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ORIGINAL ARTICLE

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A randomised comparison of C-MAC™ and King Vision® videolaryngoscopes with direct laryngoscopy in 180 obstetric patients

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ABSTRACT

Background: Current evidence suggests that there is uncertainty about which videolaryngoscope performs best in obstetric anaesthesia. The aim of this study was to compare C-MAC and King Vision® videolaryngoscopes and direct laryngoscopy for tracheal intubation of patients undergoing caesarean section.

Methods: One hundred and eighty women were randomly assigned. The primary outcome was the time to tracheal intubation. Secondary outcomes were the time to the best laryngeal view, grade of Cormack and Lehane view, overall and first-pass success, intubation difficulty, the number of intubation attempts and optimisation manoeuvres; and complications.

Results: The time to successful intubation, first-pass and overall success rates did not differ between the devices. The difficulty of intubation was less for C-MAC than King Vision® (P <0.001). No difference was observed between King Vision® and direct laryngoscopy (P=0.06) or C-MAC and direct laryngoscopy (P=0.05). King Vision® required the longest time to best laryngeal view (9 ± 6 s, P=0.028), had the highest rate of grade 1 view (47 (80%) patients, P <0.001), and the highest need for optimisation manoeuvres (59 (100%) patients, P <0.0001). Five minor complications were recorded with King Vision® and one with direct laryngoscopy.

Conclusions: Compared to direct laryngoscopy, C-MAC and King Vision® did not prolong the time to intubation, supporting these videolaryngoscopes as primary intubation devices in obstetric anaesthesia. The C-MAC was easier to use and needed fewer additional manoeuvres than the King Vision®. The C-MAC may be better suited for tracheal intubation of obstetric patients undergoing caesarean section.

Keywords: Anaesthesia; Obstetric; Intubation; Videolaryngoscope; Caesarean section

Introduction

The role of videolaryngoscopy in obstetric general anaesthesia has been subject to less scrutiny than in other areas of anaesthesia. This may be due to inherent difficulties of research in this group of patients related to the smaller overall numbers of general anaesthetics and the urgency of the caesarean section.[1] The Cochrane review evaluating videolaryngoscopy versus direct laryngoscopy (DL) in adults evaluated 64 studies, with only one specifically examining obstetric patients.[2,3] A small number of observational studies and case reports support the use of a videolaryngoscope as a rescue device or as a first-choice technique in a predicted difficult airway.[4–8] The potential of videolaryngoscopy to enhance patient safety has also been acknowledged if it is used as a primary intubation method during rapid sequence induction of anaesthesia for caesarean section.[9] There

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are, however, concerns that videolaryngoscopy, compared to DL, may prolong the time to intubation.[10] This is especially relevant in the obstetric population, where patients have a limited safe apnoea time and an increased risk of gastric content aspiration.[11]

Currently, there are many different videolaryngoscopes available, each with different characteristics and requirements for positioning of the blade and manoeuvres for optimising the view.[12] The Storz C-MAC™ videolaryngoscope (C-MAC) (Karl Storz, Tuttlingen, Germany) is a Macintosh-like blade videolaryngoscope which extends the viewing angle from the standard 15–80°. It integrates video capability of the standard Macintosh laryngoscope, making it possible to be used directly or indirectly (Fig. 1a).[12] The latter enables the entire operating room team to assess progress in real time, which is especially important during rapid sequence intubation and in patients at risk of hypoxia.[13,14]

The King Vision® videolaryngoscope (KVL) (Ambu Ltd., Ballerup, Copenhagen, Denmark) is a channelled videolaryngoscope, with an endotracheal tube preloaded, designed to enable advancement of the tube once the glottis is visualised. It uses a non-displacing technique for blade insertion down to the vallecula.[15] A colour display attached to a reusable blade provides an extended image, viewing up to 160° (Fig. 1b).[16] Studies in non-obstetric populations suggest that a channelled videolaryngoscope may be associated with faster intubation times compared to DL or videolaryngoscopy with other blades.[17,18]

We could find no studies comparing videolaryngoscope blade designs and their effect on time to intubation in an obstetric population. We therefore decided to compare the C-MAC and the channelled KVL with DL in an obstetric population undergoing caesarean section, using the time to tracheal intubation as the primary outcome. We also recorded the time to the best laryngeal view, the Cormack and Lehane grade for the best laryngeal view, overall and first-pass success rates, intubation difficulty, number of intubation attempts and optimisation manoeuvres, and any complications.

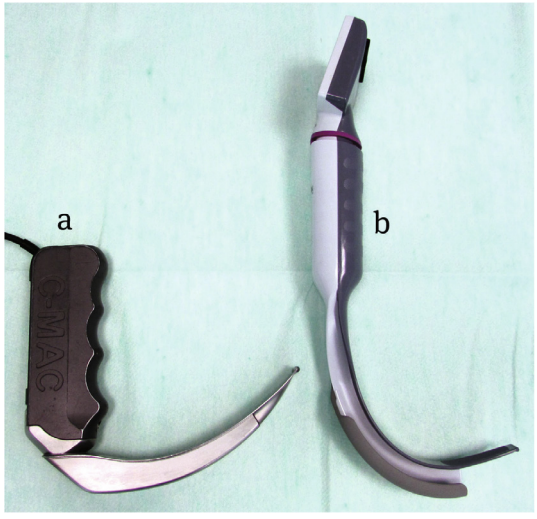

Fig. 1 Storz® C-MAC™ videolaryngoscope blade size 3 (a) and King Vision® videolaryngoscope size 3 with channelled blade (b)

Methods

This prospective, randomised trial was approved by the Institutional Ethics Committee of the University of Ljubljana (No. 33/02/15) and registered at a central database of ANZCTR (Australian New Zealand Clinical Trials Registry (https://www.anzctr.org.au/Trial/Registration/TrialReview.aspx?ACTRN=12616000527460) under the trial ID ACTRN12616000527460. Written informed consent was obtained from 180 women recruited from those undergoing caesarean sections (category 2–4 included) under general anaesthesia, in the delivery unit of the Perinatology Department in the Gynaecology Hospital, University Medical Centre Ljubljana, from March 2015 to December 2016.

Prior to randomisation, each parturient underwent pre-operative evaluation of predictive indices for difficult intubation: inter-incisor gap (graded > or <4 cm), Mallampati score 1–4, thyromental distance (graded > or <6.5 cm), and cervical spine movement (normal >90°). Those with a predicted difficult airway requiring awake intubation, of American Society of Anesthesiologists (ASA) physical status >3, with an allergy to any study medication or having a category-1 caesarean section, were excluded.[19]

The patients were assigned to one of three groups using a computer-generated random number table. In the DL group, direct laryngoscopy was performed with an appropriately-sized Macintosh blade as a part of the Storz® C-MAC™ videolaryngoscope. In the C-MAC group, intubation was performed with the same blade using an indirect view from a remote display of the Storz® C-MAC™ videolaryngoscope. In the KVL group, intubation was performed with a channelled size 3 KVL, using an indirect view from an attached display. Laryngoscopy was attempted by one of the three attending anaesthesiologists (IB, TSP, DB), all of whom had performed >30 intubations with the respective devices.

On the operating table, the patients were positioned supine with lateral left tilt and their back 30° elevated. Those with a body mass index (BMI) >30 kg/m^2 were placed in a ramped position. Before induction, standard monitoring was instituted, and pre-oxygenation performed for at least three minutes.[20] Anaesthesia was induced using a rapid sequence induction including cricoid pressure, by means of fentanyl (1 μg/kg), propofol

(2 mg/kg), and suxamethonium (1.5 mg/kg) or rocuronium (1 mg/kg).[21] A nerve stimulator (TOF-Watch® SX, Organon, Ireland) was used to monitor the level of neuromuscular block prior to intubation. According to our institution's practice, intubations using C-MAC or DL were performed with a pre-styletted 6.5 cuffed tracheal tube (Portex Endotracheal Tube, Smiths Medical ASD, Keene, New Hampshire, USA). The following parameters were measured: the time to best laryngeal view (defined as the time elapsed from insertion of the blade passing the incisors to the optimal visualisation of the glottis), time to tracheal tube placement (defined as the interval between insertion of the blade and detection of the end-tidal carbon dioxide (CO_2 signal), number of intubating attempts (each subsequent attempt defined as a re-insertion of the laryngoscope blade), laryngeal view according to Cormack and Lehane grade (C/L grade 1–4), a visual analogue scale (VAS) for intubation difficulty (subjectively assessed by the operator using a 100 mm scale with 0 mm = extremely easy and 100 mm = extremely difficult), success rate for tracheal tube placement, the use of optimisation manoeuvres or a bougie.[22] A failed intubation was defined as an attempt to place the tracheal tube involve more than two intubating attempts, failure to place the tube in the trachea within 60 seconds or a patient desaturation to < 92%. In case of intubation failure using the study device, the subsequent management of the patient was conducted according to the anaesthesiologist's preference and the United Kingdom Obstetric Anaesthetists' Association/Difficult Airway Society (OAA/DAS) guidelines.[23]

After successful intubation, anaesthesia was maintained with isoflurane in a 60/40 nitrous oxide/oxygen mixture. For patients initially given suxamethonium, 0.5 mg/kg of rocuronium was administered for maintenance of neuromuscular blockade. After cord clamping, fentanyl 3–5 μg/kg was added intravenously. Systolic and diastolic blood pressures were measured before attempting intubation and every two minutes thereafter, while the heart rate, pulse oximetry, end-tidal CO_2, inspired oxygen concentration (FiO_2), peak and plateau airway pressures, tidal volume and minute ventilation were measured continuously. At the end of the procedure, reversal of neuromuscular blockade was achieved with sugammadex having checked the degree of neuromuscular blockade with the nerve stimulator. Tracheal tubes were removed after standard extubation criteria had been met at the conclusion of the surgery.[24] Complications associated with the laryngoscopy/intubation, such as lip or dental injury and mucosal bleeding, were recorded.

The primary endpoint of the study was the time to successful intubation. For the significance level of $P < 0.01$, power of 95%, a clinically important difference of 12 s with a population standard deviation of 14.9 s 55 patients per group were needed. To allow for dropouts and for ease of randomisation, 60 patients per group were recruited for this parallel three-group study design.[3] SPSS (SPSS, Inc., Chicago, IL; USA) version 21 was used to analyse the data. For normally distributed continuous data analysis of variance (ANOVA) with Bonferroni correction for multiple comparisons was used: the Kruskal-Wallis test for non-normally distributed continuous and ordinal categorical data; and the Chi-square test for nominal data.

Results

One hundred and eighty patients gave consent to participate, with one KVL and one DL group patient excluded from the analysis because of incomplete data (Fig. 2).

The patients' characteristics and preoperative airway features are reported in Table 1. The main study findings are presented in Table 2. The time to tracheal tube placement did not differ between the devices. No failure of intubation was recorded. All intubations were successfully completed using a randomised device. The longest time to achieve the best laryngeal view was recorded in the KVL group (P=0.028), which nevertheless obtained the highest rate of grade-1 laryngeal view (P <0.001). The highest need for optimisation manoeuvres for blade insertion and intubation was recorded in the KVL group (P <0.0001), with a total number of 107 in the KVL group, 11 in the C-MAC group and six in the DL group (Fig. 3). The intubation difficulty was significantly less with the C-MAC compared to the KVL (P <0.001). There was no difference in intubation difficulty between the KVL and DL groups (P=0.06) or C-MAC and DL groups (P=0.05).

Six minor complications were noted, five in the KVL group (two lip lacerations, two minor post-intubation mucosal bleeds and one sore throat) and one in the DL group (sore throat). The bougie was used in one patient with a C/L grade 4 view in the DL group. The patient's laryngoscopic view improved with temporal removal of cricoid pressure and intubation was achieved after successful bougie placement at the first attempt. There were no differences in haemodynamic variables observed between pre- and post-induction periods between the three groups (Table 2). No differences were observed in Apgar scores.

Discussion

This study shows that in an obstetric population undergoing caesarean section, the use of a C-MAC or KVL device did not prolong the time to a successful intubation, when compared to DL. No difference in first-pass and overall success rates was observed between the three devices. The C-MAC was perceived as easier

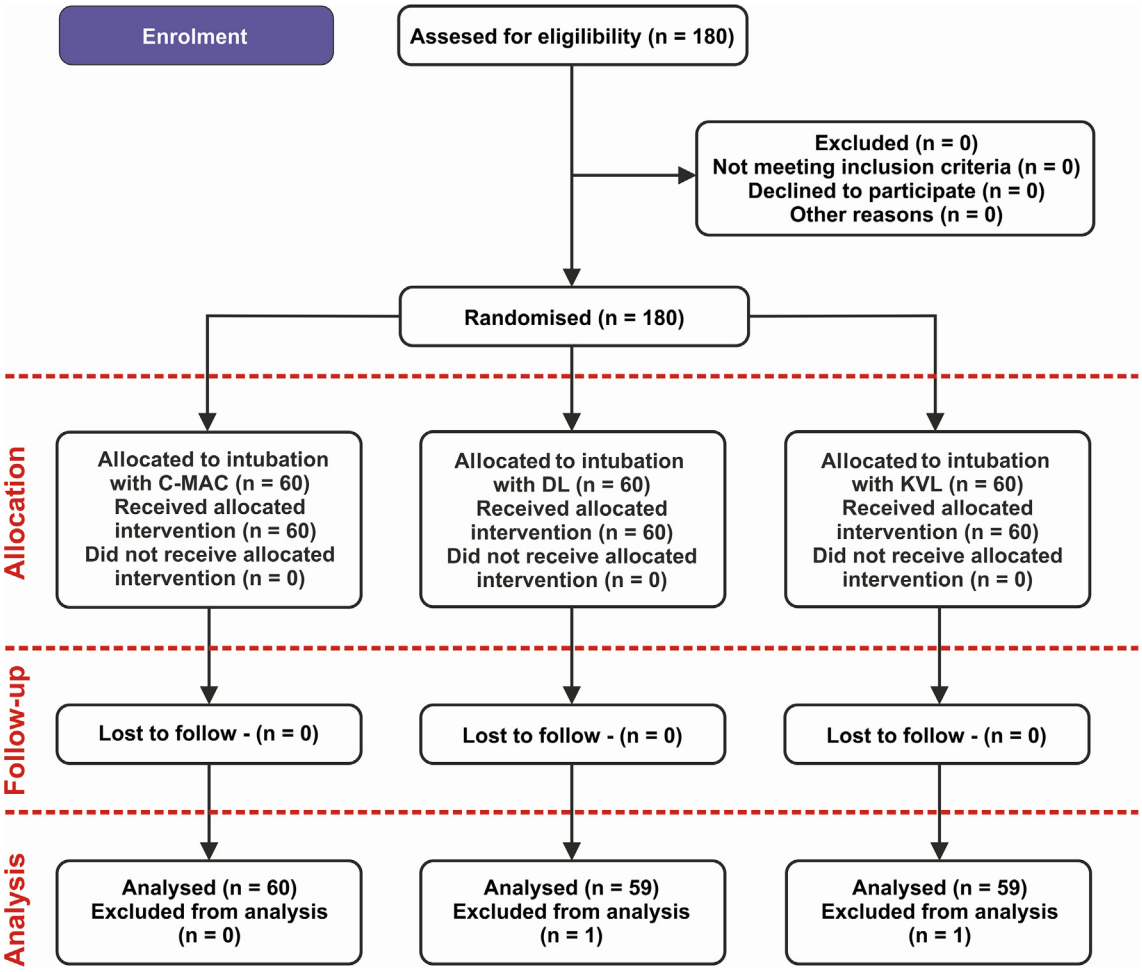

Fig. 2 CONSORT diagram representing patient enrolment, allocation, follow-up and analysis of study participants

Table 1 Patient characteristics and airway assessment data of women randomly assigned to the KVL, C-MAC or DL intubation group

		KVL	C-MAC	DL	*P*-value
Patients (n)		59	60	59	NS
Age (y)		33 (5)	33 (5)	32 (5)	NS
BMI (kg/m^2)		29 (4)	30 (5)	27 (4)	0.004*
ASA grade	2	52 (88%)	52 (86%)	52 (88%)	NS
	3	7 (12%)	8 (14%)	7 (12%)	NS
Mallampati score 1/2/3/4		5/34/20/0	13/34/12/1	12/32/14/1	NS
Inter-incisor gap of <4 cm		0	0	2	NS
Thyromental distance of <6.5 cm		13 (22%)	9 (15%)	6 (10%)	NS
Neck movement of <90°		0	0	0	NS
Muscle relaxants (suxamethonium/ rocuronium)		2/57	8/52	8/51	NS

KVL: King Vision® videolaryngoscope; C-MAC: C-MAC™ video laryngoscope; DL: direct laryngoscopy; SD: standard deviation; NS: not statistically significant; BMI: body mass index; ASA: American Society of Anesthesiologists. Values are number (proportion) or mean (SD).
*Differences between KVL, C-MAC and DL.

to use than the KVL. The KVL offered the best laryngeal view, but needed the highest number of optimisation manoeuvres to complete the intubation process.

Our finding of no difference in time to intubation between direct and indirect laryngoscopy supports the use of these videolaryngoscopes as a primary device

Table 2 Comparative data during tracheal intubation for primary and secondary outcomes

	KVL	C-MAC	DL	*P*-value
Time to successful intubation (s)	29 (9)	25 (7)	29 (14)	NS
Time to best laryngeal view (s)	9 (6)	7 (3)	8 (3)	0.028*
Cormack-Lehane view grade 1/2/3/4	47/10/2/0	27/28/5/0	20/32/6/1	<0.001*
Intubation attempts 1/2**	56/3	59/1	56/3	NS
Intubation difficulty (VAS)	20 [10–40 (5–80)]	10 [10–20 (0–80)]	20 [10–30 (0–90)]	<0.005†
Success rate	59 (100%)	60 (100%)	59 (100%)	NS
Change in mean arterial pressure (pre-induction vs. two minutes post-induction) (mmHg)	−3.60 (12.11)	−1.38 (13.27)	−5.88 (15.53)	NS
Change in heart rate (pre-induction vs. two minutes post-induction) (bpm)	−14.42 (15.83)	−12.63 (16.32)	−10.60 (18.60)	NS
Apgar score	8.6 (1.2)	8.8 (0.5)	8.8 (0.7)	NS
Manoeuvres (%)				<0.0001*
Sideway blade insertion	100	0	0	
Jaw thrust	14	0	0	
External laryngeal manipulation	32	10	2	
Blade rotation to the left	36	8	8	

KVL: King Vision® videolaryngoscope; C-MAC: C-MAC™ videolaryngoscope; DL: direct laryngoscopy; SD: standard deviation; IQR: range; NS: not statistically significant; VAS: visual analogue scale. bpm: beats per minute. The values are number (proportion), mean (SD) or median [IQR (range)] as appropriate.

†Difference between KVL and C-MAC intubation groups.

*Difference between KVL and C-MAC intubation groups and between KVL and DL intubation groups.

**1/2: 1 – first attempt success, 2 – second attempt success.

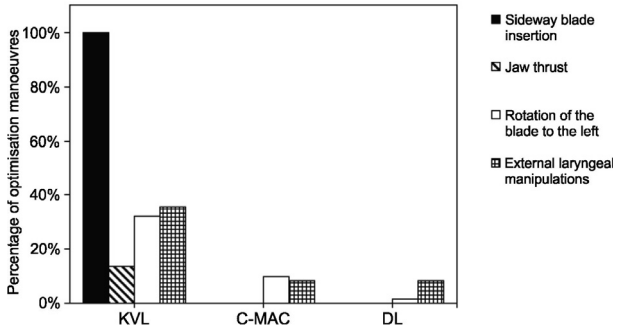

Fig. 3 Optimisation manoeuvres for blade insertion and intubation for the King Vision® videolaryngoscope (KVL), C-MAC™ videolaryngoscope (C-MAC) and direct laryngoscopy (DL); shown as sideway blade insertion (black bar), jaw thrust (striped bar), rotation of the blade to the left (white bar) and external laryngeal manipulations (squares bar). The KVL group was associated with the highest need for optimisation manoeuvres

for intubation of obstetric patients. In our study, the differences in time to intubation between the tested devices varied between only 0 and 4 s, which most clinicians would not consider clinically relevant. The result of "no apparent difference" is, however, highly relevant for obstetric patients in whom the time to intubation is an important clinical outcome. We found only one randomized controlled trial evaluating the use of videolaryngoscopes in an obstetric population. Arici et al. compared the McGrath device and DL in 80 patients undergoing caesarean section.[3] The study found that the McGrath videolaryngoscope led to a significantly longer intubation time. Differences in the videolaryngoscope blade design between the McGrath Series 5 used in Arici et al.'s study and the C-MAC and KVL devices used in our study may partly explain the longer time to intubation. In addition, these investigators did not state the experience of the intubators with the use of a McGrath videolaryngoscope. Uneven distribution of clinical experience in the use of McGrath videolaryngoscope and DL in their study is a likely confounding factor which may also have contributed to the longer intubation time with the McGrath videolaryngoscope.[25]

Our findings regarding first-pass and overall success rates with videolaryngoscopy are similar to those of Arici et al. in the same patient population with normal airways.[3] Furthermore, these studies support the use of a videolaryngoscope as a primary intubation tool, given a higher risk of difficult or failed intubation in the obstetric population.[9]

As reflected by different characteristics and requirements for positioning of the blade and manoeuvres for optimising the view, the C-MAC and KVL performed differently. Although anatomical changes associated with pregnancy might have contributed to some of the manoeuvres, sideways insertion of the blade and jaw thrust more likely result from the design of the KVL, as well as being a consequence of the use of cricoid pres-

sure, where the assistant's hand may obstruct insertion of the videolaryngoscope. In an obstetric patient's intubation, multiple adjustments to insert the device and optimise the view for intubation may add to operator stress and potentially increase the risk of failure. Similar difficulties with the KVL have already been reported in normal and difficult airways and in conjunction with other channelled videolaryngoscopes in morbidly obese patients, which suggests the anatomical features of pregnancy should also be recognised as predictors of difficult videolaryngoscopy when using channelled blades.[26–29]

The ease of intubation observed with the C-MAC, on the other hand, can be attributed to a number of factors. First, the soft tissue is displaced in a similar fashion to the classical Macintosh laryngoscope with which we are most familiar. Second, the blade insertion requires fewer optimisation manoeuvres, permitting threading of the tube more directly toward the glottis. Third, a remote display extends the video imaging, which enables a dynamic interaction during airway management and helps assistance to be given in a more focused way, without affecting the time to intubation.[17] Fourth, the C-MAC can be useful for both routine and emergency cases, as the white balance occurs automatically within one second of the device being switched on.[12] Finally, an immediate switch from indirect to direct laryngoscopy can be done in case of fogging, vomiting, salivating, or bleeding, all these being relevant to rapid sequence induction in the obstetric patient.[14]

Despite difficulties associated with blade insertion and intubation, the KVL provided the highest rate of grade-1 laryngeal views. A similar observation has been made with other channelled videolaryngoscopes, giving them a chance of being used as a rescue device when intubation with direct laryngoscopy is unsuccessful.[14,17,18] However, when using a videolaryngoscope, a clear view of the glottis does not always translate into easier intubation.[30] This is often termed 'laryngoscopy paradox' and appears to apply mostly to the videolaryngoscopes with an angulated blade.[31]

This study found no significant difference in changes to blood pressure and heart rate between the three devices, but the study was not powered for this outcome. A study of 92 patients by Koyama et al. demonstrated a significant attenuation of the haemodynamic stress response with an Airway Scope, compared with DL in normotensive, but not in hypertensive, patients.[32] Contrary to our findings, a significant increase in mean blood pressure and heart rate was reported in the study of Arici et al. with both intubating devices. This could be attributed to the different induction agents (thiopental vs. propofol and fentanyl) in their study, rather than because of the intubating devices themselves. This may have a bearing on the induction of anaesthesia in pre-eclamptic patients. Further research is needed to establish the potential role of videolaryngoscopy in reducing maternal morbidity associated with tracheal intubation in this patient subset.

The results of our study should be interpreted in the context of the following limitations. Although this was a large study, it was conducted in a single centre. Consequently, the findings may not apply to all institutions. We allowed the subjective evaluation of the intubation difficulty and quality of view obtained, as it was impossible to blind the anaesthesiologist to the airway device being used. Finally, we did not use a modified C/L grading or other grading systems, such as the percentage of glottic opening score or intubation difficulty score, which may have been more discriminating.[33–35] Indeed, there are concerns regarding the validity of the C/L grading of the views obtained during videolaryngoscopy.[36]

In conclusion, when compared to direct laryngoscopy, the C-MAC and KVL videolaryngoscopes did not prolong the time to intubation. This finding supports the use of a videolaryngoscope as a primary intubation device in the obstetric population undergoing caesarean section. Since the C-MAC was easier to use and needed fewer additional manoeuvres, it appears better suited for intubation of obstetric patients than the KVL. The highest rate of grade-1 view gives KVL a potential advantage if used as a rescue device when direct laryngoscopy fails.[14]

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Disclosure of interests

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References

1. Lucas DN, Vaughan DJA. Videolaryngoscopy in obstetric anaesthesia. *Br J Anaesth* 2017;**119**:549.
2. Lewis SR, Butler AR, Parker J, Cook TM, Smith AF. Videolaryngoscopy versus direct laryngoscopy for adult patients requiring tracheal intubation. *Cochrane Database Syst Rev* 2016;**11**:CD011136.
3. Arici S, Karaman S, Dogru S, et al. The McGrath Series 5 video laryngoscope versus the Macintosh laryngoscope: a randomized trial in obstetric patients. *Turk J Med Sci* 2014;**44**:387–92.

4. Aziz MF, Kim D, Mako J, Hand K, Brambrink AM. A retrospective study of the performance of video laryngoscopy in an obstetric unit. *Anaesth Analg* 2012;**115**:904–6.
5. Browning RM, Rucklidge MW. Tracheal intubation using the Pentax Airway Scope videolaryngoscope following failed direct laryngoscopy in a morbidly obese parturient. *Int J Obstet Anesth* 2011;**20**:200–1.
6. Turkistra TP, Armstrong PM, Jones PM, Quach T. GlideScope use in the obstetric patient. *Int J Obstet Anesth* 2010;**19**:123–4.
7. Dhonneur G, Ndoko S, Amathieu R, Housseini LE, Poncelet C, Tual L. Tracheal intubation using the Airtraq in morbide obese patients undergoing emergency caesarean delivery. *Anesthesiology* 2007;**106**:629–30.
8. Ni J, Luo L, Wu L, Luo D. The Airtraq laryngoscope as a first choice for parturients with an expected difficult airway. *Int J Obstet Anesth* 2014;**23**:94–5.
9. Gerard T, Palanisamy A. The obstetric difficult airway: if we can't predicted it, can we prevent it? *Anaesthesia* 2017;**72**:143–55.
10. Scott-Brown S, Russel R. Video laryngoscopes and the obstetric airway. *Int J Obstet Anesth* 2015;**24**:137–46.
11. Kodali BS, Chandrasekhar S, Bulich LN, Topulos GP, Datta S. Airway changes during labor and delivery. *Anesthesiology* 2008;**108**:357–62.
12. Xue FS, Li HX, Liu YY, Yang GZ. Current evidence for the use of C-MAC videolaryngoscope in adult airway management: a review of the literature. *Ther Clin Risk Manag* 2017;**13**:831–41.
13. Aseri S, Ahmad H, Vallance H. Video laryngoscopy improves endotracheal intubation training for novices. *Br J Anaesth* 2015;**115**:133.
14. Kelly FE, Cook TM. Seeing is believing: getting the best out of videolaryngoscopy. *Br J Anaesth* 2016;**117**:9–13.
15. Markova L, Stopar-Pintaric T, Luzar T, Benedik J, Hodzovic IA. Feasibility study of awake videolaryngoscope-assisted intubation in patients with periglottic tumour using the channelled King Vision® videolaryngoscope. *Anaesthesia* 2017;**72**:512–8.
16. Jarvis JL, McClure SF, Danny Johns BS. EMS intubation improves with King Video Laryngoscopy. *Prehosp Emerg Care* 2015;**19**:482–9.
17. Teoh WH, Saxena S, Shah MK, Sia AT. Comparison of three videolaryngoscopes: Pentax Airway Scope, C-MAC, Glidescope vs the Macintosh laryngoscope for tracheal intubation. *Anaesthesia* 2010;**65**:1126–32.
18. Teoh WH, Shah MK, Sia AT. Randomised comparison of Pentax Airway Scope and Glidescope for tracheal intubation in patients with normal airway anatomy. *Anaesthesia* 2009;**64**:1125–9.
19. Lucas DN, Yentis SM, Kinsella SM, et al. Urgency of caesarean section: a new classification. *J R Soc Med* 2000;**93**:346–50.
20. Bouroche G, Bourgain JL. Preoxygenation and general anaesthesia: a review. *Minerva Anestesiol* 2015;**81**:910–20.
21. Davroe S, Van de Velde M, Rex S. General anaesthesia for caesarean section. *Curr Opin Anaesthesiol* 2015;**28**:240–6.
22. Cormack RS, Lehane J. Difficult tracheal intubation in obstetrics. *Anaesthesia* 1984;**39**:1105–11.
23. Mushambi MC, Kinsella SM. Obstetric Anaesthetists' Association/Difficult Airway Society difficult and failed tracheal intubation guidelines – the way forward for the obstetric airway. *Br J Anaesth* 2015;**115**:815–8.
24. Difficult Airway Society Extubation Guidelines Group, Popat M, Mitchell V, et al. Difficult Airway Society Guidelines for the management of tracheal extubation. *Anaesthesia* 2012;**67**:318–40.
25. Cortelazzi P, Caldiroli D, Byrne A, Sommariva A, Orena EF, Tramacere I. Defining and developing expertise in tracheal intubation using Glidescope® for anaesthetists with expertise in Macintosh laryngoscopy: an in-vivo longitudinal study. *Anaesthesia* 2015;**70**:290–5.
26. Alvis BD, Hester D, Watson D, Higgins M, St., Jacques, P.. Randomized controlled trial comparing the McGrath MAC video laryngoscope with the King Vision® video laryngoscope in adult patients. *Minerva Anesthesiol* 2016;**82**:30–5.
27. Kamal S, Ali QE, Amir SH, Ahmed S, Pal K. King Vision® video laryngoscope versus Lightwand as an intubating device in adult patients with Mallampati grade III and IV patients. *J Clin Anesth* 2016;**34**:483–9.
28. Ali QE, Siddiqui OA, Amir SH, Ahmad SH, Jamil S. King Vision® video laryngoscope for severe burn contracture neck: an encouraging experience. *Rev Bras Anestesiol* 2017;**67**:641–3.
29. Dhonneur G, Ndoko SK, Amathieu R, et al. A comparison of two techniques for inserting the Airtraq laryngoscope in morbidly obese patients. *Anaesthesia* 2007;**62**:774–7.
30. Aziz MF, Healy D, Kheterpal S, Fu RF, Dillman D, Brambrink AM. Routine clinical practice effectiveness of the Glidescope in difficult airway management: an analysis of 2,004 Glidescope intubations, complications, and failures from two institutions. *Anesthesiology* 2011;**114**:34–41.
31. Martin LD, Mhyre JM, Shanks AM, Tremper KK, Kheterpal S. 3,423 emergency tracheal intubations at a university hospital: airway outcomes and complications. *Anesthesiology* 2011;**114**:42–8.
32. Koyama Y, Nishihama M, Inagawa G, et al. Comparison of haemodynamic responses to tracheal intubation using the AirwayScope® and Macintosh laryngoscope in normotensive and hypertensive patients. *Anaesthesia* 2011;**66**:895–900.
33. Yentis SH, Lee DJ. Evaluation of an improved scoring system for the grading of direct laryngoscopy. *Anaesthesia* 1998;**53**:1041–4.
34. Ochroch EA, Hollander JE, Kush S, Shofer FS, Levitan RM. Assessment of laryngeal view: percentage of glottic opening score vs Cormack and Lehane grading. *Can J Anaesth* 1999;**46**:987–90.
35. Adnet F, Borron SW, Racine SX, et al. The intubation difficulty scale (IDS): proposal and evaluation of a new score characterizing the complexity of endotracheal intubation. *Anesthesiology* 1997;**87**:1290–7.
36. Angadi SP, Frerk C. Videolaryngoscopy and Cormack and Lehane grading. *Anaesthesia* 2011;**66**:628–9.