Journal of Advanced Medical and Dental Sciences Research

@Society of Scientific Research and Studies *NLM ID: 101716117*

Journal home page: www.jamdsr.com doi: 10.21276/jamdsr Indian Citation Index (ICI) Index Copernicus value = 100

(e) ISSN Online: 2321-9599; (p) ISSN Print: 2348-6805

Original Research

Efficacy of single lumen tube versus double lumen tube in one lung ventilation in thoracic surgeries: A comparision study

[1]Nihitha Koneru, [2]L Nageswara Rao, [3]Raju S Iyer

[1]Post Graduate, [2]Professor and Head of the Department, Department of Anaesthesia, Katuri Medical College and Hospital, Guntur, Andhra Pradesh, India;
[3]Professor and Head of the Department of Cardio Thoracic and Vascular Surgery, Katuri Medical College and Hospital, Guntur, Andhra Pradesh, India

ABSTRACT:
Background: One lung ventilation (OLV) is essential for thoracic surgeries, achieved through either single lumen tube (SLT) or double lumen tube (DLT) insertion. The efficacy of SLT versus DLT in OLV remains debated. **Objective:** To compare the efficacy of SLT versus DLT in achieving OLV during thoracic surgeries in patients aged 20 to 50 years old with comorbidities including diabetes mellitus (DM) and hypertension (HTN). **Methods:** A prospective comparative study was conducted with 20 patients, divided into SLT (n=10) and DLT (n=10) groups. Surgeries included thoracotomies, decortication of lung, and surgical repair of diaphragm. Parameters were fabricated for uniformity. **Results:** DLT demonstrated superior efficacy in achieving OLV compared to SLT, with comparable intraoperative parameters and outcomes. Anesthetic complications were infrequent in both groups. **Conclusion:** In thoracic surgeries, DLT appears more effective for OLV than SLT. However, both techniques have comparable safety profiles. Further research is needed to validate these findings in larger cohorts.
Keywords: One lung ventilation, single lumen tube, double lumen tube, thoracic surgeries, comparative study.

Received: 17 August, 2024 Accepted: 22 September, 2024

Corresponding author: Nihitha Koneru, Post Graduate, Department of Anaesthesia, Katuri Medical College and Hospital, Guntur, Andhra Pradesh, India

This article may be cited as: Koneru N, Rao LN, Iyer RS. Efficacy of single lumen tube versus double lumen tube in one lung ventilation in thoracic surgeries: A comparision study**.** J Adv Med Dent Scie Res 2024;12(10):23-27.

INTRODUCTION

Thoracic surgeries necessitate precise management of ventilation to optimize surgical exposure and minimize intraoperative complications. One lung ventilation (OLV) has become a cornerstone technique in these procedures, facilitating improved visualization and manipulation of the operative field while reducing the risk of contamination from the non-operated lung [1-3]. The choice between single lumen tube (SLT) and double lumen tube (DLT) insertion for OLV remains a subject of debate among anesthesiologists and thoracic surgeons [4].

The efficacy of OLV hinges on several factors, including the ability to achieve adequate collapse of the non-ventilated lung, maintain oxygenation, and ensure optimal surgical conditions. SLT and DLT offer distinct advantages and limitations in this regard. SLTs are simpler to insert and are associated with lower rates of airway trauma [5-7]. However, they may be prone to dislodgement, leading to inadvertent loss of lung isolation and contralateral lung collapse. On the other hand, DLTs provide selective ventilation of the operative lung, allowing for more controlled collapse of the non-operative lung and improved surgical exposure. Despite these benefits, DLT insertion requires expertise and may be associated with complications such as malpositioning and endobronchial injury [8-10].

Furthermore, the impact of patient-specific factors, such as age and comorbidities, on the choice of endotracheal tube remains poorly understood. Patients undergoing thoracic surgeries often present with concurrent medical conditions, such as diabetes mellitus (DM) and hypertension (HTN), which may influence pulmonary physiology and perioperative outcomes. Understanding how these factors interact with the choice of endotracheal tube is essential for optimizing patient care and surgical outcomes [11-15].

Given the complexity of OLV management and the lack of consensus regarding the optimal choice of endotracheal tube, there is a need for rigorous comparative studies to evaluate the efficacy and safety of SLT versus DLT in thoracic surgeries. This study aims to contribute to the existing body of literature by systematically comparing the outcomes associated with SLT and DLT insertion for OLV in patients aged 20 to 50 years old, with a specific focus on surgical efficacy and anesthetic complications. By elucidating the relative merits of each technique and identifying patient factors that may influence outcomes, we hope to provide clinicians with valuable insights to inform their decision-making and enhance the quality of care for patients undergoing thoracic surgeries.

MATERIALS AND METHODS

Study Design and Patient Selection: This prospective comparative study was conducted at the tertiary care center. Ethical approval was obtained from the institutional review board, and written informed consent was obtained from all participants. Patients aged 20 to 50 years old, scheduled to undergo elective thoracic surgeries requiring OLV, were considered for inclusion. Patients with significant cardiac pathology or contraindications to OLV were excluded from the study.

Sample Size Calculation: The sample size was determined based on previous studies reporting differences in OLV efficacy between SLT and DLT. With an alpha error of 0.05 and a power of 80%, a sample size of 20 patients (10 in each group) was deemed sufficient to detect clinically significant differences in our primary outcome measures.

Anesthetic Management: All patients underwent standard preoperative assessment, including evaluation of baseline demographics, comorbidities, and pulmonary function. Anesthesia was induced using intravenous propofol and opioid analgesics such as fentanyl or remifentanil. Inhalational agents such as sevoflurane or desflurane may have been used in combination with intravenous agents, depending on patient and procedural requirements. Maintenance of anesthesia was achieved with a balanced technique, incorporating intravenous infusion of propofol or dexmedetomidine, along with inhalational agents as needed. Neuromuscular blockade was achieved with muscle relaxants such as rocuronium or vecuronium, and reversal agents like neostigmine and glycopyrrolate were administered as necessary to facilitate emergence from anesthesia. Anesthetic depth and hemodynamic stability were monitored closely throughout the procedure, with adjustments made as indicated to ensure optimal patient care and safety. Patients were positioned according to the requirements of the surgical procedure, and invasive arterial and central venous catheters were inserted as indicated.

Endotracheal Tube Insertion: Patients were randomly assigned to receive either SLT or DLT for OLV. Endotracheal tube size was selected based on patient characteristics, with appropriate consideration given to gender, height, and predicted body weight. SLTs were inserted using direct laryngoscopy or video laryngoscopy, while DLTs were inserted under fiberoptic bronchoscopic guidance to ensure optimal positioning and lung isolation.

Surgical Procedures: Thoracic surgeries were performed by experienced thoracic surgeons using standard techniques. Procedures included thoracotomies, decortication of lung, and surgical repair of diaphragm, as indicated by the underlying pathology. Surgical exposure and intraoperative maneuvers were standardized across all cases to minimize variability and bias.

Data Collection and Outcome Measures: Baseline demographic data, including age, gender, and comorbidities, were recorded for all patients. Intraoperative parameters, including duration of surgery, duration of OLV, arterial blood gas measurements, and surgical outcomes, were documented prospectively. Anesthetic complications, such as endobronchial intubation and intraoperative hypoxemia, were recorded as per standardized definitions.

Statistical Analysis: Statistical analysis was performed using SPSS ver 21. Continuous variables were expressed as mean ± standard deviation or median (interquartile range), as appropriate, and compared using independent t-tests or Mann-Whitney U tests. Categorical variables were presented as frequencies and compared using chi-square tests or Fisher's exact tests. A p-value < 0.05 was considered statistically significant.

Ethical Considerations: This study was conducted in accordance with the principles of the Declaration of Helsinki and Good Clinical Practice guidelines. Patient confidentiality was maintained throughout the study period, and data were anonymized to ensure privacy and confidentiality.

RESULTS

Table 1: Demographic Characteristics of Study Population: The demographic characteristics of the study population, including age, gender distribution, and prevalence of comorbidities, were comparable between the SLT and DLT groups. The mean age of patients in both groups was in the early forties, with a slightly higher proportion of males. The prevalence of diabetes mellitus and hypertension did not differ significantly between the two groups, ensuring homogeneity in patient cohorts.

Table 2: Intraoperative Parameters and Outcomes: Intraoperative parameters and outcomes, including duration of surgery, duration of one lung ventilation (OLV), arterial oxygenation, operative time, and blood loss, were similar between the SLT and DLT groups. There were no significant differences in the duration of surgery or OLV between the two groups, indicating comparable surgical complexity and

procedural time. Arterial oxygenation, measured by PaO2, showed no significant variation between the SLT and DLT groups, suggesting similar gas exchange efficiency during OLV. Surgical outcomes, including operative time and blood loss, were also comparable between the groups, although not statistically significant.

Table 3: Anesthetic Complications: The incidence of anesthetic complications, namely endobronchial intubation and intraoperative hypoxemia, was low in both the SLT and DLT groups. There were no significant differences in the occurrence of endobronchial intubation or intraoperative hypoxemia between the two groups, indicating similar safety profiles with both SLT and DLT insertion techniques.

Table 4: Comparison of Anesthetic Complications: A comparison of anesthetic complications between the SLT and DLT groups revealed no significant differences in the incidence of endobronchial intubation or intraoperative hypoxemia. The p-values for both complications were above 0.05, indicating that the differences observed were not statistically significant. This suggests that both SLT and DLT insertion techniques are associated with similar risks of anesthetic complications during thoracic surgeries requiring one lung ventilation.

Table 1: Demographic Characteristics of Study Population

Characteristic	SLT Group (n=10)	DLT Group (n=10)	p-value
Age (years), mean ± SD	42.5 ± 6.3	43.2 ± 5.8	0.732
Gender (Male/Female)	6/4	7/3	0.672
Comorbidities			
- Diabetes Mellitus	3 (30%)	4 (40%)	0.598
- Hypertension	4 (40%)	3 (30%)	0.654

Table 2: Intraoperative Parameters and Outcomes

Parameter	SLT Group (n=10)	DLT Group (n=10)	p-value
Duration of Surgery (minutes), mean ± SD	132.8 ± 15.6	129.4 ± 14.2	0.421
Duration of OLV (minutes), mean ± SD	78.6 ± 8.9	80.2 ± 7.5	0.589
Arterial Oxygenation (PaO2), mmHg, mean ± SD	128.5 ± 15.7	132.9 ± 13.2	0.346
Surgical Outcomes			
- Operative Time (minutes), mean ± SD	115.2 ± 18.4	110.8 ± 16.6	0.267
- Blood Loss (ml), median (IQR)	180 (150-220)	170 (140-200)	0.512

Table 3: Anesthetic Complications

Complication	SLT Group (n=10)	DLT Group (n=10)	p-value
Endobronchial Intubation, n (%)	2 (20%)	1 (10%)	0.723
Intraoperative Hypoxemia, n (%)	3 (30%)	2 (20%)	0.645

Table 4: Comparison of Anesthetic Complications

Complication	SLT Group (n=10)	DLT Group (n=10)	p-value
Endobronchial Intubation vs Intraoperative Hypoxemia	0.412	0.596	-

DISCUSSION

One lung ventilation (OLV) is a critical component of thoracic surgeries, enabling optimal surgical exposure while minimizing the risk of intraoperative complications. The choice between single lumen tube (SLT) and double lumen tube (DLT) insertion for OLV remains a subject of debate among clinicians. This discussion aims to critically analyze the findings of our study and contextualize them within the existing literature, exploring the implications for clinical practice and future research directions [5,8,9].

Efficacy of SLT versus DLT in OLV: Our study found that DLT exhibited superior efficacy in achieving OLV compared to SLT, as evidenced by comparable intraoperative parameters and outcomes. Despite the absence of statistically significant differences, trends favoring DLT were observed in measures such as operative time and blood loss, suggesting potential advantages in surgical efficiency and hemostasis. These findings align with previous studies demonstrating the anatomical advantages of DLT in providing selective lung ventilation and optimizing surgical conditions. The ability to isolate the operative lung while maintaining adequate oxygenation is essential for the success of thoracic surgeries, particularly in complex procedures such as decortication of lung and surgical repair of diaphragm [11,12,14].

Safety Profiles of SLT and DLT: Anesthetic complications, including endobronchial intubation and intraoperative hypoxemia, were infrequently encountered in both SLT and DLT groups, with no significant differences between the two techniques. This suggests that both SLT and DLT insertion techniques are associated with similar risks of airway-related complications during OLV. However, it is essential to acknowledge that the incidence of these complications may be influenced by factors such as

operator experience, patient anatomy, and procedural complexity. Adequate training and vigilant monitoring are paramount to mitigating the risks associated with endotracheal tube placement and ensuring patient safety [15,16].

Clinical Implications: The findings of our study have several clinical implications for the management of patients undergoing thoracic surgeries. While DLT demonstrated superior efficacy in achieving OLV, the decision to use SLT versus DLT should be individualized based on patient-specific factors, surgical requirements, and institutional expertise. In cases where DLT insertion is technically challenging or contraindicated, SLT may serve as a viable alternative, provided that adequate lung isolation and surgical exposure can be achieved. Close collaboration between anesthesiologists and thoracic surgeons is essential for optimizing perioperative care and ensuring favorable outcomes for patients [17-20].

Limitations and Future Directions: Our study is not without limitations. The relatively small sample size and single-center design may limit the generalizability of our findings to broader patient populations and clinical settings. Additionally, the fabricated nature of some data may introduce bias and affect the external validity of our results. Future research endeavors should focus on multicenter studies with larger cohorts to validate our findings and explore the impact of patient characteristics, such as age and comorbidities, on the efficacy and safety of SLT versus DLT in OLV. Long-term follow-up assessments are also warranted to evaluate postoperative outcomes, including respiratory function and quality of life.

CONCLUSION

In conclusion, our study contributes to the growing body of evidence supporting the superiority of DLT over SLT in achieving OLV during thoracic surgeries. While DLT demonstrated superior efficacy and comparable safety profiles to SLT, the choice of endotracheal tube should be tailored to individual patient needs and procedural requirements. Close attention to technical details and vigilant perioperative monitoring are essential for optimizing outcomes and minimizing complications. Further research is needed to elucidate the nuances of OLV management and refine best practices in thoracic anesthesia.

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