A prospective randomized comparative study between Macintosh and GlideScope in adult patients undergoing cardiac surgery

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Context
The GlideScope laryngoscope is a new device for intubation that provides an improved view of the larynx.
Aim
The aim of the study was to compare the hemodynamic effect of Macintosh laryngoscope with GlideScope during intubation in adult cardiac surgery.
Setting and design
This was a prospective, randomized, comparative study conducted in Madinah Cardiac Center, Saudi Arabia.
Materials and methods
The study included 100 patients classified into two groups (n = 50), The patients were intubated either by Macintosh laryngoscope or by GlideScope. The following parameters were monitored: heart rate, mean arterial blood pressure, catecholamine level, intubation time, number of intubation trials, and the complications.
Statistical analysis used
Data were statistically described in terms of mean ± SD or frequencies.
Measurements and main results
The intubation time was longer in GlideScope than in Macintosh (P < 0.001), and the number of intubation trials was higher in GlideScope than in Macintosh (P < 0.001). The heart rate increased significantly in patients of the GlideScope group compared with the Macintosh group at first minute (P < 0.001), third minute (P < 0.001), and at fifth minute (P = 0.034). The mean arterial blood pressure increased significantly in patients of the GlideScope group compared with the Macintosh group at first minute (P < 0.001), third minute (P = 0.003), and at fifth minute (P = 0.029). The epinephrine level was higher with GlideScope at first and fifth minute (P = 0.032 and 0.036, respectively). The norepinephrine was higher in the GlideScope group at first and fifth minute (P = 0.043 and 0.033, respectively). The incidence of oral trauma and bleeding was higher with GlideScope than Macintosh (P = 0.003).
Conclusion
The intubation by GlideScope is associated with increased heart rate, blood pressure, catecholamine level, number of intubation trials, and oral complications compared with Macintosh laryngoscope.

Keywords:
bleeding, GlideScope, heart rate, intubation, Macintosh laryngoscope, mean arterial blood pressure, sore throat

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Introduction

Tracheal intubation is the standard technique of airway management in cardiac surgery. Transient hypertension and tachycardia occur after endotracheal intubation using laryngoscopy. The peak of elevation in blood pressure and heart rate are within 1–2 min and are usually well tolerated. However, in patients with hypertension, coronary artery disease, or cerebral vascular disease, the hypertension and tachycardia are risky because of the associated increase in myocardial oxygen demand, decrease in oxygen supply, the possibility of cardiac arrhythmia, myocardial ischemia, and cerebral vascular accident [1–6]. There are many types of laryngoscopes for tracheal intubation, but Macintosh laryngoscope has been the most widely used device for intubation since its design by Robert Macintosh in 1943 [7].

GlideScope video laryngoscope is a new technique in which a digital camera and a source of light are mounted at the end of the blade. It provides a clear view of the larynx during intubation and is designed to manage difficult intubation [8]. The aim of the study was to

assess the hemodynamic effect of GlideScope and Macintosh laryngoscope during orotracheal intubation in adult patients undergoing cardiac surgery.

Materials and methods

After approval of the ethics committee in Madinah Cardiac Center, Saudi Arabia, we studied 100 adult patients who underwent elective cardiac surgery (September 2012–November 2013). Exclusion criteria included patients with renal or hepatic disease, bleeding diathesis, Mallampati score of III or IV, or history of a difficult intubation. All patients received their medications, including diuretics, β-blockers, calcium channel blockers, or angiotensin-converting enzyme inhibitors, ~2 h before anesthesia induction. The patients were classified randomly (using simple randomization) into two groups (n = 50): group A patients were intubated using Macintosh laryngoscope and group B patients were intubated using GlideScope (GS, Cobalt AVL Monitor; Verathon Medical, Canada).

The patients were premedicated with diazepam 5 mg orally at midnight and 30 min before surgery. Before induction, a peripheral venous cannula 18 or 16 G and radial arterial cannula were inserted under local anesthesia, and the central venous line was inserted after induction. The induction was started with fentanyl 5 μg/kg 5 min before intubation; and then etomidate 0.3 mg/kg and rocuronium 0.8 mg/kg were administered. After loss of response, lidocaine spray 10% (three metered doses) was administered in the oral cavity. The orotracheal intubation was performed when the train-of-four count was zero using peripheral nerve stimulator (Micro Stim; Sun Med Inc., Largo, Florida, USA) and was conducted by the same anesthesiologist. Anesthesia was maintained with sevoflurane 1–3% and fentanyl 1–3 μg/kg/h and cisatracurium 1–2 μg/kg/min, as needed. The increase in heart rate and mean arterial blood pressure during and after intubation was managed with a bolus dose of fentanyl 50–100 μg and by increasing the concentration of sevoflurane.

Monitors of patients

The monitors included: the intubation time, number of intubation trial, rate of stylet using, and the total doses of fentanyl, etomidate, and rocuronium. The heart rate and invasive mean arterial blood pressure were checked before intubation, at first, third, fifth, and 15th minute after intubation. The catecholamine level in blood (epinephrine and norepinephrine, blood samples were drawn from the anticubital vein into an air-tight tube under aseptic condition and was measured using high-performance liquid chromatography) was measured at the first, fifth, and 15th minute. The time was checked with timer built-in ventilator screen (Dräger; Primus, Germany). A continuous ECG with automatic ST-segment analysis (leads II and V) was used according to standard criteria for myocardial ischemia (ST elevations 2 mm from the baseline in leads II and V5, or ST depressions 1 mm from the baseline in leads II and V5, with the elevation or depression lasting for 1 min or more). Moreover, the postoperative complications such as bleeding or trauma to lips, teeth, or tongue were recorded.

The statistical analysis

Data were statistically described in terms of mean (SD), or frequencies (number of cases), confidence intervals (95% CI), and percentages, when appropriate. Comparison of numerical variables between the study groups was made using the Student t-test for independent samples. Within-group comparison of numerical variables was carried out using the repeated measures analysis of variance test using general linear model regression analysis. For comparing categorical data, the χ^2-test was performed. Fisher's exact test was used when the expected frequency was less than 5. P-values less than 0.05 were considered statistically significant. All statistical calculations were performed using computer programs SPSS (Statistical Package for the Social Science; SPSS Inc., Chicago, Illinois, USA), version 15 for Microsoft Windows.

Results

There was insignificant difference between the two groups as regards age, weight, sex, preoperative medications and comorbidities, and type of surgery (P > 0.05) (Table 1).

Table 1 Preoperative data of patients

Items	Group A (n = 50)	Group B (n = 50)	P-value
Age (years)	52.04 ± 9.36	51.80 ± 10.10	0.902
Weight (kg)	80.80 ± 9.12	80.28 ± 10.50	0.792
Sex			
Female	23	26	0.548
Male	27	24	0.689
DM (n)	21	24	0.546
Hypertension (n)	19	19	0.677
Preoperative medications			
Diuretic	5	3	0.746
β-Blocker	17	19	0.853
Calcium channel blocker	13	10	0.641
ACEI	10	8	0.725

Data are presented as mean ± SD or number; ACEI, angiotensin-converting enzyme inhibitor; DM, diabetes mellitus.

There was no statistical difference between the two groups as regards the Mallampati class I and II (P = 0.308). The success of first trial of intubation was higher in the Macintosh group than in the GlideScope group patients (P < 0.001). Three patients in the Macintosh group and 10 patients in the GlideScope group needed a second trial (P < 0.001). Moreover, four patients in the GlideScope group needed a third trial and no other trial was needed in the Macintosh group (P = 0.021). The intubation time was longer with GlideScope than with Macintosh laryngoscopy (P < 0.001). There were only five patients in the Macintosh group who needed stylet during intubation, whereas all patients in the GlideScope group were intubated using stylet (P < 0.001). Moreover, the incidence of oral trauma and bleeding related to intubation was higher in the GlideScope group than in the Macintosh laryngoscopy group (P = 0.003) (Table 2).

Table 3 shows no statistical difference as regards the dose of etomidate, rocuronium, and fentanyl (P > 0.05); however, after intubation, patients of the GlideScope group needed a higher dose of fentanyl, compared with the Macintosh laryngoscopy group patients, to control the increased heart rate and blood pressure associated with intubation (P < 0.001) (Table 3).

There was no statistical difference between the two groups regarding the baseline heart rate(P = 0.936), but after intubation the heart rate increased significantly in patients of GlideScope group more than Macintosh laryngoscopy group at 1st min[P < 0.001 and 95% CI (84.01 to 88.66 and 96.17 to 100.90 respectively)], 3rd min[P < 0.001 and 95% CI (83.29 to 86.46 and 94.00 to 98.07 respectively)]and at 5th min[P = 0.034 and 95% CI (79.51 to 82.04 and 86.11 to 89.84 respectively)], and the comparison at 15th min was insignificant (P = 0.710) (Table 4, Fig. 1). There was insignificant difference as regards the baseline mean arterial blood pressure between the two groups (P = 0.429); however, after intubation the mean arterial blood pressure increased significantly in patients of the GlideScope group compared with the Macintosh laryngoscopy group at first minute [P < 0.001 and 95% CI (98.25 to 102.26 and 107.35 to 111.72 respectively)], 3rd min [P = 0.003 and 95% CI (96.04 to 99.03 and 104.32 to 113.11 respectively)] and at 5th min [P = 0.029 and 95% CI (91.98 to 96.65 and 98.81 to 106.42) respectively)], and the comparison at 15th minute was insignificant (P = 0.245) (Table 4, Fig. 2).

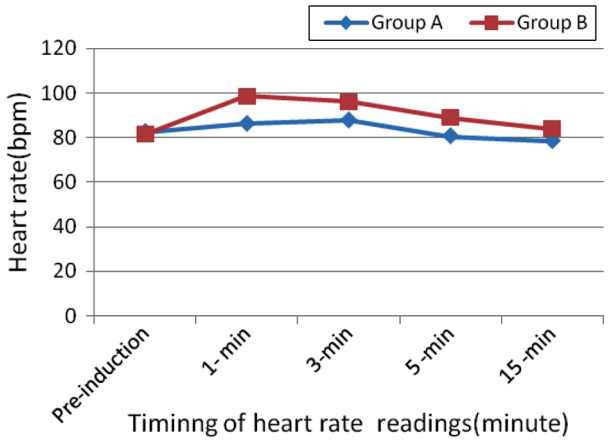
Before induction, there was no statistical difference in the catecholamine level between the two groups. The epinephrine level increased significantly at the first minute [P = 0.032 and 95% CI (0.84 to 0.97 and 0.97

Table 2 Data of intubation and complications

Items	Group A (n = 50)	Group B (n = 50)	P-value
Mallampati class			
I	39	41	0.308
II	11	9	0.308
Intubation time (s)	18.32 ± 2.76	45.86 ± 4.02	0.001
Number of intubation trials			
1st	47	26	0.001
2nd	3	20	0.001
3rd	0	4	0.021
Stylet using rate	5	50	0.001
Oral trauma and bleeding	2	11	0.003

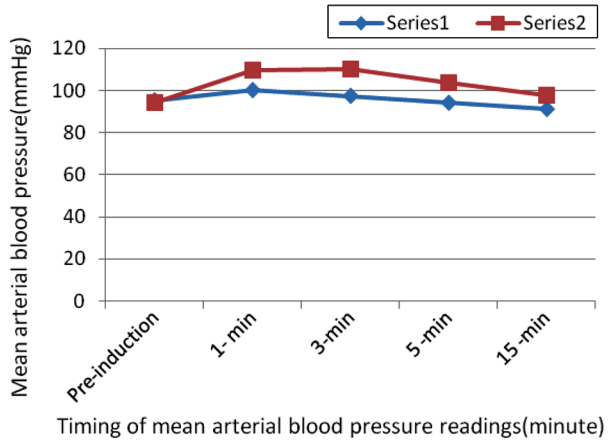
Data are presented as mean ± SD or number; 1st: first intubation trial; 2nd: second intubation trial; 3rd: third intubation trial.

Figure 1



Heart rate of patients. 1 min: the reading 1 min after intubation; 3 min: the reading 3 min after intubation; 5 min: the reading 5 min after intubation; 15 min: the reading 15 min after intubation.

Figure 2



The mean arterial blood pressure of patients. 1 min: the reading 1 min after intubation; 3 min: the reading 3 min after intubation; 5 min: the reading 5 min after intubation; 15 min: the reading 15 min after intubation.

to 1.17 respectively) and 5th min(P = 0.036 and 95% CI (0.82 to 1.05 and 1.02 to 1.36 respectively)] in the GlideScope group compared with the Macintosh laryngoscopy group, and the comparison at the 15th minute was insignificant (P = 0.514) (Table 5). The norepinephrine level increased significantly at the first minute [P = 0.043 and 95% CI (1.39 to 1.62 and 1.74 to 2.15 respectively)] and 5th min [P = 0.033 and 95% CI (1.38 to 1.79 and 1.97 to 2.30 respectively)] in patients of the GlideScope group compared with the Macintosh laryngoscopy group, and the comparison at the 15th minute was insignificant (P = 0.241) (Table 5).

Table 3 Intraoperative data of patients

Items	Group A (n = 50)	Group B (n = 50)	P-value
Etomidate	23.48 ± 3.72	23.36 ± 3.53	0.891
Rocuronium	76.60 ± 10.22	75.80 ± 10.10	0.695
Fentanyl (total dose μg)			
Preintubation	294.00 ± 74.66	298.00 ± 68.48	0.792
Postintubation	102.50 ± 39.14	180.00 ± 50.38	0.001
CABG	22	25	0.548
Valvular surgery	13	11	0.640
CABG+valvular surgery	15	14	0.826

Data are presented as mean ± SD or number; CABG, coronary artery bypass grafting.

Discussion

The hemodynamic changes typically occur within seconds during laryngscopy (stimuli to oropharynx) and intubation (stimuli to larynx and trachea) and the peak of changes is within one to two minutes and continues for 5 minutes [9].

Table 4 Hemodynamic data of patients

Items	Group A (n = 50)	Group B (n = 50)	P-value
Heart rate			
Preinduction			
Mean	82.70 ± 9.40	81.56 ± 8.06	0.936
95% CI	80.02–85.37	80.26–84.85	
1 min			
Mean	86.34 ± 8.19	98.54 ± 8.32†	0.001*
95% CI	84.01–88.66	96.17–100.90	
3 min			
Mean	84.88 ± 5.57	96.04 ± 7.17†	0.001*
95% CI	83.29–86.46	94.00–98.07	
5 min			
Mean	80.78 ± 4.46	88.98 ± 6.56†	0.034*
95% CI	79.51–82.04	86.11–89.84	
15 min			
Mean	74.58 ± 4.70	73.96 ± 5.45	0.710
95% CI	73.24–75.91	72.41–76.50	
Mean arterial blood pressure			
Preinduction			
Mean	95.46 ± 6.46	94.40 ± 6.87	0.429
95% CI	93.62–97.29	92.44–96.35	
1 min			
Mean	100.26 ± 7.05	109.54 ± 7.70†	0.001*
95% CI	98.25–102.26	107.35–111.72	
3 min			
Mean	97.54 ± 5.24	110.22 ± 6.67†	0.003*
95% CI	96.04–99.03	104.32–113.11	
5 min			
Mean	94.35 ± 6.67	103.62 ± 5.87†	0.029*
95% CI	91.98–96.65	98.81–106.42	
15 min			
Mean	91.38 ± 5.42	97.74 ± 6.50	0.245
95% CI	90.00–92.75	93.85–99.62	

Data are presented as mean ± SD and 95% confidence interval (CI); 1 min: the reading 1 min after intubation; 3 min: the reading 3 min after intubation; 5 min: the reading 5 min after intubation; 15 min: the reading 15 min after intubation; *P-value is significant between the two groups; †P-value is significant in comparison with baseline within the same group.

Table 5 Catecholamine levels in blood

Items	Group A (n = 50)	Group B (n = 50)	P-value
Epinephrine (nmol/l)			
Preinduction			
Mean	0.87 ± 0.36	0.83 ± 0.41	0.614
95% CI	0.77–0.96	0.72–0.94	
1 min			
Mean	0.91 ± 0.23	1.07 ± 0.36†	0.032*
95% CI	0.84–0.97	0.97–1.17	
5 min			
Mean	0.94 ± 0.43	1.19 ± 0.60†	0.036*
95% CI	0.82–1.05	1.02–1.36	
15 min			
Mean	0.88 ± 0.51	0.90 ± 0.41	0.514
95% CI	0.73–1.02	0.78–1.01	
Norepinephrine (nmol/l)			
Preinduction			
Mean	1.46 ± 0.43	1.39 ± 0.63	0.530
95% CI	1.34–1.58	1.21–1.56	
1 min			
Mean	1.51 ± 0.40	1.95 ± 0.73†	0.043*
95% CI	1.39–1.62	1.74–2.15	
5 min			
Mean	1.59 ± 0.74	2.14 ± 0.60†	0.033*
95% CI	1.38–1.79	1.97–2.30	
15 min			
Mean	1.47 ± 0.57	1.48 ± 0.62	0.241
95% CI	1.31–1.62	1.30–1.65	

Data are presented as mean ± SD and 95% confidence interval (CI); 1 min: the reading 1 min after intubation; 5 min: the reading 5 min after intubation; 15 min: the reading 15 min after intubation; *P-value is significant between the two groups; †P-value is significant in comparison with baseline within the same group.

In the present study, despite the excellent view of the glottis with GlideScope, the intubation time was longer with GlideScope, compared with Macintosh laryngoscope, because of the time needed to direct the endotracheal tube through the vocal cords, or longer time needed for repeated trials of intubation. The heart rate and mean arterial blood pressure increased significantly in the GlideScope group than in the Macintosh laryngoscope group at first, third, and fifth minute after intubation and gradually decreased to be around the baseline values at 15th minute after intubation. The increase in heart rate and mean arterial blood pressure was associated with an increase in epinephrine and norepinephrine, and this explains the stress response produced by a longer intubation time with GlideScope compared with Macintosh laryngoscopy. The total dose of fentanyl needed to control the increase in heart rate and mean arterial blood pressure was higher in the GlideScope group. The incidence of trauma and bleeding from oral cavity was higher in the GlideScope group, compared with the Macintosh laryngoscope group, due to the associated multiple trials and difficulty in directing the endotracheal tube to the glottis during intubation with GlideScope, which exposes the oral mucosa to trauma.

In agreement with our results, many studies showed that the intubation time is prolonged and that the number of intubation trials was higher with GlideScope compared with Macintosh laryngoscopy [10–17], and other studies documented serious complications associated with GlideScope during intubation [18,19]. Carassiti *et al*. [20] reported that the force and pressure used during intubation are localized mainly at the tip of Macintosh blade, whereas distributed homogeneously in the GlideScope blade. This may exaggerate the stimulation produced by the whole blade of GlideScope in comparison with stimulation produced by the tip of Macintosh blade. Xue *et al.* [21] evaluated the hemodynamic changes with GlideScope and reported a significant increase in heart rate and blood pressure during orotracheal intubation with GlideScope; this can be explained with the study by Jakuðenko and colleagues. They found that the prolonged intubation time with GlideScope leads to a longer contact of the GlideScope blade with the oropharyngolaryngeal zone mucosa receptors, thus producing a greater stress response [22], which potentiates more hemodynamic changes during intubation [16]. Malik and colleagues compared the hemodynamic changes with Macintosh, GlideScope and Airwayscope laryngoscope (AWS) in adult patients undergoing general surgery and reported that heart rate increased significantly with Macintosh and GlideScope and returned to the baseline within 5 min after intubation. The mean arterial blood pressure decreased significantly below the baseline in patients of the Macintosh laryngoscope group [23]. On other hand, a randomized clinical trial done by Bilehjani E and Fakhari S to assess the hemodynamic changes during intubation. The study included 80 patients underwent CABG and the intubation was done either by Macintosh laryngoscopy (n = 40) or GlideScope (n = 40). They found no difference in heart rate and mean arterial blood pressure at the 1st, 5th, 15th min following intubation in comparison to the baseline values (P > 0.05) [11], and the same result was reported by other studies [24–27].

Contrary to our findings, a randomized double-blind clinical trial included 200 patients underwent elective orthopedic surgery. Heart rate and MAP were measured before, at the time of induction and every minute for 10 minutes following intubation. After intubation, the heart rate and MAP increased significantly in the first two minutes only in direct laryngoscopy group (P < 0.001) but not in GlideScope group [28]. Another clinical trial evaluated the hemodynamic changes in 160 hypertensive patients

during intubation. The patients were intubated either with GlideScope or Macintosh laryngoscope. Noninvasive blood pressure and heart rate were recorded before induction, after induction, during laryngoscopy, immediately after intubation, and every minute for the first 5 min after intubation. The blood pressure and heart rate decreased significantly in both groups in comparison with preinduction values [29].

Conclusion

During intubation of adult cardiac surgical patients, the GlideScope is associated with increased heart rate, blood pressure, catecholamine level, intubation time, number of intubation trials, stylet using, oral trauma, and bleeding compared with Macintosh laryngoscope.

Limitations

Our study recognizes some limitations, such as the study being a single center study, the small number of patients, and scarcity of previous studies on GlideScope in cardiac surgery for comparison with our results.

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Conflicts of interest

There are no conflicts of interest.

References

1 Weber S. Traumatic complications of airway management. Anesthesiol Clin North America 2002; 20:503–512.

2 Kihara S, Brimacombe J, Yaguchi Y, Watanabe S, Taguchi N, Komatsuzaki T. Hemodynamic responses among three tracheal intubation devices in normotensive and hypertensive patients. Anesth Analg 2003; 96:890–895.

3 Kanaide M, Fukusaki M, Tamura S, Takada M, Miyako M, Sumikawa K. Hemodynamic and catecholamine responses during tracheal intubation using a lightwand device (Trachlight) in elderly patients with hypertension. J Anesth 2003; 17:161–165.

4 Takahashi S, Mizutani T, Miyabe M, Toyooka H. Hemodynamic responses to tracheal intubation with laryngoscope versus lightwand intubating device (Trachlight®) in adults with normal airway. Anesth Analg 2002; 95:480–484.

5 Horak J, Weiss S. Emergent management of the airway. New pharmacology and the control of comorbidities in cardiac disease, ischemia, and valvular heart disease. Crit Care Clin 2000; 16:411–427.

6 Saranteas T, Zotos N, Chantzi C, Mourouzis C, Rallis G, Anagnostopoulou S, et al. Ketamine-induced changes in metabolic and endocrine parameters of normal and 2-kidney 1-clip rats. Eur J Anaesthesiol 2005; 22:875–878.

7 Macintosh RR. A new laryngoscope. Lancet 1943; 1:205.

8 Mihai R, Blair E, Kay H, Cook TM. A quantitative review and metaanalysis of performance of nonstandard laryngoscopes and rigid fibreoptic intubation aids. Anaesthesia 2008; 63:745–760.

9 Adachi YU, Satomoto M, Higuchi H, Watanabe K. Fentanyl attenuates the hemodynamic response to endotracheal intubation more than the response to laryngoscopy. Anesth Analg 2002; 95:233–237.

10 Hsiao WT, Lin YH, Wu HS, Chen CL. Does a new videolaryngoscope (glidescope) provide better glottic exposure? Acta Anaesthesiol Taiwan 2005; 43:147–151.

11 Bilehjani E, Fakhari S. Hemodynamic response to laryngoscopy in ischemic heart disease: Macintosh blade versus GlideScope® video laryngoscope. RMJ 2009; 34:151–154.

12 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; 60:180–183.

13 Kim JT, Na HS, Bae JY, Kim HS, Kim CS, Kim SD. The GlideScope(R) video laryngoscope: randomized clinical trial in 200 patients. Br J Anaesth 2008; 101:531–534.

14 Barak M, Philipchuck P, Abecassis P, Katz Y. A comparison of the Truview blade with the Macintosh blade in adult patients. Anaesthesia 2007; 62(8): 827–831.

15 Turkstra TP, Harle CC, Armstrong KP, Armstrong PM, Harle CC. The GlideScope(R)-specific rigid stylet and standard malleable stylet are equally effective for GlideScope(R) use. Can J Anesth 2007; 54:891–896.

16 Jones PM, Turkstra TP, Armstrong KP, Armstrong PM, Cherry RA, Hoogstra J, Harle CC. Effect of stylet angulation and endotracheal tube camber on time to intubation with the GlideScope(R). Can J Anesth 2007; 54:21–27.

17 Adachi YU, Takamatsu I, Watanabe K, Uchihashi Y, Higuchi H, Satoh T. Evaluation of the cardiovascular responses to fiberoptic orotracheal intubation with television monitoring: comparison with conventional direct laryngoscopy. J Clin Anesth 2000; 12:503–508.

18 Cross P, Cytryn J, Cheng KK. Perforation of the soft palate using the GlideScope(R) videolaryngoscope. Can J Anesth 2007; 54:588–589.

19 Hsu T, Hsu SC, Lee YL, Huang JS, Chen CL. Penetrating injury of the soft palate during GlideScope(R) intubation. Anesth Analg 2007; 104:1609–1610.

20 Carassiti M, Biselli V, Cecchini S, Zanzonico R, Schena E, Silvestri S, Cataldo R. Force and pressure distribution using Macintosh and GlideScope laryngoscopes in normal airway: an in vivo study. Minerva Anestesiol 2013; 79:515–524.

21 Xue FS, Zhang GH, Liu J, Li XY, Yang QY, Xu YC, Li CW The clinical assessment of Glidescope in orotracheal intubation under general anesthesia. Minerva Anestesiol 2007; 73:451–457.

22 Jakuðenko N, Kopeika U, Mihelsons M. Comparison of stress response performing endotracheal intubation by direct laryngoscopy, fibreoptic intubation and intubation by the glidescope laryngoscope. Proc Latvian Acad Sci 2008; 62:176–181.

23 Malik MA, Maharaj CH, Harte BH, Laffey JG. Comparison of Macintosh, Truview EVO2(R), Glidescope(R), and Airwayscope(R) laryngoscope use in patients with cervical spine immobilization. Br J Anaesth 2008; 101:723–730.

24 Xue FS, Zhang GH, Li XY, Sun HT, Li P, Li CW, Liu KP Comparison of hemodynamic responses to orotracheal intubation with the GlideScope videolaryngoscope and the Macintosh direct laryngoscope. J Clin Anesth 2007; 19:245–250.

25 Shayeghi S, Ghasemi M, Sadeghi A, Razavi SS. Hemodynamic responses to orotracheal intubation with a video laryngoscope in infants: a comparison study. JRMS 2007; 12:251–256.

26 Siddiqui N, Katznelson R, Friedman Z. Hemodynamic response and airway morbidity following tracheal intubation: a comparison between direct laryngoscopy, video laryngoscopy and lightwand techniques. Can J Anesth 2008; 55:524–528.

27 Pournajafian AR, Ghodraty MR, Faiz SH, Rahimzadeh P, Goodarzynejad H, Dogmehchi E. Comparing GlideScope video laryngoscope and Macintosh laryngoscope regarding hemodynamic responses during orotracheal intubation: a randomized controlled trial. Iran Red Crescent Med J 2014; 16:e12334.

28 Mahjoubifar M, Boroojeny BS. Hemodynamic changes during orotracheal intubation with the Glidescope and direct laryngoscope. Iran Red Crescent Med J 2010; 12:406–408.

29 Peirovifar AM, Gharehbaghi MM, Azarfarin R, Karimi L. Comparison of hemodynamic responses to orotracheal intubation in hypertensive patients: laryngoscopy via Macintosh blade versus GlideScope video laryngoscope. Eur J Anaesthesiol 2012; 29:235.