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A COMPARATIVE STUDY OF VIDEO-ASSISTED LARYNGOSCOPY VERSUS CONVENTIONAL MACINTOSH LARYNGOSCOPY IN ELECTIVE SURGERIES: EFFICACY, INTUBATION SUCCESS RATES, AND COMPLICATIONS

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Abstract

Objective: *The Macintosh laryngoscope has long been the conventional tool for endotracheal intubation in general anaesthesia; however, video-assisted laryngoscopy (VAL) offers improved glottic visualisation. This study compared the observed efficacy and safety of VAL versus Macintosh laryngoscopy in patients with normal airways undergoing elective surgery.*

Study Design and Setting: *A prospective, comparative observational study was conducted in 200 ASA I–II adult patients scheduled for elective procedures. Based on clinical preference and device availability, participants were intubated using either VAL (C-MAC/McGrath) or Macintosh laryngoscope. Primary outcome was first-attempt intubation success. Secondary outcomes included intubation time, Cormack–Lehane grade, hemodynamic changes, and complications.*

Methodology: *Data were prospectively collected on consecutive patients meeting the inclusion criteria. To minimize bias, data collection and analysis were performed by investigators blinded to the study groups during outcome assessment. Parameters recorded included intubation success, time to intubation, glottic view, hemodynamic parameters, and postoperative complications.*

Results: *First-attempt success was significantly higher with VAL (98%) compared to Macintosh laryngoscopy (84%) ($p < 0.001$). A Cormack–Lehane grade I view was achieved more frequently with VAL (96% vs. 78%, $p < 0.001$). Intubation time was shorter with Macintosh laryngoscopy (18.2 ± 5.1 seconds vs. 22.8 ± 6.7 seconds, $p < 0.001$). Hemodynamic responses were similar between groups. Postoperative sore throat occurred less often in the VAL group (8% vs. 20%, $p = 0.01$).*

Conclusion: *In this study, the use of VAL was associated with superior first-attempt success and glottic visualization compared with Macintosh laryngoscopy, though intubation time was slightly longer. VAL was associated with fewer minor complications. These observational findings support its role as a safe and effective alternative for routine airway management, meriting consideration for broader clinical adoption.*

INTRODUCTION

Endotracheal intubation remains a cornerstone of modern anaesthetic practice, indispensable for securing the airway and ensuring effective ventilation during general anaesthesia. It is considered as one of the most critical skills in perioperative medicine, forming the basis of safe airway management across a wide range of surgical procedures.[1] For decades, direct laryngoscopy—most notably with the Macintosh blade—has been regarded as the gold standard technique.[2] Its design allows indirect elevation of the epiglottis via the glossopharyngeal epiglottic ligament, a manoeuvre that has been mastered by generations of anaesthesiologists and continues to define conventional airway management.

Despite its widespread adoption, direct laryngoscopy is not without limitations. Optimal visualisation of the glottis often requires precise alignment of the oral, pharyngeal, and laryngeal axes, a requirement that can prove challenging in patients with unfavourable anatomy such as limited neck mobility, obesity, or craniofacial abnormalities.[3] These difficulties may result in repeated attempts, increased risk of airway trauma, exaggerated hemodynamic responses, and, in rare cases, failed intubation.[4] The need to overcome these limitations has driven innovation in airway devices, leading to the development of video-assisted laryngoscopy (VAL).

VAL integrates a miniature camera at the blade tip, transmitting a magnified view of the glottis to an external monitor. This design obviates the need for strict axial alignment and provides indirect visualization of the laryngeal inlet, often improving the view even in anatomically challenging scenarios.[5] By enhancing glottic visualization, VAL has been shown to reduce the incidence of difficult laryngoscopy and improve intubation success rates, particularly in patients with anticipated or unanticipated difficult airways.[6]

Several randomized controlled trials and systematic reviews have highlighted the superiority of VAL over conventional Macintosh laryngoscopy in terms of glottic visualization and first-attempt success rates.[7]

In particular, devices such as the C-MAC and McGrath video laryngoscopes have demonstrated consistent advantages in both routine and difficult airway settings. However, despite these benefits, the role of VAL in routine elective cases with normal airway predictors remains debated.[8] While VAL consistently offers enhanced views, concerns persist regarding potential prolongation of intubation time, increased device costs, and the requirement for operator adaptation to novel techniques.[9]

Another important consideration is the hemodynamic response associated with intubation. Direct laryngoscopy is known to provoke sympathetic stimulation, leading to tachycardia and hypertension, which may be detrimental in patients with cardiovascular comorbidities.[10] Whether VAL attenuates these responses remains unclear, with studies reporting comparable outcomes between the two techniques.[11] Furthermore, peri-procedural complications such as sore throat, mucosal injury, and dental trauma require systematic evaluation to determine whether VAL confers a safety advantage in routine practice.[12]

Against this backdrop, the present study was designed to evaluate the performance of VAL in routine anaesthetic practice. We hypothesised that VAL would yield a higher first-attempt intubation success rate and superior glottic visualization compared with Macintosh laryngoscopy in adult patients with normal airways undergoing elective surgery. The primary endpoint was the success rate of first-attempt intubation. In contrast, secondary endpoints included intubation time, glottic view grading using the Cormack–Lehane classification, hemodynamic responses, and peri-procedural complications. By addressing these outcomes, this study aims to clarify the role of VAL in routine airway management and contribute to evidence-based recommendations for its integration into standard anaesthetic practice.

Methodology:

A prospective, observational comparative study was conducted from January 1, 2025, to June 30, 2024, in the operating theatres of PNS Shifa. The study protocol received approval from the Shifa Hospital Ethical Committee (Ref: ERC/2025/ANES/55). Furthermore, verbal and written informed consent explaining the purpose of the study and giving participants full authority to decline participation were obtained from all patients.

Adult patients aged 18-65 years, of American Society of Anesthesiologists (ASA) physical status I or II, scheduled for elective surgery under general anaesthesia requiring endotracheal intubation were screened. Inclusion criteria mandated a normal airway assessment, defined as Mallampati class I or II, thyromental distance >6 cm, and full neck mobility. Exclusion criteria included anticipated difficult airway (Mallampati III-IV, limited neck extension, history of difficult intubation), emergency surgery, pregnancy, and any contraindication to standard laryngoscopy.

The sample size was calculated to provide adequate power for group comparisons. Based on previous studies, assuming a first-attempt success rate of 95% for VAL and 80% for Macintosh laryngoscopy, with 80% power and a 5% significance level, a minimum of 89 patients per group was required. To account for potential exclusions, the study aimed to enroll 100 patients per group (total N=200). Consecutive eligible patients were prospectively enrolled**.** The choice of laryngoscope (VAL or Macintosh) was determined by the attending anaesthesiologist based on clinical judgment, departmental practice patterns, and device availability. Based on the device used, patients were assigned to one of two observational cohorts:

Group V (VAL Cohort): Patients intubated using a video laryngoscope (C-MAC or McGrath).

Group M (Macintosh Cohort): Patients intubated using a conventional Macintosh laryngoscope.

The study was designed with a blinded outcome assessment. The attending anaesthesiologist performing the intubation was, by necessity, aware of the device used. To minimize bias, this clinician was not involved in data collection. A separate resident anaesthesiologist, who was blinded to the device used, served as the outcome assessor. Patients were also blinded to the device used for their intubation. All procedural data were recorded by this blinded assessor. Standard monitoring (ECG, non-invasive blood pressure, pulse oximetry) was applied. After pre-oxygenation, general anaesthesia was induced with fentanyl (2 mcg/kg), propofol (2-2.5 mg/kg), and rocuronium (0.6 mg/kg). Mask ventilation was confirmed, and laryngoscopy was performed three minutes after muscle relaxant administration by an experienced anaesthesiologist (>100 previous uses with the assigned device type).

In Group V, the video laryngoscope blade was inserted in the midline, and the glottic view was optimised using the video screen. In Group M, the standard direct laryngoscopy technique was employed. A standard endotracheal tube with a stylet (pre-shaped for the VAL cohort) was used in all cases. Intubation was confirmed by capnography. A maximum of three attempts was permitted per department protocol.

Outcome Measures First-attempt intubation success rate: Defined as successful endotracheal tube placement with capnographic confirmation on the first laryngoscopy attempt.

Time to intubation (TTI): Measured in seconds from the moment the laryngoscope blade passed the dental arch until the appearance of a sustained square-wave capnograph trace.

Glottic visualisation: Recorded by the intubating anaesthesiologist using the Cormack-Lehane (CL) grading system (I-IV).

Hemodynamic response: Heart rate (HR) and systolic blood pressure (SBP) were recorded at baseline (pre-induction), post-induction (just before laryngoscopy), and at 1- and 5-minute post-intubation.

Complications: Documented intraoperatively and 24 hours postoperatively, including dental trauma, lip or mucosal injury, hypoxia (SpO_2 <92%), esophageal intubation, and postoperative sore throat (verbal rating scale)

Data were analysed using SPSS software version 25.0. Normality was assessed using the Shapiro-Wilk test. Baseline demographic and clinical characteristics were compared between the two cohorts to assess for potential confounding. Categorical variables (success rate, CL grade, complications) were compared using the Chi-square or Fisher's exact test and presented as frequencies (%). Continuous variables (TTI, hemodynamic parameters) were compared using the independent samples t-test or Mann-Whitney U test and presented as mean ± SD or median (IQR). A two-sided p-value of <0.05 was considered statistically significant. The analysis followed an intention-to-observe principle based on the initial device used.

Results:

A total of 220 patients were assessed for eligibility between January 1 and June 30, 2025. Twenty patients were excluded: 12 did not meet the inclusion criteria, 5 refused consent, and 3 had their surgery cancelled. The remaining 200 patients were enrolled and divided into two cohorts based on the laryngoscope used: the Video Laryngoscopy (VAL) cohort (n=100) and the Macintosh Laryngoscopy (ML) cohort (n=100). All patients completed the study protocol and were included in the final analysis. The study flow is presented in Figure no: 1.

The two cohorts were well-matched in terms of age, gender, body mass index (BMI), American Society of Anesthesiologists (ASA) physical status, and airway assessment parameters (Mallampati classification, thyromental distance). There were no statistically significant differences between the groups, indicating comparable baseline profiles as shown in Table no: 1.

The first-attempt intubation success rate was significantly higher in the VAL cohort (98/100, 98%) compared to the Macintosh cohort (84/100, 84%) ($p < 0.001$). The mean time to intubation (TTI) was longer in the VAL cohort (22.8 ± 6.7 seconds) compared to the Macintosh cohort (18.2 ± 5.1 seconds), a statistically significant difference ($p < 0.001$). Glottic visualization, as assessed by the Cormack-Lehane (CL) grade, was superior in the VAL cohort. A CL Grade I view was achieved in 96% of VAL patients, compared to 78% in the Macintosh cohort ($p < 0.001$). The distribution of CL grades is detailed in Table no: 2.

Hemodynamic parameters (heart rate and systolic blood pressure) were comparable between the two cohorts at all measured time points: baseline (pre-induction), post-induction, and at 1- and 5-minute post-intubation. No statistically significant intergroup differences were observed in Table no: 3.

The overall incidence of complications was low in both cohorts. However, postoperative sore throat at 24 hours was significantly less frequent in the VAL cohort (8%) compared to the Macintosh cohort (20%) ($p = 0.010$). Other complications, including minor mucosal injury and transient hypoxia, were infrequent and not significantly different between groups, as shown in Table no: 4.

Figure 1: Patient Flow Diagram

Characteristic	VAL Cohort (n=100)	Macintosh Cohort (n=100)	p-value
Age Mean ± SD	42.3± 12.7	44.1± 11.9	0.289
Gender, n (%)			
Male	58(58%)	55 (55%)	0.782
Female	42(42%)	45 (45%)	
BMI (kg/m²), Mean ± SD	24.8 ± 3.5	25.2 ± 3.8	0.421
ASA Status, n (%)			
I	68 (68%)	65 (65%)	0.658
II	32 (32%)	35 (35%)	
Mallampati Class, n (%)			
I	70(70%)	68(68%)	0.845
II	30 (30%)	32(32%)	
Thyromental Distance (cm), Mean ± SD	7.1 ± 0.9	7.0 ± 0.8	0.391

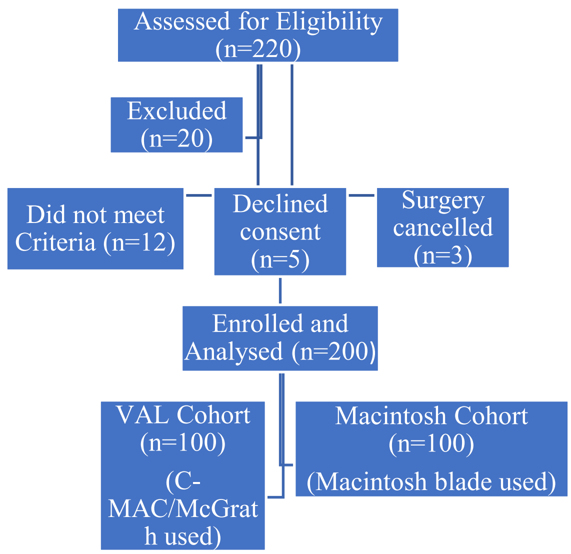

Table 1: Baseline Characteristics of the Study Cohorts

**SD = Standard Deviation; BMI = Body Mass Index; ASA = American Society of Anesthesiologists*

Table 2: Intubation Characteristics and Outcomes

Outcome Measure	VAL Cohort (n=100)	Macintosh Cohort (n=100)	p-value
First Attempt success, n (%)	98 (98%)	84 (84%)	**<0.001**
Time to Intubation (s), Mean ± SD	22.8 ± 6.7	18.2 ± 5.1	**<0.001**
Cormack-Lehane Grade, n (%)			
Grade I	96 (96%)	78 (78%)	
Grade II	4(4%)	18 (18%)	
Grade III	0(0%)	4 (4%)	**<0.001**

Grade IV	0(0%)	0 (0%)	

Table 3: Hemodynamic Parameters (Mean ± SD)

Parameter & Time Point	VAL Cohort (n=100)	Macintosh Cohort (n=100)	p-value
Heart Rate (beats/min)			
Baseline	78.2 ± 9.5	77.8 ± 10.1	**0.765**
Post-Induction	75.4 ± 8.8	76.1 ± 9.3	**0.581**
1 min post-intubation	84.6 ± 11.2	86.3 ± 12.5	**0.301**
5 min post intubation	80.1 ± 9.7	81.0 ± 10.4	**0.516**
Systolic BP (mmHg)			
Baseline	128.5 ± 12.3	126.9 ± 13.6	**0.380**
Post-induction	118.2 ± 11.5	119.8 ± 12.7	**0.343**
1-min post-Intubation	132.8 ± 14.1	135.2 ± 15.3	**0.230**
5 min post intubation	125.4 ± 12.8	127.1 ± 13.5	**0.352**

**SD = Standard Deviation; BP = Blood Pressure*

Table 4: Perioperative Complications

Complication, n (%)	VAL Cohort (n=100)	Macintosh Cohort (n=100)	p-value
Postoperative Sore Throat	8 (8%)	**20 (20%)**	**0.010**
Mucosal/Lip Injury	1(1%)	**3 (3%)**	**0.310**
Dental Trauma	0(0%	**1 (1%)**	**0.316**
Hypoxia (SpO_2 <92%)	2 (2%)	**16 (16%)**	**0.652**
Esophageal Intubation	0 (0%)	1 (1%) *	**0.316**
Number of Attempts >1, n (%)	2 (2%)	16 (16%)	**<0.001**

**This patient was successfully intubated on the second attempt.*

Discussion

This prospective comparative study evaluated the performance of video-assisted laryngoscopy (VAL) versus conventional Macintosh laryngoscopy in adult patients with normal airways undergoing elective surgery. The principal findings indicate that the use of VAL was associated with a significantly higher first-attempt intubation success rate and superior glottic visualization, albeit with a slightly longer intubation time, compared to the Macintosh laryngoscope. Furthermore, VAL use was correlated with a lower incidence of postoperative sore throat. These results contribute to the growing body of evidence supporting the utility of VAL in routine airway management.

The most salient finding of this study is the markedly higher first-attempt success rate with VAL (98%) compared to Macintosh laryngoscopy (84%). This difference is clinically significant, as a successful first attempt is a cornerstone of safe airway management, minimizing the risk of hypoxia, airway trauma, and hemodynamic instability associated with multiple attempts.[13] The observed success rate for VAL aligns with findings from recent meta-analyses and randomized trials, which consistently report first-attempt success rates above 95% for video laryngoscopy in patients with both normal and anticipated difficult airways.[14]

The superior success rate is inextricably linked to the enhanced glottic view provided by VAL. In our study, a Cormack-Lehane (CL) Grade I view was achieved in 96% of patients in the VAL cohort, compared to 78% in the Macintosh cohort. This dramatic improvement in visualization is the primary mechanistic advantage of VAL. By providing an indirect, wide-angle view from the tip of the blade, VAL effectively circumvents anatomical obstacles such as a large tongue or anterior larynx, which commonly obscure the view during direct laryngoscopy.[15]

Our findings reinforce the established principle that a better glottic view directly facilitates successful and atraumatic tube placement. Our data revealed a statistically longer mean intubation time with VAL (22.8 seconds) compared to Macintosh laryngoscopy (18.2 seconds). This finding is consistent with several studies, particularly those involving operators experienced in direct laryngoscopy but with a developing learning curve for VAL. [16] .

The additional time may be attributed to the process of aligning the indirect video image with hand-eye coordination, manipulating the stylet-shaped endotracheal tube within the optimized view, and occasionally needing to retract the blade slightly to advance the tube past the vocal cords—a recognized phenomenon known as "non-line of sight" tube delivery .[17] However, it is crucial to contextualize this difference: an increase of approximately 4-5 seconds is unlikely to be clinically detrimental in elective, pre-oxygenated patients with normal airways. Furthermore, this time difference may diminish with greater operator familiarity and proficiency with VAL.

A key finding was the comparable hemodynamic response between the two cohorts. Heart rate and systolic blood pressure fluctuations at 1- and 5-minute post-intubation were similar. This suggests that, despite the potential for longer laryngoscopy time with VAL, the stimulus provided by the two techniques is physiologically equivalent in this patient population. This finding contradicts some earlier studies that suggested VAL might cause less hemodynamic stress due to reduced lifting forces .[18] Still, it aligns with more recent literature focusing on standard laryngoscopy durations.[19]

Regarding complications, the significantly lower incidence of postoperative sore throat in the VAL group (8% vs. 20%) is a noteworthy advantage. Sore throat is a common minor morbidity that adversely affects patient satisfaction and recovery. The reduced incidence is likely multifactorial, stemming from the superior view requiring less forceful lifting and blade leverage, fewer intubation attempts, and potentially less trauma during tube insertion under direct visual guidance on the screen . [20] The rates of other minor complications, such as mucosal injury and transient hypoxia, were low and similar between groups, underscoring the overall safety of both techniques in experienced hands.

The results of this study have practical implications for clinical practice in settings similar to ours. While the Macintosh laryngoscope remains a reliable and cost-effective tool, the observed benefits of VAL—particularly its higher first-attempt success and reduced patient discomfort—support its consideration as a valuable first-line device for elective surgeries, even in patients with normal airways. The argument for adopting VAL more broadly is strengthened by its known role as a rescue device for difficult airways; familiarity gained through routine use ensures greater skill and confidence when faced with an unanticipated difficult intubation. [21]

Therefore, integrating VAL into routine practice can serve a dual purpose: improving outcomes for straightforward cases and building essential expertise for managing critical scenarios.

The strengths of this study include its prospective design, predefined sample size calculation, blinded outcome assessment to minimize observer bias, and the use of experienced operators for both techniques, which provides a realistic comparison of device performance under optimal conditions.

Limitations

However, several limitations must be acknowledged. First, as an observational comparative study, the allocation to VAL or Macintosh laryngoscopy was based on clinical practice rather than randomisation. Although our baseline characteristics showed no significant differences, residual confounding (e.g., subtle, unmeasured patient factors influencing device choice) cannot be entirely ruled out. Second, the study was conducted at a single centre with a specific patient demographic (ASA I-II, normal airways), which may limit the generalisability of the findings to other populations, such as obese patients or those with comorbidities. Third, we used two VAL devices (C-MAC and McGrath). Although both are standard video laryngoscopes, subtle differences in blade design and handling may introduce variability, reflecting real-world practice. Finally, the economic aspects, including device cost and maintenance, were not evaluated; however, they are important considerations in resource-constrained settings.

Conclusion

In this comparative study of patients with normal airways undergoing elective surgery, the clinical use of video-assisted laryngoscopy was associated with a significantly higher first-attempt intubation success rate and superior glottic visualization compared to conventional Macintosh laryngoscopy, despite a modest increase in intubation time. VAL was also correlated with a lower incidence of postoperative sore throat. These findings suggest that VAL is a safe and effective tool for routine airway management. While the Macintosh laryngoscope retains its place in the anaesthesiologist's armamentarium, the demonstrated advantages of VAL support its increasing adoption as a first-choice device in elective settings, potentially improving patient outcomes and preparing clinicians for more challenging airway scenarios. Future research should focus on long-term cost-benefit analyses and the impact of routine VAL use on skill retention for direct laryngoscopy

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