(20)
P	< 0.05	> 0.05	< 0.05	< 0.05	> 0.05	> 0.05	> 0.05

3 Discussion

The results of this study show that the combination of visual laryngeal mask airway and bronchial blocker can reduce the hemodynamic disorders and the incidence of postoperative sore throat caused by double-lumen endotracheal tube intubation. However, the time required for the insertion of the visual laryngeal mask airway combined with bronchial blocker is significantly longer than that of the visual double-lumen bronchial tube insertion. There are no statistically significant differences in the postoperative hoarseness rate, OLV success rate, degree of lung collapse, and incidence of intraoperative hypoxemia between the two OLV methods.

Although the laryngeal mask has been widely used in general anesthesia, in lateral position surgeries, body position changes often cause laryngeal mask displacement, which leads to various complications such as poor ventilation and gas leakage into the digestive tract [7], and the lateral position is not conducive to adjusting the position of the laryngeal mask and switching to tracheal intubation. The new generation of laryngeal masks, such as LMA Protector, can provide a more airtight airway seal, thereby improving the stability of laryngeal mask insertion in the lateral position [8]. Our team previously conducted research on the effects of the lateral position laparoscopic surgery on the sealing pressure of LMA Proseal and Supreme two types of laryngeal masks. The results showed that the sealing pressure of both types of laryngeal masks decreased under the lateral position and pneumoperitoneum conditions. The incidences of poor ventilation efficiency (end-expiratory CO2 pressure > 45 mmHg, 1 mmHg = 0.133 kPa) during the operation of the two types of laryngeal masks were 9.8% and 17.4% respectively [9]. Therefore, the ventilation efficiency of the laryngeal mask position may affect the application effect of the laryngeal mask in lateral position surgeries.

In addition, the traditional method of inserting a blind laryngeal mask may result in various situations where the laryngeal mask is not positioned properly, such as the part of the epiglottis being partially trapped within the laryngeal mask or covering the glottic opening entirely, the epiglottis curling and affecting the sealing performance of the laryngeal mask, the laryngeal mask being curled, the laryngeal mask being placed too deep or too shallow and failing to achieve a sealing effect, etc. [10-11]. A study [12] showed that after blind insertion and placement under direct vision with laryngoscope guidance, 42.0% of patients had completely satisfactory laryngeal mask positions (as confirmed by laryngeal mask fiberoptic bronchoscopy, with the epiglottis not visible in the field of view). Therefore, good ventilation does not necessarily mean an ideal laryngeal mask position, and an unsatisfactory laryngeal mask position may lead to displacement of the laryngeal mask during the operation.

The advantage of the visual laryngeal mask is that it allows real-time observation of the process of laryngeal mask insertion, thereby ensuring that the laryngeal mask is in the optimal position after insertion. Currently, the commonly used visual laryngeal masks in clinical practice include C-Trach [13], SaCoVLM [14], and SafeLM visual laryngeal masks. Among them, the SafeLM visual laryngeal mask has the latest registration time. Its main difference from other visual laryngeal masks is that the front-end video lens can be adjusted like the front end of a fiberoptic bronchoscope, enabling the operator to adjust the lens angle to assist in laryngeal mask positioning when the vision is poor. The results also

suggested that the bronchial occluder was not easy to pass through the glottic due to its fixed Angle. At this time, the assistant could gently press the thyroid cartilage of the patient or moderately lean the head forward of the patient, and the occluder could pass smoothly. No patient had hypoxemia due to the prolonged placement of the bronchial occluder This is a technique for quickly inserting a bronchial occluder.

The double-lumen bronchial tube has a relatively thick diameter, and the insertion and removal process will cause strong stimulation to the patient, especially during insertion, which requires rotation, causing greater damage to the laryngeal and tracheal mucosa. Strong stress reactions will promote the release of catecholamines in the body, leading to increased blood pressure and faster heart rate. The laryngeal mask is easy to place, causes little irritation, and does not expose the glottis. It is a ventilation device on the glottis. The bronchial occluder has a slender tube diameter and uses a high-capacity and low-pressure silicone balloon, which can reduce the irritation and damage to the bronchial mucosa. In this study, the visual laryngeal mask was first inserted, and then the bronchial occluder was placed under the guidance of the adjustable visual function of the visual laryngeal mask. At the end of the operation, the bronchial occluder was removed, and the visual laryngeal mask was retained as the ventilation tool during the recovery period. This significantly reduced the stimulation of the tube to the glottis and tracheal mucosa [14], ensured the stability of circulation during the induction and recovery periods of thoracoscopic surgery patients [15], and reduced the stress response of the patients. Perioperative lung protection strategy is of great significance in thoracoscopic single-lung ventilation su_1r_8gery, in which low airway pressure is the key.

The respiratory parameters were set according to the same coefficient. The oxygenation status of both groups was good, and the difference was not statistically significant ($P > 0.05$).

However, the airway plateau pressure of the visual laryngeal mask combined with the bronchial blocker was significantly lower than that of the double-lumen bronchial tube group, which was consistent with the research results of Xie Fenglei et al. [16]. This might be because the material of the double-lumen bronchi is relatively hard and its inner diameter is smaller, thereby increasing the ventilation resistance.

This might be because the material of the double-lumen bronchi is relatively hard and its inner diameter is smaller, thereby increasing the ventilation resistance. The diameter of the bronchial occluder is relatively thin, which increases the diameter of mechanical ventilation compared with the tracheal catheter. When the two-lung ventilation is converted to one-lung ventilation, the double-lumen bronchial catheter changes from the original double-lumen to the single lumen, and the ventilation tube diameter is half of the original. while the ventilation tube diameter of the experimental group remains unchanged. It is suggested that compared with double-lumen bronchial tube, laryngeal mask airway combined with bronchial blocker can reduce airway pressure to a certain extent, improve respiratory mechanics, and effectively reduce pulmonary blood shunt rate [17], so as to implement effective lung protection and reduce the occurrence of pulmonary complications. In addition, it has been proved that [18], visual laryngeal mask combined with bronchial occluder can reduce the trauma to patients to a certain extent, reduce the stress response of the body, thereby reducing the release of inflammatory mediators, which

can replace the double-lumen tracheal tube to achieve OLV in thoracic surgery to a certain extent, and the OLV effect is similar to that of the double-lumen tracheal tube. This result is similar to a recent study on SaCoVLM used in minimally invasive thoracic surgery [6], both of which can reduce the incidence of postoperative sore throat and hemodynamic disorders.

The shortcomings of this study: The study did not adopt a randomized controlled clinical trial design but was conducted as a retrospective cohort study for exploration. However, this study provides important theoretical references for the next step of conducting a randomized controlled clinical study on the application of SafeLM visual laryngeal mask.

In conclusion, the application of visual laryngeal mask airway combined with bronchial blocker in thoracoscopic surgery can not only achieve the same effect of lung collapse as double-lumen bronchial tube, but also reduce the incidence of intubation-related adverse reactions such as sore throat and hoarseness. It has less trauma to patients, better anesthesia quality, higher comfort of patients, shorter hospital stay, and faster postoperative recovery of patients . The visual laryngeal mask airway combined with bronchial blocker can be a better alternative to double-lumen bronchial tube in selected patients and surgical types.

References:

[1] SOMMA J, COUTURE É J, PELLETIER S, et al. Non-ventilated lung deflation during one-lung ventilation with a double-lumen endotracheal tube: a randomized-controlled trial of occluding the non-ventilated endobronchial lumen before pleural opening[J]. Can J Anaesth, 2021, 68(6): 801-811. DOI: 10.1007/s12630-021-01957-9.

[2] MCGRATH B, TENNUCI C, LEE G. The history of one-lung anesthesia and the double-lumen tube[J]. J Anesth Hist, 2017, 3(3): 76-86. DOI: 10.1016/j.janh.2017.05.002.

[3] CLAYTON-SMITH A, BENNETT K, ALSTON R P, et al. A comparison of the efficacy and adverse effects of double-lumen endobronchial tubes and bronchial blockers in thoracic surgery: a systematic review and meta-analysis of randomized controlled trials [J]. J Cardiothorac Vasc Anesth, 2015, 29(4): 955-966. DOI: 10.1053/j.jvca.2014.11.017.

[4] YOO J Y, CHAE Y J, PARK S Y, et al. Time to tracheal intubation over a fibreoptic bronchoscope using a silicone left double-lumen endobronchial tube *versus* polyvinyl chloride single-lumen tube with bronchial blocker: a randomized controlled non-inferiority trial [J]. J Thorac Dis, 2019, 11(3): 901-908. DOI: 10.21037/jtd.2019.01.108.

[5] WANG S, ZHANG J, CHENG H, et al. A clinical evaluation of the ProSeal laryngeal mask airway with a Coopdech bronchial blocker for one-lung ventilation in adults [J]. J Cardiothorac Vasc Anesth, 2014, 28(4): 900-903. DOI: 10.1053/j.jvca.2013.06.004.

[6] 解凤磊, 高芳, 王峰, 等. SaCo 可视喉罩联合支气管封堵器在微创胸腔镜手术患者中的应用[J]. 临床麻醉学杂志, 2021, 37(5): 502-505. DOI: 10.12089/jca.2021.05.012.

[7] KOMASAWA N, UEKI R, FUJII A, et al. Comparison of Laryngeal Mask Supreme® and Soft Seal® for airway management in several positions [J]. J Anesth, 2011, 25(4): 535-539. DOI: 10.1007/s00540-011-1145-0.

[8] UESHIMA H, OTAKE H. Emergency insertion of the LMA protector airway in patients in the lateral position [J]. J Clin Anesth, 2018, 44: 116. DOI: 10.1016/j.jclinane.2017.11.028.

[9] LAN S, ZHOU Y, LI J T, et al. Influence of lateral position and pneumoperitoneum on oropharyngeal leak pressure with two types of laryngeal mask airways[J]. Acta Anaesthesiol Scand, 2017, 61(9): 1114-1121. DOI: 10.1111/aas.12943.

[10] VAN ZUNDERT A A J, GATT S P, KUMAR C M, et al. 'Failed supraglottic airway': an algorithm for suboptimally placed supraglottic airway devices based on videolaryngoscopy [J]. Br J Anaesth, 2017, 118(5): 645-649. DOI: 10.1093/bja/aex093.

[11] VAN ZUNDERT A A, KUMAR C M, VAN ZUNDERT T C. Malpositioning of supraglottic airway devices: preventive and corrective strategies [J]. Br J Anaesth, 2016, 116(5): 579-582. DOI: 10.1093/bja/aew104.

[12] CAMPBELL R L, BIDDLE C, ASSUDMI N, et al. Fiberoptic assessment of laryngeal mask airway placement: blind insertion *versus* direct visual epiglottoscopy [J]. J Oral Maxillofac Surg, 2004, 62(9): 1108-1113. DOI: 10.1016/j.joms.2003.10.014.

[13] MATHEW D G, RAMACHANDRAN R, REWARI V, et al. Endotracheal intubation with intubating laryngeal mask airway (ILMA), C-Trach, and Cobra PLA in simulated cervical spine injury patients: a comparative study [J]. J Anesth, 2014, 28(5): 655-661. DOI: 10.1007/s00540-014-1794-x.

[14] 张斌，林赳杨，付宝军，等. SaCoVLM 可视化插管喉罩与气管插管在老年股骨头置换术中的应用效果比较 [J]. 中国实用医药，2021，16(16)：90-93. DOI：10.14163/j.cnki.11-5547/r.2021.16.034.