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Original Research Article

Comparison of (DIRECT) Macintosch, (Indirect) King Vision Video and Mcgrath Mac Video Laryngoscope in Assessment of Ease of Intubation in Adult Patients during Routine Intubations

Mansi Bhati[1], Priya Verma[2], Anil Kumar Bhiwal[3], Anoushka Shukla[4], Hiralben Sunilbhai Maheta[5], Muskan Arora[6]

[1,4,5,6]Junior Resident, Department of anaesthesia, Pacific Institute of Medical Sciences, Umarda, Udaipur, Rajasthan, India

[2]Assistant Professor, Department of anaesthesia, Pacific Institute of Medical Sciences, Umarda, Udaipur, Rajasthan, India

[3]Professor, Department of Anaesthesiology, Pacific Institute of Medical Sciences, Umarda, Udaipur, Rajasthan, India

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Corresponding author: Dr. Anil Kumar Bhiwal

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Abstract

Background: Laryngoscopy and intubation can trigger powerful reflexes that cause significant cardiovascular changes which leads to myocardial ischemia, heart failure, elevated intracranial pressure. Video-laryngoscope provides better visualization of airway making orotracheal intubation easy and minimal hemodynamic changes.

Aims and Objectives: The aims of this study was to compare the time taken for endotracheal intubation and hemodynamic stability when used Macintosh laryngoscope or video-layngoscope (Mac-Grath MAC and King Vision).

Materials and Methods: After obtaining approval from Institutional research Ethical board this prospective, randomized study was conducted on 135 patients aged 18-80, either sex, Mallampati grade 1 or 2, ASA physical status I- III. Patients were randomly divided into three group Group D (n=45): Intubated using the Direct Macintosh Laryngoscope with blade size 3 or 4, Group K (n=45): Intubated using the King Vision Video Laryngoscope with a channeled blade, Group M (n=45): Intubated using the McGrath MAC Video Laryngoscope with blade size 3 or 4. Time taken in intubation, number of attempt, hemodynamic parameters were recorded.

Results: Group D has the significant less intubation time (seconds) (12.35±2.95), as compared to Group M (16.38±3.62) and Group K (20.12±3.75 seconds) $p<0.0001$. Group M achieved the best visualization with 73.3% Grade I views, compared to 60% in Group K and 44.4% in Group D($p=0.015$).

Conclusion: The time required for intubation was increased in King Vision and McGrath MAC compared to the direct Macintosh laryngoscope but offer better glottic visualization and improve first-attempt intubation success compared to the conventional Macintosh laryngoscope in routine airway management.

Keywords: Intubation, King Vision, McGrath MAC, Macintosh laryngoscope.

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Introduction

Airway management is one of the most fundamental and critical responsibilities of an anaesthesiologist. Securing the airway ensures adequate oxygenation, ventilation, and delivery of anaesthetic gases during surgical procedures. [1]

Traditionally, direct laryngoscopy using the Macintosh laryngoscope has been the most widely used technique for tracheal intubation for several decades. This technique provides visualization of the vocal cords and facilitates endotracheal tube placement. Due to its simplicity, reliability, and cost-effectiveness, the Macintosh laryngoscope has remained the standard device in most healthcare settings. It is also considered the benchmark against which newer airway devices are compared. [2]

Successful intubation requires alignment of the oral, pharyngeal, and laryngeal axes, which often necessitates optimal patient positioning and adequate muscle relaxation. In some patients, especially those with anatomical variations, obesity, and limited neck mobility, or restricted mouth opening, visualization of the glottis may be

difficult. Furthermore, direct laryngoscopy requires significant lifting force to obtain an adequate view, which can stimulate sympathetic responses leading to tachycardia, hypertension, and arrhythmias. In high-risk patients, such haemodynamic responses may increase perioperative morbidity. [3]

Video laryngoscopy has emerged as an important development in airway management. Video laryngoscopes use miniature cameras and light sources at the blade tip to provide an indirect view of the glottis on a screen. This eliminates the need for alignment of airway axis and often provides a better view of laryngeal structures compared to direct laryngoscopy. Video laryngoscopes have shown particular usefulness in anticipated and unanticipated difficult airways. [4]

The King Vision device features an integrated LCD screen and uses disposable channeled blades that guide the endotracheal tube toward the glottic opening. This design may reduce the need for additional adjuncts like stylets. However, the bulkiness of the blade and fixed screen position may sometimes limit manoeuvrability, especially in patients with restricted mouth opening. [5]

The McGrath MAC video laryngoscope is designed to resemble the conventional Macintosh blade while incorporating video capability. It allows both direct and indirect visualization and uses disposable blades of different sizes. The adjustable screen allows flexibility in viewing angles, and its slimmer blade profile may allow easier insertion compared to some other video laryngoscopes. These design differences may influence intubation success rate, time required for intubation, and overall ease of use. [6]

Although video laryngoscopes have shown promising results in simulated and difficult airway scenarios, their role in routine airway management is still being evaluated. [7] Therefore this study was planned to compare the effectiveness of direct Macintosh laryngoscopy with King Vision and McGrath MAC video laryngoscopes in adult patients undergoing routine intubation.

Materials and Methods

After obtaining approval from Institutional research Ethical board (STU/IEC/2024/386) and written informed consent from the patients, this prospective, randomized study was conducted on 135 patients aged 18-80, either sex, Mallampati grade 1 or 2, ASA physical status I- III, BMI between 18.5 to 34.9 kg/m and patients undergoing general anaesthesia. (Figure 1) Patients were excluded who refuse to participate, mouth opening less than 3 cm, limited cervical extension (greater than 80°), short thyromental distance (less than 4 cm), maxillofacial trauma, patients with known history of difficult intubation or having oxygen saturation less than 92% after bag and mask ventilation or with known risk of aspiration.

Sample size calculation: Sample size has been calculated using software Epi info TM 7 with assumption of alpha error of 5% i.e. confidence level 95% and beta error to be 20% i.e. power of error to be 80%. SD= (Standard deviation of time for intubation = (4.44) and d= difference in mean of time for intubation score=6.74.

A total of 135 patients were enrolled, with 45 patients randomly allocated to each of the three study groups using a random number table and sealed envelope technique:

1. Group D (n=45): Intubated using the Direct Macintosh Laryngoscope with blade size 3 or 4.
2. Group K (n=45): Intubated using the King Vision Video Laryngoscope with a channeled blade.
3. Group M (n=45): Intubated using the McGrath MAC Video Laryngoscope with blade size 3 or 4

All enrolled patients underwent a comprehensive preoperative evaluation including detailed medical history, Physical examination and airway assessment.

On arrival in the operating room, standard monitoring including electrocardiography (ECG), non-invasive blood pressure (NIBP), and pulse oximetry (SpO_2) was applied. Baseline hemodynamic parameters were recorded and an intravenous line was secured.

All patients were preoxygenated with 100% oxygen for 3–5 minutes. Premedication was administered with intravenous ondansetron 0.1 mg/kg, glycopyrrolate 0.004mg/kg and fentanyl 2 µg/kg. Induction of general anaesthesia was carried out using intravenous propofol 2 mg/kg, and intravenous succinylcholine 1.5 mg/kg to facilitate endotracheal intubation.

Following successful intubation, correct placement of the endotracheal tube was confirmed by capnography and bilateral chest auscultation. Anaesthesia was maintained with a mixture of oxygen and nitrous oxide (50:50) along with sevoflurane, and further neuromuscular blockade was achieved with intravenous atracurium 0.5 mg/kg as a loading dose, followed by intermittent doses of 0.1 mg/kg as required.

Primary Outcome Measures: The primary outcomes of the study were focused on evaluating the efficiency and success of endotracheal intubation:

Intubation Time: Defined as the duration (in seconds) from the moment the laryngoscope blade

passes beyond the upper incisors until its removal after successful placement of the endotracheal tube. This parameter reflects the ease and speed of intubation with the respective device or technique.

Number of Intubation Attempts: The total number of attempts required to achieve successful tracheal intubation was recorded. Each insertion of the laryngoscope blade into the oral cavity was considered a separate attempt.

Failed Intubation: Intubation was considered a failure if any of the following conditions were met:

- Inability to visualize the glottic opening adequately.
- Failure to successfully pass the endotracheal tube into the trachea within 90 seconds.
- Oxygen desaturation with SpO_2 falling below 89%.
- Development of significant bradycardia, defined as heart rate <50 beats per minute.

Secondary Outcome Measures: Secondary outcomes were assessed to provide additional insights into intubation conditions, physiological responses, and overall patient safety:

Assessment of Laryngeal View: The glottic visualization was graded using the Modified Cormack–Lehane (CL) grading system.

Hemodynamic Parameters: Parameters were recorded to assess the physiological response to laryngoscopy and intubation such as Heart Rate (HR), Systolic Blood Pressure (SBP) Diastolic Blood Pressure (DBP)**,** Peripheral Oxygen Saturation (SpO_2) at Baseline (before induction), After induction of anaesthesia**,** 1 minute after intubation and 5 minutes after intubation.

Requirement of Intubation Adjuncts: The need for additional maneuvers or devices to facilitate intubation was documented, including: Use of a stylet, Application of BURP maneuver (Backward, Upward, and Rightward Pressure) or use of a combination of both stylet and BURP maneuver. This parameter reflects the difficulty level encountered during intubation.

Postoperative Complications: Patients were monitored for any airway-related or procedure-related complications, such as: Sore throat, Hoarseness of voice, Airway trauma (e.g., bleeding, mucosal injury), Laryngospasm. These outcomes help assess the safety profile of the intubation technique.

Overall Intubation Success Rate: Defined as the proportion of patients in whom successful endotracheal intubation was achieved within the defined criteria (≤90 seconds and without meeting failure conditions). This serves as a key indicator of the effectiveness of the technique.

Results

Comparison of demographic data include age, BMI, sex distribution, and ASA physical status classification were found to comparable in all three groups. (all p-values > 0.05). Table 1 Preoperative airway evaluation results including Mallampati classification and mouth opening measurements were found to be comparable in all three groups. ($p>0.05$) All participants in all three groups had mouth opening ≥3 cm.

Table 2 shows Group D has the fastest intubation (mean 12.35±2.95 seconds), followed by Group M (16.38±3.62 seconds) and Group K being slowest (20.12±3.75 seconds). The highly significant one-way ANOVA result ($F=88.47$, $p<0.0001$) indicates substantial differences between groups.

Table 3 compares the number of intubation attempts among the three study groups. The majority of patients in all groups were successfully intubated on the first attempt, with Group M showing the highest first-attempt success rate (91.1%), followed by Group K (84.4%) and Group D (80.0%). However, the difference in first-attempt success rates among the three groups was not statistically significant ($p = 0.312$).

Table 4 shows glottic visualization quality using the Cormack-Lehane grading system. Group M achieved the best visualization with 73.3% Grade I views, compared to 60% in Group K and 44.4% in Group D. The statistically significant difference ($p=0.015$) indicates superior laryngeal exposure with the McGrath technique.

Baseline hemodynamic like HR, BP values were comparable ($p=0.214$), but significant differences in HR emerged at 1 minute post-intubation ($p=0.009$), with Group D showing the highest heart rate (89.8±6.9 bpm) compared to Groups K and M. Values converged again by 5 minutes. Similarly at 1 minute post-intubation, Group D exhibited significantly higher systolic pressure (132.7±9.8 mmHg) compared to Groups K and M ($p=0.003$), suggesting greater hemodynamic stress response with this technique. (Figure 2 A&B)

Figure 3 shows comparison of use of stylet, BURP, and combination techniques; Group D shows the highest use of stylet, BURP, and combination techniques; Group K shows minimal use; and Group M shows intermediate use. A statistically significant difference is observed for stylet use and combination use, while BURP manoeuvre alone is not significant.

Group D consistently shows the highest incidence for all complications, with Sore Throat (12 cases) being the most notable and statistically significant ($p=0.05$). The other complications (Hoarseness, Bronchospasm/Laryngospasm, Mucosal Damage/

Bleeding) occur less frequently and lack statistical significance (p>0.05). All groups achieved a 100% success rate with no failures, resulting in p-values of 1.000 for both metrics.

Table 1: Comparison of demographic profile among three groups.

Parameter	Group D (n=45)	Group K (n=45)	Group M (n=45)	p-value
Age (years)	48.2 ± 17.9	49.8 ± 18.7	44.6 ± 19.3	0.321
BMI (kg/m²)	26.4 ± 4.8	26.8 ± 4.3	26.3 ± 5.1	0.852
Sex – Male / Female	22 (48.9%) / 23	25 (55.6%) / 20	27 (60%) / 18	0.482
ASA I / II / III	11 / 17 / 17	9 / 19 / 17	13 / 14 / 18	0.719

Table 2: Comparison of Intubation Time (seconds) among three groups

Group	Mean ± SD	Median (IQR)	Range
D	12.35 ± 2.95	12.0 (10.3–14.5)	5.8–17.8
K	20.12 ± 3.75	19.7 (17.3–22.4)	13.3–29.6
M	16.38 ± 3.62	15.9 (14.2–18.5)	7.6–26.1

One-way ANOVA: F = 88.47, p < 0.0001

Table 3: Comparison of Number of Intubation Attempts among three groups

Attempts	Group D n (%)	Group K n (%)	Group M n (%)	p-value
1	36 (80.0)	38 (84.4)	41 (91.1)	0.312
2	9 (20.0)	7 (15.6)	4 (8.9)	—

Table 4: Comparison of Modified Cormack-lehane grading Distribution among three groups

Grade	Group D (n=45)	Group K (n=45)	Group M (n=45)	p-value
I	20 (44.4)	27 (60.0)	33 (73.3)	0.015
II	13 (28.9)	11 (24.4)	8 (17.8)	—
III	12 (26.7)	7 (15.6)	4 (8.9)	—
IV	0	0	0	-

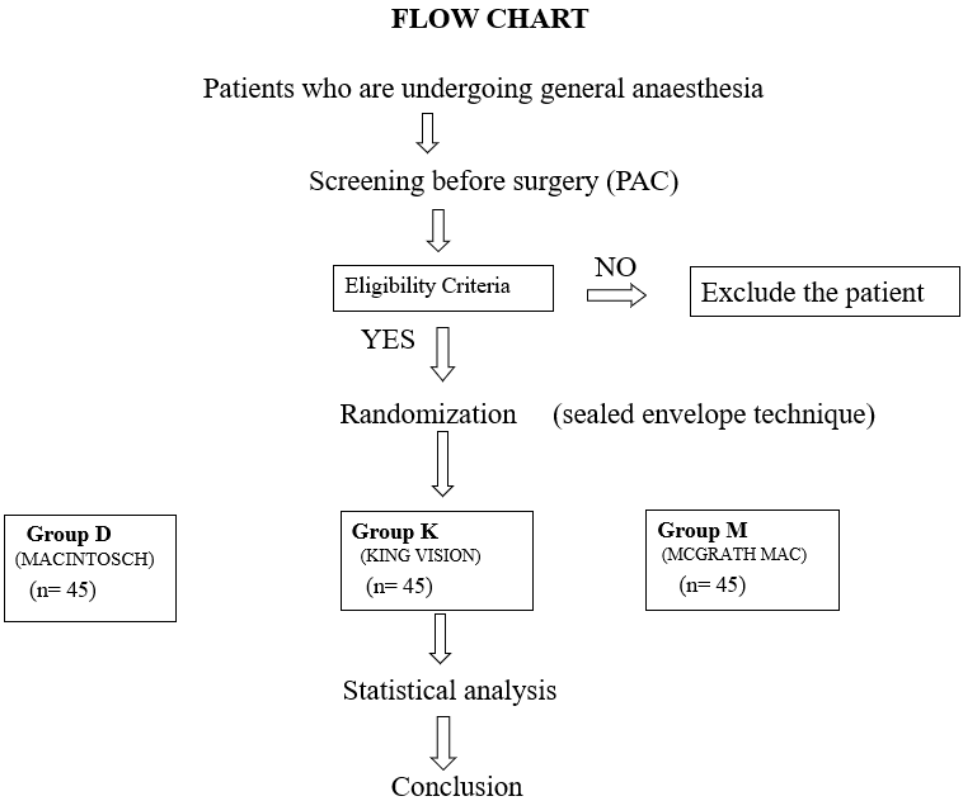

Figure 1: Consort Flow Diagram showing allocation of patients at different stages of study.

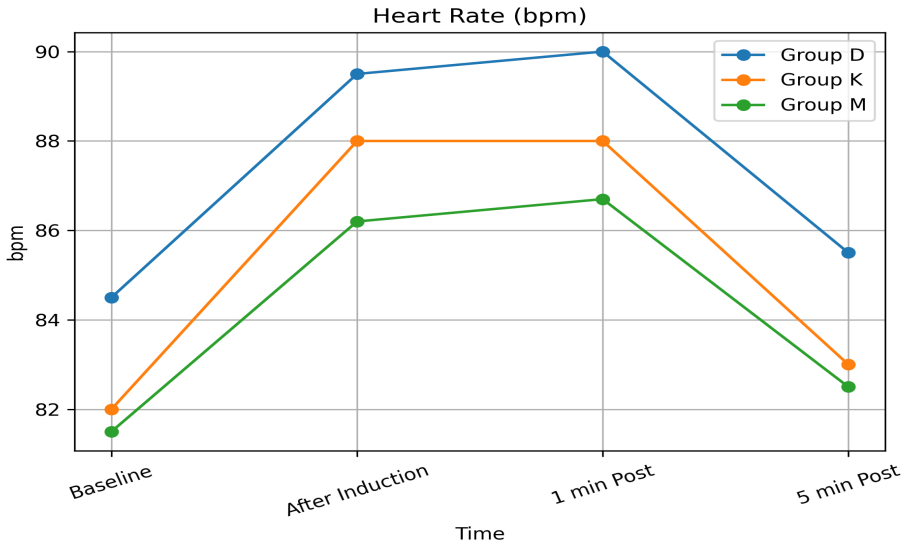

Figure 2 A: Comparison of heart rate at different time interval in all groups.

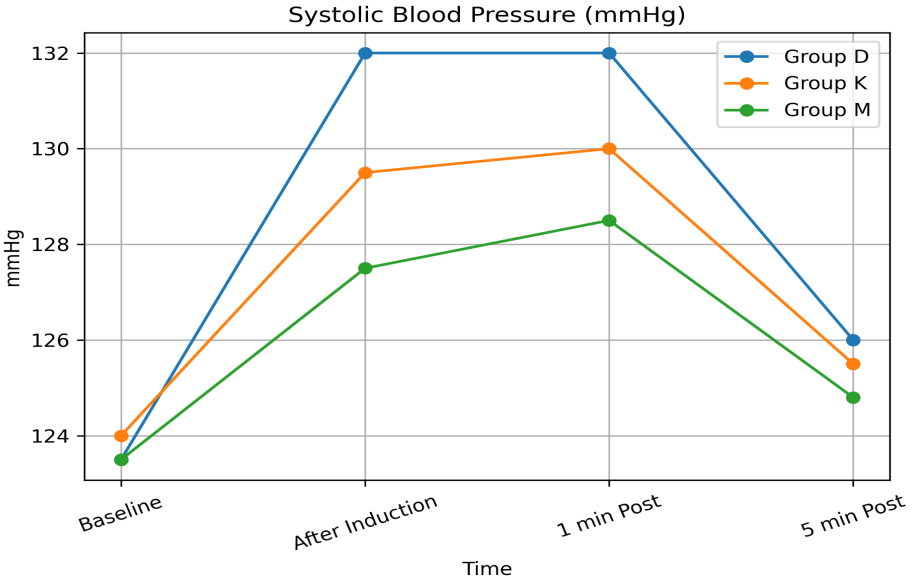

Figure 2 B: Comparison of systolic blood pressure at different time interval in all groups.

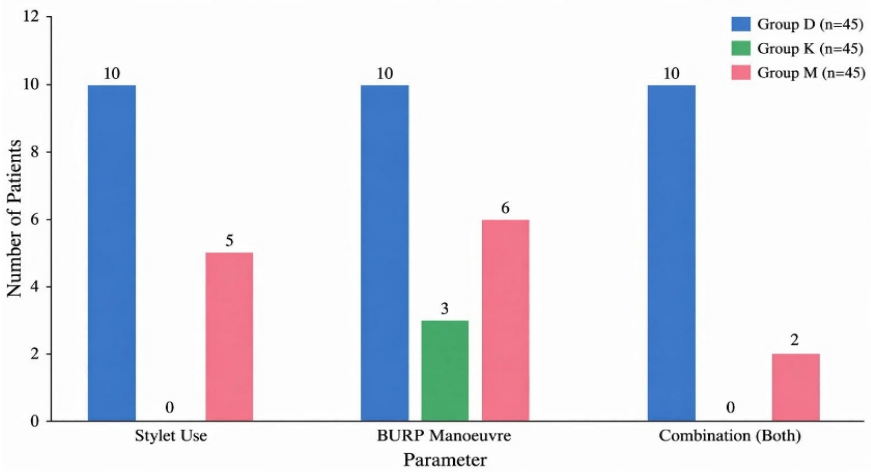

Figure 3: Use of Stylet and BURP Maneuver Across Laryngoscopes (n=45 per group)

Discussion

The present study compared the performance of Macintosh direct laryngoscopy, King Vision video laryngoscope, and McGrath MAC video laryngoscope in patients undergoing elective surgery with normal airway anatomy.

Our study found, all three groups were comparable in terms of age, BMI, sex distribution, and ASA physical status, with no statistically significant differences ($p > 0.05$) which is similar to other studies. (8-13)

Our results demonstrated that Group D (Macintosh) achieved the fastest mean intubation time (12.35 ± 2.95 seconds), significantly quicker than both video laryngoscope groups, with Group K being slowest (20.12 ± 3.75 seconds) and Group M intermediate (16.38 ± 3.62 seconds) ($p < 0.0001$). This finding aligns with Kiran S DS et al who reported significantly longer intubation times with C-MAC video laryngoscope (29.5 ± 19.12 seconds) compared to Macintosh (12.22 ± 9.25 seconds) in patients with normal airways. [12] Similarly, Panwar N et al. observed prolonged intubation time with GlideScope (18.50 seconds) versus Macintosh (11.76 seconds) in routine airway management. [11]

However, our results contrast with Adamu B et al, who found shorter intubation times with McGrath MAC (22.8 ± 7.1 seconds) compared to McCoy direct laryngoscope (29.0 ± 12.3 seconds) in patients with predicted difficult airways.(9) This discrepancy likely reflects the different patient populations studied—our cohort had normal airways (Mallampati I/II), whereas Adamu B et al. studied patients with at least two difficult airway predictors where video laryngoscopy's superior visualization confers greater time advantage. [9] Sukmono B et al also reported faster intubation with a self-assembled modified Macintosh video laryngoscope (63 seconds) compared to McGrath MAC (74 seconds), though both times were considerably longer than our observations, possibly due to the low-resource setting and device construction factors. [10]

The intermediate performance of McGrath MAC compared to King Vision may be attributed to its Macintosh-like blade design, which Golditz T et al found combines familiar handling with video advantages, yielding faster time-to-intubate than hyperangulated blades during simulated cardiopulmonary resuscitation. [14]

Our study found high first-attempt success rates across all though the difference did not reach statistical significance ($p = 0.312$). This contrasts with Alvis BD et al, who reported significantly higher first-attempt success with McGrath MAC (100%) compared to King Vision (77%) in patients with predicted easy airways ($P < 0.01$).The discrepancy may relate to operator experience—Alvis BD et al. restricted operators to those with limited video laryngoscopy experience (<10 uses), whereas our study likely involved more experienced practitioners, minimizing device-related performance gaps. [13]

Aziz MF et al demonstrated significantly higher first-attempt success with C-MAC video laryngoscope (93%) compared to direct laryngoscopy (84%) in patients with predicted difficult airways ($P = 0.026$). [15] Similarly, Jungbauer A et al reported 99% success with video laryngoscopy versus 92% with direct laryngoscopy in patients with Mallampati III/IV ($P = 0.017$). [16] Our findings in normal airways suggest that when anatomical difficulty is absent, the success rate advantage of video laryngoscopy diminishes, supporting the notion that direct laryngoscopy remains efficient for routine cases, as suggested by Kiran S DS et al. [12]

The most pronounced advantage of video laryngoscopy in our study was glottic visualization, with Group M achieving 73.3% Cormack-Lehane Grade I views compared to 60% in Group K and 44.4% in Group D ($p = 0.015$). This finding is consistent with the broader literature. Gangishetty A et al. (2024) reported significantly improved Cormack-Lehane grades with McGrath video laryngoscope compared to Macintosh in nasotracheal intubation for faciomaxillary surgeries ($p = 0.002$).(8) Adamu B et al. (2023) similarly found superior visualization with McGrath MAC, with 94.6% achieving Cormack-Lehane ≤IIa versus 28.9% with McCoy ($p < 0.001$), alongside better percentage of glottic opening scores. [9]

Dharanindra M et al demonstrated that King Vision video laryngoscope provided superior visualization in ICU settings, contributing to higher first-pass success rates (95.7% vs. 81.4%).(17) Our results support Cierniak M et al, who found that technical specifications significantly impact clinical performance, with devices offering optimal viewing angles and illumination providing superior visualization. [18] The McGrath MAC's performance in our study may reflect its Macintosh-like blade design combined with video capability, which Golditz T et al. (2024) found offers superior visualization while maintaining familiar handling characteristics. [14]

Our study revealed significant differences in hemodynamic stress responses between groups. At 1 minute post-intubation, Group D exhibited significantly higher heart rate, systolic blood pressure and diastolic blood pressure compared to Groups K and M. These differences resolved by 5 minutes post-intubation. This finding suggests that video laryngoscopy, particularly McGrath MAC,

attenuates the sympathetic stress response associated with laryngoscopy and intubation. However, Pournajafian AR et al found no significant differences in hemodynamic responses between GlideScope and Macintosh laryngoscopes, concluding that the intubation process itself rather than the specific device drives sympathetic stimulation. [19] The discrepancy may relate to our study's larger sample size (n=135 vs. n=60) or differences in anaesthetic technique. Alternatively, the faster intubation time with Macintosh in our study might paradoxically increase hemodynamic response due to more forceful manipulation required, whereas the gentler, visualization-guided approach with video laryngoscopy reduces tissue stimulation despite longer procedural time.

Adamu B et al reported more stable hemodynamics with McGrath MAC compared to McCoy, which aligns with our finding that Group M demonstrated the most favorable hemodynamic profile. [9] The reduced hemodynamic response with video laryngoscopy may reflect decreased need for optimizing manoeuvres and lower lifting force application, as demonstrated by Gangishetty A et al, who found reduced lifting force ($p = 0.002$) and lower lip trauma rates with McGrath compared to Macintosh. [8]

Our calculated Intubation Difficulty Score (IDS) revealed significantly lower difficulty with McGrath MAC (mean 0.38 ± 0.65) compared to Macintosh (1.00 ± 0.90) ($p = 0.001$), with 71.1% of Group M patients achieving IDS = 0 (no difficulty) versus 37.8% in Group D. This trend aligns with Adamu B et al, who reported markedly lower IDS scores with McGrath MAC (54% score 0) compared to McCoy (5.4% score 0) ($p < 0.001$). [9]

The requirement for adjuncts followed a similar pattern, with Group D requiring stylet use in 44.4% of cases compared to 17.8% in Group K and 11.1% in Group M ($p = 0.015$), and BURP manoeuvre needed in 22.2% (Group D) versus 11.1% (Group K) and 8.9% (Group M) ($p = 0.001$). These findings mirror Kiran S DS et al, who reported increased stylet usage (12 vs. 1 patient) and BURP manoeuvre requirements (8 vs. 1 patient) with C-MAC compared to Macintosh.[12] Ertürk T et al similarly found that 15 patients in the Macintosh group required facilitating manoeuvres compared to only 3 in the Airtraq group ($P < 0.05$). [20]

The reduced need for adjuncts with video laryngoscopy reflects the superior visualization enabling more straightforward tube delivery, as noted by Jungbauer A et al, who reported reduced need for optimizing manoeuvres with video laryngoscopy (0.5 ± 0.7 vs. 1.2 ± 1.3, $P < 0.001$). [16] However, in our study, the higher adjunct use with Macintosh did not translate into prolonged intubation time, suggesting that experienced operators can compensate for poorer visualization with technical manoeuvres efficiently in normal airways.

Our study shows that postoperative airway complications were highest with Direct Macintosh and lowest with McGrath MAC, with King Vision showing intermediate results. Sore throat was most common in the Macintosh group, while hoarseness, mucosal injury, and bronchospasm were also more frequent with direct laryngoscopy, though not statistically significant. McGrath MAC showed the least complications overall. These findings align with Gangishetty A et al, who reported reduced airway trauma and better glottic visualization with McGrath despite longer intubation times. [8] Similarly, Adamu B et al found fewer complications, improved success rates, and less airway manipulation with McGrath compared to direct laryngoscopy. The higher complication rates with Macintosh may be due to greater lifting force and airway manipulation, whereas video laryngoscopes provide better visualization with less trauma.

This study has certain limitations: Being a single-centre study, the findings may have limited generalizability. The sample size, though adequate, was relatively small to detect minor differences or rare complications. Patients with anticipated difficult airways were excluded; hence, the results cannot be applied to such cases.

Conclusion

The present study demonstrate that while all three devices are effective for routine airway management, notable differences exist in terms of ease of intubation and associated parameters. Video laryngoscopes, King Vision and McGrath MAC, offer better glottic visualization and improve first-attempt intubation success compared to the conventional Macintosh laryngoscope in routine airway management. The time required for intubation was increased in King Vision and McGrath MAC compared to the direct Macintosh laryngoscope. The King Vision facilitates smoother tube delivery due to its channeled design, while the McGrath MAC combines improved visualization with the familiarity of a Macintosh-type blade, making it easy to adopt in clinical practice.

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