

Haemodynamic responses following orotracheal intubation in patients with hypertension---Macintosh direct laryngoscope versus Glidescope®videolaryngoscope

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ABSTRACT

Background and Aims: Glidescope®videolaryngoscope (GVL) is a video intubation system with 60° angle blade that provides excellent laryngeal view, does not require alignment of oral, pharyngeal, and laryngeal axes for visualisation of glottis, thus causing less stimulation of orolaryngopharynx. The aim of this study was to compare haemodynamic responses (blood pressure and heart rate) and airway morbidity using the Macintosh direct laryngoscope (MDL) and the Glidescope®videolaryngoscope (GVL) in hypertensive patients. **Methods:** Fifty patients with hypertension controlled on antihypertensive medications scheduled for elective surgery under general anaesthesia were randomly assigned to group GVL ($n=25$) or group MDL ($n=25$). Heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), mean blood pressure (MBP) were recorded at baseline, after induction, pre-intubation, at intubation, 1, 2, 3, 4, and 5 min after intubation. Time to intubation, number of attempts, complications during intubation, and postoperative airway complications (sore throat, hoarseness, dysphagia, and cough) were also recorded. **Results:** There was a statistically significant increase in SBP, DBP, and MBP at intubation [($P=0.003, 0.013, 0.03$), 1 min ($P=0.001, 0.012, 0.02$), 2 min ($P=0.04, 0.02, 0.04$), and 3 min ($P=0.02, 0.01$)] in the MDL group as compared to GVL group. The time to intubate was significantly greater in the GVL group as compared to MDL group ($P=0.0006$). There was no significant difference in the incidence of intraoperative and postoperative airway complications. **Conclusion:** In the hands of an experienced anaesthesiologist, the use of GVL in controlled hypertensive patients is associated with less haemodynamic response as compared to Macintosh Laryngoscope without any increase in airway complications.

Key words: Glidescope, haemodynamic response, intubation, Macintosh laryngoscope

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INTRODUCTION

Laryngoscopy and tracheal intubation are associated with a haemodynamic response which remains a perpetual concern for the anaesthesiologist. The elevation in arterial pressure typically starts within 5 s of laryngoscopy, peaks in 1--2 min., and returns to control levels within 5 min. Although the increase in heart rate (HR) and blood pressure are brief and variable, they are more marked and unpredictable in patients with hypertension primarily because of increased activity of sympathetic nervous system.^[1,2] In addition, these patients have increased catecholamine concentration and increased sensitivity of peripheral

vessels to catecholamines, leading to an exaggerated haemodynamic response to laryngoscopy.^[3] The increased HR and blood pressure causes increased myocardial oxygen demand and transmural pressure

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which compromises the coronary and subendocardial blood flow. This demand-supply mismatch can lead to adverse events. Consequently, complications like myocardial infarction, pulmonary edema, cerebrovascular hemorrhage can occur with sudden rise of HR and blood pressure.^[4] In addition to the haemodynamic response, hypertensive patients may have atherosclerotic changes in arterial vasculature and microcirculatory insufficiency of the laryngeal nerves. This may cause the airway tissues to be more susceptible to mechanical damage and pressure from endotracheal intubation.^[5]

It is believed that the devices used for tracheal intubation may be responsible for variation in haemodynamic responses. We therefore studied the haemodynamic responses with the use Glidescope® videolaryngoscope (GVL) in hypertensive patients. GVL is a video intubation system that provides excellent laryngeal view, does not require alignment of oral, pharyngeal, and laryngeal axes for visualisation of glottis, thus causing less stimulation.^[6] Most importantly, it reduces the upward lifting forces needed to clearly expose the glottis because of its unique hyperangulated blade with 60° curvature that functions independent of the line of sight making GVL less stimulating than Macintosh direct laryngoscope (MDL). It is suggested by the manufacturer that upward lifting force required to expose glottis using Macintosh laryngoscope is 5.4 kg but only about 0.5-1.4 kg using GVL.^[7]

We hypothesised that the intubation response with the use of GVL would be lesser than MDL in patients with hypertension. Therefore, we conducted a prospective randomised study with the primary objective of comparison of haemodynamic responses and secondary objective of studying upper airway morbidity following orotracheal intubation in patients with hypertension using a MDL and GVL during general anaesthesia.

MATERIAL AND METHODS

The study was conducted at a tertiary care teaching hospital. It was approved by the institutional ethics committee (IES/T-218/21.06.2014). Written informed consent was obtained from all the patients assessed for inclusion in the study. Study was registered with Clinical Trials Registry -India (CTRI/2017/08/009294). The inclusion criteria was patients with hypertension controlled on antihypertensive medications scheduled

for elective surgery under general anaesthesia and requiring orotracheal intubation. The exclusion criteria were age <18 years, history of coronary artery disease, difficult airway or history of difficult intubation, obesity body mass index (BMI)>30, cervicospinal disease, otolaryngologic and neurosurgery, gastroesophageal reflux, and patients requiring rapid sequence induction. The patients randomised to the two groups were group MDL ($n = 25$) and group GVL ($n = 25$) based on a computer-generated random number list.

Prior to the surgery, all the patients were evaluated by a cardiologist to optimise their antihypertensive treatment and to exclude other cardiac conditions. Selected patients underwent a routine preanaesthetic assessment along with detailed airway examination. Mallampati scores (MMP), thyromental distances, and interincisor distances were measured and the antihypertensive medications used by the patients were recorded.

All patients were made to fast overnight and received oral alprazolam 0.25 mg on the night before surgery. The patients were administered their antihypertensive medication (diuretics, beta-blockers, calcium channel blockers, angiotensin-converting enzyme inhibitors, angiotensin II receptor blockers) according to their schedule on the night before surgery and on the morning of the surgery approximately 2 h prior to anaesthesia induction.

In the operation theatre, an intravenous cannula was inserted and midazolam 0.02 mg/kg was given to all the patients. The patients were monitored with a three-lead electrocardiogram (ECG), non-invasive blood pressure (NIBP), and pulse oximetry. Electrodes for bispectral (BIS) index monitoring, and train of four (TOF) monitoring were attached. The patients were then allowed to stabilise for 3 min in the supine position. The systolic blood pressure (SBP), diastolic blood pressure (DBP), mean blood pressure (MBP), and HR were then recorded as baseline values.

After 5 min of preoxygenation with 100% oxygen, general anaesthesia was induced with intravenous fentanyl 2 µg/kg and propofol 2-3 mg/kg to achieve a BIS value of <60. A supramaximal stimulation was ensured followed by delivery of a TOF stimulus. Neuromuscular block was achieved with atracurium 0.5 mg/kg. Patients were ventilated with 100% oxygen with isoflurane using facemask till the TOF count

was zero. All intubations were conducted by a single experienced anaesthesiologist who had performed more than 25 tracheal intubations using GVL.

In the GVL group, the hyperangulated blade was inserted into the patient's mouth along the midline, moving downward on the surface of the tongue to the epiglottis visualising all structures on the display monitor. The tip of the GVL blade was placed into the epiglottic vallecula and lifted to visualise the glottis. A precurved styletted tracheal tube was then inserted into the glottis. The intubating stylet was then gently withdrawn from the tracheal tube by an assistant, and the tracheal tube was pushed downward. The position of the tube was confirmed by auscultation of chest and capnography.

In the MDL group, a Macintosh blade was used to visualise the glottis and insert the endotracheal tube. Endotracheal tubes of sizes 7.5 and 8.0 was used for males and females, respectively.

A standardised haemodynamic management protocol was used during induction. Any hypotension (SBP <80 mmHg) was treated with volume replacement or ephedrine as indicated; persistent hypertension (SBP >160 mmHg lasting more than 1 min.) was treated with increasing the inhaled concentration of isoflurane to 2--3%; tachycardia (HR >120 bpm) was treated with bolus of 0.5 mg/kg esmolol iv; and bradycardia (HR <50 bpm) was treated with 0.5 mg atropine i.v.

Anaesthesia was maintained with 1% isoflurane, 50% nitrous oxide in oxygen and atracurium boluses. The tidal volume and respiratory rates were adjusted to maintain end-tidal carbon dioxide concentration between 35 and 40 mm Hg and oxygen saturation (SpO₂) between 95 and 100%.

At the end of surgery, neuromuscular blockade was reversed with intravenous neostigmine 0.05 mg/kg and glycopyrrolate 0.01 mg/kg and the patient's trachea was extubated.

The following data was recorded by an unblinded observer: Non-invasive blood pressure (systolic, diastolic, mean) and HR at the baseline, post-induction, pre-intubation, at intubation and at 1, 2, 3, 4, 5 min. following intubation, number of intubation attempts (counted from the beginning of insertion of laryngoscope till its removal), and total

intubation time (defined as time from insertion of the intubation device to capnographic confirmation). Complications during orotracheal intubation such as esophageal intubation (lack of a capnography trace following tracheal tube insertion), mucosal bleeding (Blood detected on the intubation device following use), lip or dental injury, episodes of desaturation during intubation (SpO₂ <95%) was noted. Postoperative airway complications (sore throat, hoarseness, dysphagia, and cough) were assessed 24 h after the surgery by an investigator not involved in the study. All complications were graded on a four-point scale (0 – None, 1 – Mild, 2 – Moderate, 3 – Severe).

Anticipating a difference of 20 mmHg in the mean arterial pressure with a combined standard deviation of 20 with 5% level of significance and a 90% power, sample size was estimated to be 25 per group.

Statistical analysis was done using Stata 14.0 software (2015). Comparison of demographic data between the two groups was made by unpaired Student's *t*-test. Gender comparison was done using Fisher's exact test. Time to intubate was analysed using Wilcoxon rank sum test. Haemodynamic parameters were compared using the generalised estimating equation. *P* value less than 0.05 was considered significant.

RESULTS

Sixty patients were assessed for eligibility for enrolment into the study, of which 50 were included in the study [Figure 1]. There were more female patients in the GVL group. There was no difference in the other demographic parameters, preoperative airway assessments, or anti-hypertensive medications used between the two groups. None of the patients required interventions to treat haemodynamic instability as per the protocol [Table 1].

The baseline haemodynamic parameters HR, SBP, DBP, MBP were comparable between the two groups. The HR in the MDL group increased significantly at intubation, 1 and 2 min following tracheal intubation when compared to baseline. In the GVL group, the increase in HR did not significantly exceed the baseline values. Though the HR remained lower in the GVL group as compared to the MDL group at most post-intubation time points, this difference was not significant [Table 2].

Table 1: Demographic data

Parameters	Group GVL (n=25)	Group MDL (n=25)	P
Age (years) (mean ±SD)	54.3±8.6	51.96±10.3	0.3
Male/Female	13 (52)/12 (48)	5 (20)/20 (80)	0.038*
Weight (kg) (mean ±SD)	66.7±11.7	65.4±10.3	0.6
Height (cms) (mean ±SD)	166.4±7.6	164±5.6	0.2
MMP [(n/%)]			
I	6 (24)	5 (20)	0.73
II	19 (76)	20 (80)	
Mouth opening >3 Finger Breadth	25	25	
Anti hypertensive medications [(n/%)]			
CCBs	12 (48)	12 (48)	0.9
βBs	2 (8)	1 (4)	
ARBs	3 (12)	1 (4)	
CCBs + ARBs	2 (8)	3 (12)	
CCBs + βBs	5 (20)	6 (24)	
CCBs + Th	1 (4)	1 (4)	
ARBs + Th	0 (0)	1 (4)	

*P<0.05 is considered significant, CCBs-Calcium channel blockers, βBs-β Blockers, ARBs-Angiotensin II receptor blockers, Th-Thiazides, MMP-Modified Mallampati grade, SD=Standard deviation

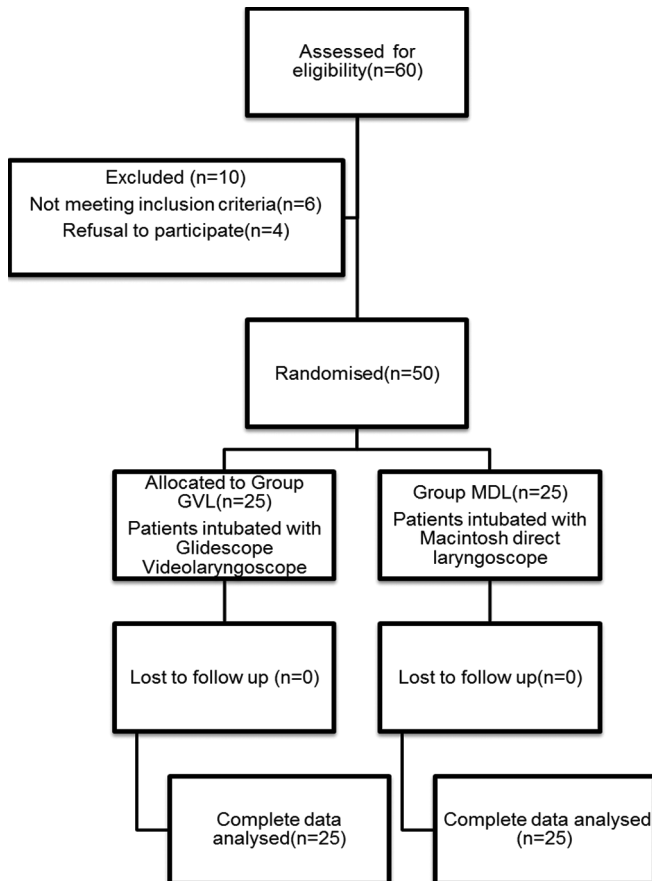


Figure 1: CONSORT diagram

The SBP and MBP in the MDL group increased significantly at intubation and 1 min following intubation. The DBP increased at intubation, 1 min and 2 min and was statistically significant as compared to baseline. The increase in SBP, DBP, and MBP in the

GVL group did not significantly exceed baseline values. Intergroup analysis showed significant increase in SBP, DBP, and MBP at intubation in the MDL as compared to GVL group [Table 2 and Figure 2, 3].

All patients were intubated in the first attempt in MDL group, whereas three patients in the GVL group required more than one attempt ($P = 0.2$). Time to intubate was significantly greater with the use of GVL ($P = 0.0006$). There was no incidence of mucosal bleed, esophageal intubation, and desaturation [Table 3]. The incidence of sore throat, hoarseness, and cough was comparable between the two groups.

DISCUSSION

In our study, we found that use of GVL led to significantly less increase in blood pressures following intubation compared to MDL. No difference was observed in the HRs in the two groups. Haemodynamic response to intubation is because of stimulation of oropharyngeal structures during laryngoscopy and stimulus to trachea by endotracheal tube insertion. GVL blade has a 60° curvature which reduces the need for alignment of oral, pharyngeal, and laryngeal axis during intubation. It thus reduces the upward lifting force to 0.5-1.5 kg as with GVL as compared to 5.4 kg with MDL.^[7] The peak, median, and average lifting forces have been found to be significantly lower with the use of GVL.^[8] Similarly, the upper limb muscular activity and perceived work load was found to be significantly lower in participants using GVL as compared to MDL in a mannequin study by

Table 2: Haemodynamic response to intubation (Mean±SD)

Timeline	Baseline	After Induction	Pre Intubation	At Intubation	1 min	2 min	3 min	4 min	5 min
Heart rate (beats/min)									
GVL	87.3±2.6	79.6±2.6	78.3±2.2	88.6±3.01	90.8±3.09	87.7±3.2	85.8±3.2	83.5±3.4	78±2.8
MDL	87.8±2.7	78.3±2.4	72.5±2.2	93.3±2.8	94.7±2.9	94.9±2.8	90.5±3.3	84.8±2.4	83±2.4
P	0.8	0.7	0.06	0.2	0.3	0.09	0.3	0.7	0.1
SBP									
GVL	140.6±2.1	100.3±3.3	92.3±2.9	129.9±4.4	132.6±4.5	128±4.4	120.5±4.8	115.4±4.1	115.4±3.3
MDL	138.9±1.9	94.8±1.7	85.7±2.9	147.9±4.2	151.6±3.6	141.5±4.2	134.2±3.9	124.8±3.4	117.5±2.3
P	0.5	0.14	0.11	0.003*	0.001*	0.04*	0.02*	0.08	0.6
DBP									
GVL	87±2	63.9±1.9	59.3±2.3	86.6±2.7	88.1±2.9	84.9±3.1	78.6±3	75.9±2.8	73.3±2.5
MDL	88.8±1.3	64±1.1	58.4±2.1	96.8±3	98.3±2.7	94.4±2.7	87±3.2	80.2±2.3	76.4±2
P	0.4	0.9	0.7	0.013*	0.012*	0.02*	0.06	0.2	0.3
MBP									
GVL	105.6±2.2	74.3±2.3	69.3±2.5	100.8±3.4	103±3.4	100±3.5	91±3.3	88.5±3.4	87.1±2.7
MDL	105±2	73.7±1.1	67.3±2.2	111.9±4	114.4±3.4	109.4±3.1	102.2±3	94.4±2.2	90.3±2
P	0.8	0.8	0.5	0.03*	0.02*	0.04*	0.01*	0.1	0.3

*P<0.05 is considered significant. SBP=Systolic blood pressure, DBP=Diastolic blood pressure, MBP=Mean blood pressure, SD=Standard deviation

Table 3: Intraoperative airway complications

Intraoperative airway complications	Group GVL (n=25)	Group MDL (n=25)	P
Time to intubation (sec)	50 (25-120)	34 (20-75)	0.0006*
No of attempts [n (%)]			
1	22 (88%)	25 (100%)	
2	3 (12%)	0 (0%)	0.2
Oesophageal intubation/Mucosal bleeding/Lip or dental injury/desaturation	0/0/0/0	0/0/1/0	0

*P<0.05 is considered significant

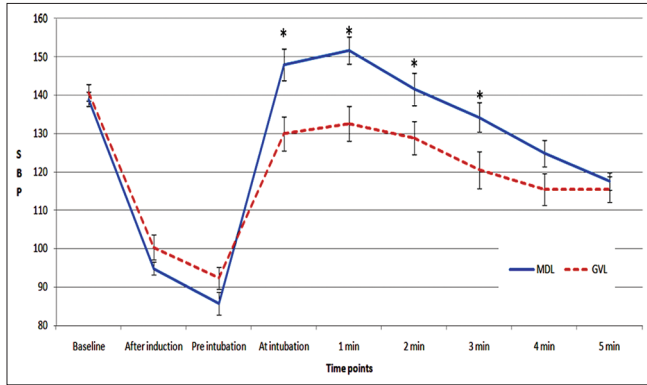


Figure 2: Systolic blood pressure (mmHg) at various time points

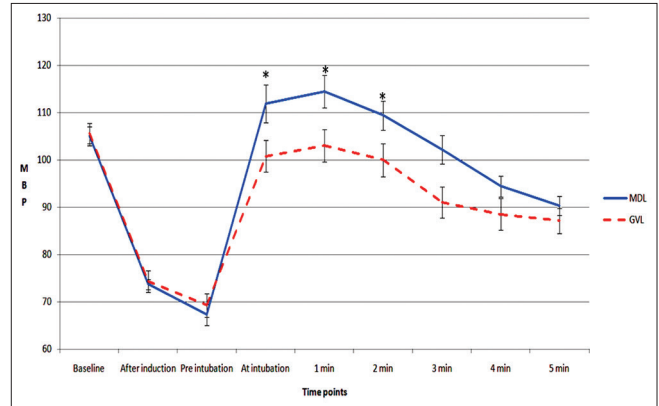


Figure 3: Mean blood pressure (mmHg) at various time points

Cardioli *et al.*^[9] Also, less effort and force is applied to the upper airway and flatter and more homogeneous pressure distribution is produced upon the blade when GVL is used, whereas the force is concentrated more on the distal part of the blade of MDL probably leading to increased haemodynamic responses.^[10,11] Several studies have shown reduced cervical spine movements with use of GVL as compared to MDL (median $\alpha = 11.8$ vs. median $\alpha = 14.3$).^[12,13] The glottis views are better with GVL which further reduces the upward lifting forces and makes it easy for use with novice users.^[13]

Dashti M *et al.* reported a significantly lower MAP, HR, and RPP at intubation and at 3 min. after intubation with the use of GVL.^[14] Another study by Mahjoubifar *et al.* in 200 patients undergoing orthopaedic surgery concluded that MAP was significantly lower in GVL group at intubation and 2 min. after intubation.^[15]

Contradicting evidences were observed in studies by Xue *et al.* and Pournajafian *et al.* which failed to show any differences in haemodynamic responses using GVL and MDL. The results were explained by the increased intubation time with the use of GVL and

the wider blade which could increase the stimulus on the base of tongue and pharyngeal structures.^[16,17] Only normotensive patients were included in these studies and all intubations were performed by an experienced anaesthesiologist who required lesser upward force for exposure of the glottis thus reducing haemodynamic responses to laryngoscopy. Several studies have shown superior glottic view with the use of GVL.^[18,19] Similar results were observed in a study conducted by Peirovifar *et al.* in patients with hypertension. They reported that the SBP, MBP, and HR during laryngoscopy as well as immediately and 1 min. after intubation were significantly lower with the use of GVL as compared to MDL.^[20]

The time to intubate using GVL was significantly increased as compared to MDL in our study. The reason for increased time to intubation with GVL is because of the need to use intubating stylet with this device. The intubating stylet maintains the curvature of the tracheal tube to maintain the curvature of the tracheal tube in concordance with the curvature of the GVL blade. The stylet then needs to be withdrawn once the tracheal tube enters the larynx. This manipulation may be the reason for increased intubation time.^[16] Also, because of the anterior curvature of the blade, the tracheal tube sometimes gets snagged on the anterior wall of the upper trachea requiring rotation of the tube or withdrawal of the GVL blade.^[6] Despite the increased intubation times, the use of GVL was not associated with increased haemodynamic response to tracheal intubation.

GVL reduces the complications during tracheal intubations because of its lesser compression on the soft tissue structures and the better glottis visualisation which reduces esophageal intubation. The incidence of postoperative airway complications: sore throat, hoarseness, cough assessed 24 h after the surgery was similar between the two groups. Pharyngotracheal tissue damage is the main mechanism for sore throat and hoarseness following laryngoscopy and tracheal intubation. GVL produces better glottic view, it reduces the upward lifting forces and compression on oropharyngeal structures. A Cochrane review reported no statistically significant differences in the incidence of sore throat in the postanaesthesia care and at 24 h postoperatively. Also, fewer incidences of laryngeal or airway trauma and postoperative hoarseness were reported when a videolaryngoscope was used.^[21] However, we did not find any difference because all patients included in the study had normal airways.

The limitations of the study are that all the tracheal intubations were performed by an experienced anaesthesiologist and thus the results cannot be extrapolated to intubations carried out by inexperienced anaesthesiologists. The study was not blinded; however, this is difficult to achieve in a study of this nature. Also, the presence of a single experienced operator may lead to some bias.

CONCLUSION

To conclude, the findings in our study suggest that in the hands of an experienced anaesthesiologist, the use of GVL in patients with controlled hypertension is associated with less haemodynamic response as compared to Macintosh laryngoscope without any increase in airway complications.

Declaration of patient consent

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

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Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

- Gupta K, Girdhar KK, Anand R, Majgi SM, Gupta SP, Gupta PB. Comparison of haemodynamic responses to intubation: Flexible fibreoptic bronchoscope versus bonfils rigid intubation endoscope. *Indian J Anaesth* 2012;56:353-8.
- Lapage KG, Wouters PF. The patient with hypertension undergoing surgery. *Curr Opin Anaesthesiol* 2016;29:397-402.
- Misra S. Systemic hypertension and non-cardiac surgery. *Indian J Anaesth* 2017;61:697-704.
- Sebastian B, Talikoti AT, Krishnamurthy D. Attenuation of haemodynamic responses to laryngoscopy and endotracheal intubation with intravenous dexmedetomidine: A comparison between two doses. *Indian J Anaesth* 2017;61:48-54.
- Kikura M, Suzuki K, Itagaki T, Takada T, Sato S. Age and comorbidity as risk factors for vocal cord paralysis associated with tracheal intubation. *Br J Anaesth* 2007;98:524-30.
- Tsai P, Chen B. Hemodynamic responses to endotracheal intubation comparing the Airway Scope®, Glidescope®, and macintosh laryngoscopes. *Int J Anesthesiol* 2009;24.
- Agro F, Barzoi G, Montecchia F. Tracheal intubation using a Macintosh laryngoscope or a GlideScope® in 15 patients with cervical spine immobilization. *Br J Anaesth* 2003;90:705-6.
- Russel T, Khan S, Elman J, Katznelson R, Cooper RM.

- Measurement of forces applied during Macintosh direct laryngoscopy compared with Glidescope videolaryngoscope. *Anesthesiology* 2009;110:32-7.
9. Cardiroli D, Molteni F, Sommariva A, Frittoli S, Guanziroli E, Cortellazzi P. Upper limb muscular activity and perceived workload during laryngoscopy: Comparison of Glidescope(R) and Macintosh laryngoscopy in manikin: An observational study. *Br J Anaesth* 2013;112:563-9.
 10. Carassiti M, Zanzonico R, Cecchini S, Silvestri S, Cataldo R, Agro F. Force and pressure distribution using Macintosh and Glidescope laryngoscopes in normal and difficult airways: A manikin study. *Br J Anaesth* 2011;108:146-51.
 11. Cecchini S, Silvestri S, Carassiti M, Agro FE. Static forces variation and pressure distribution in laryngoscopy performed by straight and curved blades. *Conf Proc IEEE Eng Med Biol Soc* 2009;24:865-8.
 12. Kill C, Risse J, Wallot P, Seidl P, Steinfeldt T, Wulf H. Videolaryngoscopy with Glidescope Reduces Cervical Spine Movement in Patients with Unsecured Cervical Spine. *J Emerg Med* 2013;44:750-6.
 13. 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;101:910-5.
 14. Dashti M, Amini S, Azafarin R, Totonchi Z, Hatami M. Hemodynamic changes following endotracheal intubation with Glidescope videolaryngoscope in patients with untreated hypertension. *Res Cardiovasc Med* 2014;2:e17598.
 15. Mahjoubifar M, Boroojeny Borjian Sh. Hemodynamic changes during orotracheal intubation with the Glidescope and direct laryngoscope. *Iran Red Crescent Med J* 2010;12:406-8.
 16. Xue FS, Zhang GH, Li XY, Sun HT, Li P, Li CW, *et al.* Comparison of hemodynamic responses to orotracheal intubation with the GlideScope videolaryngoscope and the Macintosh direct laryngoscope. *J Clin Anesth* 2007;19:245-50.
 17. Pournajafian A, Ghodraty M, Faiz S, Rahimzadeh P, Goodarzynejad H, Dogmehchi E. Comparing Glidescope videolaryngoscope and Macintosh laryngoscope regarding hemodynamic responses during orotracheal intubation: A randomized controlled trial. *Iran Red Crescent Med J* 2014;16:e12334.
 18. Cooper RM, Pacey JA, Bishop MJ, McClusky SA. Early clinical Experience with a new Videolaryngoscope (Glidescope) in 728 patients. *Can J Anaesth* 2005;52:191-8.
 19. Sun DA, Warriner CB, Parsons DG, Klein R, Umedaly HS, Moulton M. The GlideScope video laryngoscope: Randomized clinical trial in 200 patients. *Br J Anaesth* 2005;94:381-4.
 20. Peirovifar A, Mostafa Gharehbaghi M, Azarfarin R, Karimi L. Comparison of hemodynamic responses to orotracheal intubation in hypertensive patients: Laryngoscopy via Macintosh blade versus GlideScope video laryngoscope: 19AP4-2. *Eur J Anaesthesiol* 2012;29:235-8.
 21. 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.