Original Article

Bronchial Blocker Provides Hemodynamic stability for One Lung Ventilation in Right Video-Assisted Thoracoscopic Surgery: An Observational Study

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Abstract

Background: *Double lumen endotracheal tubes (DLT) and bronchial Blockers (BB) have been both been used for lung isolation in video-assisted thoracic surgery (VATS) with some inherent demerits.*

Objective: *The aim of this study was to observe the quality of lung deflation of a bronchial blocker for one lung ventilation & the hemodynamic stability in video-assisted thoracic surgery(VATS).*

Materials & methods: *A total forty adult patients have been assigned to observe the effects & hemodynamic stability of BB who undergoing VATS procedure for mediastinal 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: *Results were observed for MAP & HR at T1, T2, T3 &T4. It was shown that HR decreased after induction than the baseline (T1) & came near baseline one min after intubation(T4). Just after intubation at T3, HR increased from the baseline & immediate before induction (T1&T2). MAP was also increased at T3 than T1 & T2. Time taken for right lung collapse with BB was (4.76±0.61) similar and comparable to other studies. Total 36 patients were achieved total collapse of the lung and incidence of device malposition was observed in case of 5 patients. On the other hand, hypoxaemia was observed in case of 1 patient.*

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

Key words*: Hemodynamic Stability, Bronchial Blocker, VATS, Complications.*

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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 lungs to OLV can be achieved easily and reliably. However mal positioning of tube can occur and for its rigidness and wide diameter insertion of DLT can cause perioperative

complications like pronounced intubation reflex, tracheobronchial rupture, hematoma formation in larynx trachea & bronchus, traumatic laryngitis or arytenoids dislocation[1-5]. On the other hand, 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 observing the use of BB to evaluate the ease of use effectively, haemodynamic alterations as well as post-operative complications.

Methods

This prospective single blinded observational 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 I-III. After obtaining informed written consent and prior to induction of anesthesia all patient were assigned to have their airway managed by 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 FEV, <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), vecuronium (0.1 mg/kg). After the onset of muscle relaxation single lumen endotracheal tube (SLT) was placed and through the single lumen tube a BB was placed under fiber optic bronchoscopic guidance in the right main bronchus. The balloon of the BB was inflated with 5-8 ml of air to obtain total bronchial blockade.

After confirming correct placement BB all patients were turned into left lateral position. The balloon of BB was deflated prior and during patient positioning. After proper positioning BB was rechecked for correct placement. After proper positioning and surgical drapping OLV were started, 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 H_2O, lower tidal volume (5-7 ml/kg), higher respiratory rate (18-22 breaths/min). All ventilator parameters were adjusted to maintain the $ETCO_2$ level between 35-45 mm of Hg. Anaesthesia was maintained with halothane 0.2-0.6% muscle relaxation was maintained by incremental dose of vecuronium 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

Table-1 *Patient demography and operation characteristics:*

Variables	BB (n=40)
Mean Age (Years)	55.42 ± 6.28
Sex (M/F)	28/12
ASA grading (I/II/III)	6/28/6
Duration of surgery (min)	145.84 ± 26.12
Duration of anaesthesia (min)	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	BB (n=40) Mean ± SD
T_1	78.52 ± 6.19
T_2	73.18 ± 8.29
T_3	78.56 ± 9.06
T_4	77.26 ± 6.73

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

Table-III *Haemodynamic parameters during induction of anaesthesia-MAP (mm of Hg):*

Variables	BB (n=40) Mean ± SD
T_1	93.24 ± 7.82
T_2	86.68 ± 8.59
T_3	92.15 ± 6.47
T_4	92.04 ± 9.78

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

Variables	BB (n=40) Mean ± SD
Time for placement of device in correct position (min)	3.84 ± 1.41
Time for right lung collapse (min)	4.76 ± 0.61
Quality of lung Collapse	
Total –	36
Partial-	04
No collapse-	0
Number of patients with device malposition	5 (12%)
Number of patients with hypoxemia	1 (2.5%)

Table-V *Post-operative complications*

Variables	BB
Hoarseness of voice	0
Sore throat	0
Lung infection	0

Values are presented as mean ± SD. Analysis was done by chi squared test.

Total forty patients were selected for the study and randomly assigned to the BB group. The patient characteristics and operation characteristics were observed in table1. 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 observed from MAP of different times T1, T2, T3 and T4. Results showing that average HR decreases than base line (T1) after induction (T2) and came near to base line one min after intubation (T4). Just after intubation at T3, HR increases from base line T1, T2 (Table-2). MAP was also increased at T3 than T1& T2 (Table-III)

Time required for correct placement of device shown in Table-4 & it was 3.84+ 1.41). Time for right lung collapse (Table-4) was (4.76+0.61). The quality of lung collapse was described in terms of total & partial, which was 36 & 04 respectively. Number of patients with device malposition was 05 & and hypoxemia was observed in 01 patient.

Post-operative complication has shown in Table-5, among forty patients none has shown this complications. No patient has suffered from lung infection (Table-VI).

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 in other studies. While the use of BB is associated with longer 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 al[6], they found considerably faster lung collapse using BB. However their study cohort was different 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].

Archibald[9] 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 postoperative hoarseness[10]. However, Bauer et al[11] did not advocate the routine use of BB as a method for providing OLV during thoracoscopy. The possible reason is for its 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 BB are similar to other studies.

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]. Per operative 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 whileproblem is managed[14].

In this study we found that incidence of device displacement and desaturation comparing the device is similar but postoperative 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 endo tracheal tube and must be inserted into a major bronchus. The carina and inner wall of trachea are stimulated and induce more severe cardio vascular response than from regular intubation[5]. Consisted 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 happened in BB group. The use of BB for OLV could have beneficiary effect for those patients with severe cardiovascular disease who require OLV for surgery with a reduced adverse cardiovascular events.

Limitations: 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.

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