Received: 30.5.2006 **Accepted: 15.5.2007**

Short Communication

Hemodynamic responses to orotracheal intubation with a video laryngoscope in infants: a comparison study

Shahnaz Shayeghi, Mehdi Ghasemi**, Afsaneh Sadeghi*, Sayed Sajjad Razavi**

Abstract

Background: Differences in airway anatomy make the potential for technical airway difficulties greater in infants than in teenagers or adults. Endotracheal intubation by direct vision using a laryngoscope is frequently associated with an increase in arterial blood pressure and heart rate. In different studies, the time to intubation with a video laryngoscope was longer than with direct laryngoscopy using Macintosh, and this longer duration may be accompanied by more hemodynamic responses.

METHODS: Sixty-four infants who were scheduled for elective surgery requiring general anesthesia with orotracheal intubation were randomly assigned to intubation by direct laryngoscopy using a Macintosh size 1 blade or to intubation using a video laryngoscope. Systolic and diastolic blood pressures, heart rate and oxygen saturation were recorded at the following time points: (1) before induction, (2) after induction and before intubation, and (3) 1 minute and (4) 5 minutes after intubation.

RESULTS: No significant differences were found either between the two groups or among the different study periods. The duration for laryngoscopy and intubation with a video laryngoscope was 20.87 ± 7.95 seconds (mean ± standard deviation) and that with Macintosh was 15.41 ± 4.1 seconds ($P < 0.01$).

CONCLUSIONS: Similar hemodynamic responses in both groups suggest that laryngoscopy and intubation with a video laryngoscope, although with longer duration and therefore resulting in more stimulation, has no significant effect on hemodynamic status and oxygen saturation in infants.

KEY WORDS: Video laryngoscope, laryngoscopy, blood pressure, heart rate.

JRMS 2007; 12(5): 251-256

The video laryngoscope is a new device that was developed for management of difficult airways. John A Pacey (surgeon at the Faculty of Medicine, University of British Columbia, Vancouver, BC, Canada) developed the GlideScope video laryngoscope (GVL, the prototypical video laryngoscope), and sales of this device were commenced in late 2001 [1]. The GlideScope video laryngoscope is made of medical-grade plastic and is reusable. The device consists of a handle and a blade. The handle is similar to that of a standard laryngoscope. The blade design differs from a standard laryngoscope blade in that it is not detachable; in addition, it has a 60° curvature in the midline [2]. A digital video camera is embedded in the tip of the blade, and there are two light-emitting diodes on either side of the camera, which provide continuous illumination. The camera has a wide-angle lens and is equipped with an antifogging device. It is available in three sizes: Neonatal, Pediatric

*Assistant Professor, Department of Anesthesiology, Shahid Beheshti University of Medical Sciences, Tehran, Iran.
**Clinical Resident of Anesthesiology, Department of Anesthesiology, Shahid Beheshti University of Medical Sciences, Tehran, Iran.
e-mail: ghasemi@edc.mui.ac.ir (Corresponding Author)

(midsize), and Lo Pro Adult, with lengths (tip to front of the handle) of 48, 82, and 101 mm, maximal widths of 16, 19, 26 mm, respectively, and thickness of 14.5 mm. [3]. We used the neonatal size in our study.

The video laryngoscope is designed to be inserted along the midline of the tongue and advanced until the glottis is visible on the monitor. The tracheal tube is mounted onto a flexible stylet and the distal tip is angulated upward by about 60° to match the angulation of the blade. The preformed shape resembles that of an ice-hockey stick. The tracheal tube is then passed by the side of the blade into the trachea while the surgeon is viewing the entire process on the monitor [4]. We found only one article about the use of video laryngoscope in neonates [5]. The rest of the studies in our review of the literature were in adults. To our knowledge, this is the first randomized clinical trial evaluating the video laryngoscope in comparison with the Macintosh laryngoscope in infants. Differences in airway anatomy make the potential for technical airway difficulties greater in infants than in teenagers or adults [6]. Endotracheal intubation by direct vision using a laryngoscope is frequently associated with an increase in arterial blood pressure and heart rate [7]. In different studies, the time to intubation with GlideScope was longer than with Macintosh [2,7,8] and this longer duration may be accompanied by more hemodynamic responses [9]. This study was undertaken to evaluate hemodynamic changes during and after laryngoscopy and tracheal intubation using a video laryngoscope and direct laryngoscopy using the standard Macintosh laryngoscope in infants, with respect to the time taken for intubation.

Methods

Following approval from the Anesthesiology Department of Mofid Children Hospital, Shaheed Beheshti University of Medical Sciences, written informed consent was obtained from the parents of 64 infants. All patients recruited were scheduled for elective surgery requiring general anesthesia with orotracheal intubation to secure the airway. Infants with probable or confirmed raised intracranial pressure, those with known airway pathology or a cervical spine injury and patients who required rapid sequence induction, patients in an emergency situation or unstable hemodynamic condition, and infants in shock were excluded. All laryngoscopies were performed by one person (a resident of anesthesiology year 3 (referred to hereafter as investigator) to minimize interoperator variability. Before this study, the investigator had about 3 years experience in laryngoscopy and intubation with Macintosh laryngoscope but mostly in adults. He had performed only 10 laryngoscopies and intubations with a Macintosh or a Miller laryngoscope in infants. He had no previous experience of intubation with a video laryngoscope. Initially, 10 infants were intubated by the investigator using pediatric (midsize) and neonatal video laryngoscopes (five infants for each size). All procedures were performed under the supervision of at least one or two Anesthesiology Department staff. After these 10 cases, the staff approved the competency of the investigator to perform intubations with a video laryngoscope. The first 10 patients mentioned earlier were not included in our study.

Before the induction of anesthesia, all patients were premedicated with atropine sulfate (0.02 mg/kg, PO) 1 hour before entering the operating room. An intravenous cannula was inserted for each patient, and standard monitoring of hemodynamic responses, including noninvasive blood pressure, heart rate (HR), pulse oximetry and end-tidal CO_2 was carried out for all 64 infants in the anesthetic room. Systolic and diastolic blood pressures, HR and oxygen saturation (SpO_2) were recorded for each patient at the following time points: (1) before induction at the operating bed during pre-oxygenation as base values; (2) after induction and before laryngoscopy; and (3) 1 minute and (4) 5 minutes after intubation and tracheal tube fixation. Following 3 minutes pre-oxygenation, anesthesia was induced with thiopental sodium 6 mg/kg IV. Upon loss of lid reflex, paralysis was induced with atracurium

0.5 mg/kg IV according to the guidelines of Mofid Children Hospital. In order to maintain oxygenation and anesthesia, the infant's lungs were ventilated for 3 minutes with 0.5% Halothane in 100% oxygen using a standard face-mask while neuromuscular blockade was established. Then, the trachea was intubated using either the Macintosh blade or the video laryngoscope according to the study allocation, which was made before induction by computer-generated randomization of the patients to the two study groups.

Duration was defined as the time from when the tip of the blade passed the lips to when the endotracheal tube was positioned at the vocal cords. Attempt at intubation was abandoned if the patient's oxygen saturation dropped to below 90%, and ventilation was then re-established. Failure to intubate was defined as failure after three attempts. If the intubation sequence took longer than 120 seconds, it would be deemed a failure too and recorded as such. In the video laryngoscope group, the investigator preshaped the orotracheal tube; all laryngoscopies and intubations were performed according to the manufacturer's instructions. Cormack and Lehane (C&L) grade and need to BURP (Backward, Upward, Rightward Pressure) maneuver were recorded for each infant. Any resistance to the advancement of the tube is managed by withdrawing the stylet approximately 4 cm and withdrawing the video laryngoscope by 1–2 cm. This allowed the glottis to drop down, making the angle of the approach of the tracheal tube more favorable [4]. Hemodynamic management during induction was standardized. Hypertension and tachycardia were diagnosed if their values were greater than the 95th percentile, and hypotension and bradycardia were diagnosed if their values were less than the fifth percentile. After every use, as recommended by the manufacturer, the video laryngoscope was cleaned with a detergent solution to remove all particulate material, blood and debris from the device, after which it was sterilized. The data were analyzed using a repeated-measures analysis of variance (ANOVA) for within-group comparisons. Differences among groups were analyzed using a one-way ANOVA. T-test, chi-square test and fisher exact test were used for comparison of age, sex, C&L grade and need to BURP maneuver between the two study groups, respectively. P-value<0.05 was considered statistically significant.

Results

There were no significant differences between the two study groups with regard to demographic characteristics, C&L grades and need to BURP maneuver (table 1). Two of the first 10 patients, who had been intubated with a video laryngoscope before the start of the main study failed at first attempt and, after ventilation with 100% oxygen, were intubated with a Macintosh blade laryngoscope. Two cases were excluded from the video laryngoscope group because of a technical problem (LCD disconnection). All intubations were successful at the first attempt. No complications, such as bleeding, soft tissue damage or laceration, were observed. In relation to the hemodynamic parameters and SpO2, statistically significant differences were not observed between groups either at similar time points or before and after induction and one and five minutes after intubation in each group (table 2). The duration of laryngoscopy and intubation in the video laryngoscope group was 20.87 ± 7.95 seconds (mean ± standard deviation) and in the Macintosh group was 15.41 ± 4.1 seconds (figure 1).

Table 1. Mean age, relative distribution of sex and need to BURP, and frequency distribution of Cormack and Lehane in the video laryngoscope group (30 infants) and the Macintosh group (32 infants).

	GlideScope	Macintosh
Age; month*	2.56 ± 2.19	3.21 ± 1.77
Sex; male:female	15:15	15:17
Cormack &Lehane; 1:2:3	13:16:1	18:14:0
Need to BURP; Yes:no	3:27	4:28

* Mean ± standard deviation

Table 2. Mean systolic blood pressure (sys BP), diastolic blood pressure (dia BP), heart rate (HR), and arterial oxygen saturation (SpO2) in the Macintosh group (32 infants) and the video laryngoscope group (30 infants) before and after induction and 1 and 5 minutes after intubation. No significant changes were seen.

Time	Laryngoscope	Sys BP*	Dia BP*	HR*	Spo2*
Before Induction (base values)	Macintosh	96.38 ± 10.19	55.34 ± 8.79	157.00 ± 19.99	97.16 ± 1.11
	Videolaryngo-scope	95.80 ± 14.72	56.13 ± 13.07	160.67 ± 22.29	97.17 ± 1.42
After Induction	Macintosh	94.06 ± 11.75	53.66 ± 9.57	159.63 ± 20.36	97.50 ± 1.19
	Videolaryngo-scope	93.37 ± 15.48	54.50 ± 13.55	160.70 ± 21.48	97.70 ± 1.32
1 min after Intubation	Macintosh	95.25 ± 11.00	55.97 ± 9.22	163.22 ± 19.60	97.47 ± 1.65
	Videolaryngo-scope	99.77 ± 13.27	58.10 ± 14.31	165.70 ± 17.69	97.17 ± 1.49
5 min after Intubation	Macintosh	94.06 ± 11.26	52.34 ± 12.08	159.59 ± 18.79	97.59 ± 1.19
	Videolaryngo-scope	92.60 ± 17.06	54.30 ± 14.34	161.00 ± 20.01	97.77 ± 1.14

* Mean ± standard deviation

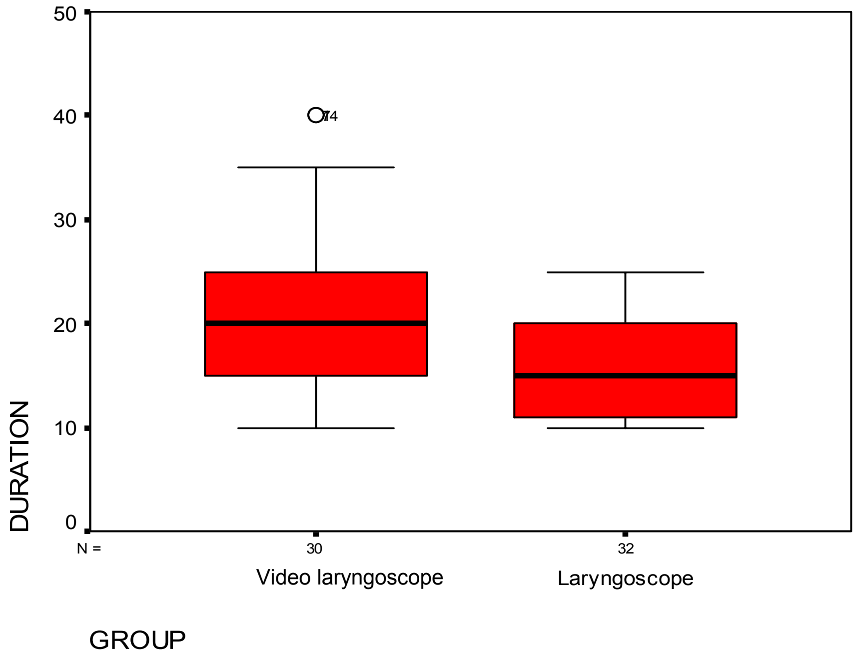

Figure 1. Mean duration of laryngoscopy and intubation in the video laryngoscope and the Macintosh groups (P<0.01).

Discussion

In this study, we compared hemodynamic responses to laryngoscopy and intubation with a video laryngoscope and a Macintosh blade laryngoscope, and no differences were observed between the video laryngoscope and the Macintosh groups or among the different study periods. Laryngoscopy itself is one of the most invasive stimuli during orotracheal intubation. Many anesthesiologists agree that reducing the force on the larynx might prevent excessive hyperdynamic responses to orotracheal intubation. The hemodynamic responses to orotracheal intubation have two components. The first is the response to laryngoscopy and the second is the response to the endotracheal intubation [9]. Orotracheal intubation using direct-vision laryngoscopy requires elevation of the epiglottis and exposure of the glottic opening, which is achieved by a forward and upward movement of the laryngoscope blade. This procedure is associated with hemodynamic changes [10]. Several studies showed that video laryngoscope offered an improved view of the larynx as compared with a standard Macintosh blade and even with fiberoptic laryngoscopy [4,7]. The blade has a 60° angulation, and the location of the camera, midway along the bottom of the blade, provides a wider field of view than a fiberoptic laryngoscope [4]. The video laryngoscope is designed to provide a view of the glottis via the camera without having to align oral, pharyngeal and tracheal axes [7]. It is a device that is not very stimulating to the patient and does not require manipulation of the head and neck to visualize the airway anatomy [4]. Other studies like our study showed that the average time for tracheal tube intubation was longer with the video laryngoscope given similar hemodynamic responses and also oxygen saturation in both groups of our study. It seems that this prolongation and resulted more stimulation did not have had any significant effect on hemodynamic status and oxygen saturation of the patient. Studies comparing two direct-laryngoscope blades, the Macintosh [4] and the Miller [1], with lighted stylet intubation showed no significant difference in hemodynamic changes among the three groups. The stimulus produced by laryngoscopy might add to that from endotracheal intubation, but it is a relatively small stimulus compared with endotracheal intubation. In summary, our study showed that hemodynamic responses to intubation and laryngoscopy with a video laryngoscope in infants who were premedicated with atropine sulfate were similar to hemodynamic responses to intubation and laryngoscopy with a standard Macintosh size laryngoscope. We are aware that this is a preliminary study and further studies with a proper sample size are suggested to determine the effectiveness of the video laryngoscope and its effect on hemodynamic responses and time of intubation.

Acknowledgments

We express sincere thanks to Mr. Akbari, Mr. Motamedi, Mrs. Hakami Miss Amiri, Miss Mohsenian, Miss Chizari, Miss Shafaee, and Miss Soltani for their assistance in this investigation in the operating room. We are grateful to the director and personnel of Medical Education Development Center of Isfahan University of Medical Sciences for their help in the preparation of the final report.

References

1. Krasser K, Missaghi-Berlini SM, Moser A, Zadrobilek E. **Evaluation of the standard adult GlideScope video laryngoscope: orotracheal intubation performed by novice users after formal instruction**. *Internet Journal of Airway Management* 2004; 3. Available from URL: http://www.ijam.at/volume03/clinicalinvestigation01/default.htm (accessed Jun 24, 2007).
2. Lim TJ, Lim Y, Liu EH. **Evaluation of ease of intubation with the GlideScope or Macintosh laryngoscope by anaesthetists in simulated easy and difficult laryngoscopy**. *Anaesthesia* 2005; 60(2):180-183.
3. GlideScope web site. Verathon [2007]. Available from URL: http://www.saturnbiomedical.com/products

4. Rai MR, Dering A, Verghese C. **The GlideScope system: a clinical assessment of performance**. *Anaesthesia* 2005; 60(1):60-64.
5. Trevisanuto D, Fornaro E, Verghese C. **The GlideScope video laryngoscope: initial experience in five neonates**. *Can J Anaesth* 2006; 53(4):423-424.
6. Cote Charles J. **Pediatric Anesthesia**. In: Miller Ronald D, editor. *Miller's Anesthesia*. 6 ed. Philadelphia: Elsevier Churchill Livingston; 2005. 2369.
7. Sun DA, Warriner CB, Parsons DG, Klein R, Umedaly HS, Moult M. **The GlideScope Video Laryngoscope: randomized clinical trial in 200 patients**. *Br J Anaesth* 2005; 94(3):381-384.
8. Turkstra TP, Craen RA, Pelz DM, Gelb AW. **Cervical spine motion: a fluoroscopic comparison during intubation with lighted stylet, GlideScope, and Macintosh laryngoscope**. *Anesth Analg* 2005; 101(3):910-5.
Adachi YU, Satomoto M, Higuchi H, Watanabe K. **Fentanyl attenuates the hemodynamic response to** 9. **endotracheal intubation more than the response to laryngoscopy**. *Anesth Analg* 2002; 95(1):233-7.
10. Montes FR, Giraldo JC, Betancur LA, Rincon JD, Rincon IE, Vanegas MV et al. **Endotracheal intubation with a lightwand or a laryngoscope results in similar hemodynamic variations in patients with coronary artery disease**. *Can J Anaesth* 2003; 50(8):824-828.