Original Article

Determination of Accurate Double Lumen Tube Position by Fiberoptic Bronchoscopy Following Blind Intubation for Thoracic surgery

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Abstract

Background: *The double lumen tube (DLT) is an important element for thoracic surgery and anesthesia. With the use of fiberoptic bronchoscopy (FOB), the position of DLT in thoracic surgery can easily be observed or adjusted. However, DLT malposition occurs when patients are changed from supine to the lateral position, leading to hypoxia and lung isolation failure during one-lung ventilation (OLV). In this study the application of bronchoscopy has been observed for detecting exact position of DLTs following blind intubation and after patient positioning.*

Methods: *A prospective study was conducted on fifty-eight patients who needed DLT insertion during thoracic surgery. 44 individuals underwent blind tracheal intubation with left-sided tubes, while 14 patients underwent it with right-sided tubes. After clinical assessment of correct placement, bronchoscopy was done in supine position and after patient positioning for thoracotomy by a different anesthesiologist. When a double lumen tube needed to be moved more than 0.6 cm to fix its position, it was deemed to be malpositioned. Extreme malposition refers to the positioning of a double lumen tube that may have jeopardized patient safety or the procedure for surgery.*

Results: *Nine patients had clinical evidence of malposition during blind DLT intubation, which was verified by fiberoptic bronchoscopy. Correct placement of DLT by clinical assessment was found in 49 patients of which 29 cases were detected in correct position by bronchoscopy and in 20 cases malposition was detected five of which were extreme. After patient positioning for thoracotomy, in 29 patients DLTs were found to be displaced, 12 of which were extreme. Following intubation and patient positioning, right-sided DLT displacement rates were higher than left-sided DLT displacement rates for left and right sided thoracotomies. There were no instances of unsatisfactory lung collapse.*

Conclusions: *Nearly half of the patients needed DLT repositioning after positioning for thoracotomy and more than one third after blind intubation. Fiberoptic bronchoscopy may take the role of traditional blind intubation techniques in order to determine the precise position of DLTs following intubation and patient placement for thoracic surgery.*

Keywords: *One lung ventilation, thoracic anesthesia, fiberoptic bronchoscopy, double lumen tube, intubation, and patient positioning.*

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Introduction:

Lung separation and single lung ventilation are an essential component of anaesthetic management for thoracic surgery[1]. For thoracic surgical procedures including lung resections, resection of mediastinal tumors, decortications, oesophageal resection and anastomosis, after trauma, thoracoscopy, etc., one-lung ventilation (OLV) is necessary. For optimal ventilation and function, double-lumen endobronchial tubes (DLTs) must be positioned correctly. DLTs can be positioned left or right to ventilate a single lung[2].For the best possible surgical field visualization and performing surgery, proper lung collapse is a prerequisite[3]. Because of its wide diameter, and fixed shape the double-lumen tube commonly obstructs the view through a laryngoscope, making its placement difficult[4,5]. Adverse events during OLV may occur due to the DLT's improper location. Therefore, precise DLT placement is essential[6, 7]. The advent of fiberoptic bronchoscopy has improved the accuracy of placing double-lumen tubes[8,9]. Surgical process can be hampered by minimal DLT movement, which can also generate hypoxemia and make single lung ventilation challenging[10,11]. The DLT may be malpositioned if the body is moved from supine to lateral[12]. It has been proposed that fiberoptic bronchoscopy is a dependable technique to assess DLT placement both during insertion and after patient positioning[13]. Therefore, the aim of this study was to use fiberoptic bronchoscopy to determine the correct placement of the DLT after blind intubation for thoracic surgery.

Materials and Methods:

58 patients (30 men and 28 women) of ASA grade II and III, aged 17–74 years, undergoing thoracic surgery (n = 44 for surgery of the lungs and n = 14 for surgery of the oesophagus) were enrolled in this observational study over a nine-month period from May 2021 to January 2022, after receiving approval from the ethics committee of the Combined Military Hospital, Dhaka, Bangladesh. Following an explanation of the procedures, informed written consent was obtained. The research did not include patients with mouth opening anomalies or Mallampati III–IV problematic airway patients. Premedication was done with 1.5µg/kg of fentanyl and 0.03 mg/kg of midazolam. Propofol 2 mg/kg for the induction and suxamethonium 1.5 mg/kg was used for intubation which was made with Robertshaw DLT. 35, 37, or 39 Fr tubes for men and 33 or 35 Fr tubes for women were selected. The tracheal cuff was inflated after insertion, and a clinical assessment of the appropriate intubation was completed. Then the bronchial cuff was inflated, and appropriately, the correct placement of the DLT was assessed by auscultation following clamping of the tracheal limb. The required adjustments were made and recorded. Then fiberoptic bronchoscopy was performed by another anaesthesiologist, without knowledge of the first anesthesiologist's observations, completed the final evaluation of DLT placement and adjusted any improper tube positioning. When the tube required moving greater than 0.6 cm to rectify its position then it was called malposition. Extreme malposition was identified when migration into the trachea was more than half of the bronchial cuff or left and right bronchial limb did not allow any clear view of the respective bronchi. Nitrous oxide, isoflurane, and oxygen were used to maintain anesthesia. Hemodynamic and respiratory parameters like arterial blood pressure, pulse oximetry, end-tidal carbon dioxide, and ECG were continuously monitored. After the patient was positioned for sternotomy (neck hyperextension) or thoracotomy (lateral decubitus), again bronchoscopy was performed, with the tube's location adjusted if needed.

Statistical analysis:

To analyze the results of DLT position findings for determining the need for additional bronchoscopy descriptive statistics were employed. The odds ratio, which compares the likelihood of an outcome occurring with a risk factor to not having one, and its standard error of the mean were computed. The chi-square test was used to test hypothesis (significant at values $p < 0.05$). The clinical bronchoscopic assessments of DLT placement were compared using the kappa-test interrater (interobserver) agreement.

Results:

Tables I and II present a summary of the key findings. Following intubation, clinical signs alone identified tube malposition in nine out of the fifty-eight patients (16%).The clinical symptoms were validated and the tube malpositions were correctly diagnosed by later fiberoptic bronchoscopy. After intubation malposition commonly occurred in the wrong principal bronchus (n = 4). Two proximal and two distal malpositions were identified. One patient had airway blockage from secretion without malposition. Fiberoptic bronchoscopy was carried out in all patients following blind intubation subsequent clinical evaluation and after positioning the patients for surgery. Despite normal clinical findings fiberoptic examination in 20 additional individuals (34.48%) revealed DLT malposition of which distal (n = 9) was more prevalent than proximal (n = 3). A considerable agreement was found in the interobserver agreement test between the clinical and fiberoptic assessments (kappa =

0.253 +/- 0.041; P < 0.001). Out of these 20 patients, five had extreme malpositions: Two left bronchial limb hindered a clean view of the left upper or lower lobe bronchus and one right bronchial limb prevented a clear view of the right upper lobe. Two individuals had almost half of the bronchial cuff dislodged in the trachea. After positioning, fiberoptic bronchoscopy showed malpositioning in 29 patients where proximal malpositions (n = 12), were more frequent than distal malposition (n = 05). Of these 29 cases, 12 had extreme malpositions: In four patients (two left, two right), the bronchial cuff was positioned too far in, making it impossible to see two lobar bronchi on the left side and right upper lobe bronchus. In one instance, the bronchial cuff was put into the incorrect principal bronchus. The bronchial cuff had fully migrated into the trachea in three patients.

Table I: Findings from bronchoscopy after intubation and after positioning the patient (n = 58)

Time point	Findings	Patients (n/%)	FOB Findings	n
After intubation	Abnormal clinical findings			
	Abnormal FOB findings	09/16	Intubation of the "wrong" mainstem bronchus (2 x left DLT/2 x right-DLT	4
				2
			DLT too distal	2
			DLT too proximal	1
			Airway obstruction due to secretion without malposition	
	Normal clinical findings			
	Abnormal FOB findings'	20/34.48	DLT too distal	9
			DLT too proximal	3
			Over inflated bronchial cuff	2
			Under inflated bronchial cuff	1
			Extreme Malpositions (No clear view of the lobar bronchus)	
			Into right mainstem bronchus	1
			Into left mainstem bronchus	2
			Endo bronchial cuff displaced into the Trachea	2
After positioning	Abnormal FOB findings	29/50.0	Proximal malposition (DLT too proximal)	12
			Distal malposition (DLT too distal)	5
			Extreme malpositions	
			Endobronchial cuff located into wrong mainstem bronchus	1
			Endo bronchial cuff completely moved into the trachea	3
			Endobronchial cuff partially moved into the trachea	4
			Endobronchial cuff too far into lobar bronchus	4

When the patient was positioned for a sternotomy, the frequency of malposition's in left-sided DLTs (1 of 2 or 50%) were slightly greater than when the patient was positioned for a thoracotomy (27 of 56 or 48.21%). Positioning the patient for right sided thoracotomy using left sided DLT produced higher rate(12 of 22, or 54.54%) of DLT malpositions than left sided thoracotomy (7 of 20 or 35%). Positioning the patient for left sided thoracotomy using right sided DLT produced higher rate (8 of 14, or 57.14%) of DLT malpositions than using left sided DLT (7 of 20 or 35%). However, the change was not significant in terms of statistics (P = 0.05). Following patient positioning, there was a difference in the frequency of DLT malpositions compared to after intubation (chi squared = 1.97; P = ns). In contrast to proximal malpositioning, which happened more frequently after patient positioning than following intubation (19 of 58 vs. 7 of 58, respectively; chi squared = 37.8, P < 0.001; odds ratio, 2.9 +/- 1.5), after intubation, distal displacement happened more frequently than following patient positioning (11 of 58 vs. 9 of 58, respectively; chi squared = 29.12, P < 0.001; odds ratio, 1.28 +/- 1.1). DLT corrections after intubation were (9 of 14 right-sided vs. 15 of 44 left-sided, chi squared = 7.83; P < 0.01; odds ratio, 1.8 +/- 1.4) and after positioning were (8 of 14 right-sided vs. 20 of 44 left-sided, chi squared = 19.72; P < 0.001; odds ratio, 1.6 +/- 1.1). DLT malposition on the right-side was more common than on the left side.

Table II: DLT repositioning by bronchoscopy in connection to the surgery (n=58)

Intervention	DLT Type	Number of Patient	DLT Correction after Intubation-		DLT Correction after Positioning of the Patient	
			n	%	n	%
Median sternotomy	Left	02	00	00	1	50
Right-sided thoracotomy	Left	22	09	40.0	12	54.54
Left-sided thoracotomy	Left	20	06	30	7	35
Left-sided thoracotomy	Right	14	09	64.28	8	57.14

Discussion:

This study is directed to the use of fiberoptic bronchoscope to insert DLT in correct position during thoracic anesthesia. The majority of thoracic procedures need DLTs, whose improper location may result in problems such hypoxia, atelectasis, excessive airway pressure, and secretion buildup[4,8,14,15.] Recently, the fiberoptic bronchoscope has become a vital instrument for preventing or treating DLT malposition. Correct placement of DLT was evaluated by clinical examination prior to the advent of bronchoscopy. Inspection, auscultation, and breathing pressure assessment were performed during this examination, both with and without unilateral DLT limb clamping[6,7,10,11,14,16,18]. In our investigation, a clinical examination by alone was able to detect malpositioning in 9 of 58 cases. Twenty more of the 58 patients had DLT malpositioning, according to fiberoptic examination, despite the clinical (auscultation and inspection) evaluation being good. Extreme malposition that could compromise patient safety or disrupt surgery was found in 5 individuals (25%). Furthermore, prior studies have shown that fiberoptic bronchoscopy was necessary for the identification of 15.5-24% of left-sided DLTs that were not detectable with just clinical assessment[3,4]. Our research unequivocally supports the proper placement of DLT by bronchoscopy in line with certain earlier studies. Contrary to our work, however, prior research had some drawbacks, including a limited sample size[2,5] and a lack of routine fiberoptic monitoring following patient positioning[3]. In our study, proximal malpositions were more common after positioning while distal malpositions were more common after intubation. We reasoned that less proximal misalignment would have occurred after placement if distally misaligned tubes had not been corrected after intubation. If a distally misplaced tube is left uncorrected after intubation, it may travel farther when positioning the patient and result in serious harm. Placing the DLT on the right side causes more problems than placing the DLT on the left side. This is most likely because there wasn't much of a safety margin when the DLT was placed on the right rather than the left. [17]. Inadequate lung isolation or blockage of the right upper lobe bronchi might result from minor proximal or distal deviations. In one instance, the latter caused secretions from the upper lung to leak into the lower lung. Routine bronchoscopy is advised while placing tubes because of the short safety margin and high rate of malposition associated with blind right-sided tube placement. [4].We acknowledge that the insertion of a borderline tube may cause blockage, dislocation, inadequate lung isolation, or any combination of these issues. These kinds of events can be avoided by using a bronchoscope. During surgery, abnormal auscultation results or difficulty breathing may be due to incorrect tube placement as well as secretions and bronchospasm. In the event that bronchoscopy is not conducted, correction will be made using repeated suctioning, moving the tube, or both, in conjunction with auscultation in order to get a fruitful result. This is laborious and may require a fiberoptic inspection in the end. It is immediately feasible to determine the reason of poor ventilation and the best course of action with primary fiberoptic examination.

Conclusion:

Fiberoptic bronchoscope has been essential equipment as an initial guide for placement of DLT in correct position, detection and correction of malposition during thoracic surgery, clearing secretions or blood obstructing the airway. By using FOB after blind intubation and after patient positioning, intraoperative complications could also be reduced. FOB increases the success rate of DLT placement and may replace conventional methods of blind intubation. According to this study, bronchoscopy may have more advantages than disadvantages, including the potential for mucosal erosions and higher expenses

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