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Research Article

Comparison of Haemodynamic Response to Intubation with KingVision and C-MAC® Videolaryngoscope in Adults

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ABSTRACT

Background: Videolaryngoscopes are now being advocated as the universal device for airway management due to their ability to provide an improved glottic visualisation. Due to their ability to see around the corners, they obviate the need to align the airway axes and thus may lead to less airway stimulation. This may result in less haemodynamic response during laryngoscopy and intubation. The present study was designed to compare the haemodynamic response to intubation with King Vision and C-MAC® videolaryngoscopes.

Methods: After obtaining informed consent, adults with unanticipated difficult intubation, scheduled to undergo surgery under general anaesthesia were randomised to be intubated with either King Vision (Group K) or C-MAC® (Group C) videolaryngoscope. Following a standardised general anaesthesia induction protocol all subjects were intubated with the allocated videolaryngoscope and haemodynamic parameters (heart rate, systolic pressure, diastolic pressure and mean arterial pressure) were recorded at specific time points. Statistical analysis was done using the SPSS Software (version 18.0).

Results: The changes in the heart rate, systolic pressure, diastolic pressure and mean arterial pressure following laryngoscopy and intubation with the allocated videolaryngoscope were statistically similar between the two groups at all time points.

Conclusion: Haemodynamic responses to laryngoscopy and intubation with King Vision and C-MAC® videolaryngoscopes were similar.

Laryngoscopy and intubation is a noxious stimulus which results in sympathetic response leading to hypertension and tachycardia. This sympathetic stimulation can in turn produce adverse cardiovascular events, especially in patients with cardiac co-morbidities. The haemodynamic response is due to the oropharyngeal stimulation produced by laryngoscopy and laryngotracheal stimulation due to tube insertion [1]. The degree of haemodynamic response is related to the force and duration of laryngoscopy [2-3]. Various methods have been adopted to blunt this haemodynamic response, with more focus on pharmacological methods than non-pharmacological ones [4-7].

Videolaryngoscopes are rapidly gaining popularity in airway management and several devices with different design features are now available. Their use is not only being advocated for difficult airway scenarios [8], but is also now being suggested by many airway experts as the first-line technique device for tracheal intubation in all patients [9-11]. Videolarygoscopes do not require the alignment of oral, pharyngeal and laryngeal axes for glottic visualisation and hence may cause less oropharyngeal stimulation. Each videolaryngoscope has unique design features and the technique of use, which may in turn lead to a difference in the degree of oropharyngeal stimulation. There is paucity of literature with respect to the pressor response comparing different

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videolarygoscopes. Hence, the primary objective of the present was to compare the haemodynamic response to intubation with the videolaryngoscopes, C MAC and King vision. The secondary objective was to assess the glottic visualisation, laryngoscopic view and intubation times.

Methods

After obtaining Ethical Committee approval and informed consent, 60 subjects of either gender aged 20 to 60 years, ASA 1 & 2 scheduled to undergo elective surgery under general anaesthesia were enrolled in the study. Subjects were excluded from the study if they had risk of gastric aspiration, difficult intubation (Mallampatti grade ≥ 3, thyromental distance < 6cm, inter incisor gap < 3cm, cervical spine instability, and oropharyngeal pathology), history of difficult intubation, BMI ≥ 30kg/m2 and hypertension. Study subjects were randomly assigned to be intubated with either King Vision channeled blade (Group K) or C-MAC Macintosh type blade (Group C) by a computer generated random number table.

A standardised anaesthesia protocol was followed in all cases. After instituting minimal mandatory monitoring (which included pulse oximetry, ECG and non-invasive blood pressure) and securing an intravenous access, all patients were preoxygenated with 100% oxygen and general anaesthesia was induced with fentanyl 2mcg/kg and propofol 2mg/kg. After ensuring bag mask ventilation, neuromuscular blockade was achieved with atracurium 0.5mg/kg. Laryngoscopy and intubation with the randomly assigned videolaryngoscope was attempted after ensuring adequate muscle relaxation (loss of responsiveness to train of four stimulation). The correct placement of the appropriate size endotracheal tube was confirmed by chest wall movements, auscultation of breath sounds, and appearance of capnograph tracing. All intubations were carried out by a single anaesthesiologist who had experience in more than 50 intubations with both the study videolaryngoscopes. Anaesthesia was later maintained using air, oxygen and inhalational agent of choice of the attending anaesthesiologist. At the end of surgery, residual neuromuscular blockade was reversed with neostigmine-glycopyrrolate combination and patient was extubated.

The haemodynamic parameters, heart rate and blood pressure (systolic pressure, diastolic pressure and mean arterial pressure) were recorded as specific time intervals; T1= Baseline prior to induction, T2= After induction, just before intubation attempt, T3= 1 min after endotracheal intubation, T4= 2 min after endotracheal intubation, T5= 3 min after endotracheal intubation, T6= 4 min after endotracheal intubation, T7= 5 min after endotracheal intubation, and T8= 10 min after endotracheal intubation. No surgical stimulation was allowed until the first 10min after endotracheal intubation till all the haemodynamic parameters were recorded.

The following parameters were noted; time required to obtain a glottic view, time for successful intubation, glottic view in terms of Cormack-Lehane grade and Percentage of glottis opening (POGO) score [12], and number of attempts at intubation. Any associated complications such as desaturation (SpO2< 90%), trauma to lip, tongue, gum or teeth, and sore throat were also noted. The time for successful intubation was defined as the time from the allocated videolaryngoscope is inserted into the subject's mouth until the CO2 is detected on the capnogram [13]. If more time is needed or there is fall in SpO2<90%, the patient received bag-mask ventilation between attempts and various maneuvers could be used, including external laryngeal pressure and use of bougie. An intubation attempt was counted each time the anaesthesiologist attempted to pass tracheal tube through the vocal cords [13]. Failed intubation was defined as failure after three attempts with the allocated videolaryngoscope and an alternative airway management plan instituted at the discretion of the attending anaesthesiologist. If intubation with the allocated videolaryngoscope failed, then intubation time was measured until the final failed attempt and an alternate airway management plan was instituted.

Haidry and Khan [14], in their study have observed that the change in heart rate from baseline was 18.7% in Macintosh and 7.7% in McCoy laryngoscope. In the present study expecting similar result with CMAC and King Vision videolaryngoscope with 80% power, 95% confidence level and considering 2% minimum change as clinically significant, the study requires a minimum of 30 subjects in each group. Continuous data were expressed as Mean±SD and categorical date were presented as number (%). Significance was assessed at 5% level of significance. Student t test (two tailed, independent) was used to find the significance of study parameters on continuous scale between two groups (inter group analysis) on metric parameters. Leven's test for homogeneity of variance has been performed to assess the homogeneity of variance. Chi-square /Fisher exact test has been used to find the significance of study parameters on categorical scale between two or more groups, non-parametric setting of qualitative data analysis. Fisher exact test was used when cell samples were small. The statistical software SPSS 18.0 and R environment ver.3.2.2 were used for analysis of data, and Microsoft word and Excel have been used to generate graphs and tables.

Results

The patients in both the groups were similar with respect to demographic variables (Table1). Mallampatti grades were also similar in both the groups (Table1). The laryngoscopic and intubation parameters are summarised in (Table 2). Intubation was possible within three attempts with both the videolarygoscopes and all subjects were included in data analysis. The time to obtain a glottic view was 7.6±2.5 sec and 8.6±2.27 sec in group C and group K respectively. The time required for successful intubation was 29.83±8.7 sec and 33.6±8.68 sec in group C and group K respectively. Both these time durations were statistically similar. The glottis view as assessed by Cormack-Lehane grading and POGO score was also similar in both the groups. Majority of patients in both groups had Cormack-Lehane grade 1 and POGO score of> 80%. Twenty one patients in group C were intubated in first attempt, whereas twenty patients were intubated with first attempt in group K.

Table 1- Demographic variables

Variable	Group C (n=30)	Group K (n=30)
Age (years)*	34.03±9.58	33.6±11
Gender (M/F)†	12/18	15/15
Weight (kg) *	59.73±11.18	55.67±10.16
Height (cm) *	161.45±9.44	158.75±8.42
BMI (kg/m2) *	22.83±3.21	22.09±3.02
ASAgrade(1/2) †	25/5	26/4
Mallampatti grade (1/2) †	12/18	10/20

*Mean±SD; †Number

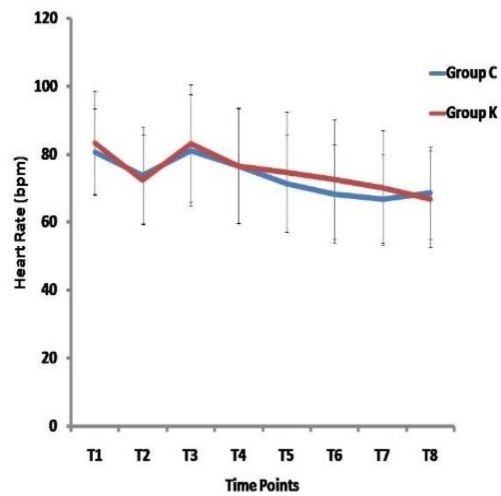
Table 2- Study parameters

Variable	Group C(n=30)	Group K(n=30)
Time to glottic view (sec) *	7.6±2.5	8.6±2.27
Time to successful intubation (sec)*	29.83±8.7	33.6±8.68
Cormack-Lehane grade (1/2/3)†	22/6/2	26/4/0
POGO score (<50%/50-80 %/> 80%) †	2/2/26	0/3/27
Number of attempts (1/2/3)†	21/7/2	20/8/2
Failed intubation	Nil	Nil

*Mean±SD; †Number

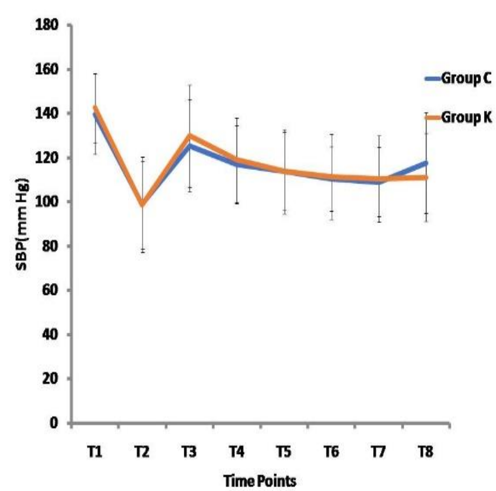
The baseline haemodynamic parameters were comparable in both the groups. There was no difference in the haemodynamic response to videolaryngoscopy and intubation in the two groups. The changes in heart rate, systolic pressure, diastolic pressure and mean arterial pressure were similar in both the groups at all time points. There was decrease in heart rate, systolic pressure, diastolic pressure and mean arterial pressure following induction and just before the intubation attempt (time point T2) in both the groups (Figure 1-4). One minute after laryngoscopy and intubation (time point T2) there was an increase in heart rate, systolic pressure, diastolic pressure and mean arterial pressure in both groups. Over the next 10 minutes the haemodynamic variables returned to near pre-intubation values in both the groups. Ten patients in group C and 8 patients in group K had sore throat, while lip trauma was noted in 2 patients in group K.

Figure 1- Comparison of heart rate between the two groups at various time points



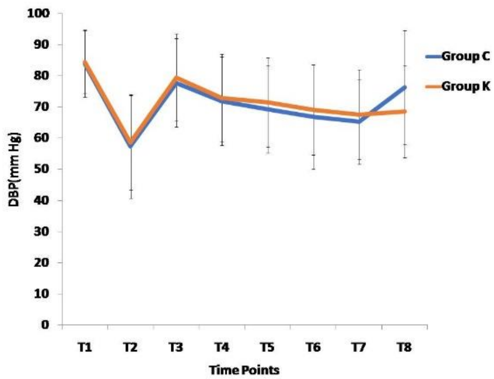
Data presented as Mean±SD; P>0.05 at all time points

Figure 2- Comparison of systolic blood pressure between the two groups at various time points



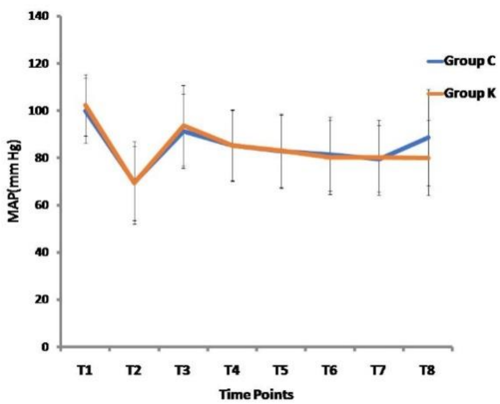
Data presented as Mean±SD; P>0.05 at all time points

Figure 3- Comparison of diastolic blood pressure between the two groups at various time points



Data presented as Mean±SD; P>0.05 at all time points

Figure 4- Comparison of mean arterial pressure between the two groups at various time points



Data presented as Mean±SD; P>0.05 at all time points

Discussion

Laryngosocpy and endotracheal intubation is one of the integral techniques of the clinical practice of general anaesthesia. Laryngoscopy and intubation is a noxious stimulus resulting in sympathetic stimulation, leading to a haemodynamic response in the form of hypertension and tachycardia [2]. These haemodynamic changes can be significant and can result in adverse outcomes in vulnerable patient population (e.g., ischaemic heart disease, cerebrovascular disease) [2, 15-16].

Haemodynamic changes to laryngoscopy and intubation is a result of the oropharyngeal stimulation produced by laryngoscopy and laryngotracheal stimulation due to tube insertion [1]. The degree of response depends on the force used and the time taken for larygoscopy and intubation [1-2]. Techniques of intubation with minimal oropharyngeal stimulation might attenuate the haemodynamic response. Unlike Macintosh direct laryngoscope, videolaryngoscopes do not require alignment of the oral, pharyngeal and laryngeal axes for visualisation of glottis opening and endotracheal intubation. Studies have shown that with videolaryngoscopes there is less force applied on upper airway structures during laryngoscopy [17-18]. This may minimise the oropharyngeal stimulation and thus attenuate the haemodynamic response.

Varieties of videolaryngoscopes are now available for clinical use. Each of them differs in the way they are used depending on their design. This variation in their design and method of use may alter the degree of oropharyngeal stimulation. There is paucity of literature comparing different videolaryngoscopes with respect to the haemodyanamic response following laryngoscopy and intubation.

Studies comparing different types of videolaryngoscopes with the conventional Macintosh direct laryngoscope with respect to haemodynamic response are equivocal. There are studies [19-23] which report videolaryngoscopes to be associated with lesser haemodynamic response compared to Macintosh direct laryngoscope. While, some investigators [24-26] have found no reduction in the haemodynamic response with videolaryngoscopes compared to Macintosh direct laryngoscope.

The present study observed no difference in the haemodynamic response to laryngoscopy and intubation with KingVision and C-MAC videolaryngoscopes. The increase in the heart rate and blood pressure seen immediately after intubation returned to near baseline values over the next 10 minutes. The trend in haemodynamics observed was similar between the two videolaryngoscopes. The result of our study was similar to that of Tempe DK et al. [24], where they found similar haemodynamic response with the two videolaryngoscopes (Truview PCD and McGrath).

Though, the forces applied to the upper airway structures has not been studied by us, one of the reasons for a similar haemodynamic response may be due to similar degree of oropharyngeal stimulation by the two videolaryngoscopes, contrary to what we initial presumed it to be. It may also be due to the fact that time to successful intubation was similar between the two videolaryngoscopes. Studies have shown that the most important factor influencing the haemodynamic response was the duration of laryngosocpy [1,27].

In the present study it was also observed that the time to glottic view, intubation time, glottis visualisation and the number of attempts required for intubation were similar between the two groups.

The limitations of the present study are; it was not possible to blind the anaesthesiologist to the device used, study was conducted in patients with normal airway cannot be extrapolated to difficult airway, all intubations are done by experienced user hence may differ with novice user, pressor response in normotensive individuals cannot be extrapolated to hypertensives, and results may not apply to other anaesthetic regimen like narcotic-based approach.

Conclusion

In conclusion the haemodynamic responses to laryngoscopy and intubation with C MAC and Kingvision videolaryngoscopes were similar when used in normotensive patients with normal airway.

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