Original Article

Evaluation of the use of the channeled King Vision video laryngoscope in improving glottic visualisation in patients with limited glottic view with the Macintosh laryngoscope: A prospective observational study

Address for correspondence:
Dr. Jaya Choudhary, Department of Anaesthesiology and Pain Medicine, Medica Superspecialty Hospital, Kolkata - 700 099, West Bengal, India.
E-mail: jayachoudhry11@gmail.com

Submitted: 06-Oct-2021
Revised: 12-Nov-2021
Accepted: 05-Dec-2021
Published: 22-Dec-2021

Access this article online
Website: www.ijaweb.org
DOI: 10.4103/ija.ija_905_21
Quick response code

Jaya Choudhary, Arijit Kumar Barai, Sandip Das, Nirjhar Mukherjee
Department of Anaesthesiology and Pain Medicine, Medica Superspeciality Hospital, Kolkata, West Bengal, India

ABSTRACT

Background and Aims: The role of King Vision videolaryngoscope (KVL) is well known in the anticipated difficult airway. However, its performance in patients with unanticipated restricted view of the glottis has never been investigated. The aim of this study was to evaluate the performance of KVL in patients with limited glottic view (POGO score <50%). **Methods:** Eighty-five patients fulfilling the inclusion criteria were included in this study. Laryngoscopy was performed in each patient with Macintosh blade followed by the channeled KVL. The laryngeal view obtained with each device was recorded using POGO score and Cormack--Lehane (CL) grade. After that, endotracheal intubation was attempted with the KVL. The haemodynamic parameters, the time taken for endotracheal tube placement and intubation, failure to intubate, modified intubation difficulty score and airway complications were also recorded. **Results:** There was a statistically significant improvement in the POGO scores with the use of KVL: 20 (0,40) vs 90 (40,100) ($P < 0.001$). The frequency of CL grade I and II increased from 63% with conventional laryngoscopy to 100% with the KVL. Although the time taken to obtain the best glottic view was significantly longer with the KVL as compared to the Macintosh blade ($P < 0.001$), the first attempt success rate was 97.65%. **Conclusion:** Channeled KVL when used by experienced operators provides superior laryngeal view as compared to Macintosh laryngoscope in patients with restricted glottic view (POGO score <50%) without any major airway complications.

Key words: Airway management, endotracheal intubation, laryngoscope

INTRODUCTION

The superiority of the video laryngoscopes over the conventional Macintosh laryngoscope is well established in the routine as well as the anticipated difficult airway scenario.[1,2] The major advantages obtained with the videolaryngoscopes include better glottic view, higher first attempt intubation success rate, reduced rate of airway trauma and successful rescue after failure with conventional laryngoscopy.[3]

However, most of these benefits have been described in either the patients with normal airway or an anticipated difficult airway. At present, the evidence regarding the efficacy of the videolaryngoscopes in improving the laryngeal view in patients with unanticipated difficult intubation is limited to C- MAC.[4] However, there are marked differences in the anatomical characteristics

How to cite this article: Choudhary J, Barai AK, Das S, Mukherjee N. Evaluation of the use of the channeled King Vision video laryngoscope in improving glottic visualisation in patients with limited glottic view with the Macintosh laryngoscope: A prospective observational study. Indian J Anaesth 2021;65:874-9.

and optical parameters of different devices and therefore each device requires individual evaluation.

The channeled King Vision video laryngoscope (KVL) [Ambu, USA] has a rigid blade with an integrated channel for introducing the endotracheal tube. Several simulation based and clinical studies have documented the efficacy of KVL in the anticipated difficult airways.[5,6] We conducted this study to evaluate the hypothesis that KVL has the potential to improve the laryngeal view in patients with a percentage of glottic opening (POGO) score <50% during direct laryngoscopy.

The primary outcome measure of this study was to compare the laryngeal view obtained with Macintosh laryngoscope vs KVL in each patient. The secondary outcomes recorded were the time required to get the best glottic view with the two devices and the intubation parameters including the time required for placement of the endotracheal tube, the time required for intubation, the modified intubation difficulty score and the airway complications recorded with KVL.

METHODS

This prospective, observational study was conducted at our tertiary care hospital between October 2020 and May 2021 after obtaining approval from the institutional ethics committee [CREC/2020/Sep/1(i)] and registration in Clinical Trials Registry-India (CTRI/2020/11/029322). A written informed consent was obtained from all subjects participating in the study. The patients between 18 and 70 years of age, American Society of Anesthesiologists (ASA) physical status I--III, scheduled for elective surgery under general anaesthesia with POGO score <50% were included in the study. The exclusion criteria were patient refusal, pregnancy, predictors of difficult airway (oropharyngeal pathologies, body mass index >35 kg/m^2, limited cervical spine mobility, restricted mouth opening, history of difficult laryngoscopy or intubation), high risk of aspiration (full stomach, emergency surgeries, hiatus hernia, gastro-oesophageal reflux).

A detailed pre-anaesthetic airway evaluation was carried out for each patient prior to enrolment into the study. In the operation theatre, the standard ASA monitors were attached to each patient. After preoxygenation, induction was carried out with intravenous 2 μg/kg fentanyl and 2-2.5 mg/kg propofol. Adequate mask ventilation was confirmed and 0.6 mg/kg atracurium was administered. Direct laryngoscopy was performed and the best view of the larynx obtained without any external laryngeal manipulation was noted using the POGO score (100% POGO = full view of glottis from anterior commissure to interarytenoid notch, 0 = even the interarytenoid notch is not seen)[7] and Cormack--Lehane grade (I = full view of vocal cords, II = only posterior part of the larynx visible, III = only epiglottis visible, IV = neither epiglottis nor glottis seen).[8] The patients with POGO score less than 50% were included in the study. Mask ventilation was continued with oxygen in sevoflurane and appropriate size endotracheal tube was loaded in the channeled KVL blade size 3. Bolus doses of propofol were given before attempting laryngoscopy with KVL to suppress the stress response. The blade was inserted from the midline, and once the tip crossed the base of the tongue, it was lifted to visualise the glottis. The best laryngeal view obtained without external laryngeal manipulation was recorded for KVL. Each laryngoscopy was performed by a senior anaesthesiologist with an experience of at least 25 intubations with channeled KVL. The time required to obtain the best glottic view was taken as the time elapsed from the introduction of the laryngoscope blade past the lips to the best possible visualisation of the glottis. The endotracheal tube was advanced through the glottis under vision and the time period between the initiation of tube insertion to the appearance of first end tidal carbon dioxide trace was recorded as time required for the tube placement. The time taken for intubation was measured as the time between the introduction of the blade past the lips to the appearance of first end tidal carbon dioxide trace. Failure to intubate was defined as more than two intubation attempts or oxygen saturation < 95% or failure to intubate within 60 seconds. In case of failure to intubate, further airway management was carried out as per the All India Difficult Airway Association (AIDAA) guidelines.[9] The ease of intubation was assessed using modified intubation difficulty score (mIDS) N1- no of intubation attempts, N2 - no of operators, N3 - alternative technique used, N4 - glottic exposure (CL grade) N5 - lifting force applied, N6 - external force applied, N7 - vocal cord position at intubation.[10] Haemodynamic parameters were recorded at regular intervals during the airway management.

After successful intubation, anaesthesia was maintained with sevoflurane in oxygen and air. At

the end of the procedure, patients were extubated and complications such as bronchospasm, laryngospasm, oro-pharyngeal injury, postoperative hoarseness and sore throat were recorded.

The sample size estimation was based on the calculation that 80 subjects were required to obtain a 95% confidence interval with 6% precision for the improvement of the POGO score. Based on a previous study, the prevalence of POGO score less than 50% was taken as 8%.[11] We studied 85 patients to compensate for any drop out. Continuous variables are represented as mean ± standard deviation. POGO scores and CL grades are represented as median (min, max) and they were statistically tested using Wilcoxon signed rank test to assess if there was a difference before and after the use of the KVL. Statistical Package for the Social Sciences Inc. 2009, version 18.0 was used to conduct all statistical analysis. A *P* value <0.05 was considered statistically significant.

RESULTS

A total of 816 patients scheduled for various elective ear nose and throat, gastrointestinal surgeries, spine and gynaecological procedures were assessed for eligibility during the study period. Out of these, 85 patients with POGO score < 50% were enroled in the study. Baseline demographic variables were noted and entered [Table 1]. A statistically significant improvement in the POGO score was recorded with the use of KVL. The median value of POGO score recorded as 20 (0,40) with the Macintosh blade rose to 90 (40,100) with the use of KVL ($P < 0.001$) [Table 2]. POGO score improved to ≥50% with KVL in all patients except one who had an initial score of 10%, which failed to improve beyond 40% [Figure 1]. Three patients with an initial POGO score of 0, improved to a score of 100, whereas two patients with an initial score of 40 improved only marginally to 50 with KVL. A significant improvement in the CL grades with the use of KVL was also observed. The frequency of CL grade 1 and 2 increased from 63% with the conventional laryngoscopy to 100% with the KVL [Figure 2].

The time taken to obtain the best glottic view was significantly longer with the KVL as compared to the Macintosh blade (15.4 ± 3.61 vs. 11.22 ± 3.93, $P < 0.001$) [Table 2]. All patients could be successfully intubated with the help of KVL and the time taken to intubate and the time required for the placement of the endotracheal tube were recorded as 23.04 ± 5.16 s and 7.67 ± 2.68 s, respectively [Table 3]. The first attempt success rate was 97.65% and only two patients required two attempts for successful intubation. The intubation difficulty score was recorded as 0 (easy intubation) in 54.12% patients and 1 or 2 (slight difficulty) in 45.88%. The worst mIDS recorded was 2 in 9.41% patients [Table 3]. None of the patients required any additional adjuncts for successful intubation.

All patients maintained oxygen saturation and remained haemodynamically stable during the airway management. None of the patients had major airway related complications such as bronchospasm, laryngospasm, or major oropharyngeal injury. Seven patients complained of postoperative sore throat and three had minor oral injury.

Table 1: Patient characteristics

Age (years)	44.68±11.338
Height (metres)	1.67±0.087
Weight (kg)	71.81±9.421
Gender (M/F)	33/52
ASA (I/II/III)	40/44/1

Data expressed as mean±standard deviationor numbers; ASA: American Society of Anesthesiologists; M:Male; F:Female

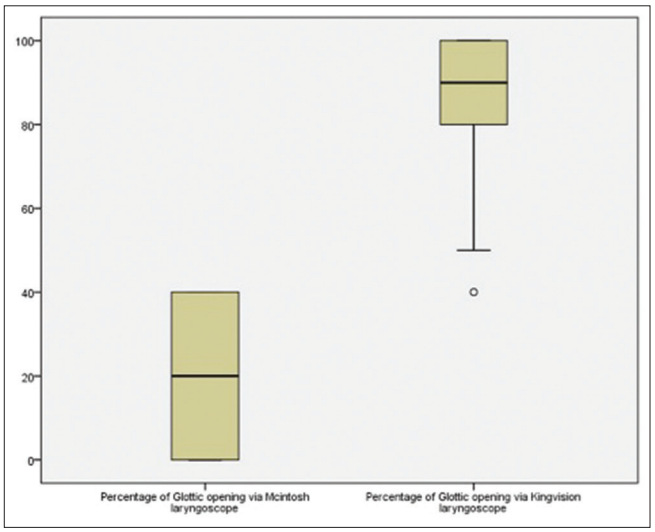

Figure 1: Boxplot comparing median POGO scores obtained with Macintosh vs KVL. The inner horizontal line within the box represents the median values and the outer horizontal lines represent the minimum and maximum values

DISCUSSION

Suboptimal glottic visualisation is a cause for significant concern to the anaesthesiologists as it may not only lead to failed intubation with disastrous consequences but may also require multiple attempts causing airway trauma and haemodynamic instability.

Table 2: Laryngoscopy pararameters

		MAC		KVL		*P*
POGO		20 (0,40)		90 (40,100)		<0.001*
CL	II	III	IV	I	II	<0.001*
	63	17	5	46	39	
	(74.1%)	(20.0%)	(5.9%)	(54.1%)	(45.9%)	
Time taken to obtain the best glottic view		11.22±3.93		15.4±3.61		<0.001*

Data expressed as median (min, max) or numbers (%), *Statistically significant, MAC: Macintosh Laryngoscope, KVL: King vision videolaryngoscope; CL: Cormack Lehane

Table 3: Intubation Parameters with KVL

Time taken to Intubate(s)	23.04±5.16		
Time taken for Placement of Endotracheal Tube(s)	7.67±2.68		
Intubation Difficulty Score	0	1	2
	46 (54.12)	31 (36.47)	8 (9.41)

Data expressed as mean±standard deviation or numbers (%); KVL: King vision videolaryngoscope

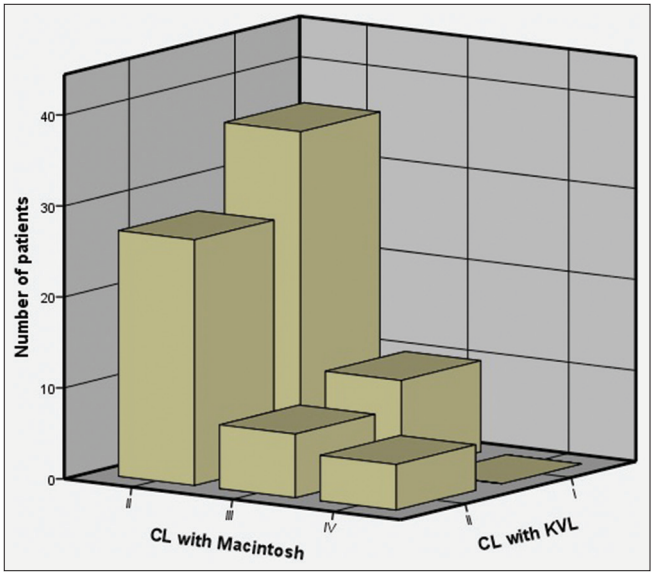

Figure 2: Comparison of Cormack Lehane grades with Macintosh (II/III/IV: 63/17/5) vs King Vision videolaryngoscope (I/II: 46/39)

Any device, which improves the glottic view, is likely to be extremely valuable in the unanticipated difficult airway scenario. The results of our study suggest that the KVL effectively improves the laryngeal view in patients recording POGO <50% with conventional laryngoscopy ($P < 0.001$).

Several authors have demonstrated similar findings in the anticipated difficult airways.[5,6,12] However, our study is the first to investigate the performance of KVL in the patients with restricted glottic visualisation in the absence of any predictors of difficult airway. Another major strength of our study is the fact that we have compared the laryngeal view obtained with the two devices in the same patient, which helped us in immediate assessment of the improvement in each patient. Conventionally, CL grades III and IV are considered as difficult to intubate, but POGO scores are preferred for documenting video laryngoscopy due to their higher accuracy and inter-rater reliability.[13] Another advantage of using POGO score is its simplicity. In our study, POGO scores >0 were equivalent to CL grade II, whereas POGO score 0 replaced both CL III and IV. Although lower POGO scores may pose significant challenges during intubation, we did not find any literature describing the correlation between the difficult intubation and POGO scores. Therefore, we included the patients with POGO <50% in our study assuming that any device attaining POGO >50% would have higher chances of successful intubation.[7]

Hossfeld *et al*.[14] documented that C-MAC improved the glottic visualisation in 94% patients with CL grade III and 93% patients with CL grade IV. Similarly, we observed a significant improvement in the CL grades and all patients with initial CL grade III and IV improved to CL grades I and II. However, the results of the two studies cannot be compared due to different specifications of the two devices leading to their variable performance. KVL has an in-built camera placed at 34 mm from the distal tip and a strong endoscopic lamp, which provide a wide field of vision of the glottic orifice as compared to direct laryngoscopy.[15] Blajic *et al*.[16] studied 180 obstetric patients and reported that KVL provided better glottic view with highest CL grade I views as compared to both Macintosh and C-MAC laryngoscopes. The bulky blade of KVL may provide superior upward lifting force in contrast to the slim Macintosh type blades providing better glottic visualisation. Improved glottic view may not always lead to successful intubation with video laryngoscopes. This is a significant drawback with the more angulated blades such as McGrath video laryngoscope. KVL with its unique anatomical blade curvature and the airway channel not only improved the glottic view but also facilitated the tube placement with minimum manipulation in our study. Another major advantage of using KVL in unanticipated difficult intubation scenario is that a

single blade type and size is suitable for all patients which further reduces the number of attempts.

Similar to the findings of Erdivanli *et al*.,[17] we observed that the time required to obtain the best glottic view was longer with KVL as compared to the Macintosh laryngoscope ($P < 0.001$). This was due to the prolonged time required for the introduction of the blade and the adjustment needed to align the blade with the glottis. However, this difficulty can be overcome with experience using techniques such as scissoring manoeuvre to open the mouth, introduction of the blade with slight lateral tilt, avoiding head extension, liberal use of lubricant and detaching the screen in case of obstruction against the chest wall.

Our study was not designed to assess the intubation success with KVL, but we recorded a first attempt success rate of 97.65%. In contrast, Kleine-Brueggeney *et al*.[18] reported 87% first attempt success rate with KVL in the patients with simulated difficult airway obtained by using cervical collar leading to restricted neck movement and reduced mouth opening. The bulky channeled KVL requires more room for insertion and alignment and thus may have provided inferior results as compared to our study where all such predictors of difficult airway were absent. Another possible explanation for the high success rate noted in our study maybe the fact that anaesthesiologists experienced in using KVL performed all intubations, which is an important predictor of difficult videolaryngoscopy.[19]

The first important limitation of our study was that we included patients with POGO < 50%, which may not always lead to difficult intubation. Successful intubation may have been possible with conventional laryngoscopy in many of these patients, but the use of KVL provided certain significant benefits such as better laryngeal view, less lifting force, high first pass success rate, intubation under vision and minimum airway trauma. One may also criticise two laryngoscopy attempts required in each patient, as KVL does not allow direct laryngoscopy. However, we noted that due to the above-mentioned benefits of KVL, despite two laryngoscopy attempts, we avoided major haemodynamic surge or airway trauma. In agreement to our findings, past studies have documented less haemodynamic response with videolaryngoscope as compared to the Macintosh laryngoscope.[20] Another unavoidable limitation of our study was the possibility of unintentional observer bias as KVL was used as the second device.

CONCLUSION

The results of our study suggest that the channeled KVL has the potential to provide several major benefits in patients with unanticipated poor glottic view when used by experienced operators. The most important advantages observed in our study were improved laryngeal view, high first pass success rate, ease of intubation, unaided intubation through the channel and minimum airway related complications. We would also like to emphasise that KVL should be an early option, before the airway gets soiled with multiple attempts and multiple adjuncts.

Acknowledgement

Ms Sudarshana Biswas for her contribution to the statistical analysis of this article.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Hoshijima H, Denawa Y, Tominaga A, Nakamura C, Shiga T, Nagasaka H. Videolaryngoscope versus Macintosh laryngoscope for tracheal intubation in adults with obesity: A systematic review and meta-analysis. J Clin Anesth 2018;44:69-75.
2. Rendeki S, Keresztes D, Woth G, Mérei Á, Rozanovic M, Rendeki M, *et al*. Comparison of VividTrac, Airtraq, King Vision, Macintosh laryngoscope and a custom-made videolaryngoscope for difficult and normal airways in mannequins by novices. BMC Anesthesiology 2017;17:68.
3. Kelly FE, Cook TM. Seeing is believing: Getting the best out of videolaryngoscopy. Br J Anaesth 2016;117:i9-13.
4. Kilicaslan A, Ahmet T, Tavlan A, Erol A, Otelcioglu S. Effectiveness of the CMAC videolaryngoscope in the management of unexpected failed intubations. Rev Bras Anestesiol 2014;64:62-5.
5. Ali QE, Amir SH, Ahmed S. A comparative evaluation of King Vision video laryngoscope (channeled blade), McCoy, and Macintosh laryngoscopes for tracheal intubation in patients with immobilized cervical spine. Sri Lankan J Anaesthesiol 2017;25:70-5.
6. Patel N, Desai DJ. Tracheal intubation with King Vision videolaryngoscope in patients with cervical spine

instability-Comparison of straight versus curved reinforced endotracheal tubes. Indian J Anaesth 2021;65:650-5.
7. Levitan RM, Ochroch EA, Kush S, Shofer FS, Hollander JE. Assessment of airway visualization: Validation of the percentage of glottic opening (POGO) scale. Acad Emerg Med 1998;5:919-23.
8. Cormack RS, Lehane J. Difficult tracheal intubation in obstetrics. Anaesthesia 1984;39:1105-11.
9. Myatra SN, Shah A, Kundra P, Patwa A, Ramkumar V, Divatia JV, *et al*. All India Difficult Airway Association 2016 guidelines for the management of unanticipated difficult tracheal intubation in adults. Indian J Anaesth 2016;60:885-98.
10. Adnet F, Borron SW, Racine SX, Clemessy JL, Fournier JL, Plaisance P, *et al*. The intubation difficulty score: Proposal and evaluation of a new score characterizing the complexity of endotracheal intubation. Anesthesiology 1997;87:1290-97.
11. Reena. Comparison of King Vision video laryngoscope (channeled blade) with Macintosh laryngoscope for tracheal intubation using armored endotracheal tubes. J Anaesthesiol Clin Pharmacol 2019;35:359-62.
12. Sahajanandan R, Dhanyee AS, Gautam AK. A comparison of King vision video laryngoscope with CMAC D-blade in obese patients with anticipated difficult airway in tertiary hospital in India – Randomized control study. J Anaesthesiol Clin Pharmacol 2019;35:363-7.
13. O'Loughlin EJ, Swann AD, English JD, Ramadas R. Accuracy, intra- and inter-rater reliability of three scoring systems for the glottic view at videolaryngoscopy. Anaesthesia 2017;72:835-9.
14. Hossfeld B, Frey K, Doerges V, Lampl L, Helm M. Improvement in glottis visualization by using the C- MAC PM videolaryngoscope as a first-line device for out-of – hospital emergency trachel intubation. Eur J Anaesthesiol 2015;32:425-31.
15. Cierniak M, Dariusz T, Wieczorek A, Sekalski P, Borkowska N, Gaszynski T. The comparison of the technical parameters in endotracheal intubation devices: The Cmac, the Vividtrac, the McGrath Mac and the Kingvision. J Clin Monit Comput 2016;30:379-87.
16. Blajic I, Hodzovic I, Lucovnik M, Mekis D, Novak-Jankovic V, Stopar Pintaric T. A randomised comparison of C-MAC and King Vision videolaryngoscopes with direct laryngoscopy in 180 obstetric patients. Int J Obstet Anesth 2019;39:35-41.
17. Erdivanli B, Sen A, Batcik S, Koyuncu T, Kazdal H. Comparison of King vision video laryngoscope and Macintosh laryngoscope: A prospective randomized controlled clinical trial. Rev Bras Anestesiol 2018;68:499-506.
18. Kleine-Brueggeney M, Greif R, Schoettker P, Savoldelli GL, Nabecker S, Theiler LG. Evaluation of six videolaryngoscopes in 720 patients with a simulated difficult airway: A multicenter randomized controlled trial. Br J Anaesth 2016;116:670-9.
19. Aziz MF, Bayman EO, Tienderen V, Todd MM, Bambrink AM. Predictors of difficult videolaryngoscopy with GlideScope or C-MAC with D-Blade: Secondary analysis from a large comparative videolaryngoscopy trial. Br J Anaesth 2016;117:118-23.
20. Meshram TM, Ramachandran R, Trikha A, Rewari V. Haemodynamic responses following orotracheal intubation in patients with hypertension—Macintosh direct laryngoscope versus Glidescope®videolaryngoscope. Indian J Anaesth 2021;65:321-7.