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Comparative Study of Intubation Performance between Macintosh, the Channeled King Vision and the C-MAC D-Blade Videolaryngoscope in Controlled Hypertensive Patients

Mona Mohamed Mogahed*, Mona Raafat Elghamri and Atteia Gad Anwar

Faculty of Medicine, Tanta University, Tanta, Egypt

***Corresponding Author:** Mona Mohamed Mogahed, Faculty of Medicine, Tanta University, Tanta, Egypt, Tel: 00964-750-709-9773; Email: monamogahedfr@hotmail.com

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Abstract

Background: The common source of anesthesia related injury is failure of tracheal intubation. Video laryngoscopes offer an enlarged video glottic view while intubating the trachea. The purpose of this study is to compare efficacy of intubation by Macintosh with C-MAC D-Blade and King Vision video laryngoscope (VL) in controlled hypertensive patients.

Patients and methods: 105 (ASA) II patients (ages 35 to 60) were planned for elective surgery under general anesthesia was enrolled in this prospective randomized single blinded study. Patients were divided into three equal groups (35 patients each): Macintosh (M), C-MAC (C), and King Vision (K). Record of intubation time was the primary goal. Heart rate, MBP, SpO_2, $EtCO_2$ were recorded at T1: before induction of anesthesia; T2: just before intubation; T3:2 min after intubation; T4:5 min after intubation. The number of intubation attempts, ease of laryngoscopy insertion, Quality of view, Assist maneuvers, Intubation difficulty and Complications were recorded.

Results: Significant short time of intubation in group C (28.6 ± 5.95 sec) and K (27.2 ± 6.63 sec) compared with group M (33.74 ± 7.23 sec; P=0.001) with less attempts of intubation in group K. Heart rate and MBP significantly increased in group M compared to C and K groups at T3 and T4 (P=0.001).Easier laryngoscopy insertion in group M but quality of glottis view significantly better in group K (grade I; P=0.041). Easy intubation by IDS was more in group K with no assist maneuvers and less complication than group M and C.

Conclusion: Video laryngoscopes need short time to achieve successful intubation, offer hemodynamic stability and better quality of glottic view than Macintosh during intubation. King Vision VL less frequently need assist maneuvers, so facilitates intubation with less complication. Thus, it is advantageous to use King Vision for intubation in hypertensive patients.

Keywords: Video laryngoscopy; Tracheal intubation; Controlled hypertension

Introduction

Direct laryngoscope and passage of endotracheal tube through the larynx is a noxious stimulus, which can provoke untoward response in the cardiovascular, respiratory and other physiological systems [1]. The peak elevation in blood pressure and heart rate within one to two minutes and are usually well tolerated. However, in patients with hypertension, coronary artery disease or cerebral vascular disease, the hypertension and tachycardia are hazardous as it is associated with rise in myocardial oxygen demand, decrease in oxygen supply, the possibility of cardiac arrhythmia, myocardial ischemia and cerebral vascular accident [2].

These complications are serious enough in normotensive patients, but an exaggerated response has been reported in hypertensive patients, whether treated before or not. Majority of these stimuli arise from the stimulation of the supraglottic region by tissue tension induced by laryngoscope. Placement of endotracheal tube and inflation of the cuff in the subglottic region produces a smaller response [3].

Perioperative myocardial ischemia that develops in the presence of hemodynamic disturbances is associated with tachycardia rather than hypotension or hypertension [4]. The concern for patient safety in the operating room and critical care areas has led to the development of new technologies, training in the simulation environment, evidence-based algorithms and perioperative checklists.

Over 20 years back, American Society of Anesthesiologists (ASA) closed claims analysis concluded that the main reason of anesthesia related injury was the inability to intubate the trachea and secure the airway [3]. With advanced digital technology and complementary metal oxide semiconductors (CMOS) video chip was produced by a number of manufacturers. This led to the development of the video laryngoscopes to see the glottis while intubating the trachea.

The Glide Scope was one of the technologically advanced video devices, which was created in 2001 by a vascular and a general specialist, John Pacey of Canada [5]. The video laryngoscope can present an enlarged video image of airway structures. While using conventional laryngoscopy presents a limited view of the airway structures, which may be obscured during attempts to intubate the trachea so, endotracheal tube (ETT) may slip into esophagus [6].

Both direct laryngoscopes (DL) and video-laryngoscopes (VLs) compromise of a handle and a blade, yet there is a video camera is fitted at the end of the blade of video laryngoscope, facilitating visualization of the glottis indirectly on a screen. Both types of laryngoscopes have common features, so that physicians who are familiar to use DL can use VLs with minimal added training. Video-laryngoscopes provide a wide angle image and reduce need of alignment of the oral, pharyngeal, and tracheal axes [7].

The improved view due to a magnified video image, anterior curvature of the blade, or reduced need to align a direct visual alignment. While DL may be associated with intubation failure when a laryngeal view cannot be achieved, VL frequently overcomes this obstacle. Improved laryngeal view does not mean increased intubation success. Since the success rate of intubation by DL on a normal airway is high [8]. An improved laryngeal view is mandatory to successfully intubate patients at risk for poor laryngeal view with DL [9].

C-Mac video laryngoscope is a portable laryngoscope with standard Macintosh blade designs and a metal oxide semiconductor video chip at the tip of the blade that extends a 60° optical axis in the vertical plane to a video screen [10].

King Vision video laryngoscope is the most recent and portable airway device. It provides high quality image of airway structure which is displayed on a video screen to facilitate visualization [11]. It is an indirect laryngoscope that provides a view of the glottis without alignment of the oral, pharyngeal and tracheal axes [12].

King Vision video laryngoscope compromises of a 2.4-inch reusable display and a disposable rigid blade. There are two blade types: one is a channeled blade that permits tracheal tube to be passed through the glottis, and the other is a non-channeled blade which just allows visualization of the glottis, and intubation is facilitated by use of a metal stylet [13].

The aim of this study is to compare efficacy of intubation by Macintosh laryngoscope compared with C-MAC D-Blade and King Vision video laryngoscope in controlled hypertensive patients scheduled for elective general surgery procedures.

Patients and Methods

With institutional ethics committee's approval and informed written consent, this prospective single blinded randomized study was carried out on 105 patients scheduled for elective surgery to compare efficacy of intubation by Macintosh laryngoscope with C-MAC D- Blade and King Vision video laryngoscope. We included (ASA) II controlled hypertensive patients of 35-60 years of age undergoing elective surgical procedures under general anesthesia. Patients with risk of gastric aspiration, anticipated difficult intubation (interincisor distance less than 3 cm, Mallampati classes III and IV, thyromental distance of less than 6 cm), history of epilepsy, or history of myocardial infarction were excluded.

Patients were randomly allocated into 3 equal groups (35 patients each) where laryngoscopy was done either with Macintosh (M group) , C-MAC D-Blade (Karl Storz, Tuttlingen, Germany) (C group) or King Vision videolaryngoscope (King Systems, Indianapolis, IN, USA) (K group).

Randomization was done using a computer generated schedule and opaque, sealed envelopes. Patients remained blinded about their intubation technique until post-operative assessment was completed. A nurse not included in the study made group allocation. Anesthesia team remained blinded until the patient entered the operating room and randomization envelop was opened.

Tracheal intubation was performed by one of the three anesthesiologists who performed at least 30 intubations with the new device in the clinical setting prior to the study.

All the patients received their antihypertensive medications till the morning of surgery. All the patients premedicated with diazepam (10 mg) orally at midnight and 30 min before surgery.

The Patient was placed in the sniffing position with monitoring (Cardiocaps/5; DatexOhmeda, Helsinki, Finland) included electrocardiogram, pulse oximetry, capnogram, non-invasive blood pressure, and neuromuscular monitoring with train-of-four.

Anesthesia was induced with fentanyl 2 μg/kg, propofol 2 mg/kg, and rocuronium 0.6 mg/kg. Mask ventilation was initiated using 100% Oxygen and after ensuring full muscle relaxation as assessed by a nerve stimulator, orotracheal intubation was performed using the selected intubation device for each group. Anesthesia was maintained with isoflurane 1-2%. Tachycardia or hypertension, defined as increase in heart rate or blood pressure by 20% more than baseline records, after intubation was managed with a bolus dose of fentanyl 50-100 μg and by increasing the concentration of isoflurane followed by nitroglycerine infusion. No local anesthetic (lignocaine) was used either as laryngotracheal spray or by intravenous route. No other medications administered or procedures performed during the five min data collection period after tracheal intubation.

The heart rate, mean blood pressure, SpO_2, end tidal carbon dioxide ($EtCO_2$) were recorded at 4 intervals namely T1: baseline (before induction); T2: just before intubation attempt; T3: 2 min after intubation; T4: 5 min after intubation.

Primary goal was to measure the time required to successful intubation. Intubation time was defined as the time taken for insertion of the blade between the teeth till the tracheal tube cuff passed through the vocal cords. Failure of intubation was defined as any intubation attempt of >120 s or inability to intubate.

Secondary goals were to measure:

Number of intubation attempts

Ease of laryngoscope insertion

Quality of view by Cormack and Lehane grade [9].

Assist maneuvers.

Intubation difficult score indicates the degree of difficulty of intubation (Table 1) using 7 parameters (0=easy intubation, 0<IDS ≤ 5=slight difficulty, 5<IDS=moderate to major difficulty, IDS=∞ impossible intubation) [14].

Complications such as bleeding, trauma to lips, teeth, tongue or airway, esophageal intubation, desaturation, or bronchospasm.

Sample size

The sample size was calculated using Epi-Info software statistical package created by World Health organization and center for Disease Control and Prevention, Atlanta, Georgia, USA version 2002. The sample size was calculated at N=35.

The criteria used for sample size calculation were as follows:

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95% confidence limit

80% power

The ratio between experimental and control groups is 1:1

Statistical analysis

The full detailed form is: SPSS 20, IBM, Armonk, NY, United States of America.

Quantitative data were expressed as mean ± standard deviation (SD). Qualitative data were expressed as frequency and percentage.

A one-way analysis of variance (ANOVA) when comparing between more than two means.

Chi-square (X^2) test of significance was used in order to compare proportions between two qualitative parameters.

S. No	Intubation difficulty scale (IDS)
1	N1-Number of intubation attempts (Each supplementary attempts add 1 point)
2	N2-Number of operators (Each additional operator add 1 point)
3	N3-Alternative technique used (Like bougie add 1 point)
4	N4-Glottic exposure (CL grade) [Grade minus one (grade 1=0, grade 2=1, grade 3=2, grade 4=3)]
5	N5-Lifting force applied (Normal=0, increased=1)
6	N6-External pressure applied (N0=0, yes=1)
7	N7-Vocal cord position at intubation (Abducted=0, adducted=1)

Table 1: Intubation difficult score.

Results

The sample size was chosen after reviewing many randomized control studies on the same subject. One hundred and five patients were included in the current study. The demographic data of the study group M, C and K are presented in Table 2. No statistically significant difference among groups.

Factor		M (N=35)	C (N=35)	K (N=35)	p value
Age	Range	35–60	35–60	35–60	0.719
	Mean ± S. D	45.89 ± 7.40	47.31 ± 7.45	46.31 ± 7.75	
Sex	Male	18 (51.4%)	21 (60%)	15 (42.9%)	0.357
	Female	17 (48.6%)	14 (40%)	20 (57.1%)	
BMI		31.27 ± 3.56	30.75 ± 2.14	30.14 ± 1.85	0.205
Data of age and BMI are expressed as mean and standard deviation					

Table 2: Demographic data of the study groups.

Significantly prolonged timed required to achieve 1st successful intubation was found in group M (33.74 ± 7.23 sec) compared to group C (28.06 ± 5.95 sec) and group K (27.20 ± 6.63 sec) (P=0.001) with no significant differences between group C and group K .The success of first trial of intubation was achieved more with King Vision VL but with no statistical significance among three groups (Table 3).

		M (n=35)	C (n=35)	K (n=35)	p-value	P1	P2	P3
Time to 1st successful intubation (sec)	Range	20-45	18-35	15-35	0.001*	0.001*	0.001*	0.589
	Mean ± S. D	33.74 ± 7.23	28.06 ± 5.95	27.20 ± 6.63				
Intubation success	1st attempt (%)	32 (91.4%)	30 (85.7%)	33 (94.3%)	0.461			
	2nd attempt (%)	3 (8.6%)	5 (14.3%)	2 (5.7%)				
*Statistically significant (p value of statistical significant <0.05). Data of time are expressed as mean and standard deviation. Numbers of intubation attempts are expressed as percentage.								

Table 3: Comparison of time taken to achieve 1st successful intubation and number of attempts in group M, C and K.

Regards heart rate and MBP, were significantly increased in group M at T3 and T4 compared to group C and group K (P=0.001) with no significant difference between group C and K as shown in (Figures 1 and 2 respectively).

No statistical significance between three groups regarding oxygen saturation and end tidal carbon dioxide as shown in (Figures 3 and 4 respectively).

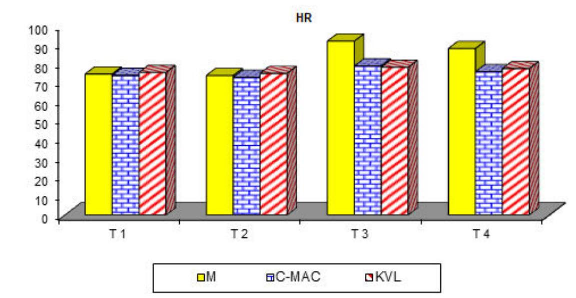

Figure1: Comparison of heart rate between M, C and K groups.

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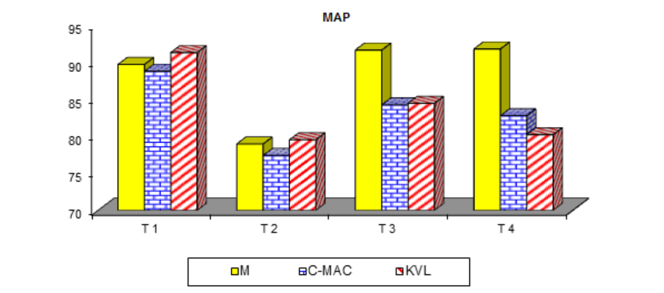

Figure 2: Comparison of mean blood pressure between M, C and K groups.

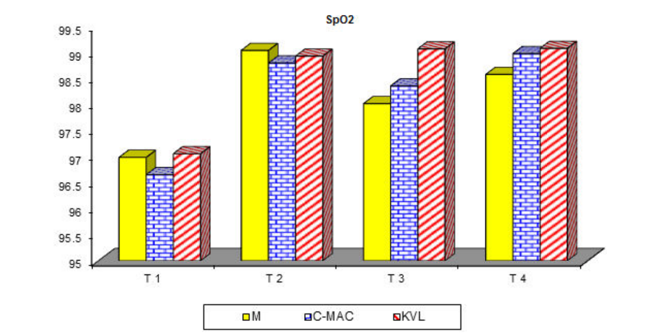

Figure 3: Comparison of oxygen saturation in M, C, and K groups.

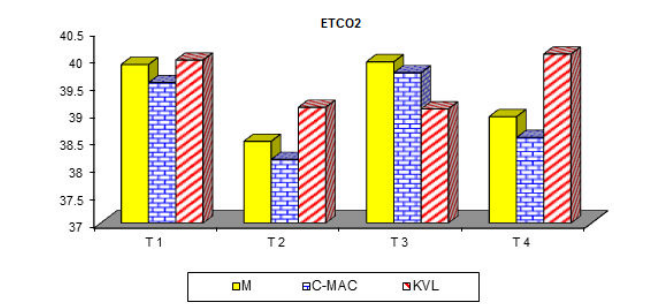

Figure 4: Comparison of end tidal carbon dioxide in M, C, and K groups.

The Quality of glottic view evaluated using C L grade was significantly improved in group K compared to group M and C (C L grade 1 was 82.9%, 57.1%, 77.1%) respectively (P=0.041) with no differences between all groups with C L grade 2 and 3. No failure of intubation was obtained (Table 4).

		M (n=35)	C-MAC (n=35)	KVL (n=35)	p-value
Quality of view (Cormack and Lehane grade)	1	20 (57.1%)	27 (77.1%)	29 (82.9%)	0.041*
	2	11 (31.4%)	6 (17.1%)	6 (17.1%)	0.249
	3	4 (11.4%)	2 (5.8%)	0 (0%)	0.12
	4	0 (0%)	0 (0%)	0 (0%)	-
Failure of intubation	Range	0	0	0	
	Mean ± S. D				

Table 4: Comparison of quality of laryngoscopic view by Cormack and Lehane grade between M, C and K groups. *Statistically significant (p value of statistical significant <0.05).

Insertion of laryngoscopic blade was more easy with Macintosh while, significant difficulty of insertion of videolaryngoscopes was observed in group C and group K (14.3% and 2.9% respectively) P=0.024 (Table 5).

Ease of insertion of laryngoscope	M (n=35)	C-MAC (n=35)	KVL (n=35)	p-value
Very easy	24 (68.6%)	16 (45.7%)	20 (57.1%)	0.155
Easy	11 (31.4%)	14 (40%)	14 (40%)	0.693
Don't know	0 (0%)	0 (0%)	0 (0%)	-
Difficult	0 (0%)	5 (14.3%)	1 (2.9%)	0.024*
Very difficult	0 (0%)	0 (0%)	0 (0%)	-

Table 5: Comparison of ease of insertion of laryngoscopic blade between group M, C and K. *Statistically significant (p value of statistical significant <0.05).

Degree of difficulty of intubation was evaluated by using intubation difficulty score (IDS). More easy intubation was obtained in group K (82.9%) than group C and group M (74.3% and 57.1%) respectively with no statistical significance between all groups (Figure 5).

No assist maneuvers were used in group K. While, significant difference between group M and group C when using external laryngeal manipulation during intubation (P=0.001) with increased intubation aided by bougie in group M compared to group C (P=0.015). Also, significantly increased lifting force was found more in group M (25.7%) compared to group C (8.6%) and no need to increase lifting force for intubation in group K (P=0.003) as shown in (Table 6).

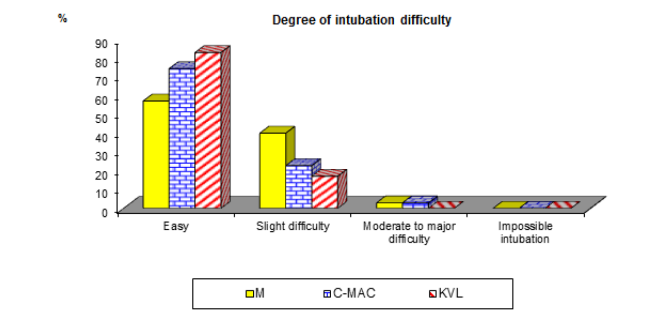

Figure 5: Comparison of difficulty of intubation using three different laryngoscopic blades in group M, C and K (intubation difficult score).

Assist maneuver		M (n=35)	C-MAC (n=35)	KVL (n=35)	p-value
External laryngeal manipulation		9 (25.7%)	0 (0%)	0 (0%)	0.001*
Aided by bougie		4 (11.4%)	6 (14.3%)	0 (0%)	0.015*
Changing blade size		1 (2.9%)	2 (5.7%)	0 (0%)	0.357
Lifting force applied	Normal	26 (74.3%)	32 (91.4%)	35 (100%)	0.003*
	Increased	9 (25.7%)	3 (8.6%)	0 (0%)	

Table 6: Comparison of using assist maneuvers during tracheal intubation in group M, C and K. *statistically significant (p value of statistical significant <0.05).

Some complications were recorded without differences. Three patients with sore throat and 2 patients with lip injury when using C MAC while only 2 patients with sore throat when using King Vision VL. Seven patients with sore throat and one patient with lip injury when using Macintosh laryngoscope (Table 7).

Complications	M	C	K	P-value
Sore throat	7 (20%)	3 (8.6%)	2 (5.7%)	0.393
Lip/teeth/tongue/airway injury	1 (2.9%)	2 (5.7%)	0 (0%)	0.357
Esophageal intubation	0 (0%)	0 (0%)	0 (0%)	-
Desaturation	0 (0%)	0 (0%)	0 (0%)	-
Bronchospasm	0 (0%)	0 (0%)	0 (0%)	-

Table 7: Comparison of occurrence of complications during intubation in group M, C and K.

Discussion

Laryngoscopy and tracheal intubation are accompanied with hemodynamic changes. [15]. Hypertensive patients have an exaggerated hemodynamic stress response compared with normotensive patients [16].

Short time of intubation with fewer attempts when using King Vision video laryngoscope compared with C MAC and Macintosh laryngoscope. Different results obtained by DA Sun et al. [8] as they demonstrated that the average time of intubation was longer with glidescope compared with direct laryngoscopy for elective surgery because of the technique required to manipulate the stylet and endotracheal tube through the vocal cords.

In agreement with our results Marrel et al. [17] who documented that shorter duration of intubation with improved glottis view when using Video laryngoscopy compared to direct laryngoscope. Although, Griesdale et al. [18] found regarding successful first-attempt intubation or time to intubation was not different when they compared Glidescope video-laryngoscopy with direct laryngoscopy for endotracheal intubation.

Against our results, M. Kleine-Brueggeney et al. [19] they showed that First-attempt success rate of intubation were better with C-MAC than King Vision laryngoscope. Different results demonstrated by Laurel D Murphy, et al. [20] who reported in their study that time of intubation was not different when compared King Vision to Macintosh laryngoscope in normal and difficult airways.

Videolaryngoscope maintained hemodynamic stability during intubation than Macintosh and it is of clinical importance especially in hypertensive patients. This is in agreement with, Elhadi et al. [12] their study demonstrated that the KVL maintains hemodynamic stability during endotracheal intubation.

Different results obtained by Kanchi et al. [21] in their study hemodynamic changes were not different between the groups. They concluded that video laryngoscopy did not provide any benefit in hemodynamic response to laryngoscopy and intubation.

Better glottic view, evaluated by Cormack and Lehane grade, was obtained by King Vision than C MAC and Macintosh laryngoscope. Similar results obtained by Valencia, et al. [22] when compared King Vision VL and direct laryngoscopy; they found significant improvement of glottic view by King Vision VL in patients without predictors of difficult airway.

Cooper RM, et al. [5] in their study to evaluate glidescope video laryngoscope documented a significantly failed intubations occurred despite good or excellent glottic visualization. So, an improved laryngeal view does not always mean an easy and successful intubation.

Easier insertion of Macintosh blade than C MAC and King Vision VL. This may be owing to differences in the curvatures of the three laryngoscopic blades. In agreement with our results, Shravanalakshmi, et al. [23] as they observed higher grades of difficulty for insertion of laryngoscope with use of C-MAC D blade as compared to conventional C-MAC and King Vision laryngoscope. The angulation of the blades of VL is higher as compared to conventional blade. The KVL blade was easier to insert as compared to D blade C MAC video laryngoscope.

While, Cooper et al. [5] during their study found that some anesthetists repeatedly experienced intubation challenging while others did not. It is may be due to the unfamiliar technique of manipulating the ETT while viewing the events on the monitor. In our study, easy intubation (based on intubation difficult score) was observed with King Vision than with D blade of CMAC and Macintosh laryngoscope with no statistical significant difference.

Evaluation of ease of intubation was done by using IDS. Easier intubation with lower IDS scores was achieved by using King Vision compared to C-MAC and Macintosh. Andersen, et al. [24] found IDS scores to be lower when using the glidescope than with direct laryngoscopy. The reductions in IDS scores were largely attributable to improved glottic views and less frequent need of applying substantial lifting force on the laryngoscope.

No optimizing maneuvers were used to aid intubation with King Vision laryngoscope and no need to increase lifting force on the blade of KVVL. Similar results obtained by Michael F Aziz et al. [10] in their study, The use of a gum-elastic bougie or external laryngeal manipulation (or both) was required less with C-MAC compared with direct laryngoscope .

In agreement with our results, Elhadi et al. [12] in their study to compare King Vision with Macintosh laryngoscope, reported that The

KVL needed less optimization maneuvers, showing that it offered easier intubating conditions.

Also, Andersen. Et al. [24] found less frequent need of applying substantial lifting force on the laryngoscope. In contrast to our study, Sarkilar et al. [25] conducted their study on video and direct laryngoscopy; they found the glottic view was better with use of video laryngoscope, whereas the use of a stylet, external pressure, and the number of trials of intubation were similar in both groups.

More complications were observed when using Macintosh laryngoscope. While, less complications occurred with King Vision than C-MAC VL which is of clinical importance but with no statistical significance. In agreement with our results QE Ali et al. [26] observed less airway trauma when using KVL which may relate to the absence of laryngoscopy like maneuver and has softer blade material. Disagreeing with our results, Jagannathan et al. [27] reported that Complications were not different between devices when compared King Vision VL with the Miller laryngoscope. Moreover, Soliman et al. [2] noted that incidence of oral trauma and bleeding related to intubation was higher with glidescope than with Macintosh laryngoscope.

Conclusion

Use of video laryngoscopes provides better intubation circumstances when compared with Macintosh laryngoscope. Shorter time with less attempts of intubation by video laryngoscopes as they offer better quality of glottic view, better hemodynamic response to intubation, and less complications. Also, the design of both King Vision VL and Macintosh laryngoscope shares common features permitting physicians skilled with the latter to use King Vision VL with minimal added training but, still the coast is a considerable factor. Thus it is advantageous to use it for intubation of hypertensive patients.

Limitations

There are few limitations to this study. First, the study was single blinded. Second, it was difficult to homogenize some patient's factors while conducting the study on hypertensive patients such as drug therapy which may affect hemodynamics. Third, small sample size so, further studies need to be conducting on large scale of population.

References

1. Henderson J (2010) Airway Management in the Adult. In: R.D. M, editor. Miller's Anesthesia 7 th ed. Philadelphia: Churchill livingstone 1573-1610.
2. Soliman R, Mofeed M, Alamoudy O, Farouk A (2015) A prospective randomized comparative study between Macintosh and GlideScope in adult patients undergoing cardiac surgery. Egypt J Cardiothorac Anesth 9: 8-13.
3. Vanilla Chopra VG, Abdul Qayoom Lone, Imtiaz A. Naqash (2017) Comparison of haemodynamic changes in response to endotracheal intubation and laryngeal mask airway in controlled hypertensive patients- a randomized study. J Evolution Med Dent Sci 6: 1313-1316.
4. Slogoff S, Keats AS (2006) Myocardial ischemia revisited. Anesthesiology 105: 214-216.
5. Cooper RM, Pacey JA, Bishop MJ, McCluskey SA (2005) Early clinical experience with a new videolaryngoscope (GlideScope®) in 728 patients. Can J Anesth 52: 191-198.
6. Channa AB (2011) Video laryngoscopes. Saudi J Anaesth 5: 357-359.
7. Paolini JB, Donati F, Drolet P (2013) Review article: video-laryngoscopy: another tool for difficult intubation or a new paradigm in airway management? Can J Anaesth 60: 184-191.
8. Sun DA, Warriner CB, Parsons DG, Klein R, Umedaly HS, et al. (2005) The GlideScope® Video Laryngoscope: randomized clinical trial in 200 patients. Br J Anaesth 94: 381-384.
9. Krage R, van Rijn C, van Groeningen D, Loer SA, Schwarte LA, et al. (2013) Cormack-Lehane classification revisited. Br J Anaesth 105: 220-227.
10. Aziz MF, Dillman D, Fu R, Brambrink AM (2012) Comparative effectiveness of the C-MAC video laryngoscope versus direct laryngoscopy in the setting of the predicted difficult airway. Anesthesiology 116: 629-36.
11. Kamal S, Ali QE, Amir SH, Ahmed S, Pal K (2016) King Vision video laryngoscope versus Lightwand as an intubating device in adult patients with Mallampatti grade III and IV patients. J Clin Anesth 34: 483-489.
12. Elhadi SM, Rady WK, Elfadly AM (2016) A comparative study between the macintosh laryngoscope and the king vision video laryngoscope in endotracheal intubation. Research and Opinion in Anesthesia and Intensive Care 3: 168.
13. Akihisa Y, Maruyama K, Koyama Y, Yamada R, Ogura A, et al. (2014) Comparison of intubation performance between the King Vision and Macintosh laryngoscopes in novice personnel: a randomized, crossover manikin study. J Anesth 28: 51-57.
14. Frederic Adnet, Stephen W Borron, Stephane X Racine, Jean-Luc Clemessy, Jean-Luc Fournier (1997) The intubation difficulty scale (IDS): proposal and evaluation of a new score characterizing the complexity of endotracheal intubation. Anesthesiology 87: 1290-1297.
15. Lee CW, Kim M (2017) Effects of preanesthetic dexmedetomidine on hemodynamic responses to endotracheal intubation in elderly patients undergoing treatment for hypertension: a randomized, double-blinded trial. Korean J Anesthesiol 70: 39-45.
16. Kihara S, Brimacombe J, Yaguchi Y, Watanabe S, Taguchi N, et al.. (2003) Hemodynamic Responses among Three Tracheal Intubation Devices in Normotensive and Hypertensive Patients. Anesth Analg 96: 890-895.
17. Marrel J, Blanc C, Frascarolo P, Magnusson L (2007) Videolaryngoscopy improves intubation condition in morbidly obese patients. Eur J Anaesthesiol 24: 1045-1049.
18. Griesdale DE, Liu D, McKinneymJ, Choi PT (2012) Glidescope video-laryngoscopy versus direct laryngoscopy for endotracheal intubation: a systematic review and meta-analysis. Can J Anesth 59: 41-52.
19. Kleine-Brueggeney M, Greif R, Schoettker P, Savoldelli GL, Nabecker S (2017) Evaluation of six videolaryngoscopes in 720 patients with a simulated difficult airway: a multicentre randomized controlled trial. Br J Anaesthe.116: 670-679.
20. Laurel D Murphy, George J Kovacs, Peter M.Reardon, John Adam Law (2014) Comparison of the King Vision Video Laryngoscope with the Macintosh Laryngoscope. J Emerg Med 47: 239-246.
21. Muralidhar Kanchi, Hema C Nair, Sanjay Banakal, Keshava Murthy, Murugesan C (2011) Haemodynamic response to endotracheal intubation in coronary artery disease: Direct versus video laryngoscopy. Indian J Anaesth 55: 260-265.
22. Valencia JA, Pimienta K, Cohen D, Benitez D, Romero D, et al. (2016) A comparison of King Vision video laryngoscopy and direct laryngoscopy as performed by residents: a randomized controlled trial. J Clin Anesth 35: 571-575.
23. Shravanalakshmi D, Prasanna U. Bidkar, K. Narmadalakshmi, Suman Lata, et al. (2017) Comparison of intubation success and glottic visualization using King Vision and C-MAC videolaryngoscopes in patients with cervical spine injuries with cervical immobilization: A randomized clinical trial. Surg Neurol Int 8: 19-25.
24. LH Andersen, L Rovsing, KS Olsen (2011) GlideScope videolaryngoscope vs. Macintosh direct laryngoscope for intubation of morbidly obese patients: a randomized trial. Acta Anaesthesiol Scand 55: 1090-1097.
25. Sarkilar G, Sargin M, Saritas TB, Borazan H, Gök F, et al. (2015) Hemodynamic responses to endotracheal intubation performed with video and direct laryngoscopy in patients scheduled for major cardiac surgery. Int J Clin Exp Med 8: 11477-11483.

26. Ali QE, Amir SH, Jamil S, Ahmad S (2015) A comparative evaluation of the Airtraq and King Vision video laryngoscope as an intubating aid in adult patients. Acta Anaesthesiol Belg 66: 81-85.

27. Jagannathan N, Hajduk J, Sohn L, Huang A, Sawardekar A, et al. (2017) Randomized equivalence trial of the King Vision aBlade videolaryngoscope with the Miller direct laryngoscope for routine tracheal intubation in children <2 yr of age. Br J Anaesth 118: 932-937.