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Research Article

A Comparative Evaluation of C-MAC Video Laryngoscope and King Vision Video Laryngoscope in Patients Undergoing Tracheal Intubation with Cervical Spine Immobilization: A Prospective Randomized Study

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Abstract

Background and Aims: Many video laryngoscopes have been invented to aid intubation in anticipated and unanticipated difficult airways. In this study we aimed to compare C-MAC VL with King Vision VL in normal patients with cervical spine immobilization mimicking a scenario of cervical spine injury.

Methods: 70 ASA physical status I & II patients were randomly divided into two groups and intubated with C-MAC VL (N=35) and King Vision VL (N=35) with application of Manual Inline Axial Stabilization and Jaw thrust. The primary outcome of this study was the time taken to intubate. Number of attempts, success rate and complications were considered as secondary outcomes.

Results: The C-MAC VL took significantly less time to intubate trachea as compared to King Vision VL (p value <0.0001). Both the devices were 100% successful in achieving first attempt intubation in trachea.

Conclusion: We conclude that both devices were 100% successful in achieving first attempt intubation in patients with cervical spine immobilization. C-MAC VL was better with respect to intubation time.

Keywords: C-MAC; King Vision; Video Laryngoscope; Cervical Spine Immobilization

Introduction

Airway management is an integral part of general anesthesia and a life saving skill for anesthesiologist. During anesthesia, complications arising from failed or difficult intubation are the leading cause of mortality and morbidity, even with the recent developments in management of airway [1]. In the 4th National Audit Project (NAP) of the Royal College of Anesthetists, 133 cases of major airway complications related to general anesthesia were reported, in which 16 patients died and 3 patients had irreversible damage to brain. In 133 cases of complications, 91 were related to endotracheal tube, of which 10 patients were died/ persistently brain damaged [2]. All anesthetists should be well versed in different airway management techniques to reduce peri-operative mortality and morbidity.

Alignment of oro-pharyngeal-laryngeal axes are required for visualization of the glottis using a direct laryngoscope and are a technical skill which is difficult to acquire and maintain in all conditions. Airway management is a key concern in trauma patients with cervical spine fracture. Application of manual inline axial stabilization (MIAS) has become the standard of care in these patients for prevention of cord injury during endotracheal intubation.

In recent years video laryngoscopes are gaining popularity. Video laryngoscopes show the view of the glottis from a video camera which is positioned near the tip of the laryngoscope blade in a screen. It provides easy visualization of the vocal cords without direct line of sight. ASA has recommended video assisted laryngoscopy as an initial approach in anticipated difficult intubation [3].

Various manoeuvres and devices have been introduced, which aims at reducing the cervical spine mobility during intubation. The Advanced Trauma Life Support (ATLS) guidelines recommend the use of a rigid cervical collar or Manual Inline Stabilization (MILS) during laryngoscopy and intubation. The manual inline stabilization reduces movement of the cervical spine during laryngoscopy but significantly reduces the laryngeal view and makes intubation difficult. The application of a cervical collar and cricoid pressure further reduces the laryngeal exposure.

King vision video laryngoscope and C-MAC video laryngoscope are new entrants in this field with claimed benefit of lesser manipulation and better glottis exposure. The King Vision is a portable, reusable, durable, video display with a disposable blade [4]. On the other hand C-MAC video laryngoscope has blade similar to standard Macintosh blade.

The number of studies comparing C-MAC and King Vision on patients with cervical spine immobilization is very limited. Most of the studies are on manikins. The objective of this study was to compare between King Vision video laryngoscope and C-MAC video laryngoscope in intubating patients with cervical spine immobilisation. Intubation time was the primary objective and success rate, number of attempts and complications were the

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Table 1: Patient Characteristics.

Parameter	Group	
	C-MAC	K V
Age (yrs mean ± SD)	35.66±11.06	36.43±11.84
Sex (M:F)	9:26	9:26
BMI (Kg/m² mean± SD)	22.81±3.25	21.32±4.22
MP Grade (I:II)	12:23	13:22

secondary objectives of our study.

Methods

Following approval from the institutional ethical clearance committee. 70 ASA grade I &II patients of either sex, aged between 20-60years, BMI≤ 30kg/m^2, Mallampati class I and II, posted for elective surgery under general anesthesia during the year 2015–2017 were included in the study. Patients with predictors of difficult laryngoscopy and intubation (Inter-incisor distance <3cm, Thyro-mental distance <6cm, Any Facial anomaly, Fixed flexion deformity, Risk of pulmonary aspiration, Surgery requiring one lung ventilation) were excluded from the study. Patients were randomly divided into two groups, with each group having 35 patients, using computer based random number generator and the allocation concealed in sealed envelopes, which was not opened until the informed written consent from patient had been obtained. A single researcher performed all the intubations throughout the study period. Learning curve on each equipment was achieved by doing intubation 10 different times on manikin and in 10 different patients.

Anesthetic technique was standardised for all patients. All patients in both the groups were uniformly pre-medicated as per the institutional protocol i.e. with inj. Midazolam 0.03mg/kg IV, Ondansetron 0.10mg/kg IV and Fentanyl 1µg/kg IV. In the operating room, patients were monitored with ECG, Pulse rate, SpO_2, NIBP and $EtCO_2$ through the multichannel monitor (Nihon Kohden make). The baseline ECG, Pulse rate, SpO_2, NIBP was recorded after induction of anesthesia. After pre oxygenation, anesthesia was induced with inj. Propofol (2-2.5mg/kg). Neuromuscular blockade was achieved with Inj. Vecuronium 0.08- 0.12mg/kg. After the onset of neuromuscular block, the neck was immobilized using manual inline axial stabilisation (MIAS), which was applied by an experienced anesthetist holding both the sides of the neck and the mastoid processes, preventing extension/flexion or rotational movements of the neck. The patients were then intubated with C-MAC Video laryngoscope (Group A) or King Vision Video laryngoscope (Group B) according to the allocated group.

The C-MAC adult size blade was entered from lateral side of mouth and once it entered into oral cavity the blade was moved in the centre of cavity. Glottic structures were focused in the centre of screen, when we have an optimal view of glottis, ETT with stylet was passed through the glottis and the ETT was held in place. Subsequently the stylet and the blade were removed. The non-channelled King Vision blade was inserted in the midline of mouth, over the centre of the tongue. The view from the monitor was used after the blade was passed over the back of the tongue to position till the tip in the vallecula. The view of the glottis was optimized by elevating the blade into the vallecula for lifting the epiglottis. After that the ETT with stylet was passed through the glottis and the ETT was held in place. Subsequently, the stylet and device were removed. Patients in whom the King Vision equipment could not be inserted as a whole, the display was detached and the blade was negotiated into the oral cavity initially and subsequently the monitor was attached to view the glottis.

Table 2: Intubation Characteristics.

Intubation Parameters		No. of cases	Group C-MAC	Group K V	p Value
MP	I	25	12	13	1
	II	45	23	22	
Position	Neutral	70	35	35	1
	Sniffing	0	0	0	
Attempts	1	70	35	35	1
Procedure Time	Sec	70	25.20±5.39	32.83±5.33	**<0.0001**
Intubation Time	Sec	70	17.40±5.10	24.80±5.20	**<0.0001**
Blood on ETT	No	63	32	31	1
	Yes	7	3	4	

An intubation attempt was defined as insertion of the laryngoscope blade into the oro-pharynx, regardless of whether an attempt was made to pass the endotracheal tube [5]. In each group, intubation attempt was considered to be failed if trachea could not be intubated [6]. Intubation time was defined as the time from introduction of the blade until visual confirmation of tube passing through the vocal cords. Total procedure time was defined as time from introduction of blade until appearance of capnographic wave form. In the recovery room patients were observed for 1 hour in the post operative room and subsequently after 24 hours and complications were noted.

In this study statistical analysis was performed using Microsoft Excel Statistical package for social sciences (SPSS) latest version software. The results were presented in number, percentage, mean and standard deviation as appropriate. Since both the devices are new we assume that their performance will be similar. Hence for continuous equivalence trial we assumed α=0.05, 1-β=0.9, SD=12 and the difference in intubation time between the two device less than 10secs. The minimum number of samples was 32 in each group. However, to have a margin of safety and round the figure 35 patients in each group were included for the study. Continuous data were compared using student's t test, categorical data using Fisher exact test. Data analysis was performed on an intention to treat basis. All data are expressed as the number of patients or mean +/- SD. A P value <0.05 is considered significant.

Results

The demographic profile was similar in both the groups with respect to age, gender, BMI and Mallampati grade (Table 1). Intubation time taken with C-MAC was 17.40 ± 5.10 and with KV was 24.80 ± 5.20 (p value <0.0001). Total procedure time taken with C-MAC was 25.2 ± 5.39 sec and with KV it was 32.83 ± 5.33sec (p value <0.0001). C-MAC VL took significantly less time for successful placement of tube in trachea. Both the devices were 100% successful in first attempt endotracheal intubation (Table 2). Both devices can be used as first hand device in the scenario of cervical spine stabilization and anticipated difficult intubation.

Discussion

The management of difficult airway is one of the corner stone in routine anesthesia practice and saving lives of critically ill patients. Direct laryngoscopy with Macintosh blade requires a greater extent of cervical spine movement, which is unacceptable in trauma victims with cervical spine fracture. However there is literature which says that intubation with newer devices with video output can be done without significant cervical spine movement [7]. We are comparing two such video laryngoscopes, C-MAC and King Vision.

With C-MAC 66% patients were intubated within 30 seconds whereas with King Vision 60% were intubated within 35 seconds. The overall procedure time, mean (±SD), taken by both the devices were significantly more in comparison to that reported in earlier literature like studies by Shravanalakshmi et al [8], Ahmad et al [9], Kamal et al [10], Alvis et al [11] and Ahmad et al [12]. The possible reason for this relatively increased intubation time in our study could be due to calculation of time from insertion of instrument to appearance of waves in $EtCO_2$. Appearance of $EtCO_2$ waves took on an average 7 seconds after successful insertion of tube into trachea under vision. Insertion of tube as a second step after insertion of non channelled devices could be another reason for lengthening the procedure time. In the previous studies the authors have used channelled blade where the tube was already loaded.

Further the intubation time was significantly less ($p<0.05$) in patients intubated with C-MAC as compared to patients intubated with King Vision. This could be probably due to shape of blade, experience of the person and resolution of screen. KV blade is more angulated than the C-MAC blade [8]. C-MAC has a blade similar to Mackintosh blade which is easy to insert and is having better hand eye coordination. C-MAC is having a larger viewing angle and better display which also could be a reason for faster intubation. On the other hand angulated King Vision blade required more time for insertion. In some patients even detaching the screen and re-attaching after insertion of blade was required due to its angulation. Screen of King Vision is smaller and having lesser resolution compared to C-MAC. Also viewing angle is also reduced in KV. These all could be the reasons for taking significantly more time for intubation with KV.

Shravanalakshmi et al [8] offer similar result to our study. Intubation with the conventional C-MAC blade took lesser time as compared to non channelled King Vision. But the difference was statistically not significant. We found no other studies comparing both these non-channelled devices in patients with cervical spine immobilization.

Studies by Ahmed et al [12] (between C-MAC and Airtraq), Smereka et al [13] (C-MAC with Macintosh laryngoscope), Goksu et al [14] (C-MAC with Macintosh laryngoscope), Jain et al [15] (McCoy laryngoscope and C-MAC) demonstrated time related advantage of C-MAC compared to other devices especially in difficult airway scenarios. Alvis et al [11] (McGrath MAC VL with the King Vision VL) also offer evidence to support our study that using King Vision VL took more time.

Incidence of successful intubation in first attempt was 100% in both groups. The reason for higher success rate was probably because we studied in patients with MP I & II and also excluded all cases of anticipated difficult intubation. Our finding was similar to the previous authors [8].

The incidence of post-operative blood staining on ETT and the incidence of post operative sore throat were comparable. The occurrence of blood stained ETT in both the groups may be attributed to minor trauma due to suctioning of oropharynx which was done prior to the removal of ETT in all the cases [12].

The study had certain limitations. Even though blinding of patients were done, blinding of anesthesiologist was not possible due to entirely different size and shape of two devices. Though the sample size was decided based on the power of the study but a large sample size including all categories of patients (all age groups, emergency/elective, ASA all classes, MP I-IV etc.) may give a different picture. The study was conducted on elective surgical patients with no predictors of difficult intubation so the results cannot be extrapolated in trauma patients with cervical spine fracture.

Conclusion

We conclude that in the setting of cervical spine immobilization both C-MAC VL and King Vision VL had satisfactory intubation performances. The C-MAC VL took significantly less time to intubate trachea as compared to King Vision VL (p value<0.0001). The two devices did not differ in terms of complications like trauma and incidence of sore throat. Changes in heart rate and MABP were similar in both the groups following intubation.

Further comparative studies with larger sample size are needed to evaluate the intubation characteristics, hemodynamic changes and complications between these two devices. More studies are required especially in patients with predicted difficult intubation and with coexisting morbidities.

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