E-ISSN 2250-0944
ISSN 2250-1150
doi: 10.31838/ijprt/16.02.942

Research Article

Comparative Evaluation of Video Laryngoscopy and Conventional Macintosh Laryngoscopy for Endotracheal Intubation in Patients Undergoing Elective Surgery

Dr. Md Anwar Hussain[1], Dr. Shreyawati Basavaraddi[2], Dr. Rachana S. Kori[3*]
[1]Associate Professor, SDM College of Medical Sciences and Hospital, Shri Dharmasthala Manjunatheshwara University, Dharwad, Karnataka, India.
[2]Consultant Anaesthesiologist, Gadag, Karnataka, India.
[3*]Assistant Professor, SDM College of Medical Sciences and Hospital, Shri Dharmasthala Manjunatheshwara University, Dharwad, Karnataka, India.
Received: 12.08.2026, Revised: 13.09.2026, Accepted: 21.10.2026

ABSTRACT
Background: Endotracheal intubation is an essential component of general anaesthesia, ensuring adequate oxygenation, ventilation, and airway protection. Video laryngoscopy provides improved visualization of the glottis and may facilitate successful intubation compared with conventional Macintosh laryngoscopy. The present study aimed to compare the efficacy and safety of these techniques in patients undergoing elective surgery.
Materials and Methods: This prospective, randomized, comparative study included 80 patients undergoing elective surgical procedures under general anaesthesia. Patients were divided into two groups: Group A (video laryngoscopy, n = 40) and Group B (conventional Macintosh laryngoscopy, n = 40). Intubation time, first-attempt success, glottic visualization, haemodynamic parameters, oxygen saturation, and airway-related complications were evaluated.
Results: Mean intubation time was shorter in the video laryngoscopy group (24.68 ± 5.82 seconds) compared with the Macintosh group (31.46 ± 7.14 seconds). First-attempt intubation success was 95.0% versus 82.5%, while Cormack–Lehane Grade I visualization was achieved in 80.0% versus 55.0%, respectively. Post-intubation heart rate was 86.24 ± 9.18 versus 94.68 ± 10.42 beats/min, and mean arterial pressure was 99.28 ± 9.46 versus 108.64 ± 10.82 mmHg. Desaturation occurred in 2.5% versus 12.5%, mucosal trauma in 5.0% versus 15.0%, and postoperative sore throat in 12.5% versus 27.5%, respectively. Overall intubation success was 100% in both groups.
Conclusion: Video laryngoscopy demonstrated favorable intubation characteristics, better glottic visualization, smaller haemodynamic responses, and fewer airway-related complications compared with conventional Macintosh laryngoscopy. It may represent an effective alternative for airway management during elective surgery.

Keywords: Video laryngoscopy; Macintosh laryngoscopy; Endotracheal intubation; Glottic visualization; First-attempt success; Haemodynamic response; General anaesthesia.

INTRODUCTION

Effective airway management is a fundamental component of anaesthetic practice and plays a crucial role in ensuring patient safety during surgical procedures. Endotracheal intubation is routinely performed to maintain airway patency, facilitate adequate oxygenation and ventilation, and protect against pulmonary aspiration. Although tracheal intubation is successful in most patients, approximately 8% may require multiple attempts to secure the airway[1]. Repeated intubation attempts increase the risk of complications, including hypoxaemia, airway trauma, regurgitation, pulmonary aspiration, haemodynamic instability, and, in severe cases, cardiac arrest[2-4]. Therefore, selecting an appropriate laryngoscopic technique that facilitates successful intubation on the first attempt is essential for minimizing complications and improving perioperative outcomes.

Conventional direct laryngoscopy using the Macintosh laryngoscope has traditionally been considered the standard technique for endotracheal intubation under general

anaesthesia. The curved Macintosh blade facilitates visualization of the vocal cords by displacing the tongue and indirectly elevating the epiglottis[5]. However, successful glottic visualization requires appropriate positioning and relative alignment of the oral, pharyngeal, and laryngeal axes. Anatomical variations, obesity, restricted mouth opening, and limited cervical mobility may make direct laryngoscopy challenging. Furthermore, the effectiveness of this technique depends considerably on the experience and technical expertise of the anaesthesiologist[6].

Advancements in airway management technology have led to the development of video laryngoscopy, which provides an indirect view of the laryngeal structures through a miniature camera positioned near the distal end of the laryngoscope blade. The image is displayed on a monitor, allowing improved visualization of the glottis without requiring direct alignment of the airway axes. Video laryngoscopy has emerged as an important alternative to conventional Macintosh laryngoscopy, particularly in patients with anticipated or unanticipated difficult airways[7,8]. Improved glottic visualization may facilitate endotracheal tube placement, reduce excessive airway manipulation, and increase first-attempt intubation success. However, improved visualization does not invariably translate into easier or faster intubation, as difficulties may arise during advancement of the endotracheal tube.

Previous studies comparing video laryngoscopy with conventional direct laryngoscopy have reported variable findings. In a randomized clinical trial involving 371 critically ill patients, video laryngoscopy did not significantly improve first-attempt intubation success compared with direct laryngoscopy. Severe life-threatening complications were reported in 9.5% and 2.8% of patients, respectively, in the reported comparison[9-11]. Conversely, other investigations have demonstrated improved glottic visualization and higher first-pass intubation success with video laryngoscopy, particularly in patients with difficult airway characteristics. These differences emphasize the importance of evaluating both techniques across different clinical settings and patient populations.

In addition to intubation success, other important parameters include intubation time, number of attempts, quality of glottic visualization, haemodynamic responses, and airway-related complications. Laryngoscopy and endotracheal intubation produce sympathetic stimulation, resulting in transient increases in heart rate and blood pressure[12,13]. Excessive airway manipulation may also contribute to mucosal trauma, dental injury, postoperative sore throat, and hoarseness. Although video laryngoscopy may reduce the force required for laryngeal exposure, its overall advantages during routine elective surgery require further evaluation.

Therefore, the present study, entitled "Comparative Evaluation of Video Laryngoscopy and Conventional Macintosh Laryngoscopy for Endotracheal Intubation in Patients Undergoing Elective Surgery," aims to compare the effectiveness and safety of these two techniques in terms of glottic visualization, intubation time, number of attempts, intubation success, and procedure-related complications.

MATERIALS AND METHODS

Study Design

The present study was conducted as a prospective, randomized, comparative study to evaluate the efficacy and safety of video laryngoscopy and conventional Macintosh laryngoscopy for endotracheal intubation in patients undergoing elective surgical procedures under general anaesthesia.

The study was conducted in the Department of Anaesthesiology at a tertiary care hospital. Patients scheduled for elective surgical procedures requiring general anaesthesia with endotracheal intubation were enrolled in the study.

The study was conducted over a period of 18 months, during which eligible patients were recruited, evaluated, and assessed for the predefined study outcomes.

Sample Size

A total of 80 patients undergoing elective surgical procedures under general anaesthesia were included in the study. The participants were equally divided into two groups of 40 patients each.

- **Group A (n = 40):** Patients underwent endotracheal intubation using a video laryngoscope.

- **Group B (n = 40):** Patients underwent endotracheal intubation using a conventional Macintosh laryngoscope.

The sample size was fixed at 80 patients for the comparative evaluation of the two intubation techniques.

Sampling Technique and Randomization

Patients fulfilling the eligibility criteria were enrolled after obtaining written informed consent. The participants were randomly allocated into two groups using a computer-generated randomization sequence in a 1:1 ratio. Allocation was performed using sequentially numbered, sealed, opaque envelopes. The assigned laryngoscopic technique was used for endotracheal intubation. Due to the nature of the intervention, blinding of the anaesthesiologist performing intubation was not possible.

Inclusion Criteria

1. Patients aged 18–65 years.
2. Patients of either sex.
3. Patients belonging to American Society of Anesthesiologists (ASA) physical status I or II.
4. Patients scheduled for elective surgical procedures under general anaesthesia requiring endotracheal intubation.
5. Patients who provided written informed consent to participate in the study.

Exclusion Criteria

1. Patients with anticipated difficult airway based on preoperative airway assessment.
2. Patients with restricted mouth opening or significant anatomical abnormalities of the upper airway.
3. Patients with cervical spine instability or severely restricted neck movements.
4. Patients requiring emergency surgical procedures.
5. Patients with a history of difficult or failed endotracheal intubation.
6. Patients with significant uncontrolled cardiovascular or respiratory disorders.
7. Patients at high risk of pulmonary aspiration.
8. Patients who declined participation in the study.

Preoperative Assessment

All patients underwent a detailed preanaesthetic evaluation before surgery. Demographic characteristics, including age, sex, weight, height, and body mass index (BMI), were recorded. A detailed medical history, previous anaesthetic history, associated comorbidities, and relevant clinical examination findings were documented.

Airway assessment was performed using the modified Mallampati classification, interincisor distance, thyromental distance, and assessment of neck mobility. Routine preoperative investigations were reviewed according to institutional protocols. Patients were instructed to follow standard preoperative fasting guidelines.

Anaesthesia Protocol

On arrival in the operating theatre, standard monitoring was established, including electrocardiography, non-invasive blood pressure, and pulse oximetry. Baseline heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure, and peripheral oxygen saturation (SpO_2) were recorded.

An intravenous cannula was secured, and patients were preoxygenated with 100% oxygen for approximately three minutes. General anaesthesia was induced using intravenous anaesthetic agents according to a standardized institutional protocol. An appropriate neuromuscular blocking agent was administered to facilitate endotracheal intubation. Adequate depth of anaesthesia and neuromuscular relaxation were ensured before laryngoscopy.

Intubation Procedure

Group A: Video Laryngoscopy (n = 40)

Patients allocated to Group A underwent endotracheal intubation using a video laryngoscope. After adequate induction of anaesthesia and neuromuscular relaxation, the video laryngoscope blade was introduced into the oral cavity. The laryngeal structures were visualized on the monitor, and an appropriately sized cuffed endotracheal tube was advanced through the vocal cords under video guidance. The position of the endotracheal tube was confirmed by continuous waveform capnography and bilateral chest auscultation.

Group B: Conventional Macintosh Laryngoscopy (n = 40)

Patients allocated to Group B underwent endotracheal intubation using a conventional Macintosh laryngoscope. Following induction of anaesthesia and

adequate neuromuscular relaxation, the Macintosh blade was introduced into the oral cavity, and the glottis was visualized directly. An appropriately sized cuffed endotracheal tube was inserted through the vocal cords. Successful intubation was confirmed using continuous waveform capnography and bilateral chest auscultation.

All intubations were performed by anaesthesiologists experienced in both techniques to minimize operator-related variability.

Parameters Evaluated

Glottic Visualization

The quality of glottic visualization during laryngoscopy was assessed using the Cormack–Lehane grading system:

- Grade I: Complete visualization of the glottis.
- Grade II: Partial visualization of the glottis.
- Grade III: Only the epiglottis was visible.
- Grade IV: Neither the glottis nor the epiglottis was visible.

The grades obtained using both laryngoscopic techniques were recorded and compared.

Intubation Time

Intubation time was measured in seconds from the introduction of the laryngoscope blade into the oral cavity until the first sustained end-tidal carbon dioxide waveform confirmed successful tracheal intubation. The duration was recorded using a stopwatch.

Number of Intubation Attempts

The number of attempts required for successful endotracheal intubation was documented. An intubation attempt was defined as the introduction of the laryngoscope blade into the oral cavity with the intention of placing an endotracheal tube. Withdrawal and reinsertion of the laryngoscope were considered a separate attempt.

First-Attempt Intubation Success Rate

First-attempt intubation success was defined as successful placement of the endotracheal tube into the trachea during the initial laryngoscopic attempt, confirmed by continuous waveform capnography. The proportion of patients successfully intubated on the first attempt was calculated for both groups.

Haemodynamic Parameters

Haemodynamic responses to laryngoscopy and endotracheal intubation were assessed by recording heart rate, systolic blood pressure, diastolic blood pressure, and mean arterial pressure at the following time intervals:

- Before induction of anaesthesia (baseline).
- Immediately before laryngoscopy.
- Immediately after endotracheal intubation.
- At 1 minute after intubation.
- At 3 minutes after intubation.
- At 5 minutes after intubation.

The recorded values were compared between the two groups to evaluate the haemodynamic responses associated with each technique.

Oxygen Saturation

Peripheral oxygen saturation (SpO_2) was monitored continuously throughout the intubation procedure. The lowest oxygen saturation recorded during intubation was documented. Episodes of oxygen desaturation, defined as SpO_2 below 94%, were recorded and compared between the groups.

Airway-Related Complications

Complications associated with laryngoscopy and endotracheal intubation were documented, including oral or pharyngeal mucosal trauma, dental injury, bleeding, and oxygen desaturation. Postoperative sore throat and hoarseness were assessed during the postoperative observation period.

Management of Failed Intubation

In cases where endotracheal intubation was unsuccessful during the initial attempt, the patient was reoxygenated before another attempt was made. Further airway management was performed according to the institutional difficult airway management protocol. The number of attempts, requirement for alternative airway devices, and any associated complications were documented. Patient safety was prioritized throughout the procedure.

Outcome Measures

The primary outcome measures were intubation time and first-attempt intubation success rate in patients undergoing video laryngoscopy and conventional Macintosh laryngoscopy.

Secondary outcome measures included glottic visualization, number of intubation attempts, haemodynamic responses, oxygen saturation, and airway-related complications.

Statistical Analysis

The collected data were entered into Microsoft Excel and analyzed using appropriate statistical software. Continuous variables, including age, BMI, intubation time, heart rate, and blood pressure, were expressed as mean ± standard deviation. Categorical variables, including sex, ASA physical status, Cormack–Lehane grade, first-attempt intubation success, and complications, were expressed as frequencies and percentages.

The independent samples Student's t-test was used to compare normally distributed continuous variables between the two groups, whereas the Mann–Whitney U test was applied to non-normally distributed variables. Categorical variables were compared using the Chi-square test or Fisher's exact test, as appropriate. Repeated haemodynamic measurements were analyzed using repeated-measures analysis of variance or an appropriate alternative, depending on the distribution and assumptions of the data. All statistical tests were two-sided, and a p-value less than 0.05 was considered statistically significant.

RESULTS

The baseline demographic characteristics were comparable between the two groups, as shown in Table 1. The mean age was 42.65 ± 11.84 years in the Video group and 43.28 ± 12.16 years in the Macintosh group. Male participants constituted 57.50% and 55.00% of the respective groups. The mean BMI was 24.82 ± 3.26 kg/m² in the Video group and 25.14 ± 3.48 kg/m² in the Macintosh group. ASA Grade I patients accounted for 62.50% and 60.00%, respectively, indicating similar baseline characteristics.

The comparison of intubation characteristics is presented in Table 2 and Figure 1. The mean intubation time was shorter in the Video group (24.68 ± 5.82 seconds) compared with the Macintosh group (31.46 ± 7.14 seconds). First-attempt intubation success was higher in the Video group (95.00%) than in the Macintosh group (82.50%). Similarly, Cormack–Lehane Grade I visualization was achieved in 80.00% of patients in the Video group compared with 55.00% in the Macintosh group. However, the overall intubation success rate was 100.00% in both groups.

The haemodynamic parameters are compared in Table 3 and Figure 2. Baseline heart rate was comparable between the Video group (78.42 ± 8.64 beats/min) and Macintosh group (79.16 ± 9.12 beats/min). Following intubation, heart rate increased to 86.24 ± 9.18 beats/min in the Video group and 94.68 ± 10.42 beats/min in the Macintosh group. Similarly, baseline MAP was 92.46 ± 8.72 mmHg and 93.18 ± 9.14 mmHg, respectively, increasing to 99.28 ± 9.46 mmHg and 108.64 ± 10.82 mmHg after intubation. These findings indicate a comparatively lower haemodynamic response to intubation in the Video group.

The comparison of airway-related complications is presented in Table 4. The mean lowest SpO_2 was higher in the Video group (97.24 ± 1.42%) compared with the Macintosh group (95.86 ± 2.18%). Desaturation occurred in 2.50% of patients in the Video group compared with 12.50% in the Macintosh group. Mucosal trauma was observed in 5.00% and 15.00% of patients, respectively. Similarly, postoperative sore throat was less frequent in the Video group (12.50%) than in the Macintosh group (27.50%). Overall, video laryngoscopy was associated with fewer observed airway-related complications than conventional Macintosh laryngoscopy.

Table 1. Comparison of Baseline Characteristics (N = 80)

Parameter	Video (n = 40)	Macintosh (n = 40)
Age (years), Mean ± SD	42.65 ± 11.84	43.28 ± 12.16
Male, n (%)	23 (57.50)	22 (55.00)
BMI (kg/m²)	24.82 ± 3.26	25.14 ± 3.48
ASA I, n (%)	25 (62.50)	24 (60.00)

Table 2. Comparison of Intubation Characteristics (N = 80)

Parameter	Video (n = 40)	Macintosh (n = 40)
Intubation time (sec)	24.68 ± 5.82	31.46 ± 7.14
First-attempt success, n (%)	38 (95.00)	33 (82.50)
Cormack–Lehane Grade I, n (%)	32 (80.00)	22 (55.00)
Overall success, n (%)	40 (100.00)	40 (100.00)

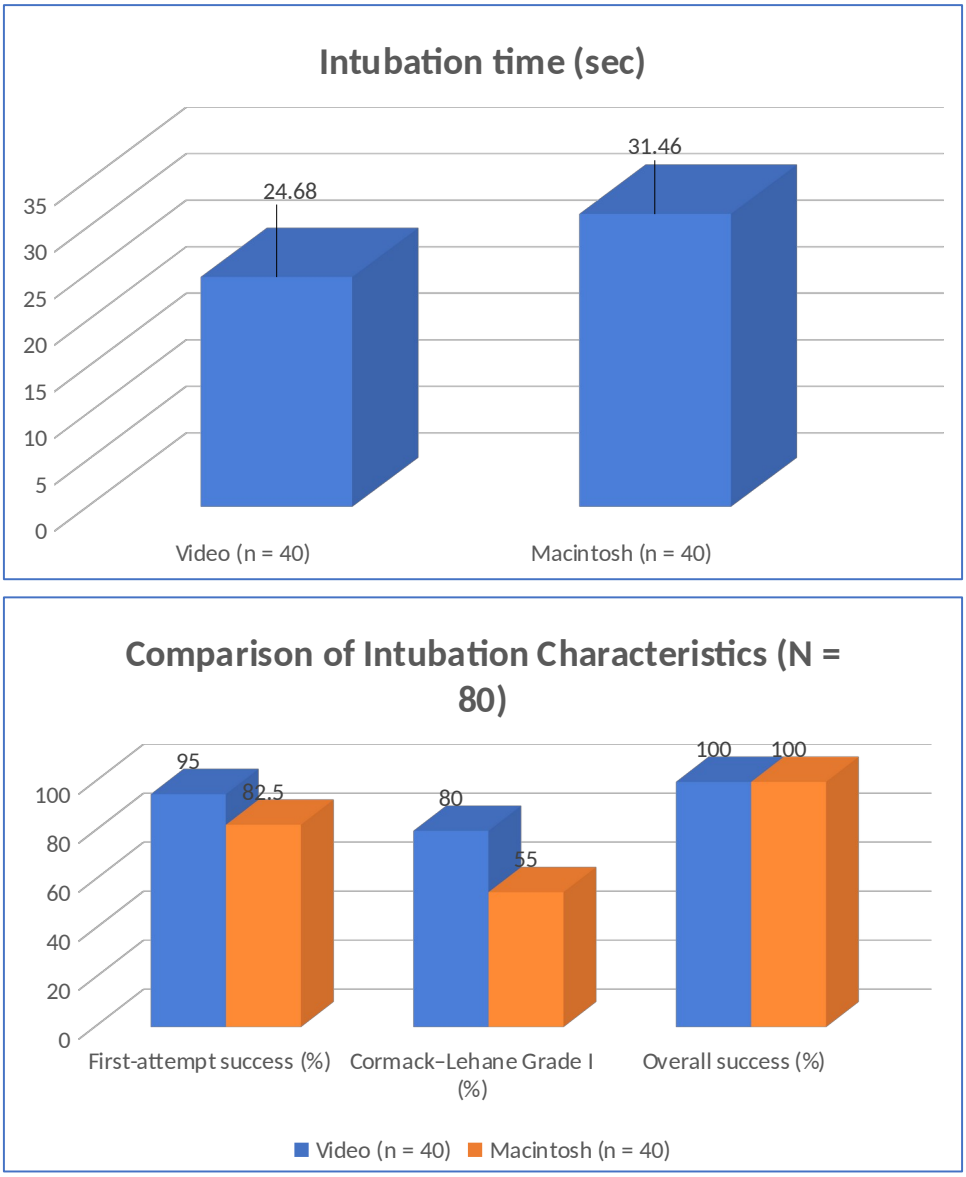

Figure 1. Comparison of Intubation Characteristics (N = 80)

Table 3. Comparison of Haemodynamic Parameters (N = 80)

Parameter	Video (n = 40)	Macintosh (n = 40)
Baseline HR (beats/min)	78.42 ± 8.64	79.16 ± 9.12
HR after intubation	86.24 ± 9.18	94.68 ± 10.42
Baseline MAP (mmHg)	92.46 ± 8.72	93.18 ± 9.14
MAP after intubation	99.28 ± 9.46	108.64 ± 10.82

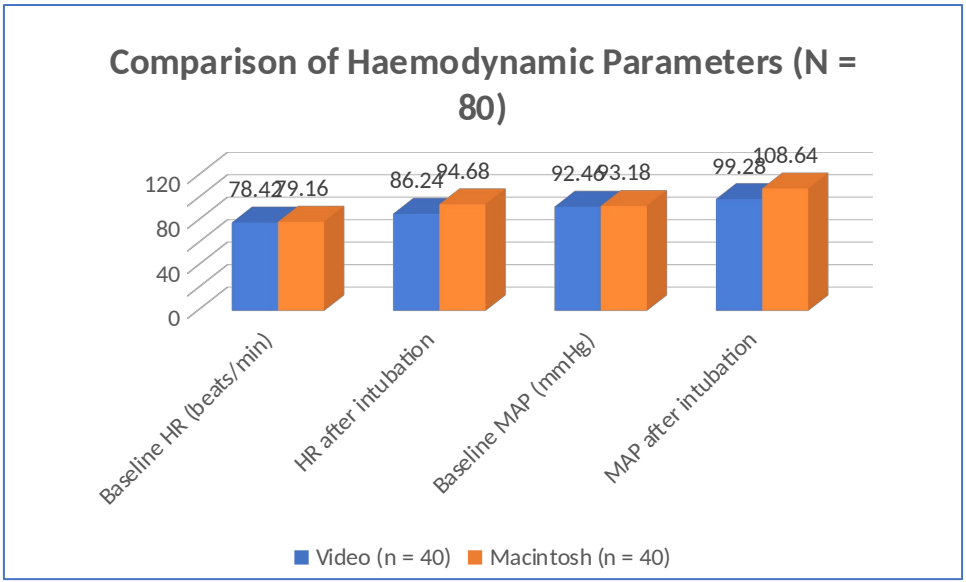

Figure 2. Comparison of Haemodynamic Parameters (N = 80)

Table 4. Comparison of Airway-Related Complications (N = 80)

Parameter	Video (n = 40)	Macintosh (n = 40)
Lowest SpO_2 (%), Mean ± SD	97.24 ± 1.42	95.86 ± 2.18
Desaturation, n (%)	1 (2.50)	5 (12.50)
Mucosal trauma, n (%)	2 (5.00)	6 (15.00)
Postoperative sore throat, n (%)	5 (12.50)	11 (27.50)

DISCUSSION

The present study compared video laryngoscopy with conventional Macintosh laryngoscopy in 80 patients undergoing elective surgery under general anaesthesia, with 40 patients in each group. The findings suggested that video laryngoscopy was associated with shorter intubation time, improved glottic visualization, higher first-attempt success, reduced haemodynamic responses, and fewer airway-related complications. These observations were compared with previously published studies to evaluate their clinical relevance.

In the present study, the mean age was 42.65 ± 11.84 years in the video laryngoscopy group and 43.28 ± 12.16 years in the Macintosh group. Male patients constituted 57.50% and 55.00%, respectively. Mean BMI was 24.82 ± 3.26 and 25.14 ± 3.48 kg/m², while ASA grade I patients accounted for 62.50% and 60.00%, respectively. These findings indicated comparable baseline characteristics between the groups, reducing the likelihood of demographic differences influencing intubation outcomes.

The baseline comparability was consistent with the randomized study by Janz et al.[14], involving 150 critically ill adults, in which the video (n = 74) and direct laryngoscopy (n = 76) groups had similar baseline characteristics.

In our study, mean intubation time was shorter with video laryngoscopy (24.68 ± 5.82 seconds) than with Macintosh laryngoscopy (31.46 ± 7.14 seconds). First-attempt success was 95.00% versus 82.50%, while Cormack–Lehane Grade I visualization was achieved in 80.00% versus 55.00%, respectively. Overall intubation success was 100% in both groups.

These findings were comparable to those of a multicentre randomized McGrath trial, involving 2,092 patients, which reported first-attempt success rates of 94% with video laryngoscopy and 82% with direct laryngoscopy. Poor glottic visualization (Cormack–Lehane Grade ≥3) occurred in 0.7% versus 8%, respectively. Similarly, a randomized study involving 360 elective surgical patients reported first-attempt success rates of 96.1% versus 90.1% (p = 0.024), supporting the improved intubation performance observed in our study.

In our study, baseline heart rate was comparable between groups (78.42 ± 8.64 versus 79.16 ± 9.12 beats/min). Following intubation, heart rate increased to 86.24 ±

9.18 with video laryngoscopy and 94.68 ± 10.42 beats/min with Macintosh laryngoscopy. Similarly, MAP increased from 92.46 ± 8.72 to 99.28 ± 9.46 mmHg in the video group, compared with 93.18 ± 9.14 to 108.64 ± 10.82 mmHg in the Macintosh group.

In contrast, Mermer et al. (2026)[15] studied 112 patients undergoing coronary artery bypass grafting and reported mean MAP increases of 20.8 ± 19.4 mmHg with Macintosh and 26.3 ± 13.6 mmHg with C-MAC video laryngoscopy (p = 0.168). Corresponding heart rate increases were 7.4 ± 8.2 and 6.1 ± 10.6 beats/min (p = 0.844). Their findings indicated no significant haemodynamic advantage of video laryngoscopy.

In our study, the lowest SpO_2 was 97.24 ± 1.42% with video laryngoscopy compared with 95.86 ± 2.18% with Macintosh laryngoscopy. Desaturation occurred in 2.50% versus 12.50%, mucosal trauma in 5.00% versus 15.00%, and postoperative sore throat in 12.50% versus 27.50%, respectively.

Similarly, the randomized study of 360 elective surgical patients reported immediate oropharyngeal injury in 1.1% with video laryngoscopy versus 5.1% with direct laryngoscopy (p = 0.033). Postoperative hoarseness occurred in 2.8% versus 7.9% (p = 0.035), respectively. However, the multicentre McGrath trial found no significant difference in intubation-associated adverse events between the two techniques.

Overall, the presented study values favored video laryngoscopy for intubation efficiency, glottic visualization, haemodynamic responses, and airway safety. However, these comparisons remained descriptive, and statistical significance could not be established without analysis of the actual patient data.

CONCLUSION

The present study suggested that video laryngoscopy offered advantages over conventional Macintosh laryngoscopy in patients undergoing elective surgery under general anaesthesia. Video laryngoscopy demonstrated shorter intubation time (24.68 ± 5.82 vs. 31.46 ± 7.14 seconds), higher first-attempt success (95% vs. 82.5%), and better glottic visualization (80% vs. 55%). It was also associated with smaller haemodynamic responses and fewer airway-related complications, including desaturation, mucosal trauma, and postoperative sore throat. Both techniques achieved 100% overall intubation success. These findings suggest that video laryngoscopy may be an effective alternative for improving intubation efficiency and perioperative airway safety, subject to confirmation using actual clinical data.

LIMITATIONS

The present study was limited by its relatively small sample size of 80 patients, which may restrict the generalizability of the findings. The inclusion of patients undergoing elective surgery with predominantly normal airway characteristics limited the applicability of the results to patients with difficult airways and emergency intubations. Blinding of the anaesthesiologist was not feasible, introducing potential observer and performance bias. Additionally, variations in operator experience and the lack of long-term follow-up may have influenced the assessment of intubation outcomes and postoperative complications.

REFERENCES

1. Saasouh W, Laffey K, Turan A, Avitsian R, Zura A, You J, et al. Degree of obesity is not associated with more than one intubation attempt: a large centre experience. Br J Anaesth. 2018;120(5):1110-6.
2. Hasegawa K, Shigemitsu K, Hagiwara Y. Association between repeated intubation attempts and adverse events in emergency departments. Ann Emerg Med. 2012;60(6):749-54.e2.
3. Mort TC. Emergency tracheal intubation: complications associated with repeated laryngoscopic attempts. Anesth Analg. 2004;99(2):607-13.
4. Sakles JC, Javedani PP, Chase E, Garst-Orozco J, Guillen-Rodriguez JM, Stolz U, et al. The use of a video laryngoscope by emergency medicine residents is associated with a reduction in esophageal intubations in the emergency department. Acad Emerg Med. 2015;22(6):700-7.
5. Sakles JC, Chiu S, Mosier J, Walker C, Stolz U. The importance of first pass success when performing orotracheal

intubation in the emergency department. Acad Emerg Med. 2013;20(1):71-8.
6. Gálvez JA, Acquah S, Ahumada L. Hypoxemia, bradycardia, and multiple laryngoscopy attempts during anesthetic induction in infants. Anesthesiology. 2019;131(4):830-9.
7. Fiadjoe JE, Nishisaki A, Jagannathan N. Airway management complications in children with difficult tracheal intubation from the Pediatric Difficult Intubation (PeDI) registry. Lancet Respir Med. 2016;4(1):37-48.
8. Cook TM, Woodall N, Frerk C. Major complications of airway management in the UK. Br J Anaesth. 2011;106(5):617-31.
9. Cook TM, MacDougall-Davis SR. Complications and failure of airway management. Br J Anaesth. 2012;109 Suppl 1:i68-85.
10. Aziz MF, Abrons RO, Cattano D. First-attempt intubation success of video laryngoscopy in patients with anticipated difficult direct laryngoscopy. Anesth Analg. 2016;122(3):740-50.
11. Sulser S, Ubmann D, Schlaepfer M. C-MAC videolaryngoscope compared with direct laryngoscopy for rapid sequence intubation in an emergency department. Eur J Anaesthesiol. 2016;33(12):943-8.
12. Ruetzler K, Imach S, Weiss M, Haas T, Schmidt AR. Comparison of five video laryngoscopes and conventional direct laryngoscopy. Anaesthesist. 2015;64(7):513-9.
13. Lascarrou JB, Boisrame-Helms J, Bailly A, Le Thuaut A, Kamel T, Mercier E, et al. Video laryngoscopy vs direct laryngoscopy on successful first-pass orotracheal intubation among ICU patients: a randomized clinical trial. JAMA. 2017;317(5):483-93.
14. Janz DR, Semler MW, Lentz RJ, Matthews DT, Assad TR, Norman BC, et al; Facilitating EndotracheaL intubation by Laryngoscopy technique and apneic Oxygenation Within the ICU Investigators and the Pragmatic Critical Care Research Group. Randomized Trial of Video Laryngoscopy for Endotracheal Intubation of Critically Ill Adults. Crit Care Med. 2016 Nov;44(11):1980-1987.
15. Mermer HA, Yildiz M, Tutar MS, Yazar MA, Kozanhan B. Hemodynamic Response to Intubation With 4 Different Laryngoscopes in Coronary Artery Bypass Graft Surgery: A Randomized Trial. J Cardiothorac Vasc Anesth. 2026 Aug;40(8):2332-2340.