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Original Research Article

# Comparison of hemodynamic responses to laryngoscopy and orotracheal intubation between Macintosh laryngoscope and king vision video laryngoscope in adult surgical patients

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ABSTRACT

**Introduction and Objectives:** Endotracheal intubation involving conventional laryngoscopy elicits a hemodynamic stress response which can be deleterious in susceptible individuals. The study was aimed to see if King Vision video laryngoscope has any advantages over conventional Macintosh laryngoscope in attenuating the hemodynamic response during endotracheal intubation.
**Materials and Methods:** 80 ASA I and II patients (aged 18-59 years) who fit the eligibility criteria and scheduled for elective surgery under general anesthesia were recruited for the study after obtaining permission from the institutional review board. By randomization they were allocated into two groups. Group A underwent intubation with King Vision video laryngoscope (KVVL) and group B were intubated with Macintosh laryngoscope (MDL). Systolic BP, diastolic BP, mean arterial pressure, heart rate and Sp02 were measured at baseline, post induction, prelaryngoscopy and post intubation at 1, 3 and 5 minutes. The time duration for intubation, numbers of attempts for intubation and postoperative pharyngeal morbidities were also noted.
**Results:** The duration of laryngoscopy and intubation was significantly longer in group A (KVVL) when compared to group B (MDL) patients (18.28 ± 6.555 Vs. 14.75 ± 3.678 seconds)(p = 0.004). However, patients in group A (KVVL) had less hemodynamic response compared to group B (MDL) with statistically significant heart rate changes at 3 minutes post intubation. (86.37 ± 15.255 Vs 94.45 ± 19.123 beats/minute respectively)(p = 0.040). There were no significant differences between both the groups in terms of number of attempts and post operative oropharyngeal morbidities.
**Conclusion:** We conclude that King Vision video laryngoscope is a useful alternative to traditional Macintosh laryngoscope for reducing hemodynamic stress response during endotracheal intubation.



## 1. Introduction

Laryngoscopy and endotracheal intubation is inherent to general anesthesia for securing the airway. Endotracheal intubation is a noxious event causing sympathetic stimulation triggering deleterious response s in the various physiological systems of the human body. These hemodynamic responses are mostly short-live d and well tolerated by healthy individuals.[1] However, they can be detrimental in susceptible patients resulting in a myriad of complications like myocardial ischemia, cardiac failure, dysrhythmias, intracranial bleed, aneurysmal rupture and increased bleeding from wounds.[2] The magnitude of the hemodynamic changes during laryngoscopy and endotracheal intubation is correlated with the duration and degree of manipulation of the oropharyngolaryngeal structures.[3]

Numerous pharmacological and non-pharmacological techniques have been developed to attenuate the pressor response. Video laryngoscopes have gained interest as they do not need alignment of the oral, pharyngeal and laryngeal axes for glottic visualization. Video

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laryngoscopes have been recommended in difficult airway algorit hms of ASA, DAS (UK) and AIDAA guidelines as an alternate laryngoscope in difficult airway scenarios.[4] Among the video laryngoscopes available, King Vision video laryngoscope (KVVL) is a solid, portable, battery-operated device with LED display featuring a camera that enables a clear view of the glottis. The angulation of the channeled blade is in such a way that it requires less lifting force leading to minimal oropharyngolaryngeal stimulation and hence potentially reduced stress responses.[5] As of now, not many studies exist directly comparing the hemodynamic stress response between King Vision video laryngoscope (KVVL) and Macintosh direct laryngoscope (MDL) in normal adult airways. Hence this study was undertaken to compare the efficacies of both the laryngoscopes in mitigating the pressor responses during intubation and this formed our primary objective. The secondary objectives were to compare the ease of intubation in terms of total intubation time, number of attempts and also to observe any postoperative oropharyngeal morbidities like sore throat, hoarseness and airway trauma.

## 2. Materials and Methods

### 2.1. Source of data

After Institutional ethical committee approval and written informed consent, 80 patients of either sexes belonging to ASA status I & II, aged 18 - 60 years posted for elective surgical procedures requiring general anesthesia with endotracheal intubation were included in this randomized double blinded study.

### 2.2. Exclusion criteria

1. Patients at risk of aspiration
2. Anticipated difficult airway
3. Patients with cervical instability
4. Pregnant females.
5. BMI $>$ 35

All the study patients underwent a comprehensive preoperative evaluation inclusive of a detailed airway examination. The basal heart rate and blood pressure were recorded prior to surgery. The patients were assigned serial numbers and allotted into either of the two groups by randomization by computer generated software. The patients were divided into 2 groups of 40 each.

1. Group A: Patients who were intubated with King Vision video laryngoscope.
2. Group B: Patients who were intubated with Macintosh laryngoscope.

The patients were blinded to randomization. The senior anesthesiologist on the case was informed and asked to open an opaque envelope which revealed the laryngoscope allotted to the patient. In all the selected patients, baseline vital parameters (systolic BP, diastolic BP, mean arterial pressure, heart rate, SpO2) were noted (T1). The intubation was done by an experienced anesthesiologist skilled in the usage of both the laryngoscopes (ie. who had performed $>$100 direct laryngoscopies and $>$20 video laryngoscopies).

Following premedication with Inj. Glycopyrrolate 0.2 mg iv, Inj. Ondansetran 4mg iv and Inj. Midazolam 1 mg iv and three minutes of pre-oxygenation, standardized anesthetic induction was performed with Inj. Fentanyl 2mcg/kg iv and Inj. Propofol 2 mg/kg iv with Inj. Atracurium 0.5mg/kg iv for neuromuscular blockade. Patients were ventilated manually with I soflurane (1% end-tidal) in oxygen using facemask and at the end of 3 minutes, intubation was accomplished using size 3 Kin g Vision channeled blade in group A and size 3 or 4 Macintosh blade in group B. Airway was secured with a cuffed endotracheal tube of size 7.5mm in females and 8.5mm in males. The vital parameters (systolic BP, diastolic BP, mean arterial pressure, heart rate, SpO2) were serially measured post induction (T2), prelaryngoscopy (T3) and post intubation at 1 minute (T4), 3 minute (T5) and 5 minute (T5). An independe nt observer noted the time for intubation along with hemodynamic parameters. No other medications were administered or procedures performed during the 5 minute data collection period after intubation.

The time for successful intubation was measured using a stop-watch from the time from when the blade was introduced into the mouth to the point when a definitive capnographic trace of EtCO2 (6 consistent capnographic waveforms) indicating endotracheal tube placement was achieved. The number of attempts was also recorded. An attempt began when the laryngoscope blade was introduced into the mouth and ended with the withdrawal of the laryngoscope outside the teeth, regardless of whether an attempt to pass endotrache al tube was made or not. Thereafter, standard anesthesia was continued till the end of surgery

Post operatively, any complaints of sore throat, hoarseness and airway trauma (oropharyngeal mucosal injury) given by the patient were noted and treated accordingly. This postoperative interview with the patient was carried out by another member of the research team.

### 2.3. Statistics

In order to find a mean difference in MAP of 5 mm of Hg during laryngoscopy and intubation between Macintosh laryngoscope and King Vision video laryngoscope, with 80% power and 5% level of significance, sample size required was 34 patients per group. To account for dropouts, we considered 40 patients in each group. So the total sample size was 80. (Pournajafian AR et al).[5]

Continuous variables were represented as mean, median, mode and standard deviation. Categorical variables were represented in frequencies and percentages. Chi-square test was used to test the association between the categorical variables. Student's t-test was used to compare the intubation time taken between the two groups. Repeated measures ANOVA was used to compare the hemodynamic parameters between the two groups over time. $P < 0.05$ was considered statistically significant. Data was analyzed using SPSS software version 16.

## 3. Results

Forty patients were enrolled in each group. A total of 80 patients were included. The demographic variables - age, sex, ASA and BMI - were comparable between the two groups [Table 1]. The airway as sessment – Modified Mallampati grading, thyromental distance, neck mobility and upper incisors between the two groups were also comparable [Table 2].

Table 3 shows the technical characteristics of the laryngoscopes which include intubation time, number of attempts and post operative complications. The number of intubation attempts and incidence of oromucosal injuries across the study groups showed no statistical significance. None of the patients in the study groups complained of sore throat or hoarseness of voice. In terms of mean duration of intubation, statistically significant difference was noted between the study groups. The overall intubation time was prolonged in Group A (KVVL) with $p = 0.004$. The intergroup hemodynamic variables - systolic BP, diastolic BP, mean arterial pressure and Sp02 did not show any statistical significance ($P > 0.05$) (Figure 1). However the heart rate changes at 3 minutes post intubation with KVVL compared to MDL was statistically significant (86.37±15.255 Vs 94.45±19.123 beats /minute respectively)($p = 0.040$)

## 4. Discussion

The pressor response to intubation initiates within seconds of laryngoscopy, typically peaking at 1-2 minutes and usually lasting for 5 minutes.[6] Shribman et al showed that the hemodynamic stress response during laryngoscopy and endotracheal intubation appear s in two phases. The first phase occurs mainly due to laryngoscopy which causes tension on the supraglottic structures producing significant increase in both systolic and diastolic pressures. The act of intubation with the placement of the endotracheal tube and inflation of the cuff constitutes the second phase. This phase occurs due to the stimulation of the infraglottic receptors resulting in exacerbation of the pressor response with the additional elevation of heart rate.[7]

It has been postulated that the upward lifting force required to achieve 'the line of sight' during a Macintosh laryngoscopy is around 35 to 47.6 N.[8] In contrast, the lifting forces required while using a video laryngoscope was around 4.9-13.7 N.[9] This implies that the lesser force required with video laryngoscope was due to the lesser traction applied to the soft tissues to view the glottis eventually leading to lesser sympathetic stimulation. King Vision video laryngoscope doesn't require alignment of the oropharyngeal and tracheal axes leading to lesser airway handling and lesser sympathoadrenal response.[10] The other advantages include use in cases with unfavorable anatomy like limited mouth opening, morbid obesity and restricted neck mobility, its applicability not only in operation theatre but also in other places like endoscopy units, MRI suites, intensive care units, emergency department and prehospital settings. It ensures higher success rate of intubation especially in novices and allows visualization of an enlarged video image of airway structures enabling both the operator and the assistants to observe the procedure.[11]

In our study we observed that the hemodynamic responses to laryngoscopy and intubation in terms of systolic BP, diastolic BP, mean arterial pressure and Sp02 were not statistically significant between King Vision video laryngoscope and Macintosh laryngoscope. However the heart rate changes at 3 minutes post intubation with KVVL compared to MDL was statistically significant (86.37 ± 15.255 Vs 94.45 ± 19.123 beats/minute respectively)($p = 0.040$). This difference maybe because of the lesser lifting force required with KVVL to view the glottis leading to lesser heart rate changes.

In agreement with our study, Mogahed et al compared the heart rate, mean arterial pressure, SpO2 changes between KVVL and MDL at baseline, pre-laryngoscopy and 2 minutes and 5 minutes after intubation. They noted statistically significant increase in heart rate and mean arterial pressure with MDL at 2 minutes and 5 minutes after intubation.[12] Similarly, Elhadi et al showed that the mean arterial pressure and heart rate immediately after intubation and 10 minutes after intubation were significantly less in the KVVL group than the MDL group.[13] Woo et al compared Pentax AWS and MDL in burns patients and observed that there were no significant differences in systolic and diastolic pressures between both the groups at various time intervals. But heart rate was significantly increased after intubation in MDL group compared to Pentax group.[14] These findings were comparable to our study. In disagreement with our study, Parasa et al observed that the hemodynamic response was clinically evident with Glidescope than MDL though the differences were not statistically significant. They found that the patients in Glidescope group had a higher rise in systolic BP, diastolic BP, mean arterial pressure and heart rate immediately and 3 minutes after intubation.[15] Different results were obtained from the study by Pournajafian et al where they observed no statistically significant differences in the hemodynamic response between the Glidescope and MDL groups.[5] So also the study by Tempe et al found that the hemodynamic responses with Truview PCD, McGrath

**Table 1:** Demographics

| Parameters | Group A (KVVL) | Group B (MDL) | p |
|---|---|---|---|
| Age (years) - mean±SD | 39.00 ± 12.302 | 37.20 ± 12.103 | 0.898# |
| Sex (M/F) - number | 20/20 | 22/18 | 0.654## |
| ASA (I/II)- number | 20/20 | 22/18 | 0.654## |
| BMI (kg m-2) | 23.2423 ± 3.46470 | 22.8314 ± 4.36822 | 0.280# |

#Student t-test ##Chi square test.
KVVL= King Vision Video Laryngoscope, MDL= Macintosh Direct Laryngoscope SD=Standard deviation, ASA=American Society of Anesthesiologists, BMI=Body mass index

**Table 2:** Airway characteristics

| Parameters | Group A (KVVL) | Group B (MDL) | P ## |
|---|---|---|---|
| Modified Mallampati grade 1 2 | 20 20 | 22 18 | 0.654 |
| Thyromental distance >6 cms 5-6 cms | 33 7 | 34 6 | 0.762 |
| Neck mobility Normal Reduced | 35 5 | 39 1 | 0.089 |
| Upper incisors Absent Normal Prominent | 0 38 2 | 1 39 0 | 0.221 |

##Chi square test.
KVVL= King Vision Video Laryngoscope, MDL= Macintosh Direct Laryngoscope

**Table 3:** Technical characteristics

| Parameters | Group A (KVVL) | Group B (MDL) | P |
|---|---|---|---|
| Number of intubation attempts 1 2 | 39 1 | 40 0 | 0.314## |
| Time for intubation (seconds)# - mean±SD | 18.28 ± 6.555 | 14.75 ± 3.678 | **0.004** * |
| Post operative oropharyngeal morbidities Present Absent | 4 36 | 2 38 | 0.396## |

#Student t-test ##Chi square test * Significant.
KVVL= King Vision Video Laryngoscope, MDL= Macintosh Direct Laryngoscope
SD=Standard deviation

and MDL were almost similar.[16] In agreement with the above results is the study by Kanchi et al wherein they observed no difference in hemodynamic changes between Pentax video laryngoscope and MDL in cardiac patients posted for CABG.[3] In all the above studies showing no d ifference in hemodynamic changes between video and direct laryngoscopes, they postulated that if the time duration taken for video laryngoscopy and intubation could be reduced, they would have been able to realize the benefit of video laryngoscope in terms of hemodynamic response.

The KVVL was introduced to our institution approximately 1 year prior to the period covered by this study. Hence our anesthesiologists involved in the study were experienced in the use of the KVVL and this may be the reason for maintenance of hemodynami c stability with KVVL compared to MDL despite the significantly prolonged intubation time. This drives home the point that greater airway stimulation with elevated pressures will be expected in less experienced hands and this could potentially nullify the beneficial effects of the KVVL observed in this study.

The magnitude of cardiovascular response has a linear relation with the duration of laryngoscopy. In our study the time taken for endotracheal intubation was significantly longer in group A (KVVL) patients as compared to group B (MDL) patients (i.e., 18.28 ± 6.555 Vs. 14.75 ± 3.678 seconds). The reasons cited for t his significant time difference are the bigger size of the KVVL blade which occupies larger oral space causing difficulty in insertion, presence of tongue in the middle of the oral cavity while performing video laryngoscopy leaving less space for ETT insertion and the greater hand eye co-ordination required with video laryngoscope coupled with the enormous experience in handling MDL than video laryngoscope. Thus improved glottic view with KVVL comes at the cost of intubati on time as the line of sight view of the glottis is not achieved by video laryngoscopy. Mogahed et al also found that lower time was needed for intubation with MDL than KVVL (35.47 ±10.65 Vs 41.53± 9.93 seconds) and the difference was statistically significant.[12] In agreement with our study, Dashti et al inferred that the time for intubation was significantly prolonged with Glidescope compared to MDL (9.80 ± 1.27 Vs 8.2 0 ± 1.17 seconds) ($P < 0.05$).[17] Tempe et al compared MDL and video laryngoscopes and noted that the duration of laryngoscopy and intubation was significantly less in MDL (36.68 ± 16.15 s) as compared with McGrath (75.25 ± 30.94 s) and TruView (60.47 ± 27.45 s) groups (P = 0.000 and 0.003 respectively).[18] Our results are also in accordance with the studies by Parasa et al comparing

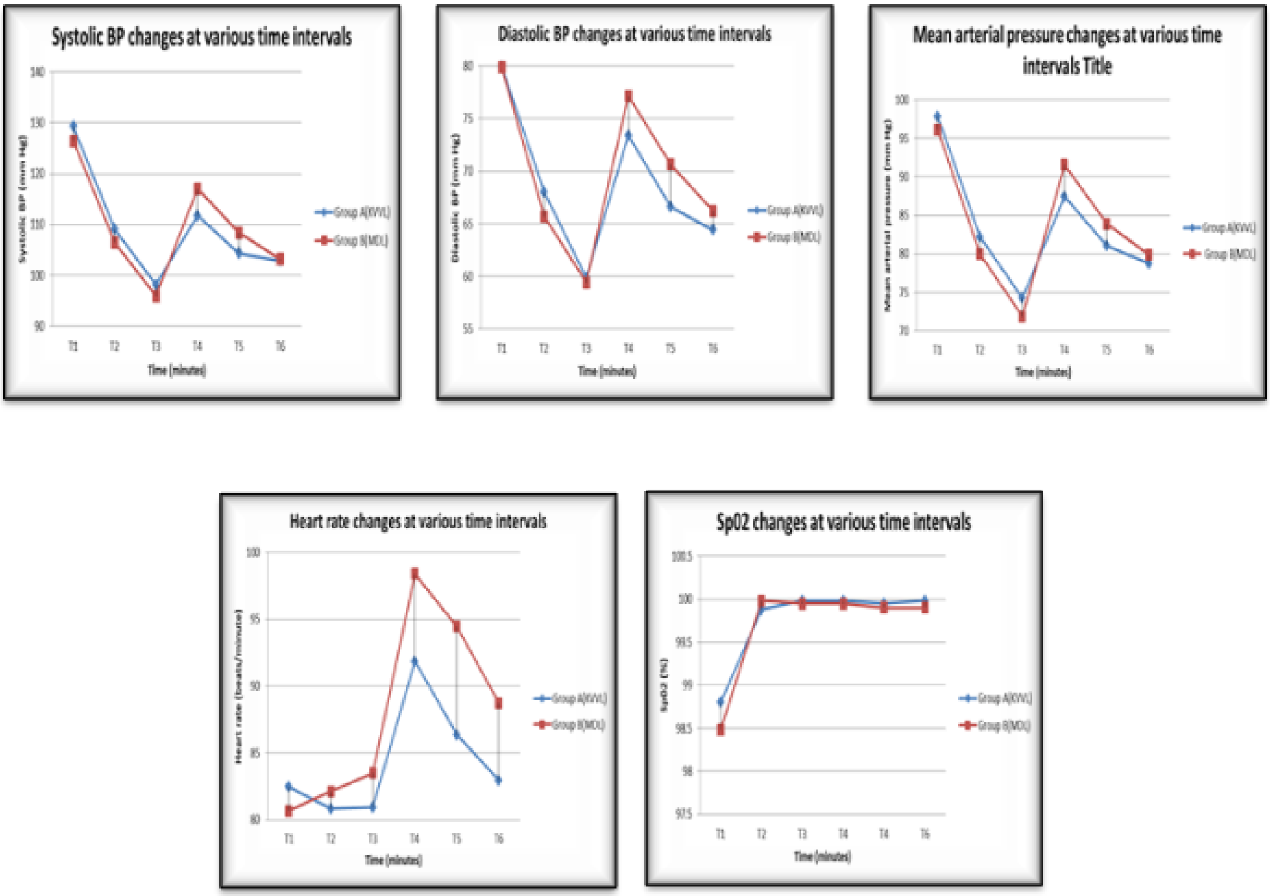


**Fig. 1:** Hemodynamic parameters

Glidescope with MDL (45.703±11.649 Vs 27.773±5.122 seconds) (p <0.0001)[15] and Kanchi et al comparing Pentax AWS with MDL (i.e., 36.4±2 vs. 22.08±8 seconds).[3] In contrast to our study Elhadi et al noted that there was no difference in the time for intubation between the MDL group and KVVL group. (19.10±7.08 and 17.34±4.62 seconds respectively).[13]

With regard to the number of attempts for intubation, only 1 patient was intubated in the second attempt and belonged to the KVVL group. However this was not statistically significant. Reiterating this fact is the study by Elhadi et al where they found no statistically significant difference in the number of attempts between KVVL and MDL.[13] Likewise Griesdale et al found that the successful first attempt at intubation was not statistically different between Glidescope and MDL.[19] However the study by Mogahed et al observed that the success of first trial of intubation was achieved more with KVVL compared to MDL and C-MAC D-blade laryngoscopes but with no statistical significant differences among the three groups.[12] In disagreement with our study, Brueggeney et al showed that the first attempt success rate of intubation was better with C-MAC video laryngoscope than the KVVL.[20]

With regard to the post operative oropharyngeal morbidities, in our study, 4 patients in KVVL group and 2 patients in MDL group had oromucosal injuries. The width of the channeled blade of KVVL is 29mm which is bigger than the 13mm width of MDL blade. Hence the larger blade of KVVL can cause more oropharyngeal trauma compared to MDL blade. However these findings were not statistically significant in our study. None of the patients in our study complained of sore throat or hoarseness of voice. In agreement with our study, Parasa et al found that the incidence of mucosal injury was more with Glidescope than the MDL though not statistically significant.[15] Also, N Jagannathan et al reported that the post operative complications were not significantly different between the KVVL group and Miller's blade laryngoscope group when used in pediatric patients.[21] In contrast, Mogahed et al observed more complications with use of MDL compared to KVVL. However the difference was not statistically significant.[12] Another study by Ali et al observed less airway trauma when using KVVL and reasoned that it may be due to absence of direct laryngoscopy like maneuver and the presence of softer blade material.[22] But Soliman et al. noted that the incidence of oral trauma and bleeding related to intubation was higher with Glidescope than with MDL which was statistically significant and concluded that the oral trauma maybe due to the multiple trials and difficulty in directing the endotracheal tube to the glottis during intubation with GlideScope.[23]

Our experience with KVVL showed that the familiarity with the instrument reduces the chances of oromucosal injuries. Expertise in the use of video laryngoscope has definitely a learning curve

## 5. Conclusion

We conclude that King Vision video laryngoscope is a useful alternative to traditional Macintosh laryngoscope in attenuating pressor response to laryngoscopy and endotracheal intubation in patients with normal airways. The mean time taken for successful intubation was significantly longer in our study. A shorter intubation time with KVVL could have improved our results in minimizing the stress response. It is worthwhile to evaluate the hemodynamic response in difficult airways also to explore the full potential of King Vision video laryngoscope

## 6. Financial support and sponsorship

None.

## 7. Conflicts of interest

None.

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