Balkan Med J 2012; 29: 268-72 • DOI: 10.5152/balkanmedj.2012.025

Comparison of the Laryngeal Mask Airway (CTrach™) and Direct Coupled Interface-Video Laryngoscope for Endotracheal Intubation: a Prospective, Randomized, Clinical Study

Tülay Hoşten, Yavuz Gürkan, Dilek Özdamar, Murat Tekin, Mine Solak, Kamil Toker

Department of Anesthesiology and Reanimation, Faculty of Medicine, Kocaeli University, Kocaeli, Turkey

ABSTRACT

Objective: Video laryngoscopy was developed to facilitate tracheal intubation of difficult airways. We aimed to compare the efficacy of CTrach™ (CT) and Direct Coupled Interface-Videolaryngoscope (DCI-VL) in patients with normal airways.

Material and Methods: Sixty ASA I–II (American Society of Anesthesiologists) adult patients admitted for elective surgery were enrolled in this prospective study. The patients were randomly assigned to two groups, where intubation was performed via CT or DCI-VL. Time to obtain a good glottic view, total intubation time, success rates and the number of patients who required maneuvers for a good glottic view were recorded.

Results: The mean time to obtaining a good glottic view was significantly longer with CT than with DCI-VL (29.4±20.3 seconds vs. 12.8±1.9 seconds, respectively; p=0.01). Intubation was achieved on the first attempt in 28 patients in the CT group (93.3%) and in 24 in the DCI-VL group (80%) (p=0.77). The total intubation time for CT was significantly longer compared to DCI-VL (99.9±36.0 seconds vs. 39.2±21.4 seconds, respectively; p=0.01). Optimization maneuvers were required in eight and two patients in the CT and DCI-VL groups, respectively (p=0.03).

Conclusion: Although the normal airway endotracheal intubation success rates were similar in both groups, the time to obtain a good glottic view and the total intubation time were significantly shorter with DCI-VL.

Key Words: CTrach, video laryngoscope, airway management

Received: *25.08.2011* ***Accepted:*** *18.03.2012*

Introduction

Airway management is the primary responsibility of the anesthesiologist and tracheal intubation is an essential step for patient safety. Therefore, performing rapid intubation successfully is one of the most intense procedures required by an anesthesiologist. Many difficult intubations are not recognized until after the induction of anesthesia, and these conditions constitute a major problem for the anesthesiologist (1). Such difficulties, even if ultimately successful, may result in multiple laryngoscopic attempts causing airway damage and airway edema, and initially ventilated patient may not be ventilated. Since poor glottic visualization is encountered in 1-9% of intubation attempts (2, 3) in recent years, the technique of videolaryngoscopy has begun to play an important role in the management of patients with an unanticipated difficult or failed laryngoscopic intubation (4). The laryngeal mask airway CTrach™ (CT, The Laryngeal Mask Company Ltd, Le Rocher, Victoria, Mahe, Seychelles), was developed to minimize the technical effort required by the user; the goal of CT was to introduce visual guidance to the blind technique of intubating with a laryngeal mask airway (ILMA). This system is attached to a full-color viewer that provides the light source and image visualization, allowing continuous video-endoscopy of illuminated anatomical structures facing the fiber optics (5). The video system is located below the epiglottis elevation bar. Initial studies have yielded success rates between 96% and 98% for tracheal intubation using CT, and it was used in patients with different types of difficult airways (5-7). The other video laryngoscope system is the Direct Coupled Interface-Video laryngoscope system (DCI-VL, The Karl Storz BERCI DCI Video Laryngoscope; Karl Storz, Tuttlingen, Germany), which consists of a light source and a microcamera that are positioned at the tip of the laryngoscope with a standard Macintosh blade (8). Although DCI-VL offers several advantages, including better visualization of the glottic entrance and intubation conditions, a good laryngeal view does not guarantee easy or successful tracheal tube insertion (9, 10). The time spent obtaining a good glottic view and the number of attempts necessary for successful intubation are also critical to safe and successful airway management. To our knowledge, there has been no randomized clinical trial evaluating DCI-VL versus CT. The primary objective of this study was to compare the time to obtaining a good glottic view between CT and DCI-VL in elective surgical patients with normal airways. The secondary objectives were to compare the total intubation

Address for Correspondence: *Dr. Tülay Hoşten, Department of Anesthesiology and Reanimation, Faculty of Medicine, Kocaeli University, Kocaeli, Turkey*
Phone: +90 262 303 79 03 E-mail: tulayhosten@hotmail.com

time, intubation success rates, hemodynamic responses to intubation and airway complications.

Material and Methods

This prospective study enrolled 60 American Society of Anesthesiologists (ASA) I–II adult patients with a mean age of 40.35±15.7 years, admitted for elective surgery. Prior to the study, institutional review board approval and written informed consent were obtained.

Patients who had respiratory tract pathologies, severe cardiac or respiratory disease, had a history of sore throat within the past 10 days and with a high risk of regurgitation (who were pregnant, non-fasted, morbidly obese or had gastroesophageal reflux) and anticipated difficult intubation were excluded from the study. Difficult intubation was defined according to ASA guidelines (relation of the maxillary and mandibular incisors during normal jaw closure, relation of the maxillary and mandibular incisors during voluntary protrusion of cannot bring, inter incisor distance, visibility of the uvula, shape of the palate, compliance of the mandibular space, thyromental distance, length of the neck, thickness of the neck and the range of motion of the head and neck) (11).

All intubation attempts were performed by the same anesthesiologist who had performed at least 30 intubations with the DCI-VL and the CT. After the induction of anesthesia, patients were randomly divided into two groups using the sealed envelope method. The patients in the CT group (n=30) were intubated using the CT device, while the patients in the DCI- VL group (n=30) were intubated using the DCI-VL device, blade size 3 or 4. After entering the operating room, the patients were premedicated with midazolam (Dormicum, Roche) (0.02-0.03 mg/kg intravenously, and standard monitoring, including electrocardiography, non-invasive blood pressure measurements and pulse oximetry was established. Anesthesia was induced with fentanyl (Fentanyl citrate, Abbott) (2 μg/kg), propofol (Propofol 1%, Abbott) (2-3 mg/kg IV mixed with 40 mg lidocaine) and rocuronium (Esmeron, Organon) 0.6 mg/kg.

In the CT group, all airway devices were lubricated with a 10% lidocaine pump spray, (Xylocaine 10%, AstraZeneca), an antifog gel was applied to the lens and the CT viewer was pre-focused according to the manufacturer's instructions before insertion of the airway device. The CT was inserted using a one-handed rotational movement in the sagittal plane, as recommended by the manufacturer. The cuff was inflated to provide an airtight seal and the CT position was confirmed by chest movements and capnography. Once adequate ventilation was achieved, the viewer was connected to the CT to obtain a clear image of the vocal cords. Ventilation via the CT was maintained throughout this time. In case of failure, we subsequently performed adjustment maneuvers to obtain an optimum view. Adjustment maneuvers included the "Chandy maneuver" (rotation of the device in the sagittal plane, using the handle to lift the cuff slightly away from the posterior pharyngeal wall), the forward maneuver (pushing the CT in deeper) and the "up–down maneuver" (partial withdrawal and reinsertion with the cuff inflated) (12). Three insertion attempts were allowed and more than three attempts were regarded as a failed insertion. Upon optimization of a laryngeal view, a lubricated straight, cuffed and wire-reinforced reusable tube, that was specially developed using silicone (The Laryngeal Mask Company Ltd, Le Rocher, Victoria, Mahe, Seychelles), was passed through the CT into the trachea under direct vision. After deflating the cuff, the CT was removed using a special stabilizing rod, 25 cm long, to keep the tube in place and prevent accidental extubation while the intubating device was withdrawn. During the insertion and intubation period, the handle of the CT was held continuously. The CT size was chosen according to the patient's body weight. A size 3 CT was used for adults weighing 30-50 kg, size 4 for 50-70 kg and a size 5 for adults weighing 70-100 kg.

In the DCI-VL group, the patient's head was placed in the sniffing position and standard tracheal intubation was performed using size 3 or 4 video laryngoscope blades. An antifog agent was applied to the lens before use. The video laryngoscope blade was introduced into the patient's mouth in the midline and advanced until the larynx was seen on the liquid crystal display screen. When needed, optimal external laryngeal manipulation (OELM) was applied to optimize the laryngeal view. Upon optimization of the laryngeal view, a polyvinyl chloride endotracheal tube (Kelland, Thailand) was inserted parallel to the video laryngoscope blade, and while monitoring the screen view, intubation was performed. In case of failed intubation despite a clear view of the vocal cords on the first attempt, a reusable stylet was used in the second attempt. Two failed intubations with a stylet were defined as failed intubations and direct laryngoscopy was planned.

The time to a good glottic view was defined as the period of time that passes from the time the instrument was inserted into the patient's mouth until the time when a clear image of the vocal cords is achieved. Accurate positioning of the endotracheal tube (ETT) was verified by capnography and lung auscultation in both groups. The time between the insertion of airway device and capnographic verification of ETT position was defined as the total intubation time. Airway complications were defined as lip or dental injury, mucosal injury (blood detected on the airway device) or desaturation (peripheral oxygen saturation, (SpO_2) <94% for more than 10 seconds). Hemodynamic parameters and peripheral oxygen saturation (SpO_2) were recorded every 2 min for the first 10 min following the induction of anesthesia.

Statistical analysis

The primary aim of this study was to compare the time to obtain a good glottic view with CT and DCI-VL. Based on the results of our pilot study, 30 seconds with a standard deviation of 20 seconds was needed to obtain a good view of glottis with CT. According to the power analysis, 24 patients would be needed to detect a difference of 15 seconds in the time to obtain a good glottic view with 80% power. Therefore, we included 30 patients in each group to increase the dependability of the study and in order to compensate for possible patient dropout for any reason. The statistical analysis was done using Student's t-test (parametric data) and the Chi-square test (non-parametric data). A p value of <0.05 was considered significant.

Results

Patient demographics and preoperative airway assessments were similar between the groups (Table 1). Face mask ventilation was easily achieved in all patients. All patients could be successfully ventilated with CT. Time to obtain a good glottic view, total intubation time, intubation success rates, the number of adjustment maneuvers and airway complications are presented in Table 2. The time to obtain a good glottic view was significantly longer in the CT group than in the DCI-VL group (29.4±20.3 seconds vs. 12.8±1.9 seconds, respectively; p=0.01). The total intubation time was significantly longer for CT compared to DCI-VL (99.9±36.0 seconds vs. 39.2±21.4 seconds, respectively; p=0.01). All patients were successfully intubated. Intubation was achieved on the first attempt in 28 patients in the CT group (93.3%) and in 24 patients in the DCI-VL group (80%), (p=0.77). The number of patients who required a second attempt for intubation was two in CT group and six in DCI-VL group. In the CT group, the number of patients who required adjustment maneuvers was significantly greater than in the DCI-VL group (p=0.03). The quality of the laryngeal view in the CT group was optimized with a forward maneuver in four patients, with the Chandy maneuver in three patients and with the up-down maneuver in one patient, while OELM was required in two patients in the DCI-VL group. Hemodynamic and respiratory responses to intubation were similar between the groups (Figures 1-3). Despite the achievement of good quality images from time to time with CT, the general visual quality of DCI-VL was better in our study (Figure 4a and 4b). Desaturation was not observed in any of the patients. Mucosal injury was seen in only one patient in the CT group.

Table 1. Demographic characteristics of the patients

	CT Group (n=30)	DCI-VL Group (n=30)
Age (year)	42.5±15.6	37.8±16.0
Weight (kg)	70.5±15.3	72.1±15.2
Height (cm)	164.5±7.8	166.6±8.0
Sex (M/F)	15/15	16/14
ASA I/II	27/3	25/5
Mallampati score I/II	28/2	27/3

Data are presented as mean ± SD or numbers. CT: CTrach™, DCI-VL: DCI-Videolaryngoscope, M=male, F=female, ASA: American Society of Anesthesiologists

Table 2. Intubation success rates, intubation times and airway complications

	CT Group (n=30)	DCI-VL Group (n=30)
Time to a good glottic view (seconds)	29.4±20.3	29.4±20.3
Total intubation time (seconds)	99.9±36.0	39.2±21.4*
Intubation success rate		
First attempt	28 (93.3)	24 (80)
Second attempt	2 (6.7)	6 (20)
Adjustment maneuvers		
Yes / No	8 (26.7)/22 (73.3)	2 (6.7)/28 (93.3)
Forward	4	0
Chandy maneuver	3	0
Up-down maneuver	1	0
ELM; (n)	0	2
Airway complications		
Mucosal injury	1	0
Desaturation		
Yes / No	0 /100	0 /100

Data are presented as mean ± SD or numbers (%). CT: CTrach™, DCI-VL: DCI-Videolaryngoscope. *Comparison between CT and DCI-VL groups, p<0.05

Discussion

Our study demonstrates that a significantly shorter time was required to obtain a good glottic view with the DCI-VL when compared with CT. Despite the improved laryngeal

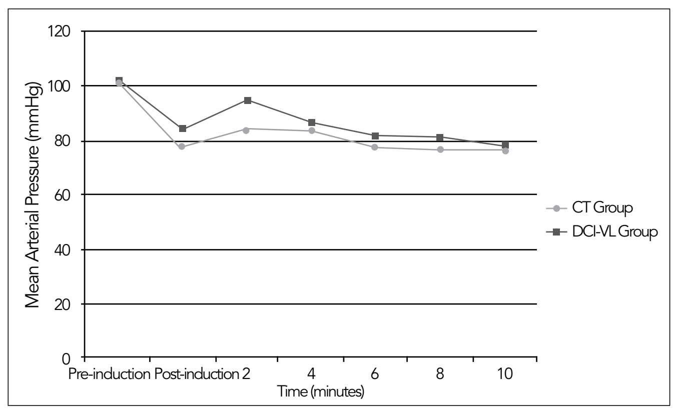

Figure 1. Changes in mean arterial blood pressure before and after insertion of airway devices (mean±SD). Values at the same measurement times were compared between the groups

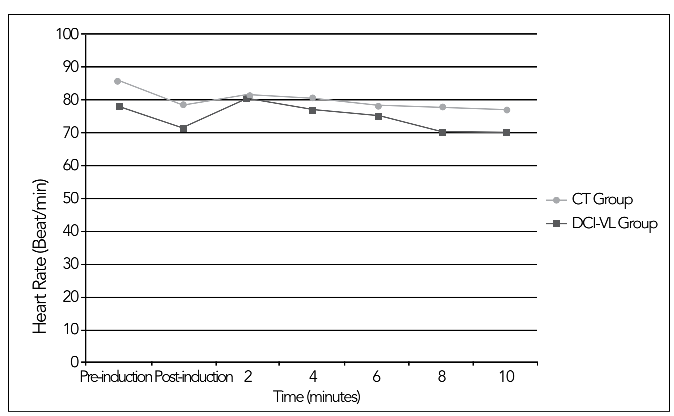

Figure 2. Changes in heart rate before and after insertion of airway devices (mean± SD). Values at the same measurement times were compared between the groups

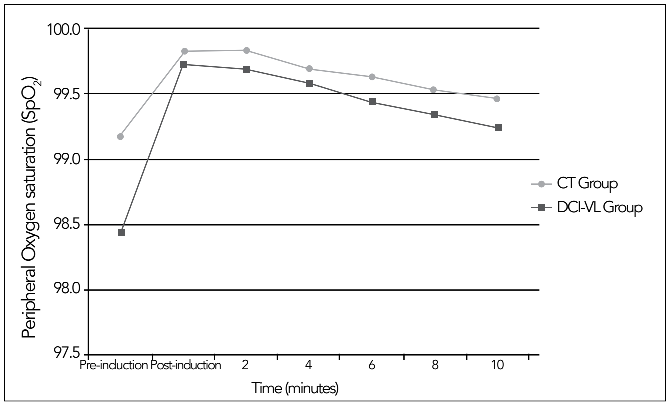

Figure 3. Changes in peripheral oxygen saturation before and after insertion of airway devices (mean±SD). Values at the same measurement times were compared between the groups

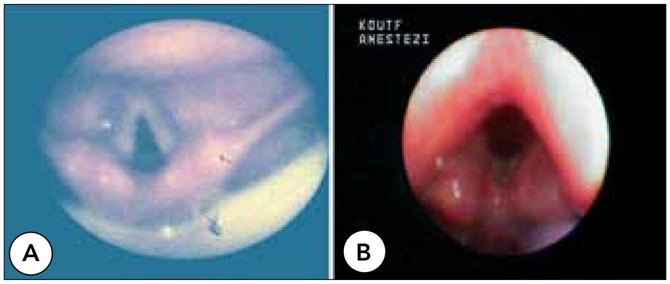

Figure 4. Clearer views were obtained with DCI-VL (panel b) compared to CT (panel a)

views and short optimal glottic view time with the DCI-VL, intubation success rates at the first attempt were not different. Poor views due to secretions or epiglottic structures were very common when using CT, and Liu et al. (5) have argued that the failure in achieving an acceptable larynx view in a great number of patients compromises the clinical value of CT. Another reason for the poor quality of the initial laryngeal view with CT may be attributed to the position of the lens in the CT. Because the lens is very close to the laryngeal structures, the process of obtaining images can be easily disrupted by secretions and moisture (12). In addition, the possibility of epiglottic downfolding and obstruction by the arythenoids is increased with the LMA design of the CT. All of these reasons may increase the time to achieve a good view of the glottis with the CT. Some adjustment maneuvers can be performed to improve ventilation and optimize the glottic view with CT. The up-down maneuver is an effective corrective maneuver because epiglottic downfolding is seen frequently (12). In our study, we found that the forward maneuver was the most useful maneuver in the CT group to optimize the glottic view.

The camera of the DCI-VL is placed within the laryngoscope handle and a screen displays the magnified image; the user's eye is "positioned" at the tip of the instrument. Therefore, the usual viewing angle of 15° is expanded to 80°. A larger, brighter and higher resolution image is seen in the bigger monitor, and the DCI video system allows access to multiple viewers, an improvement in documentation and user comfort, all of which bring about benefits in the teaching of tracheal intubation (13).

Because the shape of the DCI-VL blade is similar to the original Macintosh blade, the same "lifting" technique is required. This conventional approach may facilitate the insertion of the video laryngoscope into the mouth and so provide a short glottic time. However, an improved laryngeal view does not always match with a higher intubation success rate (14). Despite the clear visualization of the glottis, the insertion and advancement of the ETT with video laryngoscopes may occasionally fail (15). In order to achieve successful intubation with videolaryngoscopes, stylet requirements should be considered.

Following the introduction of video laryngoscopes into clinical practice, few complications have been reported. Although not specific to DCI-VL, perforations of the soft palate and tonsillar pillars have been reported following the use of another video laryngoscope (16). The lack of reported complications related to DCI-VL may be attributed to the small number of studies performed using this method. Successful tracheal intubation with the GlideScope video laryngoscope necessitates extreme flexion (i.e., 60°) of the distal portion of the ETT (17). Thus, it is somehow more difficult to pass the tube through the oropharynx, which may increase the probability of palatal trauma (16). The use of stylets may prove beneficial in some instances; however, using a rigid stylet may play a role in injuries of the soft palate. In our study, the small number of patients which required stylet use could explain the absence of complications. It was suggested that ETT should be inserted under direct vision in video laryngoscopy and disposable stylets should be used to insert the ETT (16). The blade of the DCI–VL resembles a conventional Macintosh blade and therefore it is often possible to intubate without a stylet (10, 18).

Conclusion

Although the normal airway endotracheal intubation success rates were similar in both groups, the time required to obtain a good glottic view and the total intubation time were significantly shorter in DCI-VL.

Conflict of Interest

No conflict of interest was declared by the authors.

References

1. Tse JC, Rimm EB, Hussain A. Predicting difficult endotracheal intubation in surgical patients scheduled for general anesthesia: a prospective blind study. Anesth Analg 1995;81: 254-8. [CrossRef]
2. Combes X, Le Roux B, Suen P, Dumerat M, Motamed C, Sauvat S, et al. Unanticipated difficult airway in anesthetized patients: prospective validation of a management algorithm. Anesthesiology 2004;100:1146-50. [CrossRef]
3. Crosby ET, Cooper RM, Douglas MJ, Doyle DJ, Hung OR, Labrecque P, et al. The unanticipated difficult airway with recommendations for management. Can J Anaesth 1998;45:757-76. [CrossRef]
4. Stroumpoulis K, Pagoulatou A, Violari M, Ikonomou I, Kalantzi N, Kastrinaki K, et al. Videolaryngoscopy in the management of the difficult airway: a comparison with the Macintosh blade. Eur J Anaesthesiol 2009;26:218-22. [CrossRef]
5. Liu EH, Goy RW, Chen FG. The LMA CTrach, a new laryngeal mask airway for endotracheal intubation under vision: evaluation in 100 patients. Br J Anaesth 2006;96:396-400. [CrossRef]

6. Timmermann A, Russo S, Graf BM. Evaluation of the CTrach--an intubating LMA with integrated fibreoptic system. Br J Anaesth 2006;96:516-21. [CrossRef]
7. Liu EH, Wender R, Goldman AJ. The LMA CTrach in patients with difficult airways. Anesthesiology 2009;110:941-3. [CrossRef]
8. Low D, Healy D, Rasburn N. The use of the BERCI DCI Video Laryngoscope for teaching novices direct laryngoscopy and tracheal intubation. Anaesthesia 2008;63:195-201. [CrossRef]
9. Cavus E, Thee C, Moeller T, Kieckhaefer J, Doerges V, Wagner K. A randomised, controlled crossover comparison of the C-MAC videolaryngoscope with direct laryngoscopy in 150 patients during routine induction of anaesthesia. BMC Anesthesiol 2011;11:6. [CrossRef]
10. Van Zundert A, Maassen R, Lee R, Willems R, Timmerman M, Siemonsma M, et al. A Macintosh laryngoscope blade for videolaryngoscopy reduces stylet use in patients with normal airways. Anesth Analg 2009;109:825-31. [CrossRef]
11. American Society of Anesthesiologists Task Force on Management of the Difficult Airway. Practice guidelines for management of the difficult airway: an updated report by the American Society of Anesthesiologists Task Force on Management of the Difficult Airway. Anesthesiology 2003;98:1269-77. [CrossRef]
12. Liu EH, Goy RW, Chen FG. An evaluation of poor LMA CTrach views with a fibreoptic laryngoscope and the effectiveness of corrective measures. Br J Anaesth 2006;97:878-82. [CrossRef]
13. Kaplan MB, Ward DS, Berci G. A new video laryngoscope-an aid to intubation and teaching. J Clin Anesth 2002;14:620-6. [CrossRef]
14. Niforopoulou P, Pantazopoulos I, Demestiha T, Koudouna E, Xanthos T. Video-laryngoscopes in the adult airway management: A topical review of the literature. Acta Anaesthesiol Scand 2010;54:1050-61. [CrossRef]
15. Cavus E, Kieckhaefer J, Doerges V, Moeller T, Thee C, Wagner K. The C-MAC videolaryngoscope: first experiences with a new device for videolaryngoscopy-guided intubation. Anesth Analg 2010;110:473-7. [CrossRef]
16. Vincent RD Jr, Wimberly MP, Brockwell RC, Magnuson JS. Soft palate perforation during orotracheal intubation facilitated by the GlideScope videolaryngoscope. J Clin Anesth 2007;19:619-21. [CrossRef]
17. Cuchillo JV, Rodriguez MA. Considerations aimed at facilitating the use of the new GlideScope videolaryngoscope. Can J Anaesth 2005;52:661-2. [CrossRef]
18. Maassen R, Lee R, Hermans B, Marcus M, Van Zundert A. A comparison of three videolaryngoscopes: the Macintosh laryngoscope blade reduces, but does not replace, routine stylet use for intubation in morbidly obese patients. Anesth Analg 2009;109:1560-65. [CrossRef]