

Comparative Study between Bronchial Blocker and Left Double Lumen Endotracheal Tube for One Lung Ventilation in Right Video-Assisted Thoracoscopic Surgery

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Summary:

Background: Double lumen endotracheal tubes (DLT) and bronchial Blockers (BB) have both been used for lung isolation in video-assisted thoracic surgery (VATS) with some inherent demerits. Though not well studied is widely thought that DLT provides faster and better quality of lung collapse.

Objective: The aim of this study was to compare the quality of lung deflation of a left sided double lumen endotracheal tube with a broncheal blocker for one lung ventilation in video-assisted thoracic surgery.

Materials methods: A total forty adult patients have been assigned to either DLT or BB group who undergoing VATS procedure for mediastenal mass surgery. Correct placement of airway was confirmed by fiber optic bronchoscopy. The variables assessed were: 1. Time required for correct placement of device, 2. Time taken for lung collapse, 3. Quality of Lung collapse, 4. Number of times of airway mal-positioned, 5. Changes of blood pressure and heart rate at baseline (T_1) and immediate before (T_2) and after (T_3) intubation and one minute after (T_4) intubation, 6. Number of patients with hypoxemia ($SpO_2 < 90\%$) during one lung ventilation, and 7. Post-operative complication like hoarseness of voice, sore throat and lung infection.

Result: The time required to place the device in correct position was similar between two groups. Time taken for right lung collapse in DLT was faster than BB group, DLT (2.46 ± 0.85) BB (4.76 ± 0.61) $P < 0.05$. HR was similar and comparable at T_1 , T_2 , T_4 between groups & was significantly high at T_3 in DLT (88.24 ± 7.42) than BB group (78.56 ± 9.06) and p value ($=0.00007$) was significant. Mean arterial pressure (MAP) were comparable between groups at T_1 , T_2 , T_4 , but at T_3 was higher in DLT (99.36 ± 9.62) than BB (92.15 ± 6.47) and the result was statistically significant ($P = 0.0084$).

Conclusion: Result showed that BB could be a better and effective alternative of DLT in VATS Procedure considering a longer time to achieve complete lung collapse with minimum hemodynamic changes and with minimum post-operative complication.

Key words: One lung ventilation (OLV), Video-assisted thoracoscopic surgery (VATS), Double lumen tube (DLT), Bronchial blocker (BB).

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Introduction

Video assisted thoracic surgery (VATS) is a minimally invasive, popular technique increasingly used in thoracic surgery which requires one lung ventilation (OLV). A key to successful VATS surgery is maximizing intra

thoracic visualization by optimizing the quality of lung isolation and deflation within the relatively closed thoracic cavity.

Double lumen endotracheal tube (DLT) has generally been considered the gold standard for lung isolation.^{1,2} Its large lumen facilitates the

suctioning of blood or secretions from bronchi and switch from two lung to OLV can be achieved easily and reliably. However mal positioning of tube can occur and for its rigidity and wide diameter insertion of DLT can cause preoperative complications like pronounced intubation reflex, tracheobronchial rupture, hematoma formation in larynx trachea & bronchus, traumatic laryngitis or arytenoids dislocation.¹⁻⁵ In comparison the bronchial blocker (BB) is inserted through a single lumen endotracheal tube previously placed into trachea. Due to less friction during placement to the trachea bronchus larynx there is minimum hemodynamic alteration with the patients when BB is being used. This is a single blinded randomized prospective clinical trial for OLV by comparing the use of left sided DLT and BB to evaluate the ease of use effectively, haemodynamic alterations as well as post-operative complications.

Methods:

This prospective single blinded study was done after getting clearance from ethical committee of Combined Military Hospital Dhaka Cantonment. Forty patients who were scheduled for removal of mediastinal mass under VATS procedure between the periods of January 2017 to December 2018 were approached for the study. The patients were aged between 25-65 years old and of American Society of Anesthesiologist (ASA) physical status 2-Ø. After obtaining informed written consent and prior to induction of anesthesia all patient were assigned to have their airway managed by either a left sided DLT or a BB according to a randomize trial. Patients with anticipated or with previous difficult intubation, severe obstructive pulmonary disease, pleural and/or interstitial pathology, history of psychological or neurologic function impairment and FEV₁ <50% of predicted value were excluded from the study.

Prior to induction all patients were attached to all standard monitors required for VATS & OLV. Anesthesia was induced with midazolam (0.05 mg/kg), propofol (1.5 mg/kg), fentanyl (1-2 mgm/kg), norcurone (0.1 mg/kg). After the onset of muscle relaxation single lumen endotracheal tube (SLT) or double lumen tube (DLT) was inserted under direct laryngoscope and then the tube was connected to ventilator. In the DLT group, the patients were intubated using a left

sided DLT of an appropriate size (32-35 for women and 35-37 for men).

The DLT was positioned using a fiber optic bronchoscope at an appropriate depth so that bronchial cuff remain to the left main bronchus and the port for right bronchus remain fitted to the opening of right bronchus just above carina. The BB was also positioned through the lumen of regular endobroncheal tube (size 7.5-8 mm for female and 8-8.5 mm for male) using a flexible bronchoscope such that the cuff was just with in the right main bronchus. The balloon of the BB was inflated with 5-8 ml of air to obtain total broncheal blockade.

After confirming correct placement of DLT or BB all patients were turned into left lateral position. The bronchial cuff of DLT or balloon of BB was deflated prior and during patient positioning. After proper positioning both the DLT and BB were rechecked for correct placement. After proper positioning and surgical drapping OLV were started, for DLT group the right channel was clamped and opened into the air and for the BB group the lung was deflated prior to inflating the balloon of the blocker by turning the ventilator off and opening the breathing circuit. No further maneuvers were performed to facilitate lung collapse.

During OLV, ventilator setting was adjusted to keep peak airway pressure bellow 25 cm H₂O, lower tidal volume (5-7 ml/kg), higher respiratory rate (18-22 breaths/min). All ventilator parameters were adjusted to maintain the ET-CO₂ level between 35-45 mm of Hg. Anaesthesia was maintained with halothane 0.2-0.6% muscle relaxation was maintained by incremental dose of norcurone and analgesia was maintained by continuous epidural anagesia by 0.25 % Bupivacaine plane 1-2 ml/hour and Fentanyl 2.5 micro gm/hour through epidural catheter, titrated according to the hemodynamic response of the patient.

After completion of surgery all patients were extubated and shifted to post anaesthesia case unit (PACU). Post-operative analgesia was maintained by thoracic epidural route. All demographic parameters information, findings, events were compiled in a preformed data sheet and analyzed by appropriate test using SPSS version 22 & P-value <0.05 was considered significant.

Results:

Total forty patients were selected for the study and randomly assigned to the DLT on BB group. There were no significant differences in patient characteristics and operation characteristics between groups ($p>0.05$) as Table-I.

Hemodynamic values are listed in table 2 and 3 (HR and MAP). Blood pressure were measured and recorded during induction and after intubation. Final results are obtained and compared from MAP of different times T1, T2, T3 and T4 between groups so do heart rates. Results showing that average HR decreases than base line (T1) after induction (T2) in both the groups and

came near to base line one min after intubation (T4) & the p value is not significant at T1, T2, T4 ($P>0.05$). Just after intubation at T3 in both the groups HR increases from base line T1, T2 but in DLT at T3 HR increases more than BB group and the difference is statically significant ($P<0.05$) (Tale-II). MAP was also increased significantly In both the groups at T3 than T1, T2 & T4 and the differences between the groups at T3 was also significant ($P<0.05$) but not significant at T1, T2 or T4 (Table-III)

Time required for correct placement of device shown in Table-4 and the difference was not significant between DLT and BB groups (2.81+

Table-I. Patientdemography and operation characteristics:

Variables	DLT (n=20)	BB (n=20)
Mean Age (Years)	52.16 ± 7.51	55.42 ± 6.28
Sex (M/F)	16/4	14/6
ASA grading (I/II/III)	4/12/4	3/13/3
Duration of surgery (min)	134.59 ± 32.38	145.84 ± 26.12
Duration of anaesthesia (min)	170.34 ± 29.16	178.41 ± 30.72

Values are presented as mean ± SD. Analysis was done by Student's 't' test.

Table-II. Haemodynamic parameters during induction of Anaesthesia-HR (Beats/min):

Variables	DLT (n=20) Mean ± SD	BB (n=20) Mean ± SD	P value
T ₁	76.23 ± 8.52	78.52 ± 6.19	>0.05
T ₂	72.16 ± 6.71	73.18 ± 8.29	>0.05
T ₃	88.24 ± 7.42	78.56 ± 9.06	<0.05
T ₄	74.34 ± 7.84	77.26 ± 6.73	>0.05

Values are presented as mean ± SD. Analysis was done by Student's 't' test. Not significant $p>0.05$ (among two groups). Significant $p<0.05$ (among two groups).

Table-III. Haemodynamicparameters during induction of anaesthesia-MAP (mm of Hg):

Variables	DLT (n=20)Mean ± SD	BB (n=20)Mean ± SD	P value
T ₁	96.12 ± 8.43	93.24 ± 7.82	>0.05
T ₂	90.42 ± 10.35	86.68 ± 8.59	>0.05
T ₃	99.36 ± 9.62	92.15 ± 6.47	<0.05
T ₄	93.29 ± 8.08	92.04 ± 9.78	>0.05

Values are presented as mean ± SD. Analysis was done by Student's 't' test. Not significant $p>0.05$ (among two groups). Significant $p<0.05$ (among two groups).

Table-IV. *Effects of one lung ventilation with perioperative incidence:*

Variables	DLT (n=20) Mean ± SD	BB (n=20) Mean ± SD	P value
Time for placement of device in correct position (min)	3.72 ± 1.84	3.84 ± 1.41	>0.05
Time for right lung collapse (min)	2.46 ± 0.85	4.76 ± 0.61	<0.05
Quality of lung Collapse			
Total –	17	18	>0.05
Partial-	0	02	>0.05
No collapse-	0	0	>0.05
Number of patients with device malposition	4 (20%)	5 (20%)	>0.05
Number of patients with hypoxemia	2 (10%)	1 (5%)	>0.05

Values are presented as mean ± SD. Analysis was done by Student's 't' test + chi square test. Not significant p>0.05 (among two groups). Significant p<0.05 (among two groups).

0.74in DLT, 2.96+ 0.87 in BB, p>0.05). Time for right lung collapse (Table-4) in BB group (4.76+0.61) was significantly longer than DLT group (2.46+0.85) and the deference between groups is statically significant (P<0.05). The quality of lung collapse, duration of OLV, number of device malposition and hypoxemia were comparable between groups (Table-IV).

Post-operative complication has shown in Table-V, among forty patients only 05 (25%) patients from DLT hassuffered from hoarseness of voice in post-operative period and the statistical deference between groups are significant (P=0.0183). Only one patient from DLT group hassuffered from post-operativesore throat and none from BB group has shownthis complications. No patient from either group has suffered from lung infection and result is insignificant (Table-V).

Table-V. *Post-operative complications:*

Variables	DLT	BB	P value
Hoarseness of voice	05	0	p= 0.018
Sore throat	01	0	p= 0.312
Lung infection	0	0	-

Values are presented as mean ± SD. Analysis was done by chi squared test. p value not significant p>0.05 (among two groups), significant p<0.05 (among two groups).

Discussion:

Form this study the data demonstrated that the use of BB could achieve similar quality of lung collapse compared with DLT for OLV in VATS procedure. While the use of BB is associated withlonger time required to induce right lung collapse, but with a reduced incidence of hoarseness of voice and sore throat with in first 48 hours after surgery. These results contrast with those of Bussiereset al⁶, they found considerablyfaster lung collapse using BB. However their study cohort wasdifferent from those of the current study.

DLTs generally have been considered the gold standard for lung isolation and are proved by many to offer more rapid and better quality of lung collapse for its wide diameter.^{7,8}

Archibald⁹ first introduced BB into clinical practice in 1935. The results from one meta-analysis study showed that DLTs were more effective than BB for lung isolation but were associated with a significantly greater incidence of airway injury and post operative hoarseness.¹⁰ However, Bauer et al¹¹ did not advocate the routine use of BB as a method for providing OLV during thoracoscopy. The possible reason is for it's difficulties in placement with requirement of prolong time than do DLT in correct position. Then the author selected cases scheduled for esophageal tumour surgery undergoing VATs procedure and all of them received OLV. Therefore in this study time required for correct placement of DLTs and

BB are similar Safety as well as efficacy is a prime consideration to put different device for lung isolation. Airway injury such as haematoma of the vocal cords, may cause sore throat and hoarseness of voice as long as two weeks post operatively.¹² Bronchial edema was also a reported complication after using DLT.^{12,13} Perioperative difficulties like mal positioning of device is not very uncommon which can result in hypoxemia and may cause complete airway obstruction leading to even discontinuation of surgery while problem is managed.¹⁴

In this study we found that incidence of device displacement and desaturation comparing both the device is similar but post operative complication like hoarseness and sore throat within 48 hrs after surgery can be reduced using BB. Therefore it is important to select devices for OLV keeping in mind patients safety and for ease of anaesthesiologist and surgeons involved in the procedure.

DLTs have a larger diameter than the regular endotracheal tube and must be inserted into a major bronchus. The carina and inner wall of trachea are stimulated and induce more severe cardiovascular response than from regular intubation.⁵ Consistent with previous studies^{5,15} the current result showed that intubation with DLT could significantly increase blood pressure and heart rate, however this phenomenon did not happen in BB group. The use of BB for OLV could have a beneficial effect for those patients with severe cardiovascular disease who require OLV for surgery with a reduced adverse cardiovascular events.

There were some limitations of the study, firstly the method of assessing lung collapse by using surgeons rating scale, which was not completely objective. Secondly the study population was restricted to patients presenting good lung recoil as patients with potentially altered lung recoil were excluded from the study. Patients with pulmonary pathology associated with bad recoil correspond to a population in which the BB could be used but rarely with optimum result.

Conclusion:

The result of this study showed that despite requiring a longer period to achieve lung collapse

the use of BB can reduce the risk & magnitude of exaggerated haemodynamic responses. BB can also reduce the incidence of post-operative sore throat & hoarseness of voice which magnifies the advantages of VATS procedure over DLTs.

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