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Araştırma / *Research Article*

Comparison of Fiberoptic Bronchoscope and Disposcope Endoscope in Cohen Endobronchial Blocker Placement

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Cohen Endobronşiyal Bloker Yerleştirmesinde Fiberoptik Bronkoskop ve Disposcope Endoskopun Karşılaştırması

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ABSTRACT

Objective: *In this study, we aimed to compare fiberoptic bronchoscope (FOB) and Disposcope® endoscope (DE),which is one of the optical imaging methods used in Cohen flexitip bronchial blocker placement.*
Methods: *In this study, a total of 40 patients in whom a bronchial blocker was inserted for one-lung ventilation were randomly assigned into two groups as FOB (n=20) and DE (n=20). Data including demographic and clinical characteristics of the patients, Cormack-Lehane grade, duration and ease of bronchial blocker placement were recorded.*
Results: *The mean bronchial blocker insertion time in the DE group (196±32 sec) was shorter than the mean BB insertion time in the FOB group (244±21 sec) with a statistically significant intergroup difference (p<0.05). In both FOB and DE groups, it was found that placement of DE, and BB into the right main bronchus was easier when compared with the left main bronchus (p<0.05).*
Conclusion: *Disposcope® endoscope-guided Cohen flexitip bronchial blocker placement is a suitable option for one- lung ventilation in thoracic surgery with its easy placement within a shorter time.*

Keywords: *one-lung ventilation, lung isolation, endoscopes, bronchial blocker, flexible fiberoptic bronchoscopy*

ÖZ

Amaç: *Bu çalışmada, Cohen fleksitip bronşiyal bloker yerleştirilmesinde kullanılan optik görüntüleme yöntemlerinden, fiberoptik bronkoskop (FOB) ve Disposcope® endoskopu (DE) karşılaştırmayı amaçladık.*
Yöntem: *Bu çalışmada, tek akciğer ventilasyonu için bronşiyal bloker yerleştirilen 40 hasta randomize olarak FOB grubu (n=20) ve DE grubu (n=20) olmak üzere 2 gruba ayrıldı. Hastaların demografik ve klinik özellikleri, Cormack-Lehane sınıflaması, bronşiyal blokerin yerleştirme süresi ve kolaylığı kaydedildi.*
Bulgular: *DE grubunun ortalama bronşiyal bloker yerleştirilme süresinin (196±32 sn); FOB grubunun bronşiyal bloker yerleştirilme süresine göre (244±21 sn) daha kısa olduğu belirlendi ve istatistiksel olarak anlamlı bulundu (p<0.05). Hem FOB hem de DE gruplarında; sağ ana bronşa yerleşimin, sol ana bronştan daha kolay olduğu bulundu (p<0.05).*
Sonuç: *Torasik cerrahi pratiğinde Disposcope® endoskop kılavuzluğunda Cohen flexitip bronşiyal bloker yerleştirilmesi, kısa ve kolay yerleşimi ile, tek akciğer ventilasyonu için uygun bir seçenektir.*

Anahtar kelimeler: *tek akciğer ventilasyonu, akciğer izolasyonu, endoskoplar, bronşiyal bloker, fleksibl fiberoptik bronkoskopi*

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INTRODUCTION

In the practice of thoracic surgery, several lung isolation techniques have been used for one-lung ventilation (OLV). The use of double-lumen tubes (DLTs) are the gold standard method for lung isolation. However, bronchial blockers (BBs) can be used when DLTs are unavailable or in cases of a difficult airway, morbid obesity, in surgeries requiring segmental blockage, nasal intubation, in already intubated patients, having tracheotomy or tracheostomy, those requiring postoperative mechanical ventilation, and in the presence of unexpected OLV detected intraoperatively [1,2].

Although fiberoptic bronchoscopy (FOB) is the gold standard method for the placement of BBs, it is associated with high cost and high-level training and experience. In recent years, thus, cost-effective and practical imaging tools as an alternative to FOB have been searched.

The Disposcope® endoscope (DE) (Disposcope Taiwan, Hsinchuang, Taiwan) is a recently introduced medical device for endotracheal intubation. It has a wire transmitter for handling and for wireless connection to a portable display screen and a wire transfer tube where the microcamera located at the tip of the wire enables visualization of the glottis more easily. The endotracheal tube (ETT) can be placed over the wire transfer tube. As it is made of flexible memory metal, it can be easily bent, which allow adjusting it to an optimal angle. These features seem to make the DE as a favorable alternative to FOB for BB placement [3].

To the best of our knowledge, there is no study available in the literature investigating use of DE for the BB placement. In the present study, we, for the first time, aimed to compare FOB and DE in Cohen® flexi-tip BB placement in patients undergoing OLV.

MATERIAL and METHOD

This prospective, randomized clinical study was conducted at Gulhane Military Medical Academy between February 2014 and July 2014. A written informed consent was obtained from each patient. The study protocol was reviewed and approved by the Ethics Committee of Kecioren Training and Research Hospital (approval #: 468). The study was conducted in accordance with the principles of the Declaration of Helsinki.

The study included a total of 40 patients aged between 18 to 65 years who were in the American Society of Anesthesiologists (ASA) Class I-III risk category, and scheduled for thoracic surgery with OLV. The laterality of the lung isolation to be performed (right or left) was previously determined. Randomization was performed using sealed envelope technique. All patients were randomly assigned into two equal groups as FOB (n=20) and DE (n=20). As the study was not blinded for right or left-sided lung isolation, each group was further divided into two equal groups including 10 patients in each. Those requiring urgent surgery, cases with tracheal fistulas or masses, tracheotomy, a forced expiratory volume in one second (FEV1) of <1,000 mL, obesity (having a body mass index of >30 kg/m2, and history of difficult airway were excluded from the study.

Induction of anesthesia was performed using propofol (2-3 mg/kg IV), fentanyl (1-2 µg/kg IV), and rocuronium bromide (1 mg/kg IV). Following the induction, female and male patients were intubated through the oropharyngeal route using an 8.0 mm-, and 8.5 mm -single-lumen ETT, respectively. The correct placement of the ETT was confirmed by auscultation.

Following endotracheal intubation, BB and optical imaging tools (FOB or DE) were passed through the multiport airway adapter and the adapter was connected to the ETT. Under the guidance of BB and optical imaging system, the carina where the trachea bifurcates into the right and left mainstem bronchi was visualized and BB was directed to the side which was planned to be blocked. The blue cuff of the BB

was inflated with 4 to 8 mL air to seal the bronchus completely. All patients received 100% oxygen during the BB placement. The mean duration of BB placement was defined as the mean time from the transition of ETT at the vocal cord level to the placement of BB into the orifice of the targeted main bronchus. The anesthesiologist using each optical imaging device was at the level of assistant professor. Anesthesia maintenance was established with O_2/air mixture containing an inspiratory oxygen fraction (FiO_2) of 50% through total intravenous anesthesia.

Data including demographic characteristics of the patients, ASA Class, Cormack-Lehane grade, type of surgical procedure (thoracotomy/video-assisted thoracoscopic surgery), duration of BB placement, the ease of BB placement as subjectively assessed by the anesthesiologist (1: Easy; 2: Moderate; 3: Difficult; 4: Very difficult), the degree of lung collapse as assessed by an experienced thoracic surgeon with a minimum five-year experience in thoracic surgery (1: Poor; 2: Moderate; 3: Good; 4: Very good), the number of patients requiring intraoperative optical imaging at least once due to inadequate OLV, and malpositions as detected by additional optical imaging tools in such cases were included. Intraoperative malpositions related to inadequate OLV included herniated BB cuff into the trachea, overpassing the orifice of the main bronchus leading to inadequate visualization of the BB cuff, and inadequate right upper lobe isolation in right-sided BB placement were also noted In both groups, FOB was used to identify and correct intraoperative malpositions and their incidence was recorded.

Statistical Analysis

The primary endpoint was the mean time from the transition of ETT at the vocal cord level to the BB placement into the orifice of the targeted dmain bronchus. Accordingly, the sample size was calculated as 34 with 0.05 error margin and 0.9 power. Considering the drop rate due to protocol violations and early withdrawals, a total of 40 patients including 20 in each group were recruited.

Statistical analysis was performed using the SPSS version 17.0 software (SPSS Inc., Chicago, IL, USA). Descriptive data were expressed in mean ± standard deviation (SD) or nuumerical values, and frequencies. The Student t-test was used to analyze continuous variables. The chi-square test was performed to examine categorical variables. A p value of <0.05 was considered statistically significant.

RESULTS

A total of 40 patients were randomized into two equal groups as FOB (n=20) and DE (n=20). There was no significant difference between the groups as for demographic characteristics, ASA Class, Cormack-Lehane grade, and type of surgical procedure (Table 1).

Table 1. Patients demographic data.

	FOB Group (n=20)	DE Group (n=20)
Age (years)	58±16	54±18
ASA I/II/III	1/14/5	2/15/3
Sex ratio (Male-Female)	13-7	14-6
Weight (kg)	71±19	67±17
Height (cm)	168±15	164±12
Cormack and Lehane grade; 1-2/3-4	17/3	16/4
Thoracotomy/VATS	15/5	16/4
Surgical side (Right/left)	10/10	10/10

Abbreviations: ASA, American Society of Anesthesiologists; DE, Disposcope Endoscope; FOB, Fiberoptic Bronchoscope; VATS, video-Assisted Thoracoscopic Surgery;
Data are expressed as numbers of patients or means ± SD. SD, standard deviation.

Table 2. Duration of bronchial blocker placement in main groups.

	FOB Group (n=20)	DE Group (n=20)	p value
Duration of bronchial blocker placement (s)	244±21	196±32	0.002

Abbreviations: DE, Disposcope Endoscope; FOB, Fiberoptic Bronchoscope; s, seconds
Values are expressed as means±SD, SD, standard deviation.

The mean duration of BB placement was 196±32 sec in the DE group and 244±21 sec in the FOB group, indicating statistically significantly shorter duration in the DE group (p<0.05) (Table 2). According to the

Table 3. Duration of bronchial blocker placement in subgroups.

	Right Sided FOB (n=10)	Left Sided FOB (n= 10)	Right Sided DE (n=10)	Left Sided DE (n=10)	p value
Duration of bronchial blocker placement (s)	195±40	294±36			0.005
Duration of bronchial blocker placement (s)			152±34	241±27	0.005

Abbreviations: DE, Disposcope Endoscope; FOB, Fiberoptic Bronchoscope; s, seconds
Values are expressed as means±SD, SD, standard deviation.

subgroup analysis based on the side of the procedure, the mean duration of BB placement was statistically significantly shorter in the right-sided DE group than the left-sided DE group (152±34 sec vs. 241±27 sec,) and in the right-sided FOB group than the left-sided FOB group (195±40 sec vs. 294±36 sec) ($p<0.05$) (Table 3).

According to the ease of BB placement, the procedure was significantly easier for the right main bronchus than the left main bronchus both performed with the aid of optical imaging systems ($p<0.05$) (Table 4).

Table 4. Ease of bronchial blocker placement.

	Right Sided DE + Right Sided FOB (n=20)	Left Sided DE + Left Sided FOB (n=20)	p value
Ease of bronchial blocker placement (1/2/3/4)*	15/5/0/0	8/5/5/2	0.027

Abbreviations: DE, Disposcope Endoscope; FOB, Fiberoptic Bronchoscope
**1, Easy; 2, Moderate; 3, Difficult; 4, Very difficult*
Data are expressed as numbers of patients

The degree of lung collapse was assessed by an experienced thoracic surgeon in a blinded manner and no significant difference was found between the groups. In addition, there was no significant difference in the number of patients requiring intraoperative optical imaging at least once due to inadequate OLV between the groups and subgroups. Also, there was no significant difference in the rate of intraoperative malpositions as detected by additional optical imaging tools in patients with inadequate OLV (Table 5).

DISCUSSION

Firstly in this study DE was used as an alternative optical imaging system to FOB for BB placement during OLV. The DE is the first wireless, malleable videostylet and its main advantages include its lower cost (90% lower cost than FOB), portable and operator-friendly design, battery-powered, fast visualization without any need for wiring for the light source with a small display screen [3].

Table 5. Lung collapse and bronchial blocker malpositions.

	FOB Group (n=20)	DE Group (n=20)	p value
Degree of lung collapse (1/2/3/4)*	2/2/5/11	0/2/5/13	0.568
Number of patients requiring intraoperative optical imaging at least once	8	6	0.532
Malpositions			
Blocker balloons herniation into the trachea	4	4	0.568
Blocker balloons not visible below the carina	2	1	0.532
Inadequate right upper lobe isolation in right-sided BB placement	2	1	0.238

Abbreviations: DE, Disposcope Endoscope; FOB, Fiberoptic Bronchoscope
**1, Poor; 2, Moderate; 3, Good; 4, Very good*
Data are expressed as numbers of patients

In the present study, we observed significantly shorter duration of BB placement under the guidance of DE than FOB. Similarly, Nizard et al. [4] reported a mean duration of Cohen® flexitip BB placement of 256±75 sec and Kus et al. [5] reported a mean duration of 241±51 sec under the guidance of conventional FOB. These results are consistent with our study findings.

In addition, we observed significant differences in the mean duration of BB placement into the right and left main bronchus. The left main bronchus is smaller, longer, and runs more horizontally than the right main bronchus which complicates the BB placement. Consistently, the mean duration of BB placement was significantly longer and the procedure was more difficult for the left main bronchus using both FOB and DE.

The DE has been primarily designed for endotracheal intubation. In two Chinese studies, intubation with the DE yielded higher success rates and shorter intubation times than conventional laryngoscopy [6,7]. Similarly, two other studies demonstrated favorable results with shorter intubation times, higher success rates, and hemodynamic stability with DE compared to conventional laryngoscopy [8,9]. In their study, Liu et al. [10] compared FOB versus DE in patients with obesity with expected difficult airway during awake orotracheal intubation and found shorter intubation time , more feasible intubation setting, and lesser incidence of sore throat. In another study, Kamburoglu et al. [11] investigated the efficacy of conventional FOB versus DE for the confirmation of the correct position of the DLT and reported shorter confirmation time with DE. Similarly, Chen et al. [12] compared conventional blind tube placement versus DE using DLTs and showed higher success rates and shorter duration of placement with DE.

Furthermore, experience of the anesthesiologist is one of the major factors which affect the duration of BB placement. The anesthesiologist must have the recognition of the tracheobronchial anatomy and its endoscopic view to achieve OLV successfully. In our study, although the mean duration of BB placement was longer in the initial cases in both groups, the procedure could be completed in a shorter period of time with increasing experience.

The Cohen® flexitip BB relies on a wheel-twisting device and has been purposely pre-angled at the distal tip to facilitate the insertion into a targeted bronchus. For the BB placement into the left main bronchus, the cuff was held (~2 cm located in the midline) and was rotated 180° anti-clockwise. Then the controller located in the upper tip was rotated and advanced into the left main bronchus. As an alternative, the BB was fixed and the ETT was rotated 180° toward left.

Irrespective of the side of the main bronchus, the tubing of the Cohen® flexitip BB should be primed and simulated and the axis should be calibrated and placed into the multiport airway adapter before induction of anesthesia. While advancing BB, the black arrow can be seen at the distal tip of the blocker. In addition, BB should be lubricated with a sterile gel adequately under both FOB and DE guidance.

The tip of conventional FOB allows rotation through an external mechanism. Therefore, both Arndt-type BBs which have a wire loop without a wheel-twisting device and Cohen-type BBs can be used under the guidance of FOB to achieve OLV. In our study, the tip of the DE was non-steerable, which makes it unfeasible for Arndt-type BBs. Hence, FOB seems to be more advantageous than DE for the guidance of BB placement.

Furthermore, an aspirator can be connected to the controller of conventional FOB which allows identification and removal of secretions that disrupt ventilation and visualization. The fact that DE lacks this feature indicates another disadvantage of DE compared to FOB. However, although the Cohen® flexitip BB has a small lumen for aspiration or ventilation, aspiration could not be adequately performed as expected in our study.

In their study, Campos et al. [13] reported that the position of the patient could be changed during BB placement, mostly from the supine to lateral decubitus position. In addition, the authors recommended advancing the blocker approximately 1 cm forward to avoid dislodgment toward the trachea during changing the patient's position. Similarly, we advanced the blocker 1 cm forward from the its ideal depth in the supine position and no malposition related to the changing position from supine to lateral decubitus was observed as confirmed by optical imaging tools.

In the patients with inadequate OLV, the rate of intraoperative malpositions as assessed by additional optical imaging systems was similar between both tools, but higher for the right main bronchus. In addition, herniation of the BB cuff into the carina was the most common intraoperative malposition in both imaging systems, predominantly in the right main bronchus. This can be attributed to the fact that the vertical axis of the right main bronchus is narrower than of the trachea. Due to the close anatomical proximity of the bronchial orifice of the right upper lobe to the carina, BB placement for the right main bronchus should be meticulously handled.

In the practice of anesthesiology and intensive care, DE can be used as a favorable alternative to FOB for the procedures performed from the oral cavity to carina, in conventional intubation, awake fiberoptic intubation, DLT placement or confirmation. However, DE is not feasible for below-the-carina level, as it is shorter and less flexible than FOB and it has not been designed for aspiration.

Nonetheless, there are some limitations to this study. Its single-center design and the lack of blinded allocation for the right and left main bronchus by the surgeon are the main limitations. In addition, the degree of lung collapse was evaluated by more than one thoracic surgeon and the ease of BB placement was evaluated by different anesthesiologists with varying experience in thoracic anesthesia.

In conclusion, the Cohen® flexitip BB placement under the guidance of DE is a favorable option for OLV in thoracic surgery practice with shorter procedural and preoperative preparation times, and .easier placement However, the BB placement into the left main bronchus is more challenging and time-consuming with both FOB and DE. In health care settings where FOB is unavailable or unfeasible due to high cost or technical limitations, DE can be effectively used.

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