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Original Article

Cardiovascular responses to laryngoscopy and tracheal intubation with GlideScope or Macintosh laryngoscope in elderly patients undergoing gynecologic surgery: A randomize clinical trial

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Abstract
Introduction: The purpose of this study was to compare the GlideScope and Macintosh laryngoscopes for cardiovascular response to laryngoscopy and endotracheal intubation in elderly patients undergoing gynecological procedures.
Methods: In this clinical trial, endotracheal intubation was performed using a GlideScope (study group; n=35) and Macintosh laryngoscope (control group; n=35). Hemodynamic parameters were recorded, before induction of anesthesia (baseline), 30 and 15 seconds after starting the laryngoscopy, and every minute up to 5 minutes after intubation. Intubation time and complications of laryngoscopy and intubation were compared between two study groups.
Results: Systolic blood pressure (SBP) in 1 ($P=0.002$), 2 ($P=0.003$) and 3 ($P=0.003$) minutes were significantly lower in the study group than that of the control group. The duration of laryngoscopy and intubation was not statistically different between two study groups. The frequency of hypertension after endotracheal intubation in the study group (20%) was significantly lower than that of patients in the control group (45.7%) ($P=0.02$). There was no significant difference in terms of postoperative complications related to laryngoscopy and intubation (hoarseness and sore throat) between two study groups ($P>0.05$).
Conclusion: This study showed that the use of GlideScope better attenuated cardiovascular responses to laryngoscopy and intubation compared to Macintosh laryngoscope in elderly patients undergoing gynecologic surgery. Also, the frequency of hypertension following laryngoscopy and endotracheal intubation was lower with GlideScope compared to Macintosh laryngoscope. Durations of laryngoscopy, intubation and postoperative complications related to airway management (hoarseness and sore throat) were similar.

Introduction

Endotracheal intubation is the gold standard for airway management during general anesthesia. Laryngoscopy remains a key component of airway management. The most common technique used for endotracheal intubation is laryngoscopy with direct vision of the glottis using a Macintosh blade.[1,2]

Laryngoscopy and intubation are painful procedures because of stimulation of the oropharyngeal structures by the laryngoscope, the larynx, and trachea by the exertion of endotracheal tube. Autonomic reflex activity is triggered by noxious stimulation of the vague, lingual, and pharyngeal nerves, resulting in unpleasant hemodynamic changes such as tachycardia, hypertension, and cardiac arrhythmias. In addition, in patients with decreased intracerebral compliance, increasing CNS activity during airway management, including electroencephalography (EEG), cerebral metabolic rate, and cerebral blood flow, increases intracerebral pressure.[1,3,4] Cardiovascular responses are typically brief and have few effects in healthy young patients. However, it may have a greater impact on elderly patients, particularly those with hypertension, myocardial infarction or ischemia, and severe cardiac disease.[5-7] It is essential for these patients to avoid hemodynamic instability during laryngoscopy and intubation.[8-10]

The aging process can alter hemodynamic responses to laryngoscopy and tracheal intubation by increasing abnormalities in cardiac rhythm such as the prolongation of QT interval on ECG and changes in cardiac function.

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These adverse effects may progress during anesthesia and surgery. Thus, it is important to maintain hemodynamic stability ind.uction of general anesthesia.[1,3,4,11-13] The severity of the hemodynamic responses is directly related to the force and duration of laryngoscopy and intubation.[8,14-18]

During the induction of anesthesia, cardiovascular instability may increase which can be manifested in the increased risk of myocardial ischemia, left ventricular failure, stroke, cardiac arrhythmias, cerebral hemorrhage, or sudden death. Therefore, it is crucial to reduce cardiovascular responses in elderly patients.[12,19,20] Tracheal intubation techniques that minimize oropharyngeal stimulation may reduce these stress responses. A significant technological development, the video laryngoscope (GlideScope), has revolutionized airway management by eliminating the need to align the oral, pharyngeal, and laryngeal axes for glottis visualization. GlideScope has been proven advantageous over direct laryngoscopy using a classic Macintosh blade, for improved viewing of the glottis, with subsequent more successful intubations. GlideScope with a specially designed blade and a 60° curvature could decrease the cervical spine motion. Therefore, less upward lifting force is needed to expose the glottis. It has an LCD display monitor that gives a high quality view to an anesthetist.[21]

Even though using a GlideScope is similar to using a Macintosh laryngoscope, it causes less damage to oropharyngeal structures.[1,3] The use of a GlideScope can also be standardized for oral and nasal intubation. That is due to the requirement for less vertical lifting force during laryngoscopy that prompts smooth intubation. As a result, cardiovascular responses to endotracheal intubation are reduced.[1,3,4,22,23] It also has a miniature camera positioned toward the blade's tip for indirect glottis visualization.[24]

The cardiovascular responses to laryngoscopy and endotracheal intubation using video laryngoscopy and their comparison with direct laryngoscopy in elderly patients has not yet reviewed. The present study aimed to compare the cardiovascular responses to laryngoscopy and intubation with video laryngoscope or Macintosh laryngoscope in elderly patients undergoing elective gynecologic surgeries.

Methods

The present randomized and single blind clinical trial was conducted at Al-Zahra hospital; an obstetric and gynecologic educational center. Initially 76 patients were considered to participate in this study, however 6 patients excluded and finally only 70 patients entered the present study (Figure 1). The patients were older than 60 years and ASA class's I-III, and were scheduled for elective gynecologic surgery under general anesthesia and tracheal intubation.

The exclusion criteria included Mallampati score III or IV, body mass index (BMI) > 25 kg/m^2, recent receiving vasoactive medications, history of cervical spine deformity or limited neck movement, ejection fraction less than 45% (EF < 45%). All patients were fast for eight hours and oral intake of clear fluids for 2-3 hours before operation were restricted. All daily medications except angiotensin converting enzyme inhibitors continued until the morning of operation day. In the operating room, standard monitoring including noninvasive blood pressure, pulse-oximetry, ECG, and capnography were established for all patients.

We identified study groups in terms of the variables studied and all factors so that all study participants were similar across all variables to minimize the impact of confounding factors. Patients were randomized into two groups; study group (GlideScope; n = 35) and control group (Macintosh laryngoscope; n = 35) using computerized random list software. After preoxygenation with 100% oxygen (O_2) for three minutes, standard general anesthesia was induced with midazolam (0.05 mg/kg), fentanyl (2 μg/kg), and propofol (1.5-2 mg/kg), and atracurium (0.5 mg/kg). After three minutes, oral tracheal intubation was performed with a GlideScope in the study group and with a size 3 Macintosh laryngoscope blade in the control group.

All tracheal intubations were performed by one experienced anesthesiologist. Anesthesia was maintained by isoflurane 1-1.5 minimum alveolar concentration (MAC) and nitrous oxide (N2O) 50% in O_2 under controlled ventilation to maintain end-tidal pressure CO_2 ($ETCO_2$) at the level of 35 ± 5 mm Hg. Fentanyl (1-2 μg/kg) and atracurium (0.2-0.3 mg/kg) were used as supplement of analgesia and muscle relaxation during surgery, if needed. Non-invasive blood pressure (Systolic blood pressure [SBP], diastolic blood pressure [DBP], and mean arterial pressure [MAP]), heart rate (HR), ECG, arterial blood saturation (SPO2), and $ETCO_2$ were monitored with the Datex Ohmeda S/5 anesthesia machine prior to induction of anesthesia (baseline). Thirty seconds after induction, recordings were made 15 seconds after the start of laryngoscopy and then every minute for up to 5 minutes after intubation. The number of intubation attempts, the duration of intubation, and the postoperative phase were recorded.

All parameters were recorded by a second observer who was blinded to intubation technique. Patients were monitored for up to 48 hours after surgery.

The intubation time was defined as the time from the starting of laryngoscopy up to filling the cuff of tracheal tube. Hypotension was defined as SBP < 100 mm Hg or 20% reduction in SBP from baseline lasting for 60 seconds. Intensity of sore throat as none = no sore throat, moderate (similar to when it feels cold), and severe (much more severe than cold) was scored. Hoarseness scoring was in the form of none = no noise, moderate and severe (aphonic).

For treatment of hypertension (SBP > 200 mm Hg > or greater than 20% increase in SBP from baseline for 60 seconds), the inspired concentration of isoflurane was maintained at 0.5% MAC in incremental concentration and tachycardia (HR > 100 bpm/min 60 seconds) inhalation concentrations of isoflurane in incremental concentrations of 0.5% MAC were used. The dysrhythmia was treated with lidocaine (1.5 mg/kg).

Statistical analysis

In order to explore a 20% difference in hemodynamic variables between two methods of laryngoscopy, with a 0.8 power and a *P* value of 0.05, the sample size was 35 patients in each group. The patients were randomly enrolled in two study groups and intubated with either GlideScope (study group) or Macintosh direct laryngoscope (control group).

$$n=\frac{\left(z_{1-\frac{\alpha}{2}}+z_{1-\beta}\right)^2\left(\delta_1^2+\delta_2^2\right)}{\left(\mu_1-\mu_2\right)^2}$$

In this study, 70 patients aged over 60 years, in ASA class I -III were evaluated in two study groups. The data were analyzed by SPSS software, version 16. *P* values < 0.05 were considered statistically significant.

Categorical and non-continuous data were analyzed using descriptive statistical methods (chi-square ratio or Fisher's exact test). Continuous data using student's t-test were compared between the groups. Changes in continuous data at different times were tested by repeated measures ANOVA within each group.

Results

From 76 patients enrolled to this study, 6 patients were excluded and finally 70 patients in ASA class I-III were examined in two study groups (Figure 1).

The groups were comparable in terms of age, ASA class, medical history, type of surgery, duration of surgery, and anesthesia (Table 1). Baseline patient characteristics were similar between the study groups.

The hemodynamic variables (SBP, DBP, MAP, HR and SPO2) at the studied time intervals are presented in Table 2. Comparison of the SBP values between the study groups shows that the SBP values at 1 ($P = 0.002$),

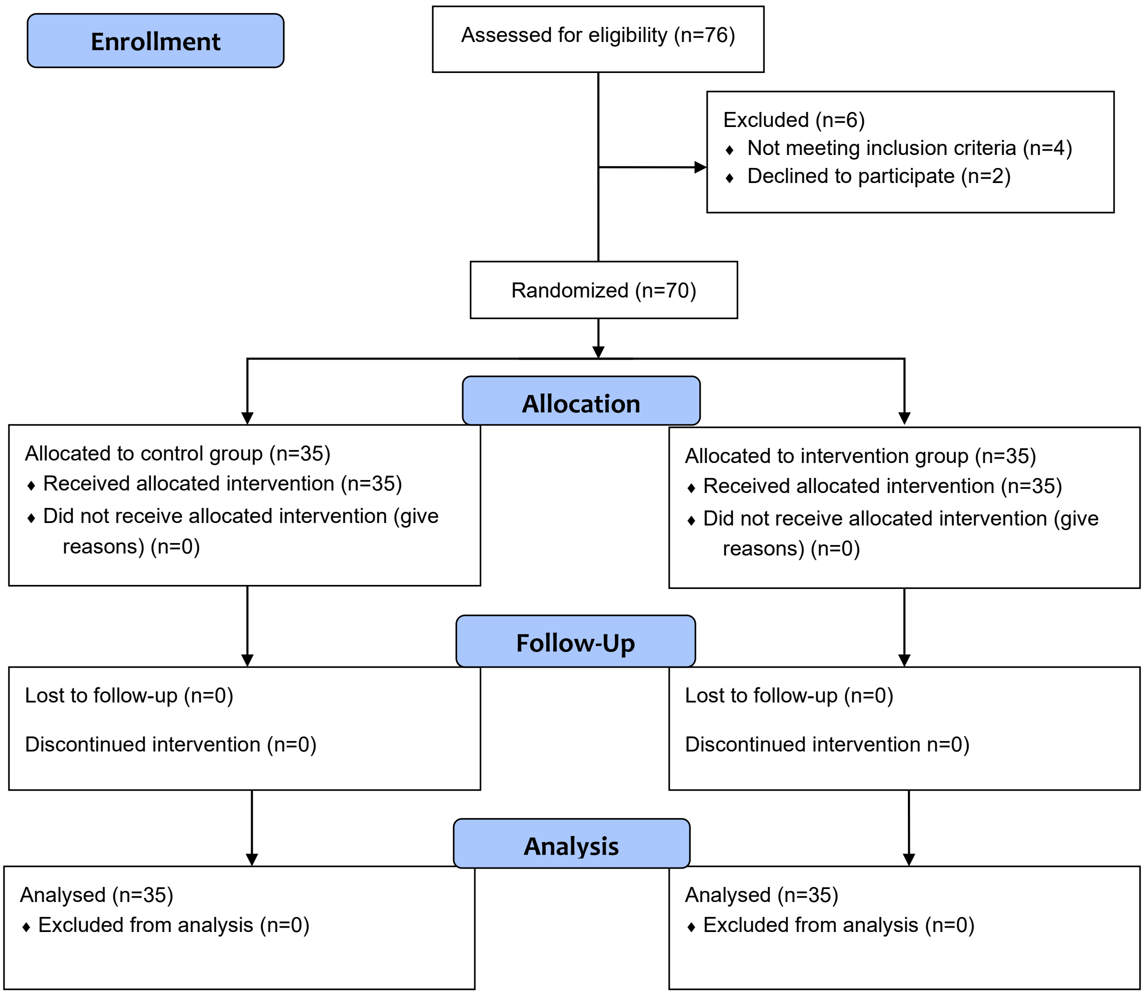

Figure 1. CONSORT flow chart of the study

Table 1. Demographic, surgical and anesthesia data of two groups

Variable	Group		P
	Study group (n = 35)	Control group (n = 35)	
Age (y)	65.00 ± 3.16	65.62 ± 4.16	0.47
Weight (kg)	74.51 ± 11.01	78.48 ± 10.60	0.12
Height (cm)	155.94 ± 9.46	158.31 ± 4.78	0.19
ASA class (%)			
I	3 (8.5)	2 (5.7)	0.53
II	31 (88.5)	33 (94.2)	
III	1 (2.8)	0 (0)	
Type of systemic disease (%)			
No systemic disease	3 (8.5)	2 (5.7)	0.59
HTN	18 (51.4)	24 (68.5)	
DM	3 (8.5)	2 (5.7)	
HTN + DM	4 (11.4)	5 (14.2)	
Hypothyroidism	3 (8.5)	1 (2.8)	
COPD	1 (2.8)	0 (0)	
HTN + HLP	3 (8.5)	1 (2.8)	
Type of surgery (%)			
TAH	25 (71.4)	(48.5)	0.09
TAH + debulking	6 (17.1)	11 (31.4)	
TAH + lymphadenectomy	4 (11.4)	7 (20)	
Duration of surgery (min)	173.34 ± 41.46	171.29 ± 38.08	0.736
Duration of anesthesia (min)	187.29 ± 43.17	185.43 ± 38.84	0.07

Data are expressed as mean ± SD and No. (%).
HTN, Hypertension; DM, Diabetes mellitus; COPD, Chronic obstructive pulmonary disease; HLP, Hyperlipidemia; TAH, Total abdominal hysterectomy.

2 ($P = 0.003$) and 3 ($P = 0.001$) minutes after intubation were significantly lower in the study group than that of the control group. In addition, the mean DBP one minute after intubation was significantly lower in the study group compared to the control group ($P = 0$).

However, the HR values in the study groups were within the normal range. Patients in the study group showed significantly higher SPO2 values at first ($P = 0.008$), second ($P = 0.002$), third ($P = 0.003$), forth ($P = 0.001$) and fifth ($P = 0.001$) minutes after intubation compared to the control group. The SPO2 values in the study groups were in the normal range. Intubation was successful with one attempt in 90% of patients in the study groups. The mean number of intubation attempts was 1.11 ± 0. 32 times in the study group and 1.06 ± 0.23 times in the control group ($P = 0.003$). There was no statistically significant difference between the study groups regarding to the duration of intubation ($P = 0.47$). The minimum and the maximum intubation times were 13 and 32 seconds, respectively (Table 3). Complications following laryngoscopy and intubation were including hypertension, tachycardia, and arrhythmia (e.g., PVC). High blood pressure (22.9%) is the highest complication after intubation, which was significantly lower in the study group compared to the control group ($P = 0.02$). After endotracheal intubation, isoflurane and lidocaine were used to treat hypertension and dysthymia, respectively. Sore throat occurred in five (14.28%) patients in the study group (four patients were mild and one patient was moderate) and six (17.14%) patients in the control group (four mild and two moderate patients) ($P = 0.304$). Pharyngeal ulcers occurred in a patient in the study group and two patients in the control group ($P = 0.125$) (Table 3).

Discussion

In this clinical study, 70 patients were examined in the two groups. There was no statistically significant difference between the patients in the study groups in terms of demographics such as age, weight and height, suggesting that these variables do not affect the results. The results of the present study showed that the mean of SBP, DAP and MAP in the first three minutes after endotracheal intubation was lower in the study group compared to the control group. In addition, the incidence of cardiovascular reactions after endotracheal intubation by laryngoscopy, including hypertension, tachycardia, and arrhythmia, was lower in the study group.

The two main causes of hemodynamic changes after laryngoscopy and intubation are the stimulation of the oropharyngeal and tracheal structures by the laryngoscopy and the endotracheal tube.[25] Lim et al showed that about 4 to 5 kg of pressure is applied to the floor of the tongue during direct laryngoscopy, which is consistent with the results of our study.[26]

The hemodynamic changes after intubation are due to the direct tracheal stimulation rather than laryngeal stimulation.[27] These changes are transient, lasting only about 5 minutes after intubation, but can result in cardiac ischemia in patients with ischemic heart disease. Bruder et al believe that direct laryngoscopy can affect the cardiovascular system and increase blood pressure by 40% to 50% and HR by 20%, with results similar to ours.[28] Greater depth of anesthesia can prevent these effects. However, changes in the concentration of anesthetics in the blood and their site of action are slower than the onset and cessation of airway stimulation and hemodynamic responses.[29,30] On the other hand, taking a drug in this situation can inhibit the cardiovascular system and lead to bradycardia and unwanted hypotension. Another method to reduce cardiovascular reactions after laryngoscopy and intubation is to improve the laryngoscopy technique.[31] Videolaryngoscopy with a GlideScope provides a very good view of the glottis.[32] Compared to the direct laryngoscopy, less force is required to grasp the glottis during laryngoscopy using a GlideScope. The GlideScope puts less pressure on the soft tissues of the oropharynx, allowing less stimulation of the sympathetic system.

The results of the present study are consistent with the study by Dashti et al, in which patients with a history of uncontrolled hypertension were intubated with a

Table 2. Hemodynamic changes in the two groups

	Base line	30 s	15 s	1 min	2 min	3 min	4 min	5 min
SBP								
Study group	141.60 ± 16.68	127.43 ± 14.33	131.57 ± 21.11	130.23 ± 18.85	127.43 ± 14.43	125.20 ± 11.19	125.20 ± 9.74	124.57 ± 10.24
Control group	136.94 ± 11.54	123.57 ± 18.34	132.14 ± 13.85	144.89 ± 18.57	138.54 ± 16.02	141.49 ± 26.57	129.83 ± 12.83	123.71 ± 10.81
P	0.180	0.330	0.894	0.002	0.003	0.002	0.094	0.735
DBP								
Study group	91.31 ± 10.48	84.14 ± 11.83	87.09 ± 13.99	85.43 ± 11.88	85.34 ± 10.86	82.86 ± 10.06	81.80 ± 9.80	81.74 ± 10.34
Control group	87.57 ± 9.59	77.80 ± 13.36	85.69 ± 11.40	96.83 ± 16.14	91.09 ± 16.27	85.40 ± 15.78	83.09 ± 9.84	85.49 ± 8.73
P	0.124	0.039	0.648	0.001	0.088	0.425	0.586	0.107
MAP								
Study group	110.02 ± 12.43	99.57 ± 12.79	102.89 ± 16.75	100.66 ± 15.05	100.83 ± 12.22	97.09 ± 9.88	97.66 ± 9.72	95.94 ± 10.71
Control group	105.69 ± 9.21	92.54 ± 20.21	102.69 ± 9.33	115.17 ± 17.47	106.37 ± 16.39	105.14 ± 16.97	100.69 ± 9.74	99.71 ± 9.58
P	0.089	0.087	0.951	0.001	0.114	0.019	0.198	0.125
HR								
Study group	99.34 ± 15.58	94.06 ± 14.80	93.69 ± 15.41	91.06 ± 14.62	91.46 ± 15.85	85.43 ± 16.39	87.31 ± 14.00	81.46 ± 12.18
Control group	83.80 ± 17.72	87.51 ± 19.37	84.49 ± 17.14	84.89 ± 17.12	84.06 ± 16.82	84.80 ± 14.90	85.09 ± 16.12	79.26 ± 10.24
P	0.001	0.117	0.021	0.110	0.063	0.867	0.539	0.417
SPO_2								
Study group	96.97 ± 1.07	97.71 ± 1.07	97.89 ± 1.20	98.49 ± 1.12	98.66 ± 0.99	98.89 ± 0.96	98.91 ± 0.98	98.89 ± 0.96
Control group	96.94 ± 1.30	97.31 ± 1.64	97.49 ± 1.68	97.69 ± 1.49	97.69 ± 1.49	98.00 ± 1.41	97.77 ± 1.57	97.77 ± 1.53
P	0.921	0.232	0.258	0.008	0.002	0.003	0.001	0.001

Data are expressed as mean ± SD.
SBP, Systolic blood pressure; DBP, Diastolic blood pressure; MAP, Mean arterial pressure; HR, Heart rate, SPO2, O_2 saturation.

Table 3. Intubation data and intra and postoperative complications

Variable	Group		*P*
	Study group (n = 35)	Control group (n = 35)	
Number of intubation attempts (%)			0.633
Once	31 (88.6)	32 (91.4)	
Twice	4 (11.4)	3 (8.6)	
Duration of intubation (s)	17.66 ± 4.16	15.66 ± 3.04	0.080
Complications of intubation (%)			
Hypertension	7 (20.0)	16 (45.7)	0.020
Tachycardia	4 (11.4)	5 (22.8)	0.171
Dysrhythmia	2 (5.7)	6 (17.1)	0.130
Desaturation	0 (0)	1 (2.8)	0.103
Treatment of complication (%)			
Isoflurane	3 (8.6)	14 (40)	0.002
Lidocaine	3 (8.6)	6 (17.2)	0.239
Postoperative complications related to intubation (%)			
Sore throat	5 (14.3)	6 (17.2)	0.304
Hoarseness	2 (2.8)	2 (5.7)	0.125

Data are expressed as mean ± SD and frequency (%)

GlideScope. They found that MAP and HR values after GlideScope intubation were significantly lower than those of patients who underwent direct laryngoscopic intubation. GlideScope was comparable with the direct laryngoscopy only in the first minute after intubation.[33] In our study, the most common complication after intubation was hypertension, which was higher in patients in the control group than in the study group. In addition, the incidence of tachycardia was higher in the patients in the control group than in the study group; however, no statistically significant difference was observed. In the study by Amini et al, similar to the present study, the most common complications after intubation were arterial hypertension and tachycardia.[21] Another complication after intubation in our study was arrhythmia, which was observed in direct laryngoscopy with a frequency of 8.6%. However, in patients undergoing intubation with a GlideScope, arrhythmias were observed in only 2.9% of patients. It appears that this response to intubation in patients with cardiac disease leads to malignant cardiac rhythms, followed by cardiac arrest.[34] On the other hand, in the present study, the most common underlying disease in both groups was hypertension.

In our study, the mean duration of intubation was longer in patients in the study group than in the control group; but there was no statistically significant difference between the study groups. In the study by Xue et al, the duration of intubation was longer with the Macintosh direct laryngoscope rather than with the GlideScope. However, the duration of intubation was longer in all patients than in the present study.[31] In our study, respiratory complications, including sore throat and hoarseness, occurred in the post-anesthesia ward and within 48 hours of surgery in six patients in the study group and eight patients in the control group, although the difference was not significant. This may be due to the less manipulation of the tongue and epiglottis in patients in the study group and a shorter duration of intubation in both study groups.

Limitations

This study also had several limitations: 1) This was a randomized study, but not a multicenter trial. 2) Patients with difficult airway were excluded from this study. 3) All of tracheal intubations were performed by experienced anesthesiologist. 4) This study was single blind clinical trial. 5) Depth of anesthesia was not monitored in the present study and intubation was not standardized to a specific monitored depth of anesthesia. However, the technique of induction of anesthesia was similar in all patients. 6) The present study depended on the hemodynamic parameters for assessment of the attenuation of cardiovascular response to laryngoscopy and intubation without measuring the blood level of catecholamines and cortisone. 7) We record noninvasive blood pressure, however, invasive blood pressure monitoring for research purposes was ethically unacceptable.

Conclusion

The results of this study showed that using GlideScope for intubation attenuates hemodynamic responses during laryngoscopy and tracheal intubation in elderly patients undergoing gynecologic surgery. Also, the frequency of cardiovascular responses following laryngoscopy and endotracheal intubation, including hypertension, tachycardia and dysrhythmia, was lower with GlideScope compared to Macintosh laryngoscope. The results of our study showed that GlideScope is superior to Macintosh laryngoscope in countries like Iran, where access and use of GlideScope is very limited, this method can be used to reduce complications.

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Study Highlights

What is current knowledge?

- Previous studies have reported that GlideScope may not decreases the cardiovascular responses during airway managements.

What is new here?

- This study supported that GlideScope induces more attenuated cardiovascular
- responses during airway managements in elderly patients.

Authors' Contribution

Conceptualization: Bahman Naghipour, Simin Atashkhoei.
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Funding acquisition: Simin Atashkhoei.
Investigation: Simin Atashkhoei, Bahman Naghipour, Foad Loloei, Solmaz Fakhari.
Methodology: Eissa Bilehjani, Bahman Naghipour.
Project administration: Eissa Bilehjani, Simin Atashkhoei.
Resources: Eissa Bilehjani, Simin Atashkhoei, Bahman Naghipour.
Software: Eissa Bilehjani.
Supervision: Bahman Naghipour.
Validation: Eissa Bilehjani, Bahman Naghipour.
Visualization: Eissa Bilehjani, Bahman Naghipour.
Writing–original draft: Eissa Bilehjani, Simin Atashkhoei, Solmaz Fakhari.
Writing–review & editing: Eissa Bilehjani.

Competing Interests

Authors declare that they have no conflict of interests.

Ethical Approval

The study was approved by the Institutional Committee of Ethics at Tabriz University of Medical Sciences (code number: IR.TBZMED.REC. 1396.791) and was registered in the Iranian Registry of Clinical Trials center (identifier: IRCT20110712007013N21).

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