COMPARISON OF CLINICAL EFFICACY OF RIGHT VERSUS LEFT SIDED DOUBLE LUMEN ENDOBRONCHIAL TUBE IN CONJUNCTION WITH FIBEROPTIC BRONCHOSCOPE

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ABSTRACT

Objective: We compared right and left sided double lumen endobronchial tube (DLT) regarding their clinical efficacy and safety profile in when they are used in conjunction with flexible fiberoptic bronchoscope.
Study Design: Quasi experimental study.
Place and Duration of Study: Anesthesiology department, Combined Military Hospital Rawalpindi for 05 months, from Apr to Aug 2017.
Material and Methods: After the approval of the hospital ethical committee, 90 patients were included in our study. Auscultation was used to check proper position. A flexible fiberoptic bronchoscope was used to confirm auscultation finding. The insertion time; incidence of tube malposition (supine and lateral); intra-operative hypoxia and hypercapnia were recorded.
Results: A total of 90 patients underwent various thoracic surgery procedures with one lung ventilation. After the data collection, 13 patients were excluded from final analysis. Of the 77 cases, 55 patients (group L) had placement of left sided double lumen endobronchial tube; whereas 22 patients (group R) had right sided double lumen endobronchial tube. The two groups didn't vary in their demographic profile. The insertion time was significantly longer in right DLT insertion, 296.6 ± 49.8 second versus 239 ± 33.4 second (p-value<0.001). The frequency of tube malposition was higher in right DLT, 45.4% versus 16.6% in left, p-value 0.01. However, the incidence of hypoxia, hypercapnia and tube migration (all p-value>0.05) did not vary between the two groups. One patient in right DLT versus two patients in left group required return to two lung ventilation for treatment of hypoxia, p-value 0.64.
Conclusion: Our study has shown that right sided double lumen endobronchial tubehad similar clinical efficacy as left double lumen endobronchial tube when they are used for fiberoptic bronchoscope.

Keywords: Flexible fiberotpic bronchoscope, Insertion time, Intra-operative hypoxia incidence, Oxygen insufflations, Right versus left double lumen endobronchial tube.

INTRODUCTION

Double lumen endotracheal tubes are the most frequently used method of one lung ventilation. The right main bronchus is at more acute angle (25 degrees) and is 1-2.5cm long with a variable upper lobe bronchus take off which may be anteriorly, posteriorly or laterally or from trachea[1]. The left main bronchus is approximately 5cm long where it bifurcates into left upper and lower lobe bronchus. The anatomical differences in the left and right side bronchus has led to use of separate, specially designed left and right sided DLT. In addition, the margin of safety of left sided tube is higher than right sided DLT (16-19 mm versus 1-8mm)[2]. There are a number of situation that require insertion of right sided double lumen endobronchial tube. These include left pneumonectomy, left lung transplant, left sleeve resection, descending thoracic aortic aneurysm, external or intraluminal tumor resection and left lung transplantation[3].

Optimal one lung ventilation requires optimal positioning of double lumen endobronchial tube, as hypoxemia due to obstruction of one lobe during one lung ventilation cannot be corrected by increasing inspired oxygen concentration or any other maneuver. Hypoxemia may

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be present is as many as 5-10% of thoracic surgeries under one lung ventilation[4]. Hypoxemia is associated with worse patient outcomes including cognitive impairment, renal failure, pulmonary hypertension and atrial fibrillation[5].

Traditionally, left sided DLT are considered to be safer than righted sided DLT for intra-operative one lung ventilation. Right sided double lumen tubes are considered to be time consuming during insertion, technically difficult to insert, easily dislodged, increased risk of malpositioning intra-operatively and have a smaller margin of safety with increased incidence of upper lobe obstruction, hypoxia and increased airway pressures. But a study on 691 patients (241 right versus 450 left double lumen tubes) by Ehrenfeld et al showed the clinical efficacy of right sided and left sided Mallincdrodt double lumen endobronchial tube were similar in thoracic surgery[6].

At our institute various thoracic surgeries, Like pneumonectomy, lobectomy, decortication, esophagectomy, thymectomy and video assisted thoracosopic (VATS) surgeries, are being performed under GA with OLV. Left sided double lumen endobronchial tube (DLT) are being used for both side lung collapse, and right double lumen endobronchial tube is being used only for left pneumonectomy or lobectomies. Although fiberotpic bronchoscope is increasingly being used for the placement and confirmation of DLT position; the anesthetists vary in their opinion about the use of fiberoptic bronchoscope (FOB) for confirmation of double lumen endobronchial tube. We compared right and left sided double lumen endobronchial tube (DLT) regarding their clinical efficacy and safety profile in when they are used in conjunction with flexible fiberoptic bronchoscope. We also compared the efficacy of auscultation for confirmation of DLT position.The outcomes studied were insertion time, the frequency of DLT malposition (as seen by bronchoscopy), tube migration after positioning, intra-operative hypoxia and hypercapnia.

PATIENTS AND METHODS

This Quasi experimental study was conducted at Anesthesiology department, Combined Military Hospital, Rawalpindi for a duration of 05 months, from April to August 2017. After the approval of the hospital ethical committee, 90 consecutive patients were included in our Quasi experimental study. These patients required OLV for various elective thoracic surgery. Patients with age <12 years, with anticipated difficult airway, emergency thoracic surgery and position other than lateral were excluded in our study. The preanesthesia assessment and preparation was done according to institute protocol and no changes were made for our study. On the day of surgery; IV access was achieved with 18G cannula and standard monitoring with ECG, SpO2, ETCO2, NIBP as well as invasive intra-arterial blood pressure and P.peak / P plat was done in all the patients[7]. All the patients were premedicated with IV dexamethasone 0.1mg/kg, metoclopramide 0.15mg/kg and nalbuphine 0.1mg/kg. IV propofol 1.5 mg/kg and IV atracurium 0.5mg/kg were administered for induction and muscle relaxation. The selection of double lumen tube size was 26 Fr for adolescent, 32 Fr for small sized females and adolescent, 35 Fr for adult female and 37 Fr for adult males. As per recommendations, left sided double lumen endobronchial tube (group L) were used in majority of thoracic surgery and right sided double lumen endobronchial tube (group R) only used in left pneumonectomy and left sided lobectomies. The double lumen endobronchial tube was passed under direct laryngoscopy with MacIntosh blade, once the tracheal cuff passed the vocal cords, the DLT was rotated 90 degrees, stylet removed and the tube inserted upto 29cm. Endotracheal intubation confirmed by ETCO2 and sequential clamping of tracheal and bronchial lumen was done to confirm the position. Adjustments in tube were made according to auscultation finding. A 1.2 mm Portex flexible fiberoptic bronchoscope was passed through the tracheal lumen to visualize the carina and bronchial cuff just distal to the

carina. Then it was passed through the bronchial lumen to visualize left upper and lower lobe bronchus in left sided double lumen endobronchial tube; whereas the right upper - lobe bronchus was visualized through the Murphy's eye in the bronchial cuff. Volume control ventilation was used for thoracic surgeries intraoperative. A tidal volume of 5ml/kg with variable respiratory rate was used to maintain minute ventilation (100ml/kg), ETCO2 35-45 mm Hg and peak airway pressure less than 30 mm Hg. For maintenance of anesthesia, isoflurane with a fraction inspired oxygen concentration (FiO2) of 60% was used. FiO2 was titrated to maintain SpO2 >90%. The accurate position was reconfirmed after placing the patient in lateral position.

A left sided DLT position was considered optimal when bronchial cuff was immediately below carina and there is clear visualization of left subcarina with unobstructed upper and lower bronchi[8]. A right side DLT position was considered optimal when the right upper lobe bronchus was visualized through the Murphy's eye in the bronchial lumen. Initially the position was checked by auscultation. If the tube required readjustment on bronchoscopy, it was labelled as DLT malposition. DLT was considered migrated if it required to be moved more than 0.5cm to correct its position. To rule out observer variability in bronchosospic findings, it was done by either of the two consultants performing thoracic anesthesia. We considered SpO2 less than 90%[9] lasting more than 2 consecutive minutes as hypoxia. Hypercapnia was labelled as ETCO2 greater than 45mm Hg for more than 5minutes and it was treated with either increased in tidal volume, respiratory rate or both. The insertion time; frequency of malpositioning, migration, intraoperative hypoxia and hyper-capnia were recorded.The various corrective measures for treatment of intraoperative are shown in figure[10,11,17].

The data was analyzed using SPSS version 25. Qualitative values like gender, size of tube, surgery performed, frequency of malposition, migration, hypoxia and hypercapnia were represented as frequency and percentage. Chi square and Fischers exact test was applied. For qualitative values like age and insertion time, mean ± standard deviation were calculated. Independent t-test was applied. A *p*-value less than or equal to 0.05 taken as significant.

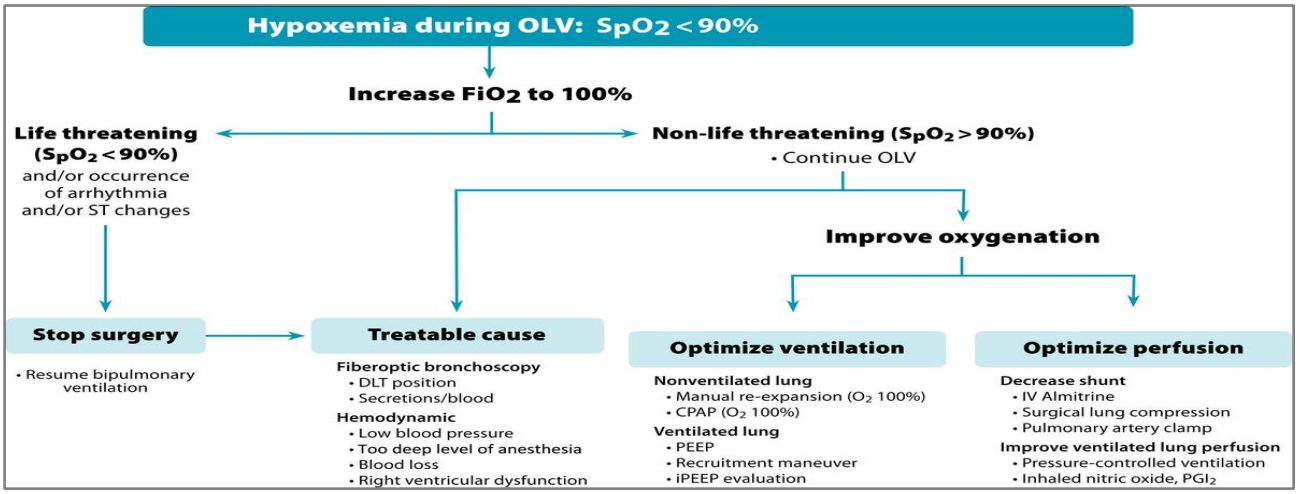

Figure: Algorithm recommended to be performed in case of hypoxemia during one-lung ventilation (OLV). CPAP = continuous positive airway pressure; DLT = double lumen tube; Fio2= inspired fraction of oxygen; PEEP = positive end-expiratory pressure; PGI2 = prostacyclin; ST = ST segment[12].

RESULTS

A total of 90 consecutive patients underwent various thoracic surgery procedures with OLV. After the data collection, 07 patients were excluded from the final analysis due to non-

availability of complete intra-operative data and 06 patients required OLV for esophagectomy in prone position. So the study group included 77 patients; 55 patients (group L) had placement of left sided DLT; whereas 22 patients (group R) had right sided DLT. The demographic profile of the two groups is given in table-I.

A 1.2 mm Pentax FB V8 flexible fiberoptic bronchoscope was used to confirm position in 21 (94.5%) of right DLT and 35 (63.63%) of the left DLT. The insertion time was significantly longer in right double lumen endobronchial tube insertion (*p*-value<0.001); and DLT malposition when auscultation was used for position confirmation (*p*-value 0.01). However, the incidence of hypoxia, hypercapnia and tube migration (all *p*-value>0.05) did not vary between the two groups. One patient in right DLT versus two patients in left group required return to two lung ventilation for treatment of hypoxia, *p*-value 0.64. The results are tabulated as table-II.

Table-I: Demographic profile of study groups.

Variable	Values	Group R n=22 (%)	Group L n=55 (%)	*p*-value
Age	Mean ± SD	40.8 ± 17.0	45 ± 17.3	0.340
Gender	Male	16 (72.7)	39 (70.9)	0.604
	Females	6 (22.3)	16 (29.1)	
DLT size	26 Fr	2 (9.1)	-	0.15
	32	1 (4.5)	1 (1.8)	
	35 Fr	4 (18.2)	15 (27.3)	
	37 Fr	15 (68.2)	39 (70.9)	
Surgery	Pneumonectomy	4 (18.2)	-	<0.001
	Lobectomy	14 (63.6)	4 (7.3)	
	Decortication	2 (9.1)	24 (43.6)	
	VATS	2 (9.1)	22 (40.0)	
	Esophagectomy	-	4 (7.3)	

Table-II: Comparison of results of two study groups.

Variable		Group A n=22 (%)	Group B n=55 (%)	*p*-value
Insertion time (seconds)		296.6 ± 49.8	239.2 ± 33.4	<0.001
DLT malposition by auscultation		10 (45.4)	9 (16.36)	0.01
PeCO2 >45 mm Hg		2 (3.6)	1 (1.8)	0.641
DLT migration		3 (13.6)	2 (3.6)	0.13
Hypoxia	Supine	-	-	-
	Lateral	-	-	-
	Intra-op	5 (9.1)	5 (22.7)	0.11

DISCUSSION

Most anesthetist performing thoracic anesthesia use left sided DLT for both side surgery and right sided DLT is used only in selective cases as recommended by Slinger *et al*[13]. The clinical efficacy of right and left sided DLT have come under scrutiny in recent researches. At some centers, right and left sided DLT are used for contralateral side surgery and a retrospective study by Ehrenfeld on 691 thoracic found that there was no difference in the incidence of hypoxemia, hypercapnia or high airway pressure whether right or left sided DLT was used. They reported that hypoxia occurred in 11.1% of left versus 7.9% in right DLT, *p*-value 0.22[6]. Similar finding have been reported in others studies that showed that the frequency of hypoxia was same for either tube but hypoxia lasted longer in left sided tube as well as similar risk of right upper lobe collapse[14,15]. We have found that the incidence of intra-operative

hypoxia and hypercapnia did not differ in either sided double lumen tubes. These findings do not correlate with the findings by Kaplan *et al* who reported a higher incidence of perioperative hypoxia ($p<0.05$), hypercapnia (<0.01) and inadequate deflation of the lung (<0.001) in right sided DLT. They studied 80 patients requiring OLV; right DLT used in 33 patients and left DLT in 47 patients. They also reported a higher incidence of respiratory acidosis and atelectasis ($p<0.001$) when right sided DLT were used[16]. We did not study post-operative incidence of atelectasis or respiratory acidosis. The difference in the incidence and clinical efficacy of the studies may be attributable to the use of FOB by us and Ehrenfeld for confirmation of DLT position. Kaplan *et al* did not use fiberoptic bronchoscope (FOB) in thoracic surgery operations.

The insertion time in our study was significantly longer in right DLT than left DLT; $p\leq0.001$. The insertion time was taken from start of laryngoscopy till confirmation of position, with or without fiberoptic bronchoscopy. This finding correlate with result of 3.37 versus 2.08 minutes in right and left DLT, *p*-value=0.04. In their study, the mean time of lung collapse, number of bronchoscopies and surgical exposure were similar in both groups[15].

The accurate position of DLT is one of the most important measures for prevention of intraoperative hypoxia, hypercapnia, lobe collapse and high airway pressure[17]. Before the advent of FOB, the placement and positioning of DLT was done using clinical parameters alone. Unilateral chest rise, auscultation and airway pressure assessment were the primary and initial assessment tools for confirmation of DLT position. However, auscultation is not reliable method for confirmation of tube placement[18]. The increasing expertise in use of fiberoptic and better knowledge of bronchial anatomy has revolutionized the placement and position confirmation of DLT[19,20]. Other authors also recommend use of fiberotpic bronchoscope for confirmation for position of DLT. Our study has shown that auscultation is a not the most accurate method of confirming the position of DLT, especially in right sided DLT. However, there is no difference in frequency of tube migration when the patient is placed in lateral position. Our results correlate with study by de Belles *et al*, who reported an incidence of 32% tube malpositioning and 5% critical malposition[21]. Similar results were reported by Klein *et al* that FOB showed 39.5% of blindly inserted double tubes were mal-placed with distal malpositioning (52 cases) occurring more frequently than proximal, critical tube malposition was seen in 25 cases. They showed that FOB assessment showed a small but significant incidence of double lumen tube malposition when auscultation alone was used for confirmation of tube placement[22]. Other authors have also recommended that the thoracic anesthetist should be familiar with use of fiberoptic bronchoscope for optimal tube placement[23]. We confirmed the accurate positioning in almost all right sided DLT whereas bronchoscope was used for 63.6% of left sided DLT position confirmation, *p*-0.0046. We could not use bronchoscope in all DLT position confirmation, as we have only one 1.2 mm flexible bronchoscope and it requires sterilization between its use.

As our data was collected manually, so we could not measure the duration of hypoxia or intraoperative hemodynamics of our study group. We also did not take into account the preoperative spirometry, PaO2 or PaCO2, functional capacity or the cardiopulmonary reserves in our study population; which may affect the incidence of intraoperative hypoxia or hypercapnia. In addition, our study population included more left sided DLT than right sided. A randomized control trail with larger sample size is required to validate results.

CONCLUSION

Our study has shown that both right and left sided tube can be safely used for one lung ventilation without increasing the frequency of hypoxia or hypercapnia. However, increased insertion time and requirement of bronchoscopy

is present in right DLT. We also recommend that fiberoptic bronchoscope should be used for confirmation of position of DLT, especially right sided DLT; both after placement and change in position. The anesthetist must have adequate expertise in its use and appropriate knowledge of the tracheobronchial anatomy.

CONFLICT OF INTEREST

This study has no conflict of interest to declare by any author.

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