

# TWO LUNG VENTILATION THROUGH SINGLE LUMEN TRACHEAL TUBE IN THORACOSCOPIC THYMECTOMY: A RANDOMIZED CLINICAL TRIAL OF EFFICACY AND SAFETY

MIHAN J JAVID\*, KARAMOLLAH TOOLABI\*\*  
AND ALI AMINIAN\*\*

## Abstract

**Background:** Video assisted thoracoscopic surgery (VATS) has been successfully used for thymectomy in myasthenia gravis (MG). Thoracoscopic thymectomy (TT) is usually done under general anesthesia with double lumen tubes (DLT). The aim of this study is evaluation of two lung ventilation through single lumen tubes (SLT) during TT.

**Methods:** In this prospective randomized study, TT was done in 30 patients with MG from January 2004 to December 2007. Patients were randomly intubated with either a DLT or SLT, 15 patients in each group. All patients were evaluated for hemodynamic stability, oxygen saturation of hemoglobin (Sp<sub>o</sub><sub>2</sub>), end-tidal Pco<sub>2</sub> (ETPco<sub>2</sub>), times required for intubation and surgery, satisfaction of surgeon about exposure and postoperative complications.

**Results:** In the SLT group, all patients had stable hemodynamic, Sp<sub>o</sub><sub>2</sub> and ETPco<sub>2</sub>. In the DLT group, hemodynamic instability occurred in one, decrease in Sp<sub>o</sub><sub>2</sub> in one and increase in ETPco<sub>2</sub> in another patient. One

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From Department of Anesthesiology & Surgery, School of Medicine Medical Science/University of Tehran, Iran.

\* MD, Assist. Prof. Anesth.

\*\* MD, Assist. Prof. Surgery.

Corresponding author: Ali Aminian, MD, Department of Surgery, Imam Hospital Complex, End of Keshavarz Boulevard, Tehran, Iran. Mobile phone: +98-9122054635, Fax: +98-21-66937185. E-mail: [aliaminian@doctor.com](mailto:aliaminian@doctor.com).

patient in DLT group developed vocal cord granuloma two months later. Time required for surgery and surgeon's opinion about exposure were similar in the two groups.

**Conclusion:** SLT is safe in TT. It provides good surgical exposure and decreases the cost, time and undesirable complications of DLT.

**Keywords:** Myasthenia gravis, video assisted thoracoscopic surgery, thoracoscopy, double lumen tube, single lumen tube.

## Introduction

Myasthenia gravis (MG) is an autoimmune disorder characterized by muscle weakness and fatigue. Thymectomy is a radical but effective treatment for MG. The strongest evidence of its efficacy is a computer-matched series, which has shown a reduction in myasthenia-related mortality from 44% to 14% and an increase in remission rate from 8% to 35%<sup>1</sup>.

Recently, thoracoscopic thymectomy (TT) has been successfully used in adults and children with MG. It has been described as achieving the same functional improvement as median sternotomy or as transcervical approach but with less morbidity<sup>2</sup>.

Video assisted thoracoscopic surgery (VATS) is usually performed under general anesthesia using double lumen endobronchial tubes (DLT) or bronchial blockers<sup>3,4</sup>. However, a DLT has complications and cost. Undesirable complications of endobronchial intubation are desaturation, increase in airway pressure, poor lung ventilation, airway trauma, malposition and dislocation of tube during operation<sup>5</sup>.

In this randomized clinical trial, we evaluated the efficacy and safety of two lungs ventilation through single lumen tube (SLT) in TT.

## Patients and Methods

From January 2004 to December 2007, 30 consecutive patients with MG referred from Neurology Department to the minimally invasive

surgery ward for TT were enrolled in this prospective randomized study. All patients signed an informed consent. Single surgical team performed all operations, in cooperation with an experienced anesthesiologist and neurologist for handling perioperative cares. The study was conducted at the Imam Hospital Complex, affiliated to Tehran University of Medical Sciences, Tehran, Iran.

After induction of anesthesia with midazolam, fentanyl, thiopental and adjusted dose of atracurium, patients were randomly intubated either with a DLT or SLT, 15 patients in each group. In DLT group, left sided endobronchial tubes were placed by traditional blind approach and one lung ventilation was confirmed clinically. In SLT group, the right hemithorax was insufflated with CO<sub>2</sub> (up to maximum pressure of 8 mmHg) in conjunction with two-lung anesthesia.

Patients were monitored with ECG, non-invasive blood pressure (NIBP), pulse oximetry and capnography during operation. Patients were placed on semi-lateral position and surgery was done through the right sided approach with one 10 mm and two or three 5 mm thoracoscopic ports. A clear view of the entire mediastinum allowed a complete en bloc removal of all mediastinal fat and the thymus gland. The thymic vein (s) were double-clipped. A single 28 Fr chest tube was left in place of one port and remaining incisions were closed. At the end of surgery, lungs were hyperinflated to reverse atelectasis. Patients were routinely sent to the intensive care unit.

Blood pressure <30% of baseline, heart rate> 120 beats/min, oxygen saturation of hemoglobin (SpO<sub>2</sub>) <90%, end-tidal Pco<sub>2</sub> (ETPco<sub>2</sub>)> 45mmHg during operation, times required for intubation and surgery, and perioperative complications, were recorded.

At the end of operation, surgeon was asked to score from 1 to 5, his impressions regarding the appropriate surgical view and the exposure of the working field, during operation. Statistical analysis was performed with t-test. P<0.05 was set as a criterion of significance.

## Results

All patients in SLT group had straightforward intubation and operation. There was no unsuccessful or second attempt intubation. No desaturation,  $Pco_2$  rise, hemodynamic disturbances or significant complications occurred (Table 1).

*Table 1*  
*comparison of SLT and DL in TT*

	DLT group	SLT group
N	15	15
Sex (M/F)	3/8	2/9
Age (years) (Mean)*	27.7	24.8
Second try intubation	2	0
Poor lung isolation	1	-
Hemodynamic instability**	1	0
$SpO_2 < 90\%$	1	0
$ETPco_2 > 45$ mmHg	1	0
Time required for intubation (min) (Median)	12	2
Time required for surgery (min) (Mean $\pm$ SD)*	168 $\pm$ 35	175 $\pm$ 24
Surgeon opinion about exposure (Mean $\pm$ SD)*	3.6 $\pm$ 0.3	3.4 $\pm$ 0.9
Significant complications	1***	

\*  $P > 0.05$

\*\* Define as blood pressure  $< 30\%$  of baseline or heart rate  $> 120$  beats/min

\*\*\* Vocal cord granuloma

In DLT group the first attempt at intubation failed in 2 patients. Poor lung isolation was observed in one patient. Hemodynamic instability occurred in one, decrease in  $SpO_2$  in one and increase in  $ETPco_2$  in another patient. One patient in DLT group developed hoarseness due to vocal cord granuloma 2 months later and underwent excision of the lesion (Table 1).

The median time for placement and securing of an SLT averaged 2 min, compared to 12 min for a DLT. Time required for surgery was the same between two groups (Table 1).

Surgeon opinion regarding exposure during operation was not significantly different between two groups ( $3.6 \pm 0.3$  for DLT group and  $3.4 \pm 0.9$  for SLT group,  $P$  value = 0.1).

## Discussion

Although thoracoscopy was initially performed for diagnostic purposes, it later evolved into therapeutic procedures. The benefits of thoroscopic operations include less postoperative pain, less pulmonary trauma, shorter hospitalizations, and improved patient satisfaction<sup>2</sup>.

TT was introduced in 1992 as a minimally invasive alternative for thymectomy in patients with MG. It was hoped that the less invasive thoroscopic approach would be associated with less morbidity, equal effectiveness and greater patient acceptance leading to earlier thymectomy in more patients with the disease<sup>2,3</sup>.

Different techniques have been suggested for lung ventilation during video assisted thoroscopic surgery (VATS), including one lung ventilation with DLT or bronchial blockers, jet ventilation periods of apneic oxygenation, and two lung ventilation with SLT<sup>6,7</sup>.

Various factors need to be taken into account to decide which method is most appropriate. Most anesthesiologists prefer one lung ventilation to provide appropriate working field and facilitate surgical process. However, a DLT has complications and cost.

Physiologic changes during VATS largely result from one-lung ventilation and patient positioning. One-lung ventilation decreases the surface area available for gas exchange and results in loss of normal pulmonary autoregulation. Single-lung ventilation also increases pulmonary vascular resistance and right heart work. Lateral decubitus positioning minimizes the effects of one-lung ventilation, in which a gravity-induced decrease in blood flow through nonventilated lung improves the ventilation-perfusion relationship. Ultimately, the tolerance of one-lung anesthesia is dependent on preparation of the patient for surgery, the patient's pulmonary

reserve, and comorbidities<sup>6-8</sup>.

Undesirable complications of bronchial intubation with DLT have been reported in literature<sup>5,9-17</sup>. Hurford and Alfillle reported the rates of some complications of endobronchial intubation in 234 patients: desaturation 9%, increased airway pressure 9%, poor lung isolation 7%, air trapping 2%, and airway pressure trauma 0.4%<sup>5</sup>.

Tajima K *et al.* reported the anesthetic management for thoroscopic thymectomy (TT) of 40 patients with MG. Operations were performed under general anesthesia using DLT. Seven patients presented hypoxemia under single lung ventilation and needed bilateral lung ventilation or addition of CPAP to nondependent lung<sup>9</sup>.

Malpositioned DLTs have been reported to be found with bronchoscopy in 37-78% of cases despite auscultatory findings suggestive for correct placement<sup>10,11</sup>.

There are various reports that tracheobronchial injury is far more with the use of DLT than SLT. These lesions are usually located in the membranous portion of the trachea near the carina<sup>12-15</sup>. Another rare complication attributed to DLT is arytenoids cartilage dislocation<sup>16</sup>.

Although Lee *et al.* reported no statistical difference in the incidence of sore throat and hoarseness between DLT and SLT<sup>17</sup>, another study showed higher cumulative number of days with hoarseness and sore throat with use of DLT<sup>12</sup>.

VATS when used in cases where a well-collapsed lung may not be essential, since surgery is not performed on the lung itself, does not require DLT. Satisfactory uses of SLT in thoroscopic pleural biopsy<sup>18</sup> and thoracic sympathectomy<sup>19,20</sup> have been shown. Similarly, in this study we show successful application of SLT in thoroscopic mediastinal surgery. We did not observe any complications in SLT group. Patients had stable hemodynamic,  $\text{Spo}_2$  and  $\text{ETPco}_2$ . In contrast, in DLT group, hemodynamic disturbances, decreased  $\text{Spo}_2$ , increased  $\text{ETPco}_2$ , failed first try intubation and poor lung isolation were observed. Additionally surgeon satisfaction about surgical exposure was similar between two groups.

The main limitation of this study was small sample size studied in a single center. Another problem with this study was the lack of use of the fiberoptic bronchoscopy to confirm proper placement of the DLTs, which may leads to malpositioning and subsequent consequences.

In conclusion, one lung ventilation with DLT is not necessary for TT. Use of SLT is a safe method of intubation for TT and provides good surgical exposure. It avoids the risk, time, and cost of DLTs.

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