

A randomized trial to assess the utility of preintubation adult fiberoptic bronchoscope assessment in patients for thoracic surgery requiring one-lung ventilation

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ABSTRACT

Background: Confirmation of placement of Double lumen endobronchial tubes (DLETT) and bronchial blockers (BBs) with the pediatric fiberoptic bronchoscope (FOB) is the most preferred practice worldwide. Most centers possess standard adult FOBs, some, particularly in developing countries might not have access to the pediatric-sized devices. We have evaluated the role of preintubation airway assessment using the former, measuring the distance from the incisors to the carina and from carina to the left and right upper lobe bronchus in deciding the depth of insertion of the lung isolation device. **Methods:** The study was a randomized, controlled, double-blind trial consisting of 84 patients (all >18 years) undergoing thoracic surgery over a 12-month period. In the study group ($n = 38$), measurements obtained during FOB with the adult bronchoscope decided the depth of insertion of the lung isolation device. In the control group ($n = 46$), DLETTs and BBs were placed blindly followed by clinical confirmation by auscultation. Selection of the type and size of the lung isolation device was at the discretion of the anesthesiologist conducting the case. In all cases, pediatric FOB was used to confirm accurate placement of devices. **Results:** Of 84 patients (DLETT used in 76 patients; BB used in 8 patients), preintubation airway measurements significantly improved the success rate of optimal placement of lung isolation device from 25% (11/44) to 50% (18/36) ($P = 0.04$). Our incidence of failed device placement at initial insertion was 4.7% (4/84). Incidence of malposition was 10% (8/80) with 4 cases in each group. The incidence of suboptimal placement was lower in the study group at 38.9% (14/36) versus 65.9% (29/44). **Conclusions:** Preintubation airway measurements with the adult FOB reduces airway manipulations and improves the success rate of optimal placement of DLETT and BB.

Key words: Airway assessment; Bronchial blocker; Double-lumen tubes; Fiberoptic bronchoscope; One-lung ventilation; Thoracic surgery

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INTRODUCTION

The use of double-lumen endobronchial tubes (DLETT) and bronchial blockers (BBs) for lung isolation is a well-established technique. For years, the blind technique was used for their placement and position was further confirmed clinically by auscultation.^[1-3] It was later established that most preferred method for placement of these devices was a real-time visualization of airway anatomy using the of pediatric fiberoptic

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bronchoscope (FOB) (Klein, 1998 #3). This, owing to cost, is not available in many developing nations; however, most centers in the developing world do have an adult FOB. Furthermore, all patients posted for lung surgeries undergo bronchoscopy as a part of their workup before surgery. The study objective was to assess if preintubation assessment of airway with adult FOB would improve the precision of double-lumen tubes (DLETT) and BB placement and also decrease the number of attempts and manipulations required for placement of these devices. Preoperative airway assessment using an adult FOB may also help in identifying patients, in whom placement of DLETT/BB may be difficult due to anatomical problems.^[4,5]

METHODS

The study was carried out after approval from the institutional review board. Written informed consent was obtained from all patients over 18 years of age who were undergoing thoracic surgery requiring lung isolation. Patients who consented for the study were included and randomized into two groups: The control group (in whom the isolation device was placed blindly) or the study group (in whom the preintubation adult FOB assessment was performed). Demographic data, age, sex, height, and weight were recorded. All patients were administered general anesthesia with or without epidural catheterization. The choice of isolation device (either DLETT or BB) and size and side of DLETT were left to the discretion of the anesthesiologist conducting the case. The DLETT used was Portex® Blue Line® endobronchial tubes (Smiths Medical) and the BBs were Coopdech™ endo BBs (Daiken Medical Company, Ltd.). The experience of the person inserting the device was also noted and categorized as <5 insertions, 5–20 insertions, and >20 insertions.

After patients were anesthetized, patients in the study group underwent a FOB with a 5.3 mm adult FOB performed by a thoracic surgeon. During this preintubation bronchoscopy, the following parameters were noted: Any existing airway abnormality, distances from incisor to carina and primary carina to secondary carina on the left side, and from carina to opening of the right upper bronchus on the right side. Following this, the isolation device was inserted in both groups; however, in the study group, distances measured were used to determine the depth of insertion of the lung isolating device.

Isolation device	Depth fixed
Left side DLETT	A + C
Right side DLETT	B cm + 0.5 cm
Bronchial blocker	A cm + 2 cm

A: Distance from the incisors to the carina which will be measured on FOB, B: The distance from incisors to the take off of the right upper lobe bronchus, C: Distance from tracheal to bronchial opening. DLETT: Double lumen endobronchial tubes, FOB: Fiberoptic bronchoscope

We found that for 35F, 37F, and 39F left DLETT, the distance C was 4 cm, 4.5 cm, and 5 cm, respectively [Figure 1].

After the insertion was performed, the anesthesiologist confirmed the position of the isolation device clinically by auscultation method for patients in the control group and made necessary manipulations to optimize the position. When the DLETT was used, first the tracheal cuff was inflated, and bilateral lung expansion was confirmed by inspection of chest wall movement and by auscultation. Now the tracheal limb of the catheter mount was clamped, and the lung was ventilated through the bronchial lumen. The bronchial cuff was inflated until there was no leak of air from the tracheal limb, and there was no air entry heard in the nonventilated lung.

For the right-sided DLETT, air entry was heard at the apex while ventilating through the bronchial lumen. The amount of air required to inflate the bronchial cuff to achieve the lung isolation was noted.

When BB was used, the cuff was inflated with sufficient air to achieve the lung isolation.

Following this, confirmation of placement of isolation devices was done by a senior anesthesiologist who was blinded to the randomization with a pediatric FOB (3.0 mm diameter). The positions of isolation devices were considered as optimal, suboptimal, and malpositioned depending on the following criteria based on view through tracheal and bronchial lumina [Table 1].

For cases where BBs were used, the placement was considered optimal when the proximal edge of the fully inflated cuff was visualized just 5–10 mm below the tracheal carina and the placement was considered malpositioned when the cuff of the blocker had herniated into the trachea or the blocker was in the opposite bronchus or blocker on the right side was distal to the origin of the right upper lobe bronchus.

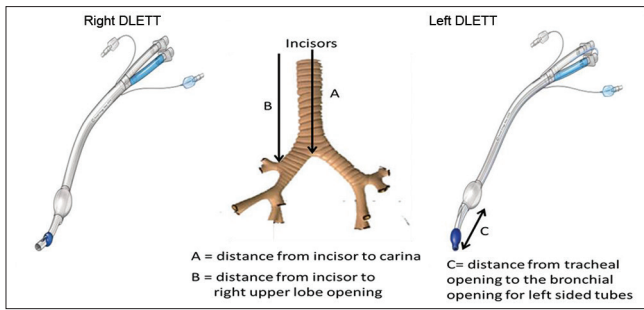


Figure 1: Endotracheal tube and Tracheo-bronchial distance calculations

All suboptimal and malpositioned devices were repositioned by a senior anesthesiologist under FOB guidance, and the number of manipulations done was noted.

Furthermore, during surgery, the operating surgeon was asked for the condition of surgical field, and it was graded as excellent (completely collapsed lung with no movements on respiration); good (no movements on respiration, however, lung not completely collapsed); and poor (no isolation and lungs inflating with inspiration).

The DLETT size was deemed appropriate if the volume of air in the bronchial cuff required for isolation was in the recommended range of 1–3 ml; oversized if <1 ml was needed to inflate the cuff, and undersized if >3 ml was required to inflate the cuff. Peak pressures after achieving lung isolation were also noted.

The sample size was determined on the basis of an unpublished study performed in our institution which showed about 30% optimal placement rate by conventional method. Thus, to achieve a 60% optimal rate with the desired power analysis of study 0.80 and assuming type 1 error protection as 0.05, sample size calculated was 84. We studied 84 patients over a period of 1-year. After randomization, the patients were stratified according to the type of lung isolation device used, and analysis was performed using Chi-square test to find the significance in difference in positions, number of attempts, and surgical condition in both control and study group. The Statistical package used was IBM Corp. Released 2010. IBM SPSS Statistics for Windows, Version 19.0. Armonk, NY: IBM Corp, with a $P < 0.05$ being considered statistically significant.

RESULTS

A total of 84 patients were included in the study (DLETT 76, BB 8 patients). Four patients were

Table 1: Classification of isolation device positions

Position	Tracheal view	Bronchial view
Optimal	Unobstructed unintubated bronchus and proximal end of bronchial cuff visible just below the carina	Unobstructed secondary carina on the left side and good alignment of the right upper lobe bronchus and opening of endobronchial lumen on the right side
Suboptimal	Proximal end of bronchial cuff is not visible through tracheal lumen or <50% bronchial cuff has herniated into the trachea	No obstruction to the right main or left upper lobe bronchi
Malpositioned	The tracheal carina or unintubated bronchus is not seen, or more than half the bronchial cuff is herniating into the trachea	Intubation of the wrong mainstem bronchus or tracheal carina is visible through the bronchial lumen, or secondary carina is not visible through the bronchial lumen

excluded from the analysis because DLETT insertion failed and FOB-guided insertion was performed; 80 patients were included in the final analysis of which 36 were in the study group and 44 in the control group; 1 patient from the control group had narrow subglottis which prevented DLETT from being inserted in spite of multiple attempts which could have been avoided if preintubation FOB had been performed.

The baseline demographic data of the two groups were comparable [Table 2].

Pediatric FOB assessment done after the placement of the lung isolation device showed there was a statistically significant difference ($P = 0.045$) in the success rate of placement of the lung isolation devices between both the groups [Figure 2].

There was no significant difference in success rate of double-lumen tubes (DLT) placement in the right- and left-sided DLT with $P = 0.639$. There was no statistically significant difference in the number of attempts for insertion of either isolation device ($P = 0.525$). In 31 out of 37 patients in the study group, the isolation device was inserted in a single attempt as opposed to 41 of 45 patients in the control group. In both groups, 2 patients each required 3 attempts for placing the device. We did not find any association between the experience of the person inserting the lung isolation device and the number of attempts required for placement of lung isolation device ($P = 0.25$ in study group and $P 0.09$ in control group).

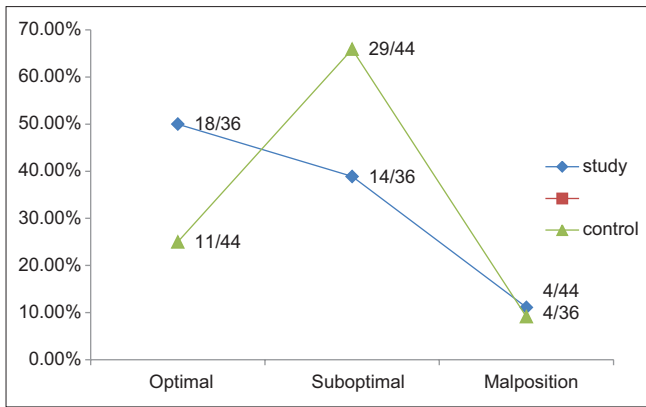


Figure 2: Success rates of lung isolation device placement

Table 2: Demographic data of both groups

	Control	Study	P
ASA (1, 2, 3)	30/16/0	20/17/1	0.3
Sex (male/female)	27/19	26/12	0.2
Anesthesia tech (GA/GA+epidural)	17/29	17/21	0.3
Lung isolation (DLT/BB)	42/4	34/4	0.5
Size of DLT (35/37/39)	13/17/11	4/17/14	0.09
Side of DLT (left/right)	38/3	33/2	0.5

ASA: American Society of Anesthesiologists, GA: General anesthesia, DLT: Double-lumen tubes, BB: Bronchial blocker

We also studied the number of manipulations required for optimal placement of the device in each randomization group and categorized the cases as requiring no (i.e., zero) manipulation; 1 manipulation; and >1 manipulation. It was found that the study group required significantly fewer manipulations as compared to the control group [Figure 3].

In addition, no significant difference was found in the intraoperative surgical field with respect to the lung isolation device and randomization (*P* value for DLETT 0.5 and for BB 0.4).

Based on the volume of air used for inflation of bronchial cuff, the appropriate size of DLETT was inserted in 74% of patients (54/74); in 24.7% (18/74) of patients the smaller size of DLETT was placed; whereas in 1.3%, the larger size DLETT was placed.

DISCUSSION

Lung isolation is essential for virtually all thoracic surgical procedures. The most important step in achieving lung isolation is accurate positioning of the lung isolation device.^[6] It is an accepted practice that all DLETTs and BBs should be placed under FOB guidance; however, with pediatric FOB being unavailable in many centers

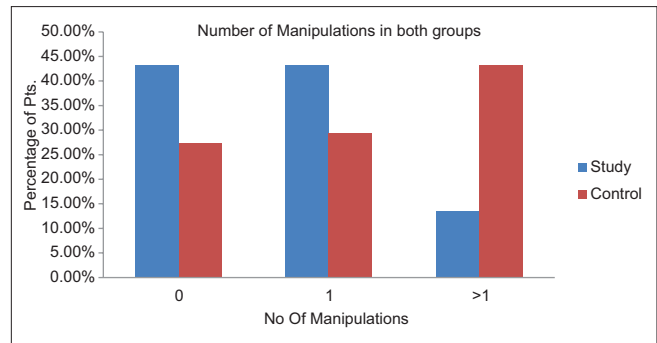


Figure 3: Number of manipulations in both groups

in the developing world, our goal was to assess whether pre intubation assessment of the airway with adult FOB would aid in achieving lung isolation. Furthermore, pre intubation airway assessment could help in detecting airway abnormalities such as narrow subglottis which in turn could help in choosing the appropriate lung isolation device (BB or smaller size DLT). We did not detect any airway abnormalities in the intervention group. However, in the control group, there was 1 patient in whom the DLT could not be inserted due to narrow subglottis. In this patient, a BB was inserted. If pre intubation assessment would have been done, excessive airway handling could have been avoided for the patient.

FOB assessment performed after the placement of the lung isolation device showed that 50% of DLETTs in the FOB group (study group) were optimally placed as compared to only 25% optimally placed DLETTs in the control group; however, malposition rate was not found to be significantly different in both groups. de Bellis *et al.* showed that 48% of patients required repositioning in spite of satisfactory findings on auscultatory examination.^[2] In our study, even though the clinical assessment showed satisfactory results, 70% of patients in the control group and 56.7% of patients in the study group needed FOB-guided manipulations to ensure optimal placement.

In addition, the percentage of patients in whom optimal position of DLETT was achieved by blind insertion was only 25% as compared to other studies where it was 73.3% and 63% in studies by Cheong and Koh, respectively.^[7] In our study, a large proportion of patients were found to have DLETTs and BBs in suboptimal position, and we did not find any association between the experience of the anesthesiologist inserting the lung isolation device and success rate of placement. Our center, however, does not have dedicated thoracic anesthesiologists, and the relatively infrequent assignments in the thoracic

operation rooms may have resulted in a lower success rate of optimal positioning of DLETT by blind insertion.

Regarding limitations-all measurements were made before insertion of lung isolation device. The measurements were made with the FOB inserted orally in the sniffing position. There may have been small differences in measurements due to variation in the path taken by the FOB in the pharynx and also by the variable position of patient's head and neck.

In addition, the clinical impact of the suboptimal position could not be studied as all suboptimal positions were also corrected by repositioning the lung isolation device.

CONCLUSIONS

This study showed that preintubation assessment of the airway in patients for thoracic surgery using the adult FOB improved the success rate of optimal positioning of the lung isolation device. We feel this has important implications for hospitals and centers without access to pediatric bronchoscopes. In addition, our study, although small, suggests that using an appropriate preintubation strategy using commonly available adult bronchoscopes which may decrease the necessity of pediatric FOB in operation theaters and facilitate smaller centers to improve their accuracy with lung isolation devices.

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Conflicts of interest

There are no conflicts of interest.

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