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King Vision Video Laryngoscope versus Macintosh Laryngoscope for Endotracheal Intubation in Elective Surgery: A Prospective Randomized Comparative Study.

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Abstract

Background: Laryngoscopy and tracheal intubation trigger sympathetic stimulation that may produce transient tachycardia and hypertension. Video laryngoscopy improves laryngeal visualization without requiring the same degree of alignment of the oral, pharyngeal, and laryngeal axes as direct laryngoscopy, but its effect on intubation difficulty and peri-intubation haemodynamics remains variable across studies. The study is designed to compare the King Vision Video Laryngoscope with the Macintosh laryngoscope for ease of tracheal intubation, assessed by the Intubation Difficulty Score, and for changes in haemodynamic variables during elective general anaesthesia. ***Methods:*** This prospective randomized comparative study included 101 adults aged 18-60 years with American Society of Anesthesiologists physical status I or II and Mallampati class I or II who underwent elective surgery requiring endotracheal intubation. Patients were randomized to Macintosh laryngoscopy (MCL, n=51) or King Vision video laryngoscopy (KVVL, n=50). A standardized anaesthetic technique was used. Intubation difficulty was graded using the seven-component Intubation Difficulty Score. Heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure, and oxygen saturation were recorded before induction, after induction, and at 1, 3, and 5 minutes. Between-group p values are reported as presented in the source study. ***Results:*** The groups were comparable in sex, age distribution, body mass index, ASA class, and Mallampati grade. The mean total Intubation Difficulty Score was lower with KVVL than with MCL (0.36 ± 0.80 vs 0.84 ± 1.28; p=0.027). Better glottic exposure contributed to this difference (N4: 0.08 ± 0.27 vs 0.38 ± 0.53; p=0.001), and external laryngeal pressure was required less often with KVVL (N6: 0 vs 0.16 ± 0.37; p=0.003). Heart rate, systolic blood pressure, and oxygen saturation did not differ significantly between groups at the reported time points. Diastolic blood pressure and mean arterial pressure were higher in the KVVL group at baseline and remained higher during follow-up. ***Conclusion:*** King Vision video laryngoscopy reduced overall intubation difficulty, mainly through improved glottic visualization and less need for external laryngeal manipulation. It did not demonstrate a clear advantage over Macintosh laryngoscopy in attenuating the cardiovascular response to intubation in this study.

Keywords: airway management; endotracheal intubation; haemodynamic response; Intubation Difficulty Score; King Vision; Macintosh laryngoscope; video laryngoscopy.

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INTRODUCTION

Endotracheal intubation is a routine component of general anaesthesia, but the act of laryngoscopy and passage of the tracheal tube is physiologically active rather than neutral. Mechanical stimulation of the tongue base, supraglottic tissues, larynx, and trachea activates autonomic reflexes and is commonly followed by a short-lived increase in heart rate and arterial pressure [1-5]. These changes are usually well tolerated in healthy adults, although they can be clinically important in patients with limited cardiovascular or cerebrovascular reserve [3-5,24].

The Macintosh laryngoscope remains a familiar and widely used device for direct laryngoscopy. Its use depends on obtaining a direct line of sight to the glottis, which generally requires positioning of the head and neck and application of lifting force to displace the tongue and related soft tissues [1,2,23]. Difficult or failed laryngoscopy can increase the number of airway manipulations and the possibility of dental, mucosal, and hypoxaemic complications [13,18,19,22,25,26].

Video laryngoscopes were developed to improve laryngeal visualization by transferring the image from a camera near the blade tip to an external display. This design reduces dependence on direct alignment of the airway axes and may improve

the glottic view, particularly when conventional direct laryngoscopy is difficult [8,13,19-22,30]. However, a better view does not always translate into faster tube delivery or a smaller haemodynamic response. Differences in blade geometry, tube channel design, operator familiarity, and the stimulation produced by tracheal tube passage can influence the overall response [9,10,12,15-17,21].

The King Vision Video Laryngoscope is an indirect video laryngoscope with a reusable display and disposable blades, including a channelled blade that guides the endotracheal tube toward the glottis. Previous investigations have reported favourable laryngeal views and useful intubating conditions with this device, although results differ according to airway difficulty, comparator device, and clinical setting [6,7,14,27-29]. Evidence from larger comparative studies and systematic reviews also supports a general advantage of video laryngoscopy for glottic visualization and first-attempt success, while showing considerable variation in intubation time and haemodynamic outcomes [27,30].

The present study was therefore undertaken in adults with an apparently normal airway who were scheduled for elective surgery. The primary practical question was whether King Vision video laryngoscopy made intubation easier than conventional Macintosh laryngoscopy when difficulty was assessed with a structured Intubation Difficulty Score. A second objective was to compare peri-intubation heart rate, blood pressure, mean arterial pressure, and oxygen saturation between the two techniques.

MATERIALS AND METHODS

Study design and setting

A prospective randomized comparative study was conducted at Narayana Hrudayalaya, Bommasandra, Bangalore. Institutional review and ethics approval were obtained before recruitment, and written informed consent was taken from each participant. The study compared tracheal intubation performed with a Macintosh laryngoscope and with the King Vision Video Laryngoscope in patients undergoing elective surgery under general anaesthesia.

Participants and eligibility

Adults aged 18-60 years of either sex were eligible when they had American Society of Anesthesiologists physical status I or II, Mallampati class I or II, and were scheduled for elective surgery requiring general anaesthesia with endotracheal intubation. Patients were excluded for upper airway pathology such as maxillofacial fracture or tumour, cervical spine disease, anticipated difficult intubation including Mallampati class III or IV, emergency surgery, obesity, pregnancy, or ASA physical status III or IV. The discussion section of the source thesis specified obesity as body mass index above 30 kg/m^2.

Sample size and randomization

The sample size was derived from an earlier comparison in which first-attempt success was 97% with King Vision and 86% with Macintosh laryngoscopy [6]. Using a two-proportion calculation with a two-sided alpha of 0.05 and 80% power, a total sample of 101 patients was selected. One day before surgery, patients were allocated by a computer-generated random number table to the Macintosh group (MCL) or the King Vision group (KVVL). The final groups contained 51 and 50 patients, respectively.

Preoperative assessment and anaesthetic technique

A preanaesthetic evaluation was completed on the day before surgery. Clinical history, physical examination, airway assessment, height, weight, and body mass index were recorded, together with a history of previous difficult intubation when present. Patients received standardized premedication and remained fasting overnight. In the operating room, intravenous access was established and routine monitoring included electrocardiography, non-invasive blood pressure, heart rate, and pulse oximetry.

After preoxygenation, anaesthesia was induced with fentanyl 2 micrograms/kg, midazolam 0.03 mg/kg, propofol 2 mg/kg, and vecuronium 0.1 mg/kg. Mask ventilation was continued for three minutes with oxygen and isoflurane at approximately 1% end-tidal concentration. Laryngoscopy was then performed with the allocated device. In the Macintosh group, direct laryngoscopy and intubation were performed with an appropriate blade and tracheal tube. In the King Vision group, the video laryngoscope blade was introduced in the midline, advanced over the tongue with the tip positioned in the vallecula, and lifted until the glottic view was optimized. The endotracheal tube was then advanced through the vocal cords. Tube position was confirmed by bilateral air entry and a sustained end-tidal carbon dioxide waveform.

Outcome measures

Ease of intubation was assessed with the Intubation Difficulty Score, a composite measure that captures the number of supplementary attempts and operators, use of alternative techniques, grade of glottic exposure, lifting force, need for external laryngeal pressure, and position of the vocal cords. Glottic exposure was graded using the Cormack and Lehane

system [26]. An IDS of 0 represented easy intubation, a score greater than 0 but below 5 indicated slight difficulty, a score above 5 indicated moderate or major difficulty, and an unsuccessful intubation was classified as impossible. The components of the score were recorded as N1 through N7, consistent with the study proforma.

Haemodynamic assessment included heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure, and oxygen saturation. Measurements were documented before induction, after induction, and at 1, 3, and 5 minutes during the peri-intubation observation period. The study also planned to record intubation time, but a numerical comparative intubation-time table was not available in the thesis results and was therefore not reconstructed for this manuscript.

Statistical analysis

The source study used SPSS version 22.0. Continuous variables were summarized as mean ± standard deviation and categorical variables as counts and percentages. Independent-samples t tests were used for continuous between-group comparisons, while chi-square or Fisher exact tests were used for categorical data as appropriate. A p value below 0.05 was considered statistically significant. The protocol stated that serial haemodynamic variables would be assessed with repeated-measures analysis of variance; however, the available results tables reported unpaired t tests at individual time points. Because patient-level data were not available for reanalysis, this manuscript reports the pointwise p values presented in the thesis rather than generating unreported repeated-measures statistics.

Ethical considerations

The study documents were reviewed and approved by the Narayana Health Academic Ethics Committee. The thesis includes the committee approval letter and records written informed consent from participants. Participation was voluntary, and the study information sheet stated that withdrawal would not affect subsequent clinical care.

RESULTS

Participant profile and baseline comparability

A total of 101 patients were analyzed, with 51 patients in the Macintosh group and 50 in the King Vision group. Men accounted for 52.94% of MCL and 58.0% of KVVL participants, and the sex distribution was not significantly different (p=0.687). Mean age was 43.80 ± 10.84 years in MCL and 43.38 ± 12.70 years in KVVL. The groups were also comparable in the reported distributions of age, body mass index, ASA physical status, and Mallampati grade. Baseline characteristics are summarized in Table 1.

Table 1: Baseline demographic and airway characteristics

Characteristic	MCL (n=51)	KVVL (n=50)	P value
Male sex, n (%)	27 (52.94)	29 (58.0)	0.687
Female sex, n (%)	24 (47.06)	21 (42.0)	
Age <=30 years, n (%)	6 (11.77)	9 (18.0)	0.600
Age 31-45 years, n (%)	23 (45.09)	18 (36.0)	
Age >=46 years, n (%)	22 (43.14)	23 (46.0)	
Mean age, years	43.80 ± 10.835	43.38 ± 12.697	
Height, cm	163.62 ± 3.61	165.08 ± 15.79	0.506
Weight, kg	59.10 ± 8.299	60.96 ± 1.323	0.995
BMI, kg/m²	22.09 ± 3.112	22.36 ± 3.799	0.337
ASA I, n (%)	29 (56.86)	32 (64.0)	0.539
ASA II, n (%)	22 (43.14)	18 (36.0)	
Mallampati I, n (%)	24 (47.06)	22 (44.0)	0.688
Mallampati II, n (%)	27 (52.94)	28 (56.0)	

Data are n (%) or mean ± SD. P values are those reported in the source thesis. Categorical comparisons used chi-square or Fisher exact tests as appropriate; continuous variables used independent-samples t tests. ASA, American Society of Anesthesiologists; BMI, body mass index; MCL, Macintosh laryngoscope; KVVL, King Vision Video Laryngoscope

Reported comorbidities were similarly distributed between groups. Hypertension was present in 10 MCL and 9 KVVL patients (p=0.799), diabetes mellitus in 10 and 6 (p=0.275), chronic obstructive pulmonary disease in 1 and 0 (p=0.315), bronchial asthma in 2 and 3 (p=0.646), smoking history in 3 and 4 (p=0.695), and hypothyroidism in 2 and 1 patients (p=0.558). None of these comparisons reached statistical significance.

Intubation difficulty

The total Intubation Difficulty Score was significantly lower in the King Vision group. Mean total IDS was 0.84 ± 1.28 with Macintosh and 0.36 ± 0.80 with King Vision (p=0.027). The largest contribution to this difference came from glottic

exposure. The N4 component was 0.38 ± 0.53 in MCL and 0.08 ± 0.27 in KVVL (p=0.001), indicating a better laryngoscopic view with King Vision. External laryngeal pressure was also required less often with the video laryngoscope, reflected by an N6 score of 0.16 ± 0.37 in MCL and 0 in KVVL (p=0.003). Other IDS components did not differ significantly (Table 2 and Figure 1).

Table 2: Intubation Difficulty Score components

IDS component	MCL	KVVL	P value
N1: supplementary attempts	0.06 ± 0.23	0.06 ± 0.23	1.000
N2: supplementary operators	0.02 ± 0.14	0.06 ± 0.23	0.312
N3: alternative techniques	0.00 ± 0.00	0.00 ± 0.00	NA
N4: glottic exposure	0.38 ± 0.53	0.08 ± 0.27	0.001
N5: lifting force	0.18 ± 0.38	0.16 ± 0.37	0.793
N6: external laryngeal pressure	0.16 ± 0.37	0.00 ± 0.00	0.003
N7: vocal cord position	0.04 ± 0.28	0.00 ± 0.00	0.320
Total IDS	0.84 ± 1.28	0.36 ± 0.80	0.027

Values are mean ± SD. IDS is the sum of N1-N7. P values are those reported in the thesis. NA, not applicable because both groups had a zero value for N3. Statistically significant comparisons are N4, N6, and total IDS.

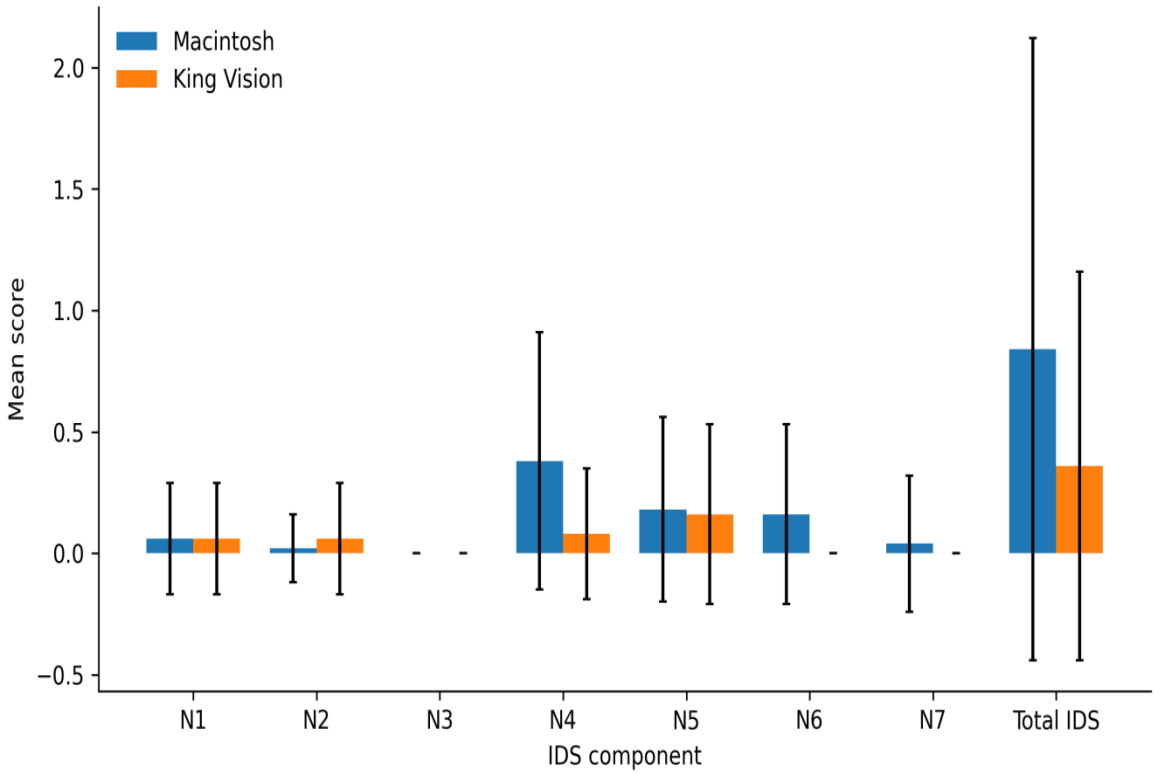

Figure 1: Mean Intubation Difficulty Score components in the Macintosh and King Vision groups. Error bars represent standard deviation. The largest between-group differences were seen for glottic exposure (N4), external laryngeal pressure (N6), and total IDS

Haemodynamic response

Heart rate

Baseline heart rate was 79.98 ± 11.89 beats/min in the Macintosh group and 82.02 ± 9.40 beats/min in the King Vision group (p=0.344). Both groups showed their highest mean heart rate after induction, followed by a gradual return toward baseline. No between-group heart-rate comparison reached statistical significance at the reported time points, although the difference at 1 minute approached significance (84.74 ± 11.57 vs 88.60 ± 8.42 beats/min; p=0.059). The time course is shown in Figure 2.

Table 3: Heart rate at measured time points

Time point	MCL, beats/min	KVVL, beats/min	P value
Before induction	79.98 ± 11.886	82.02 ± 9.401	0.344
After induction	89.24 ± 11.754	90.32 ± 8.849	0.605
1 min	84.74 ± 11.568	88.60 ± 8.420	0.059
3 min	80.68 ± 11.316	81.40 ± 8.091	0.715
5 min	79.26 ± 11.593	80.40 ± 17.565	0.703

Values are mean ± SD. P values are from the unpaired t tests reported in the source results. MCL, Macintosh laryngoscope; KVVL, King Vision Video Laryngoscope

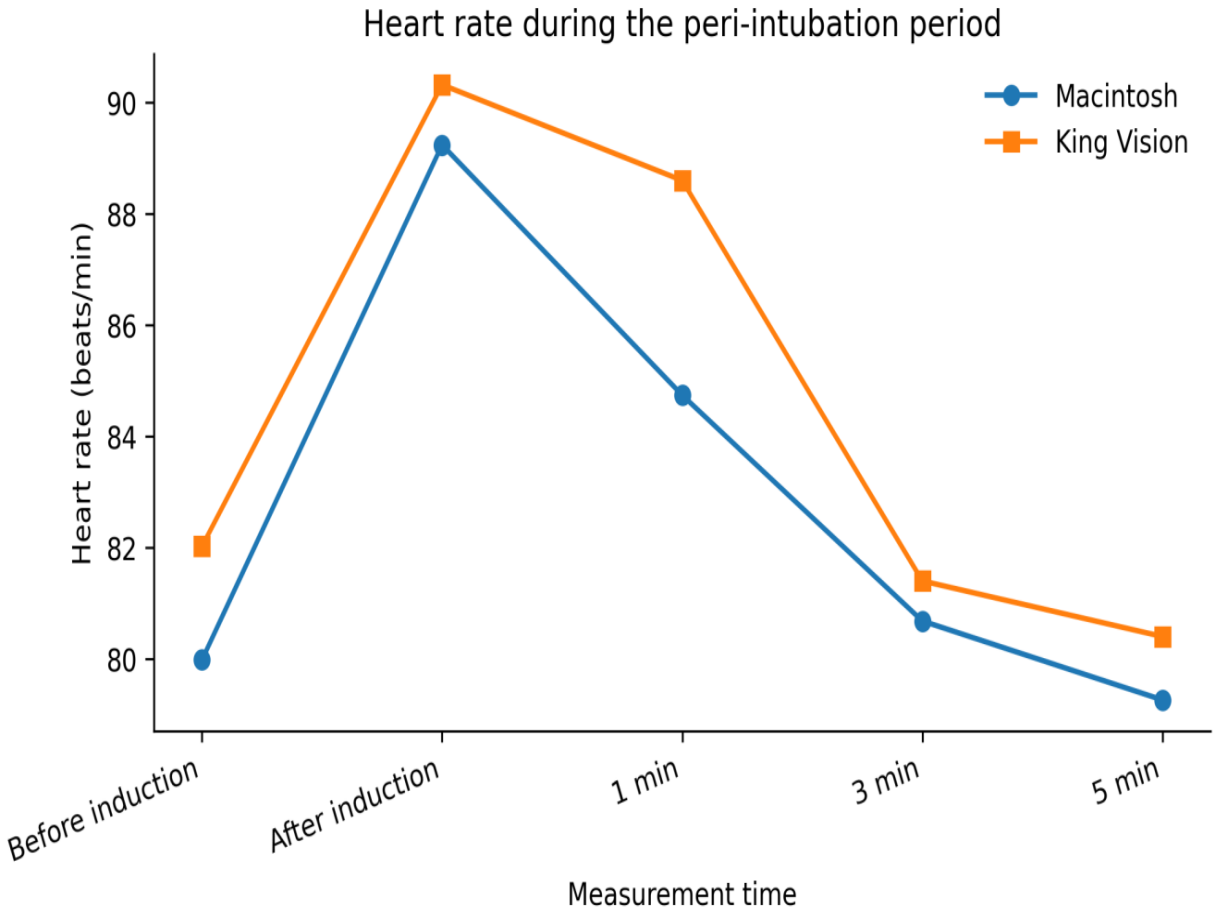

Figure 2: Mean heart rate before induction, after induction, and at 1, 3, and 5 minutes in the two study groups

Blood pressure

Systolic blood pressure was similar between groups at baseline and throughout the observation period. Baseline values were 128.32 ± 8.26 mmHg in MCL and 127.88 ± 7.56 mmHg in KVVL (p=0.782). Both groups reached their highest mean systolic pressure after induction and showed lower values by 5 minutes, with no significant between-group difference at any reported time point (Figure 3).

In contrast, diastolic blood pressure and mean arterial pressure were already higher in the KVVL group before induction and remained statistically higher at all subsequent reported measurements. Baseline diastolic pressure was 76.10 ± 5.70 mmHg in MCL and 81.22 ± 5.78 mmHg in KVVL (p<0.001), while baseline mean arterial pressure was 93.20 ± 5.84 and 96.76 ± 6.02 mmHg, respectively (p=0.003). Because these differences were present before induction, the absolute between-group values cannot be attributed solely to the laryngoscopy technique. The detailed measurements are provided in Table 4 and Figures 4 and 5.

Table 4: Systolic, diastolic, and mean arterial pressure

Parameter and time	MCL, mmHg	KVVL, mmHg	P value
SBP: before induction	128.32 ± 8.257	127.88 ± 7.561	0.782
SBP: after induction	137.14 ± 9.483	135.46 ± 7.696	0.333
SBP: 1 min	133.80 ± 9.470	132.92 ± 7.693	0.611
SBP: 3 min	125.18 ± 8.528	122.94 ± 6.756	0.149
SBP: 5 min	120.24 ± 8.620	118.34 ± 6.598	0.219
DBP: before induction	76.10 ± 5.704	81.22 ± 5.783	<0.001
DBP: after induction	79.38 ± 7.082	85.00 ± 5.739	<0.001
DBP: 1 min	77.30 ± 7.377	83.06 ± 5.836	<0.001
DBP: 3 min	72.66 ± 6.297	77.38 ± 5.182	<0.001
DBP: 5 min	69.86 ± 5.599	74.50 ± 5.108	<0.001
MAP: before induction	93.20 ± 5.841	96.76 ± 6.019	0.003
MAP: after induction	98.40 ± 7.100	101.84 ± 5.905	0.010
MAP: 1 min	96.10 ± 7.284	99.64 ± 6.134	0.010
MAP: 3 min	90.21 ± 6.246	92.52 ± 5.281	0.048
MAP: 5 min	86.42 ± 5.693	89.10 ± 5.250	0.016

Values are mean ± SD. P values are from the unpaired t tests reported in the source results. SBP, systolic blood pressure; DBP, diastolic blood pressure; MAP, mean arterial pressure. Baseline DBP and MAP differed significantly between groups, which should be considered when interpreting later absolute values

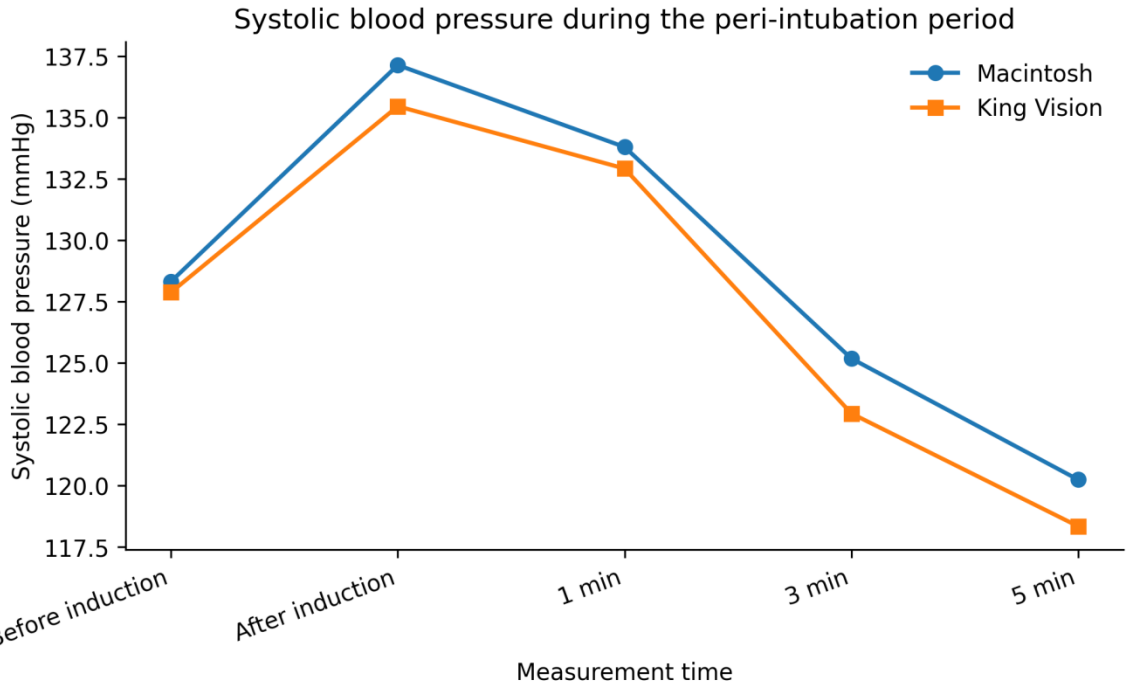

Figure 3: Mean systolic blood pressure during the peri-intubation observation period

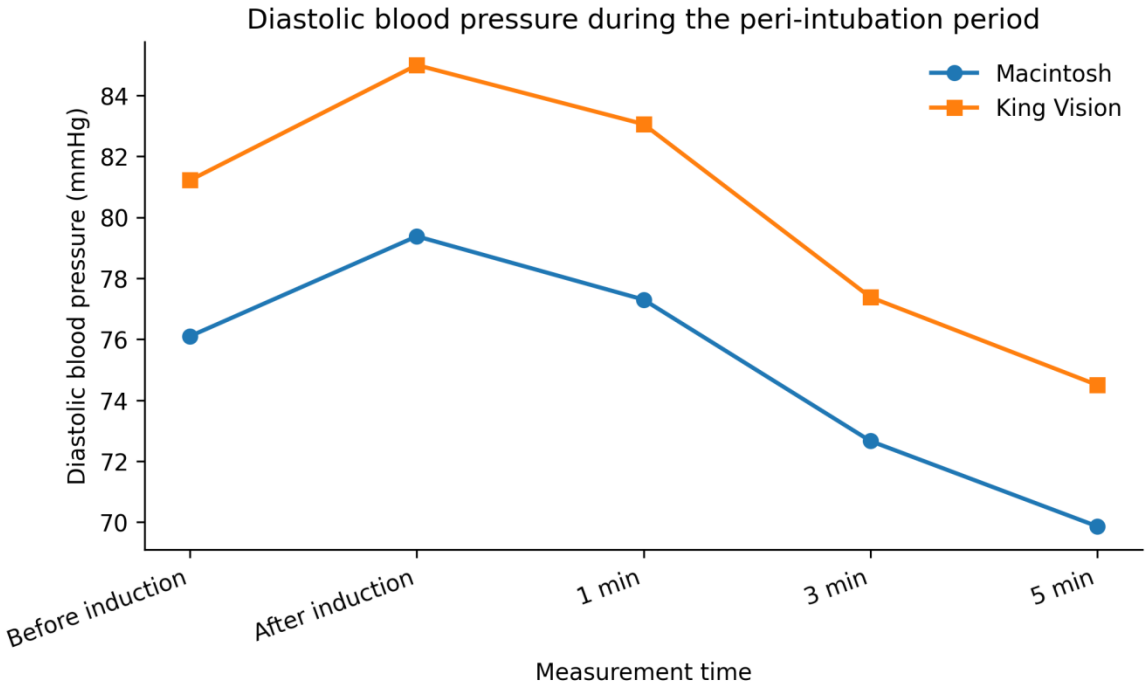

Figure 4: Mean diastolic blood pressure during the peri-intubation observation period. The KVVL group had a higher baseline DBP before induction

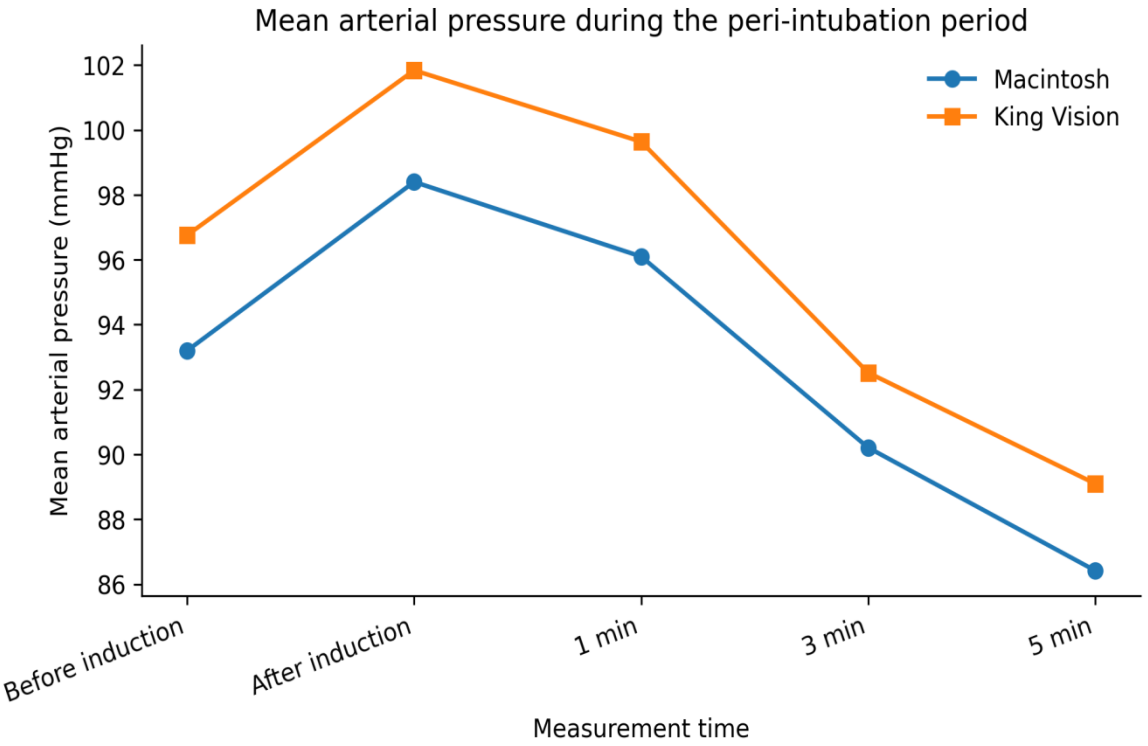

Figure 5: Mean arterial pressure during the peri-intubation observation period. Baseline MAP was higher in the KVVL group

Oxygen saturation

Oxygen saturation remained stable in both groups. Mean SpO2 ranged from 97.74% to 98.26% in MCL and from 97.94% to 98.48% in KVVL across the reported measurements. No comparison was statistically significant, suggesting that both techniques maintained adequate oxygenation during the observed peri-intubation period.

Table 5: Oxygen saturation at measured time points

Time point	MCL, %	KVVL, %	P value
Before induction	97.74 ± 1.306	98.14 ± 1.443	0.149
After induction	98.26 ± 1.411	98.20 ± 1.340	0.828
1 min	98.00 ± 1.471	97.96 ± 1.498	0.893
3 min	97.84 ± 1.517	97.94 ± 1.531	0.744
5 min	98.26 ± 1.226	98.48 ± 1.282	0.383

Values are mean ± SD. P values are from the unpaired t tests reported in the thesis. SpO2, peripheral oxygen saturation

DISCUSSION

This randomized comparative study found a practical advantage of the King Vision Video Laryngoscope in ease of intubation. The total Intubation Difficulty Score was lower with King Vision, and the difference was mainly explained by better glottic exposure and less need for external laryngeal pressure. These are clinically relevant components of the intubation process because they reflect how much additional manipulation is required to obtain a usable view and pass the tracheal tube. The haemodynamic findings were less persuasive. Heart rate, systolic pressure, and oxygen saturation were similar between groups, while diastolic pressure and mean arterial pressure were higher in the King Vision group from baseline onward. Taken together, the data support easier visualization and intubation conditions with King Vision but do not show clear attenuation of the cardiovascular response.

The reduction in IDS is consistent with earlier work involving King Vision and other video laryngoscopes. Ali and colleagues reported a lower IDS with King Vision in patients with cervical spine immobilization [6]. Elhadi and colleagues also observed favourable intubating conditions and reduced need for assisting manoeuvres with King Vision compared with conventional laryngoscopy [7]. Studies of C-MAC and other indirect devices have similarly shown improved glottic visualization, fewer adjunctive manoeuvres, or higher first-attempt success in difficult or non-standard airway settings [8,13,18-22]. Maharaj and colleagues reported a modest improvement in IDS with the Airtraq compared with Macintosh laryngoscopy [11]. These findings suggest that improved visualization can reduce some of the mechanical steps that contribute to intubation difficulty, even when the device itself requires a distinct tube-delivery technique.

The present glottic-view result also agrees with more recent King Vision data. Erdivanli and colleagues found that King Vision and Macintosh laryngoscopy produced similar first-pass success in experienced hands, although King Vision required more time for glottic visualization and intubation [27]. Reena reported a higher first-attempt success rate and less need for optimization manoeuvres with a channelled King Vision blade when armoured tracheal tubes were used [29]. Schoettker and Corniche observed good laryngeal visualization with King Vision in a simulated difficult-airway comparison [14]. These studies reinforce an important distinction: visualization may be excellent while tube advancement can still depend on blade channel geometry, operator familiarity, and alignment of the tube with the glottic opening.

The haemodynamic literature is more heterogeneous. Pournajafian and colleagues found no significant overall difference in cardiovascular response between GlideScope and Macintosh laryngoscopy despite a longer intubation time with the video device [9]. Siddiqui and colleagues similarly reported no clear haemodynamic benefit among direct laryngoscopy, GlideScope, and Trachlight techniques [10]. Kanchi and colleagues found comparable haemodynamic responses in patients with coronary artery disease despite a longer procedure with video laryngoscopy [12]. Xue and colleagues also reported similar responses between GlideScope and Macintosh laryngoscopy [17]. In contrast, Tsai and colleagues suggested that an indirect device could attenuate the stress response under specific conditions [15], and Mahjoubifar and Boroojeny observed a smaller rise in mean arterial pressure with GlideScope than with direct laryngoscopy [16]. These differences are likely related to anaesthetic depth, operator technique, intubation duration, degree of airway manipulation, and the timing of haemodynamic measurements.

A later comparison of King Vision with GlideScope found no significant difference in haemodynamic response between the two video devices, although both were considered effective alternatives for limiting the stress response [28]. The current study does not provide the same evidence of attenuation. Heart rate and systolic pressure were not significantly different between groups, and the statistically higher diastolic and mean arterial pressures in the King Vision group were already present before induction. This baseline imbalance makes it difficult to interpret the later absolute differences as an effect of the laryngoscope itself. A change-from-baseline analysis or a mixed-effects model would have been more informative, but individual patient data were not available for such reanalysis.

The broader evidence base increasingly favours video laryngoscopy for airway success rather than for a predictable reduction in sympathetic response. Hypes and colleagues found higher first-attempt success and fewer desaturation events with video laryngoscopy in the intensive care unit [13]. Noppens and colleagues reported improved laryngeal visualization

and first-attempt success in ICU patients with predictors of difficulty [19], while Sakles and colleagues observed improved Cormack-Lehane views and higher success in emergency department practice [22]. A large Cochrane review including 222 trials and more than 26,000 participants concluded that video laryngoscopes generally reduce failed intubation and improve first-attempt success and glottic views compared with direct laryngoscopy [30]. The same evidence base shows substantial heterogeneity in intubation time, which helps explain why superior visualization does not always produce a smaller haemodynamic response.

The study has several limitations. It included mainly ASA I and II patients with Mallampati class I or II, so the results should not be generalized directly to anticipated difficult airways, emergency intubation, critical illness, or patients with marked cardiovascular instability. Blinding of the laryngoscopist was not possible, and operator experience with each device was not quantified in the available thesis. The protocol planned repeated-measures analysis for serial haemodynamic variables, but the reported results provided separate unpaired t tests at each time point. Baseline DBP and MAP were also significantly different between groups, which limits causal interpretation of later absolute values. Finally, although intubation time was planned as a recorded variable, a numerical comparative result was not available in the thesis. These issues do not alter the observed IDS difference, but they do reduce confidence in any claim that one device produces a superior haemodynamic profile.

From a clinical perspective, King Vision appears useful when the goal is to obtain a clearer glottic view with less external laryngeal manipulation. This may be particularly valuable when conventional alignment is difficult or when repeated direct-laryngoscopy manoeuvres are undesirable. The findings should not, however, be interpreted as evidence that video laryngoscopy alone reliably prevents the sympathetic response to tracheal intubation. Anaesthetic depth, opioid administration, duration of airway instrumentation, and the stimulation caused by the endotracheal tube remain important determinants of the cardiovascular response [3-5,9,10,12,24].

CONCLUSION

In adults undergoing elective surgery with an apparently normal airway, the King Vision Video Laryngoscope produced a lower Intubation Difficulty Score than the Macintosh laryngoscope. The advantage was driven mainly by improved glottic exposure and a reduced need for external laryngeal pressure. These findings support King Vision as an effective device for facilitating laryngeal visualization and reducing selected components of intubation difficulty.

The study did not demonstrate a clear haemodynamic advantage for King Vision. Heart rate, systolic blood pressure, and oxygen saturation were similar between groups, while diastolic blood pressure and mean arterial pressure differed from baseline onward. Larger studies using prespecified repeated-measures or change-from-baseline analyses are required to determine whether the mechanical advantages of King Vision translate into meaningful cardiovascular benefit.

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