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Application of Visual Double-Lumen Bronchial Tube in Standardized Training of Anesthesiology Residents

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ABSTRACT

Objective: To observe the effect of the Visual Double-Lumen Bronchial Tube (V-DLT) in the standardized training of anesthesiology residents.

Methods: Forty anesthesiology graduate students undergoing standardized training in the Department of Anesthesiology, Second Affiliated Hospital of Dalian Medical University from March to June 2023 were selected. All trainees had been working in clinical anesthesia for at least three months and were proficient in endotracheal intubation but had no experience with double-lumen bronchial intubation. The trainees were guided to perform double-lumen bronchial intubation, starting with conventional double-lumen bronchial intubation (DLT), and the success rate was recorded. Then, the visual double-lumen bronchial intubation was performed, and the success rate was recorded. After DLT intubation, positioning was guided by a fiberoptic bronchoscope (FOB), and after V-DLT intubation, positioning was guided by the camera within the tube. Patients were classified into the DLT group and the V-DLT group. The incidence of postoperative sore throat and hoarseness was recorded, and trainees' learning satisfaction was surveyed.

Results: The first intubation success rate of trainees was significantly higher with V-DLT than with conventional DLT ($P<0.05$). There was no significant difference in the incidence of postoperative sore throat and hoarseness between the two groups ($P>0.05$). The learning satisfaction of trainees in the V-DLT group was higher than that in the DLT group ($P<0.05$).

Conclusion: V-DLT can improve the intubation success rate of trainees, enhance their learning satisfaction, stimulate their learning enthusiasm, and boost their confidence in performing the procedure.

Keywords: Visual Double-Lumen Bronchial Tube; Standardized Training of Residents; Thoracic Surgery; Fiberoptic Bronchoscope

Abbreviations: V-DLT: Visual Double-Lumen Bronchial Tube; DLT: Double-Lumen Bronchial Intubation; FOB: Fiberoptic Bronchoscope; ASA: American Society of Anesthesiologists; BIS: Bispectral Index

Introduction

Thoracic surgery anesthesia is one of the key and difficult points in the standardized training of anesthesiology residents. The double-lumen bronchial intubation technique is the first hurdle in thoracic surgery anesthesia. Many doctors develop a fear of thoracic anesthesia after experiencing failure in double-lumen tube intubation during their standardized training. How to quickly and effectively enable residents to master the double-lumen bronchial intubation technique is one of the urgent issues to be addressed in standardized training. With the development of visualization technology and the clinical application of visual double-lumen tubes, intubation complications have been significantly reduced [1,2] thus introducing this technology into teaching. This study aims to explore the role of visual double-lumen tubes in improving residents' competency and core skills in thoracic anesthesia intubation training.

Materials and Methods

General Information

A total of 40 anesthesiology residents undergoing standardized training in the Department of Anesthesiology, Second Affiliated Hospital of Dalian Medical University from March to June 2023 were included in this study, comprising 13 males and 27 females. All trainees had been working in clinical anesthesia for at least three months, were proficient in endotracheal intubation, but had no experience with double-lumen tube intubation. Eighty patients undergoing thoracic surgery at our hospital were selected, classified as American Society of Anesthesiologists (ASA) grade I-II; 47 cases of lobectomy and 33 cases of segmental or local lung resection. Considering the trainees were all first-time users of double-lumen tubes, patients with Mallampati grades I-II and suitable for 35Fr and 37Fr double-lumen tubes were selected. Four patients in the V-DLT group were excluded due to excessive sputum obstructing the lens.

Methods

All patients underwent bronchial anesthesia and single-lung ventilation for thoracoscopic lung resection surgery. Anesthesia induction drugs included remimazolam 3 mg, alfentanil 0.2 mg/kg, rocuronium bromide 0.6 mg/kg, and etomidate 0.3 mg/kg. The bispectral index (BIS) value was monitored, and intubation was performed when the BIS value was around 40-50. The fiberoptic bronchoscope was a Zhejiang Youyi visual fiberoptic bronchoscope with a diameter of 2.88 mm; the DLT was a left-sided type (Covidien, USA); the V-DLT was a left-sided type (Weili, Guangzhou). Trainees were guided to perform double-lumen bronchial intubation, with successful intubation defined as insertion into the left side. The intubation success rate was recorded for both conventional and visual double-lumen intubation. Positioning was guided by FOB after DLT intubation and by the camera within the tube after V-DLT intubation. The incidence of postoperative sore throat and hoarseness was recorded, and trainees' learning satisfaction was surveyed.

Observation Indicators

The success of each intubation (insertion into the left side) was recorded, and the success rates of each double-lumen tube were calculated. The incidence of postoperative sore throat and hoarseness was recorded. Trainees' learning satisfaction was surveyed.

Statistical Methods

Statistical analysis was performed using SPSS 20.0 software. Normally distributed measurement data were expressed as mean ± standard deviation (x±s), and comparisons between groups were made using t-tests; comparisons of count data were made using χ^2 tests. $P<0.05$ was considered statistically significant.

Results

Comparison of General Conditions Between the Two Groups

The study included 40 patients in the DLT group and 36 in the V-DLT group. The DLT group had 17 male and 23 female patients; the V-DLT group had 15 male and 21 female patients. There was no significant difference in age, height, and weight between the two groups ($P>0.05$), as shown in Table 1. The intubation success rate in the V-DLT group was significantly higher than in the DLT group, as shown in Table 2. V-DLT can replace FOB for double-lumen tube positioning and continuous monitoring near the carina, as shown in Figures 1 & 2. For patients using V-DLT, any slight displacement of the tube during surgery due to traction could be promptly detected and adjusted. Observations throughout the surgery showed that for patients intubated with V-DLT, once accurately positioned, the lung collapse in the surgical area was consistent with the effect of bronchial positioning by FOB in the DLT group and met surgical requirements.

Table 1: Comparison of General Conditions Between the Two Groups.

		DLT Group (n=40)	V-DLT Group (n=36)	*P* Value
Sex	Male	17(42.5%)	15(31.7%)	
	Female	23(57.5%)	21(58.3)	0.670
Age		62.3±10.2	65.7±12.1	0.243
Height		166.4±10.2	168.1±7.9	0.657
Weight		65.2±7.3	64.9±6.3	0.192

Table 2: Comparison of Other Conditions Between the Two Groups.

	DLT Group (n=40)	V-DLT Group (n=36)	*P* Value
Intubation Success Rate	82.5%	100%	0.008
Incidence of Sore Throat	65.0%	61.1%	0.726
Incidence of Hoarseness	5.0%	2.7%	0.619
Trainee Satisfaction	55.0%	88.9%	0.001

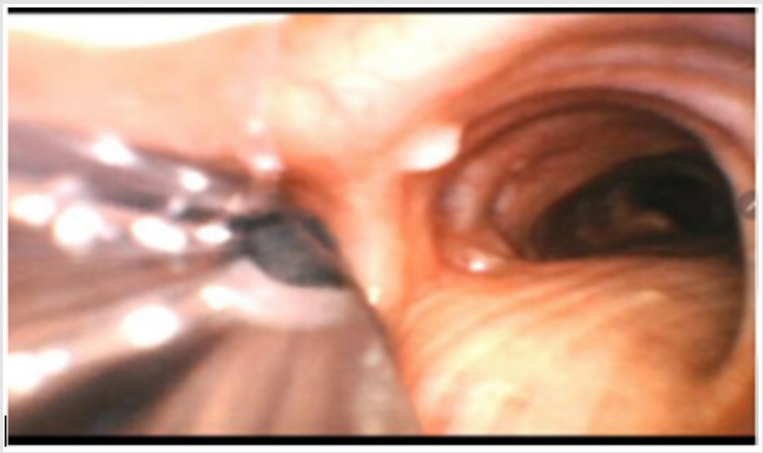

Figure 1:

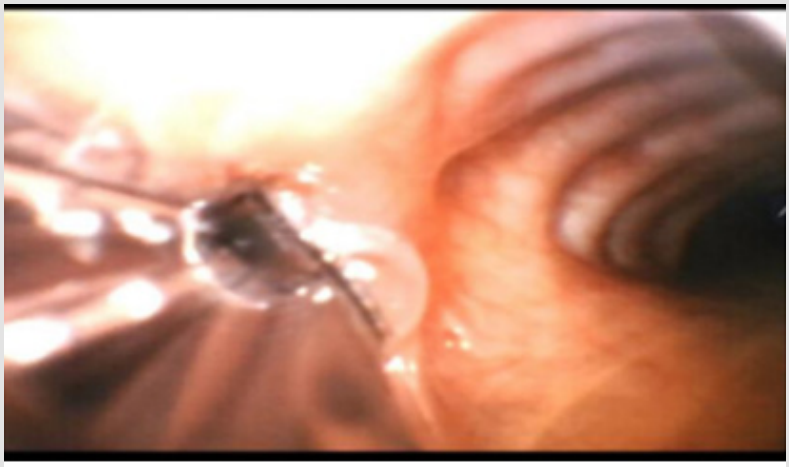

Figure 2:

Comparison of Postoperative Adverse Reactions Between the Two Groups

In the DLT group, 26 cases of postoperative sore throat and 2 cases of hoarseness were reported, while in the V-DLT group, there were 22 cases of sore throat and 1 case of hoarseness. There was no significant difference in the overall incidence of sore throat and hoarseness between the two groups (χ^2=0.123, P=0.726; χ^2=0.247, P=0.619), as shown in Table 2.

Comparison of Trainees Satisfaction Between the Two Groups

Postoperative satisfaction surveys showed that trainees in the V-DLT group had significantly higher satisfaction than those in the DLT group, as shown in Table 2.

Discussion

Standardized training of residents is an important stage of postgraduate medical education. The standardized training of anesthesiology residents is essential for achieving the standardization, normalization, and homogenization of anesthesiologists in China [3]. According to the national standardized training outline for residents, the main content of resident training is to consolidate students' professional knowledge and enhance their clinical practical skills, improving the overall quality of trained residents nationwide. In the medical field, anatomical structures are highly abstract. Traditional teaching methods mainly involve acquiring theoretical knowledge from books, which can be relatively tedious, followed by simulation training, and finally clinical practice. In traditional clinical practice teaching, procedures such as endotracheal intubation and central

venous puncture are based on experience and tactile feedback. With the rapid development of medical technology, visualized teaching has been widely used in other fields, and the use of visual laryngoscopes for endotracheal intubation has achieved good results in standardized resident training [4]. Thoracic surgery anesthesia is one of the key and difficult points in the standardized training of anesthesiology residents. The double-lumen bronchial intubation technique is the first hurdle in thoracic surgery anesthesia. Many doctors develop a fear of thoracic anesthesia after experiencing failure in double-lumen tube intubation during their standardized training.

Mastering the use of a fiberoptic bronchoscope requires long-term training and clinical practice. How to quickly and effectively enable residents to master the double-lumen bronchial intubation technique is one of the urgent issues to be addressed in standardized training. V-DLT places a video camera in the bifurcation area of the double-lumen tube, providing a visual field similar to that seen by FOB near the carina. Therefore, V-DLT can partially replace FOB in DLT positioning and provide continuous monitoring near the carina. This study introduced V-DLT into the training of residents, significantly improving their double-lumen tube intubation success rate, enhancing their learning satisfaction, and boosting their confidence in performing thoracic anesthesia. Using V-DLT for intubation provides a visual guide throughout the intubation process, allowing the operator to directly visualize the carina and place the bronchial tube in the ideal position, thus eliminating the need for FOB to position and adjust the tube after conventional DLT intubation.

Subsequent patient position changes, surgical manipulation of lung tissue, or traction on the bronchial tree causing double-lumen tube displacement are clearly visible on the monitor, allowing anesthesiologists to adjust the tube position at any time, ensuring the smooth completion of surgery. In this study, the intubation success rate of trainees in the V-DLT group reached 100%, significantly higher than that of the DLT group. Any procedure involves some risk of injury, especially during endotracheal intubation. Studies have reported that the incidence of sore throat after DLT intubation is 14%-90%, and the incidence of hoarseness is 10%-50%, related to the skill level of the anesthesiologist and the patient's susceptibility [5].

Other studies have shown that the incidence and severity of postoperative hoarseness and sore throat are directly related to the size of the endotracheal tube, and the insertion, removal, and intraoperative positioning of double-lumen tubes can cause damage to the vocal cords and throat [6,7]. In this study, the incidence of sore throat and hoarseness in the V-DLT group was lower than in the DLT group, but the difference was not statistically significant, which we attribute to the small sample size. If a larger sample size were available, V-DLT might show a significant advantage in reducing intubation complications. Despite the significant advantages of visual V-DLT, its relatively high cost limits its widespread clinical use. Additionally, this study found that for patients with excessive oral or airway secretions or intraoperative bloody fluids, once the V-DLT lens is covered, it is often difficult to effectively clear it, consistent with issues encountered in other studies [8]. Moreover, for patients with particularly difficult airways, V-DLT alone cannot complete bronchial intubation without FOB guidance.

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