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Comparison Between C-MAC Blade D Video Laryngoscope and Macintosh Laryngoscope for Insertion of Double Lumen Tube in Patients Undergoing Elective Thoracic Surgeries

Sidra[1*], Sidra Javed[1], Mirza Shahzad Baig[1], Iqra Ashraf[1], Layiba Masroor[1], Sumreen Begum[2]

[1]Department of Anesthesia and ICU, SMBBIT, Karachi, Pakistan
[2]Department of Stem Cell Research Laboratory, SIUT, Karachi, Pakistan
**Corresponding author`s email address:* drsidratahir@yahoo.com

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Abstract: *The insertion of a double lumen tube (DLT) for lung isolation during thoracic surgeries is technically challenging and may be associated with airway trauma and significant hemodynamic fluctuations. Video laryngoscopy, particularly with devices like the C-MAC blade D, has improved visualization and is increasingly employed to manage difficult airways. However, its efficacy compared to the conventional Macintosh laryngoscope in DLT intubation remains under investigation.* ***Objective:*** *To compare the performance of the C-MAC blade D video laryngoscope and the Macintosh laryngoscope for DLT intubation, focusing on intubation time and hemodynamic changes associated with laryngoscopy.* ***Methods:*** *A single-blind randomized controlled trial (ClinicalTrials.gov ID: NCT06759038) was conducted at the Department of Anesthesia, Shaheed Mohtarma Benazir Bhutto Institute of Trauma, from December 2024 to March 2025. Sixty adult patients (aged 18–60 years), classified as ASA I or II and scheduled for elective thoracotomy requiring DLT placement, were randomly assigned to either the C-MAC or Macintosh laryngoscope group. Only participants were blinded to group allocation. The primary outcome was the time taken for successful intubation. Secondary outcomes included intra-group and inter-group comparisons of hemodynamic parameters (heart rate, systolic and diastolic blood pressure) at baseline, during, and after intubation. Data were analyzed using SPSS version 26.0, with $p < 0.05$ considered statistically significant.* ***Results:*** *The mean intubation time was significantly longer in the C-MAC group (51.53 ± 7.25 seconds) compared to the Macintosh group (47.6 ± 5.46 seconds; $p = 0.021$). Although hemodynamic changes between groups were not statistically significant, within-group comparisons showed significant variations at different time points post-laryngoscopy.* ***Conclusion:*** *The Macintosh laryngoscope demonstrated superior performance in terms of shorter intubation time for DLT placement compared to the C-MAC blade D video laryngoscope. Both devices exhibited similar hemodynamic responses, suggesting comparable safety profiles. Further studies with larger sample sizes may validate these findings.*

Keywords: C-MAC blade D video laryngoscope, double lumen tube (DLT), Macintosh laryngoscope

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Introduction

Double lumen tubes (DLT) are widely used airway management devices used to facilitate lung isolation technique, enabling surgeons to operate on a deflated lung for better surgical field and to avoid contamination of opposite lung. (1) For this purpose proper positioning of DLT is crucial for safe conduct of anesthesia during one lung ventilation (OLV) (2). DLT is the gold standard for achieving OLV in thoracic surgeries.(3) Patients undergoing thoracic surgeries usually present with pulmonary diseases, which are associated with high risk of hypoxemia and low oxygen reserves. However, the intubation with DLT poses significant challenges due to its much larger diameter and rotational insertion and proper placement technique is associated with significant risk of prolong intubation, intubation failure, greater hemodynamic changes and airway trauma which can lead to morbidity and mortality (4). Moreover, patients undergoing thoracic surgeries usually have limited tolerance for apnea; thus, precise and rapid tube insertion is a priority in such patients (5).

The American Society of Anesthesiologists (ASA) difficult airway algorithm recommended the use of video laryngoscope as the initial approach to intubation (6). Video laryngoscope give advantage of improvement in glottic view over classical Macintosh laryngoscope as they have built in camera, that allows visualization of vocal cords, larynx and other anatomical structures on screen (7). Video laryngoscopes are now used in clinical setting and significantly improved the success rate of challenging airway management (7, 8). Karl Storz in 2009 introduced C-MAC video laryngoscope with conventional Macintosh blade for insertion of endotracheal tube in routine airway scenario (9, 10). The C-MAC system recently launched, highly angulated D blade, which is half-moon shaped and it makes feasible to view glottis even without alignment of orotracheal axis, so it requires less cervical spine movement (11-13) This additional angulation makes direct laryngoscopy difficult but enhance indirect visualization of the larynx on the screen, particularly in case of difficult airway (14). The advantage of video laryngoscope for DLT intubation compared with traditional Macintosh laryngoscope is controversial in terms of differences in time of intubation and the associated injuries (15).

The current literature on hyperangulated blades is limited and inconsistent, warrants more rigorous and well-designed randomize controlled trials to provide clearer insight (16). A study by shagun et al reported 53% successful first attempt intubations using Macintosh laryngoscope and 87% by using C-MAC blade D video laryngoscope (17) Therefore, in this clinical trial, we decided to employ the C-MAC blade D video laryngoscope for DLT intubation in patients with normal airway in our population. We will compare the performance of C-MAC blade D and Macintosh laryngoscope for DLT intubation. The primary outcome of our study will be the time taken to DLT intubation and secondary outcome will be the hemodynamic changes.

Methodology

This prospective, single-centered, randomized controlled trial was conducted at Shaheed Mohtarma Benazir Bhutto Institute of Trauma,

from December 2024 to April 2025, after obtaining ethical approval [ERC-000146/SMBBIT/approval/2024]. This trial was registered at ClinicalTrials.gov registry with registration No: NCT06759038. Written informed consent was obtained from all patients before inclusion. Patients of either gender, aged between 18-60 years, having Mallampatti I and II, ASA physical status I and II and who were scheduled for elective thoracic surgeries under general anesthesia with DLT, were included in this study. Patients were excluded from the study, if they were pregnant, having anticipated difficult airway, body mass index (BMI) greater than 35, risk of aspiration and failure to intubate after three attempts.

Patients were enrolled by the primary investigator the day before the surgery. All patients were undergone simple randomization by lottery method and were divided into group D and group M. In Group D, C-MAC blade D video laryngoscope was used for endotracheal intubation with DLT and in Group M Macintosh laryngoscope was used. This was single blind study, only patients were blind.

The anesthesia protocol was standardized. All patients were received ASA standard monitoring. The patients were preoxygenated for 3-5 minutes. Induction was done with propofol (2 mg/kg), nalbuphine (0.15mg/kg) and isoflurane inhalation 1.2 MAC. Additional propofol boluses (maximum up to 3 mg/kg) were titrated till loss of verbal response. After checking for adequacy of mask ventilation, atracurium (0.5 mg/kg) was administered then positive pressure ventilation was given for 3-4 minutes to attain complete response of muscle relaxant. 32-37 Fr left sided DLT was used for female patients and 35-39 Fr left sided DLT was used for male patients depending on patient's height. After glottic visualization, DLT was introduced, once the blue cuff was beyond the vocal cords, the stylet was removed and the tube was rotated 90° counter clockwise and inserted till mild resistance was perceived. Patients who had Cormack & Lehane grade more than 2, backward, upward and right-sided pressure (BURP) maneuver was applied to improve glottic view.

The primary outcome of this study was time taken for intubation with DLT between the groups. Time of intubation with DLT was recorded from introduction of either laryngoscope blade till three complete capnographic cycles, appeared on monitor after successful intubation. The position of the tube was confirmed by auscultation. The secondary outcome of this study was hemodynamic changes to laryngoscopy between the groups. Systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP) and heart rate (HR) was recorded at baseline before induction, and at one min, three min, and five min after DLT intubation.

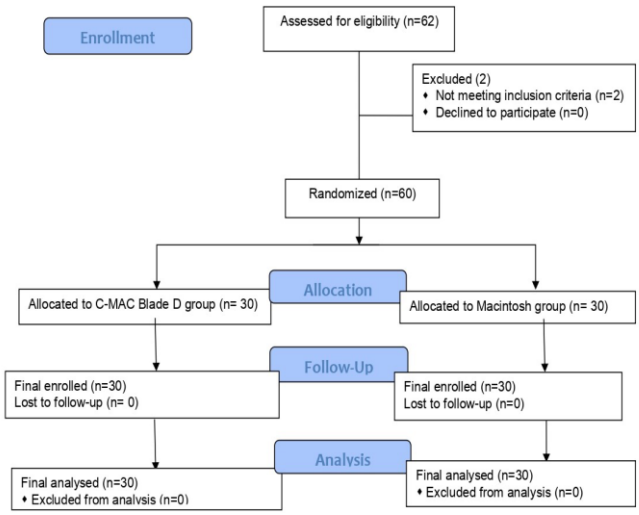
All quantitative variables including age, weight, height, BMI, time of intubation and hemodynamic parameters, were analyzed using descriptive statistics and summarized as mean ± standard deviation. Quantitative parameters normality was tested using the Shapiro–Wilk test. Data was normally distributed so parametric tests were applied. Time of intubation between the groups were assessed using the Independent Sample t-test. All qualitative variables including gender, ASA class, Mallampati score, and comorbidities were presented as frequencies and percentages. For analysis of hemodynamic parameters including SBP, DBP, MAP and HR, a repeated measure ANOVA was performed. Sphericity was corrected by Greenhouse Geisser effect. For significant results post hoc Bonferroni test applied. All statistical analyses were conducted using the SPSS software for Windows (version 26.) P-values < 0.05 were considered statistically significant for all parameters.

The sample size came out to be 60 carrying 30 patients in each group. It was estimated using previous study where mean time to intubate with Glide scope video laryngoscope is 45.6±10.7 and for with Macintosh laryngoscope is 62.5±29.7. The sample size was calculated using OpenEpi version 3 software using 1 as an alpha value and 80% as a power (10).

Results

A total of 62 patients were screened, of which 2 patients were excluded from the study as they did not meet the inclusion criteria. Recruitment was done between December 2024 and March 2025, until sample size was attained. Our final sample size was 60, with 30 assigned randomly to the D group and 30 to the M group. The flow of participants is shown in the Consort diagram (Figure 1).

Fig.1. CONSORT diagram showing the flow of patients in the study



Both groups were comparable in terms of demographic parameters like age, gender, weight, height, BMI, ASA status, comorbidities and airway characteristics (Table 1). During lung isolation, left DLTs were preferred due to an increased margin of safety.

Table 1: Demographic parameters of patients

Variables	Group D	Group M
Age (years)	31.00±12.15	31.07±13.42
Weight (kg)	63.93±13.37	62.27±13.81
Height (cm)	161.60±10.40	163.23±8.92
BMI	24.51±3.61	23.29±4.19
Gender		
● Male	23 (76.7)	23 (76.7)
● Female	7 (23.3)	7 (23.3)
ASA		
● ASA I	24 (80)	26 (86.7)
● ASA II	6 (20)	4 (13.3)
Mallampatti		
● MP I	27 (90)	29 (96.7)
● MP II	3 (10)	1 (3.3)
Comorbidities		
● None	24 (80)	26 (86.7)
● Hypertension	3 (10)	2 (6.7)
● Diabetes	3 (10)	2 (6.7)

BMI- Body Mass Index, ASA- American Society of Anesthesiologists, MP - Mallampatti

The mean time taken to intubate from Macintosh laryngoscope 47.6 ± 5.46s was shorter in duration than C-MAC blade D video laryngoscope 51.53 ± 7.25s with significant p-value 0.021 is shown in Table 2.

Table:2	Groups	Number of patients	Mean	Standard Deviation (SD)	Degree of freedom (df)	t-Value	p-Value	Mean Difference	95% confidence interval difference	
Patients time of intubation (sec)	Group D	30	51.53	7.25	58	2.37	0.021	3.93	Lower	upper
	Group M	30	47.60	5.46					0.61	7.25

The change in hemodynamic parameters with mean and standard deviations are shown in (Table 3).

Table 3: Changes in hemodynamic parameters between the groups

	D Group	M Group
Baseline SBP	128.03±18.93	121.60±17.95
Post intubation SBP at 1 min	122.90±21.62	117.27±22.76
Post intubation SBP at 3 min	117.37±23.53	112.30±15.452
Post intubation SBP at 5 min	110.87±26.95	107.07±12.58
Baseline DBP	77.90±14.05	79.07±12.163
Post intubation DBP at 1 min	78.13±14.47	76.83±13.43
Post intubation DBP at 3 min	75.43±13.75	73.43±9.92
Post intubation DBP at 5 min	70.17±15.35	69.90±9.44
Baseline MAP	94.23±14.80	92.89±13.32
Post intubation MAP at 1 min	92.70±16.32	90.03±15.78
Post intubation MAP at 3 min	89.07±16.35	86.03±11.05
Post intubation MAP at 5 min	83.40±18.57	81.93±9.88
Baseline HR	90.63±16.50	95.27±18.60
Post intubation HR at 1 min	97.67±15.64	104.63±16.55
Post intubation HR at 3 min	95.03±15.96	100.17±15.15
Post intubation HR at 5 min	89.47±12.89	96.13±13.28

Multivariate analysis revealed that overall hemodynamics do not differ significantly between the groups with (p-value: 0.248). Both groups had similar pattern of hemodynamic changes over time with (p-value: 0.820) shown in [Figure 2-5].

But within subject time effect is significant, that shows significant change in hemodynamics over time within groups with (p-value: 0.000). In post hoc Bonferroni analysis, baseline SBP is significantly higher than SBP at 3rd and 5th minute with (p-values: 0.002 and 0.000) respectively. SBP at 1st and 3rd minute is higher than SBP at 5th minute (p-values: 0.013 and 0.016). Baseline DBP, DBP at 1st and 3rd minute is significantly higher than DBP at 5th minute (p-values:0.000, 0.007 and 0.010) respectively. Baseline MAP is significantly higher than MAP at 3rd and 5th minute (p-value: 0.018 and 0.000). MAP at 1st and 3rd minute is higher than MAP at 5th minute (p-value: 0.007 and 0.007). HR at 1st minute is significantly higher than baseline HR, HR at 3rd and 5th minute (p-value: 0.000, 0.005 and 0.000). HR at 3rd minute is higher than HR at 5th minute (p-value: 0.000).

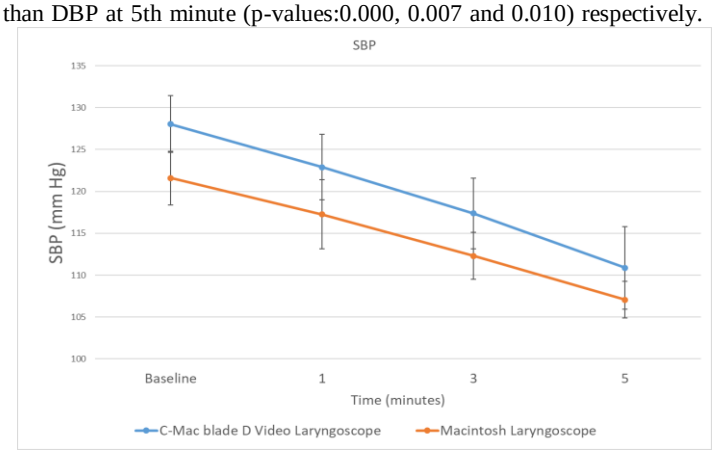


Fig 2

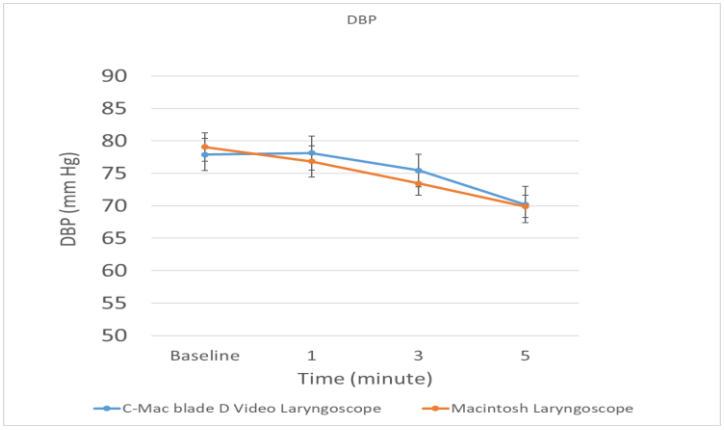


Fig 3

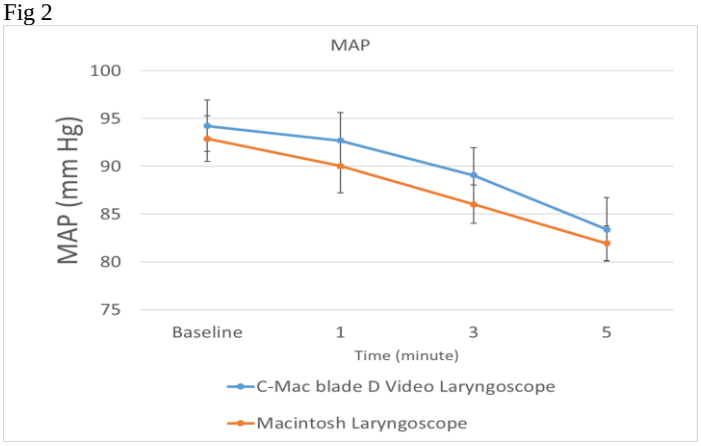


Fig 4

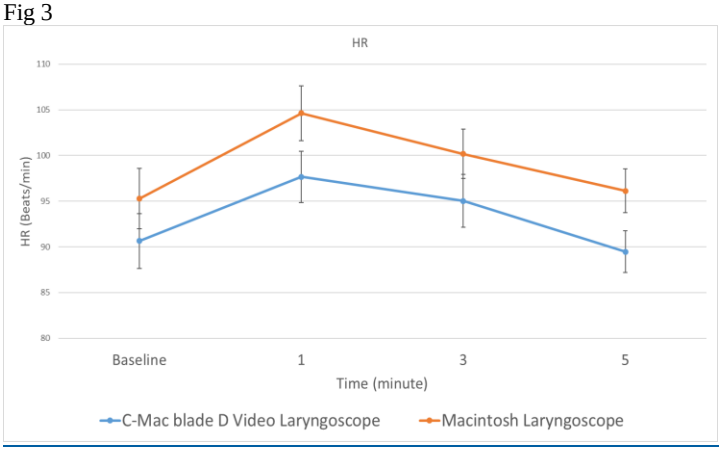


Fig 5

Figure 2-5 hemodynamic changes between the study groups

Discussion

As per our study, the mean intubation time for double lumen tube was significantly less with the Macintosh laryngoscope (47.6 ± 5.46 seconds) as compared to the C-MAC D-blade videolaryngoscope (51.53 ± 7.25 seconds; p = 0.021). Although this finding may seem unexpected considering the improved visualization provided by video laryngoscopes, it aligns with a growing body of evidence, various studies show that although videolaryngoscopes provide better glottic visualization, this does not necessarily lead to shorter intubation times.

For instance, a randomized controlled trial by Zhang et al.(18) reported comparable intubation times between the Macintosh and C-MAC D-blade laryngoscopes in patients with predicted normal airways (55.92 ± 18.75 s vs. 51.08 ± 15.27 s; p = 0.61). Similarly, a systematic review and meta-analysis by Lewis et al.(19) found no difference in intubation times between the two.

Despite the difference in intubation time, both groups in our study showed similar hemodynamic responses. There were no significant differences between the two groups in terms of systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), and heart rate (HR) at various time intervals post-intubation.

These results align with the findings of Yoosamran and Sengnon (2021) (10) , which found insignificant changes in heart rate and blood pressure post-intubation between C-MAC and Macintosh devices in normotensive patients. Similarly, Hsu et al. (2012) (20) reported that despite better glottic visualization with video laryngoscopes, hemodynamic parameters were not significantly improved compared to Macintosh laryngoscope use.

However, Zhang et al. (2016) (21) did report milder hemodynamic responses with videolaryngoscopy during DLT placement. Such variations could be due to differences in patient populations, the devices used, or operator experience.

We also observed that hemodynamic values tended to decrease over time in both groups, possibly due to the natural decline in stress response after intubation or the effect of anesthetic depth. Unlike studies such as that by Gvalani and Mane (2016) (22) , which showed more pronounced cardiovascular changes with Macintosh laryngoscopy in hypertensive patients, our study included only ASA I–II patients without significant comorbidities or predictors of a difficult airway. This likely contributed to the stable hemodynamics seen in both groups. Thus, our findings support the notion that while the choice of laryngoscope may influence intubation duration, it does not consistently affect cardiovascular stability during elective DLT intubation in stable patients.

Operator experience played a key role in our findings. While videolaryngoscopes offer better visualization, they may not provide a time advantage unless the user is familiar with the device. Russell et al. (10), for instance, found that junior anesthetists took longer to intubate using the GlideScope compared to the Macintosh, mainly due to limited experience (70 s vs. 32 s).In our study all the intubations were done by senior anesthetists to overcome this factor. Literature suggests at least 15 attempts are needed to reach a basic level of proficiency.(6, 23)

Although the C-MAC D-blade may reduce lifting force and be more comfortable for less experienced users, these advantages did not translate into faster intubation in our study. Lewis et al., noted that while videolaryngoscopy improves visualization and may reduce trauma, it does not necessarily improve speed unless the operator has overcome the learning curve.(24) In complex procedures like DLT placement, technical familiarity remains just as important as the equipment used.

Conclusion

In conclusion, Macintosh laryngoscope proves to be a more efficient tool for double lumen tube intubation, with significant shorter intubation times than C-MAC blade D video laryngoscope, while maintaining comparable hemodynamic changes.

Declarations

Data Availability statement
All data generated or analysed during the study are included in the manuscript.
Ethics approval and consent to participate
Approved by the department concerned. (IRBEC-MS-086-24)
Consent for publication
Approved
Funding
Not applicable

Conflict of interest

The authors declared the absence of a conflict of interest.

Author Contribution

S (Anesthesia Resident)
Manuscript drafting, Study Design,
SJ (Assistant proffessor)
Review of Literature, Data entry, Data analysis, and drafting articles.
MSB (Assistant Professor)
Conception of Study, Development of Research Methodology Design,
IA (Anesthsia Resident)
Study Design, manuscript review, critical input.
LM (Anesthesia Resident),
Manuscript drafting, Study Design,
SB (Assistant Professor)
Conception of Study, Development of Research Methodology Design,

All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the integrity of the study.

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