Comparative Evaluation of Direct Laryngoscopy Versus GlideScope for the Purpose of Laryngoscopy Management and Intubation in Candidates of Cesarean Delivery with General Anesthesia

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Abstract

Background: The present study aimed at comparing the hemodynamic responses to laryngoscopy and initiation of intubation with either direct or video-assisted laryngoscopy.

Materials and Methods: This double-blind clinical trial was performed on 90 pregnant women candidates for cesarean section under general anesthesia. The participants were divided into two groups. In the first group, intubation was performed using direct Macintosh laryngoscope (MCL group). The second group underwent intubation using the GlideScope video laryngoscope (GSL group). Then, systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), heart rate (HR), the percentage of the saturation of peripheral oxygen (SpO2), the time-to-intubation (TTI), and the number of intubation attempts were recorded.

Results: SBP, DBP, and MAP in the MCL group were significantly higher than GSL group 1, 3, and 5 min after laryngoscopy ($P < 0.05$). HR in the MCL group with the mean of 118.44 ± 15.53 bpm was significantly higher than that the GSL group with the mean of 110.11 ± 16.68 bpm only 3 min after laryngoscopy ($P = 0.016$). The TTI in the MCL group was significantly longer than that of the GSL group (12.80 ± 1.86 vs. 10.15 ± 2.61; $P = 0.001$). The frequency of the first intubation attempt in the GSL group with 91.1% was significantly higher than that the MCL group with 84.4% ($P = 0.003$).

Conclusion: It seems that the GSL technique is a better choice to conduct laryngoscopy with more success in intubation and a higher stability of the patients' hemodynamic status.

Keywords: Airway management, cesarean section, intubation, laryngoscopy

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Introduction

Anesthesia is considered a rare but exceeding cause of maternal mortality. Nevertheless, it is correspondent with specific hazards including difficult airway management.[1] Once the leading cause of anesthesia-related maternal mortality, maternal deaths caused by failed intubation are reportedly decreasing.[2] However, difficulty in intubation is associated with many side effects including hemodynamic instabilities, laryngospasm or bronchospasm; thus, its significance cannot be ignored.[3] Multiple physiologic changes occur in the body during pregnancy which may add to the difficulty in airway management especially while intubating with direct laryngoscopy. Anatomical changes adding to difficulty in airway management occur particularly in the upper airways. Changes of the upper airways include edema in the airways caused by preeclampsia or iatrogenic fluid administration, fat deposition due to maternal weight gain, more friable oral

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mucosa, increasing tongue size, and decreased soft tissue mobility. These situations cause anxiety and haste for the operator, making the process even more difficult.[4,5]

Macintosh laryngoscope (MCL) blade is commonly used for direct laryngoscopy but sometimes maintenance of the airways becomes demanding and makes the intubation process difficult. The GlideScope® video laryngoscope is a new device with a high-resolution camera placed within the blade. The device was initially designed to give a better view of the glottis and therefore, compared to direct laryngoscopy, is more suitable for difficult airway management.[5,6] Patients with obesity, including pregnant women undergoing caesarian section, are more difficult to intubate, and elevated obesity markers such as neck circumference (NC) and body mass index (BMI) are associated with more difficult intubation.[7] These markers are elevated in the third trimester of pregnancy as well, and although to this date many studies have compared the effectiveness and complications of direct laryngoscopy with GlideScope video laryngoscopy in different patient groups, due to the sensitivity of the subject, no studies have reported this comparison among pregnant patients. Therefore, the present study aimed at comparing Macintosh laryngoscopy with GlideScope video laryngoscope (GSL) among a group of pregnant patients who underwent general anesthesia during cesarian section.

Materials and Methods

The present study was a randomized double-blind controlled clinical trial. The study population included all pregnant women that were candidates for elective cesarean section under general anesthesia and referred to Beheshti Hospital in Isfahan, Iran from July 20, 2018, to September 21, 2019.

The sample size of 90 participants (45 ones per group) was selected from the mentioned population using the simple randomization and according to the sample size formula for comparing two groups, at a 95% confidence interval, 80% test power, and the mean laryngoscopy time for MCL and GSL to be equal to 3.4 ± 8.2 s and 1.7 ± 6.7 s, respectively, as reported in previous studies[8] [Figure 1].

Inclusion criteria consisted of pregnant women that were candidates for cesarean section under general anesthesia, with the American Society of Anesthesiologists (ASA) score of one or two, the gravidity of one or two, and Intubation Difficulty Scale score of ≤5. Moreover, the patients were not included in the study if the thyromental distance was <6 cm, the NC was equal or more than 43 cm, the ASA score was equal or more than 3, patients with an increased intracranial pressure, any airway pathology, any cervical spinal cord injury, and any requirement for rapid induction. Furthermore, patients with Cormack–Lehane score was equal or more than 3 were excluded from the study.

After obtaining the code of ethics from the Ethics Committee of Isfahan University of Medical Sciences (IR.MUI.MED.REC.1397.282), a clinical trial code (IRCT20200825048515N44), and an informed written consent from eligible patients, 90 patients were selected and included in the study using the simple random sampling technique.

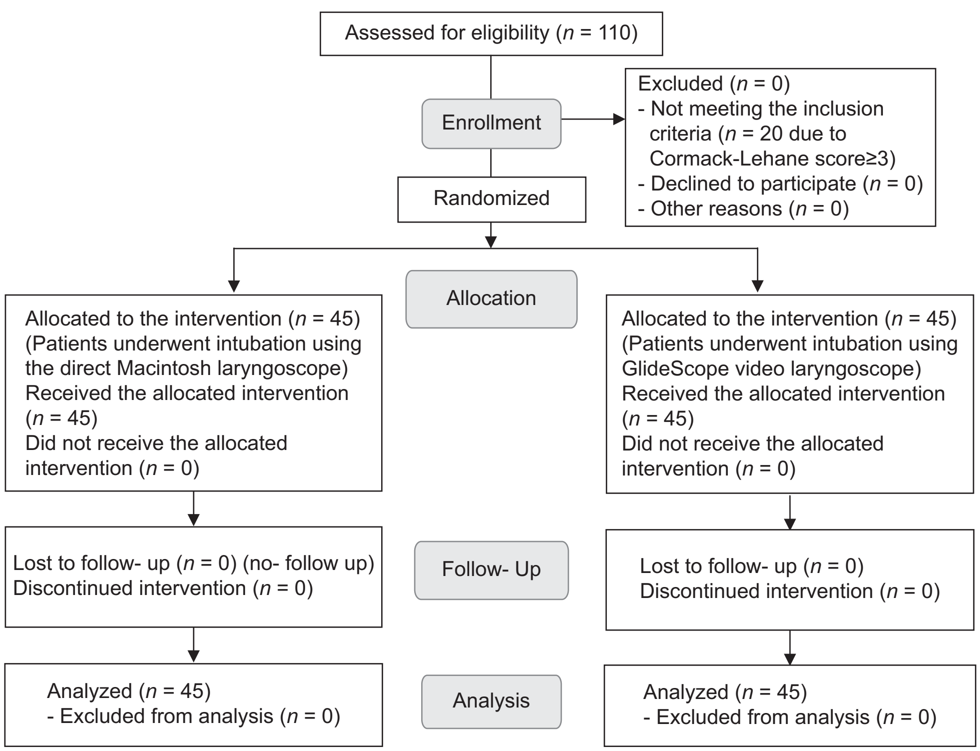

Figure 1: Consort flowchart of patients

Then, the patients were divided into two groups of 45 using random allocation software. Pregnant women's demographic information including their maternal age, gestational age, weight, height, BMI, prominent incisors, TMD, NC, and micronichia were recorded. Moreover, at the beginning of the study (baseline), patients' hemodynamic parameters including systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), heart rate (HR), and percentage of the saturation of peripheral oxygen (SpO2) were recorded, as well.

Then, general anesthesia was performed for all patients with 2 µg/kg fentanyl, 1.5 mg/kg succinylcholine, 6 mg/kg sodium thiopental, and 1.5 mg/kg lidocaine. All patients were then placed in a sniffing position with a pillow under their head. Patients in the first group underwent intubation using the direct MCL with Macintosh blade No. 3 (MCL group) while patients in the second group underwent intubation using (GSL group).

It should be noted that all intubations were performed by a single resident of anesthesia that was expert at both intubation methods. To meet the blinding condition in the study, the anesthesiologist that was responsible for performing intubation did not take part in the collection of patients' information due to knowledge of the type of intervention in each of the two groups; however, the patient, the patient's data collector, and the statistician were not aware of the type of intervention in two groups.

Patients' hemodynamic parameters including SBP, DBP, MAP, HR, and SpO2 were re-evaluated and recorded before laryngoscopy and in the 1st, 3rd, 5th, and 10th min after laryngoscopy.

In addition, the time-to-intubation (TTI) (from the time, the laryngoscope was inserted into the mouth to the filling of the endotracheal tube cuff and the confirmation of the insertion of the intubation with capnography), the number of intubation attempts, and the frequency of complications including bradycardia (HR <60 bpm), tachycardia (HR >100 bpm), hypertension (SBP/DBP: 14/9 mmHg), hypotensionsys (SBP ≤9 mmHg), hypoxia (SPO2 <90%), damage to the tooth and soft tissue, laryngospasm, and bronchospasm were recorded up to 5 min after laryngoscopy.

Finally, the collected data were entered into the Statistical Package for Social Sciences (SPSS) software for windows®, version 26, (SPSS Inc., Chicago, IL, USA). The data were presented as means ± standard deviation or frequency (percentage). At the level of inferential statistics, according to the result of the Kolmogorov–Smirnov test indicating the normal distribution of data, independent samples *t*-test, repeated measures ANOVA, and Chi-square test were used. The significance level of < 0.05 was considered in all analyses.

Results

In the present study, the mean maternal age and gestational age of pregnant women that were candidates for cesarean section in the MCL group were 30.44 ± 5.45 years and 38.25 ± 0.97 weeks, respectively ($P > 0.05$) while the mean maternal age and gestational age of pregnant women in the GSL group were 30.47 ± 3.83 years and 38.56 ± 0.80 weeks, respectively ($P > 0.05$). Statistically, the baseline and clinical characteristics of the patients were not different between the two groups ($P > 0.05$) [Table 1].

The evaluation of the patients' blood pressure during the studied periods indicated that there was no significant difference between the two groups in terms of SBP, DBP, and MAP before anesthesia and before laryngoscopy ($P > 0.05$). SBP in the MCL group with the mean of 127.44 ± 9.65 mmHg, 135.84 ± 11.23 mmHg, and 130.82 ± 8.62 mmHg 1, 3, and 5 min after laryngoscopy, respectively was significantly higher than SBP in the GSL group with the mean of 123.69 ± 10.04 mmHg, 129.27 ± 13.54 mmHg, and 125.82 ± 9.73 mmHg 1, 3, and 5 min after laryngoscopy, respectively ($P < 0.05$). DBP in the MCL group with the mean of 83.87 ± 4.50 mmHg, 89.89 ± 6.89 mmHg, and 87.09 ± 6.02 mmHg 1, 3, and 5 min after laryngoscopy, respectively was significantly higher than DBP in the GSL group with the mean of 81.75 ± 4.68 mmHg, 83.07 ± 4.68 mmHg, and 83.00 ± 5.54 mmHg 1, 3, and 5 min after laryngoscopy, respectively ($P < 0.05$). Moreover, MAP in the MCL group with the mean of 96.48 ± 6.22 mmHg, 104.68 ± 8.85 mmHg, and 97.97 ± 6.47 mmHg 1, 3, and 5 min after laryngoscopy, respectively was significantly higher than

Table 1: Demographic and clinical characteristics of the patients in the two groups

Variables	Group MCL (*n*=45), *n* (%)	Group GSL (*n*=45), *n* (%)	*P*
Maternal age (years)	30.44±5.45	30.47±3.83	0.982
Gestational age (week)	38.25±0.97	38.56±0.80	0.094
Gravity			
1	24 (53.3)	28 (62.2)	0.393
2	21 (46.7)	17 (37.8)	
Weight (kg)	76.45±7.97	76.10±7.32	0.828
Height (cm)	164.60±6.41	162.44±5.14	0.082
BMI (kg/m^2)	28.26±2.41	28.85±1.86	0.199
Neck circumference (cm)	39.51±1.37	39.83±1.28	0.257
TMD (cm)	7.88±0.82	7.92±0.72	0.827
Prominent incisors	7 (15.6)	3 (6.7)	0.315
Micronichia	3 (6.7)	5 (11.1)	0.862
ASA score			
I	7 (15.9)	5 (11.1)	0.508
II	37 (84.1)	40 (88.9)	
Mallampati score			
I	25 (55.6)	26 (57.8)	0.832
II	20 (44.4)	19 (42.2)	
Cormack-Lehane score			
I	34 (35.6)	39 (86.7)	0.226
II	11 (24.4)	6 (13.3)	

Data is shown as means±SD or *n* (%). SD: Standard deviation, MCL: Macintosh laryngoscope, GSL: Glidescope laryngoscope, BMI: Body mass index, TMD: Thyromental distance, ASA: American Society of Anesthesiologists

MAP in the GSL group with the mean of 93.43 ± 5.50 mmHg, 97.64 ± 7.13 mmHg, and 94.94 ± 5.76 mmHg 1, 3, and 5 min after laryngoscopy, respectively ($P < 0.05$). Ten minutes after laryngoscopy, the patients' mean blood pressure including SBP, DBP, and MAP was not significantly different between the two groups ($P > 0.05$) [Table 2].

Furthermore, the patients' HR in the MCL group with the mean of 118.44 ± 15.53 bpm was significantly higher than the HR in the GSL group with the mean of 110.11 ± 16.68 bpm only 3 min after laryngoscopy ($P = 0.016$). At other times, the mean HR was not significantly different between the two groups ($P > 0.05$). Moreover, the patients' mean SpO2 did not differ significantly between the two groups from the beginning of the study to 10 min after laryngoscopy ($P > 0.05$) [Table 3].

Finally, the TTI in the MCL group with the mean of 12.80 ± 1.86 s was significantly longer than the TTI in the GSL group with the mean of 10.15 ± 2.61 s ($P = 0.001$). In addition, the frequency of the first intubation attempt in the MCL group with 84.4% was significantly lower than that of the GSL group with 91.1% ($P = 0.003$). In contrast, the incidence of complications including hypertension, tachycardia, and laryngospasm was not significantly different between the two groups ($P > 0.05$) [Table 4].

Table 2: Comparison of the patients' mean of blood pressure among the two groups

Blood pressure	Group MCL (*n*=45)	Group GSL (*n*=45)	P^a
SBP (mmHg)			
Baseline	117.40±12.09	118.40±8.75	0.654
Before laryngoscopy	107.02±11.30	106.51±11.39	0.831
1 min after intubation	127.44±9.65	123.69±10.04	0.044
3 min after intubation	135.84±11.23	129.27±13.54	0.014
5 min after intubation	130.82±8.62	125.82±9.73	0.012
10 min after intubation	120.84±6.27	118.67±7.83	0.149
P^b	<0.001	<0.001	
DBP (mmHg)			
Before laryngoscopy	77.93±5.03	79.22±5.04	0.228
Before injecting the drug	72.75±4.45	73.40±6.69	0.592
1 min after intubation	83.87±4.50	81.75±4.68	0.032
3 min after intubation	89.89±6.89	83.07±4.68	<0.001
5 min after intubation	87.09±6.02	83.00±5.54	0.001
10 min after intubation	79.82±5.17	78.18±4.53	0.113
P^b	<0.001	<0.001	
MAP (mmHg)			
Before laryngoscopy	91.02±7.09	90.12±12.75	0.681
Before injecting the drug	84.31±6.27	84.36±7.35	0.968
1 min after intubation	96.48±6.22	93.43±5.50	0.016
3 min after intubation	104.68±8.85	97.64±7.13	<0.001
5 min after intubation	97.97±6.47	94.94±5.76	0.021
10 min after intubation	92.81±5.67	91.36±4.22	0.172
P^b	<0.001	<0.001	

[a]Significance level obtained from comparing the mean of the variables between two groups in each times, [b]Significance level obtained from comparing the mean of the variable over time up to 10 min after intubation in each of the two groups. Data are shown as means±SD. SD: Standard deviation, MCL: Macintosh laryngoscope, GSL: Glidescope laryngoscope, SBP: Systolic blood pressure, DBP: Diastolic blood pressure, MAP: Mean arterial pressure

Discussion

Pregnancy is one of the many conditions that can make the intubation process difficult and can thus put the mother and infant at risk of hypoxemia and hemodynamic instabilities, which can lead to many early-life complications.[9] Videolaryngoscpy, is a device which has been recently promoted and suggested by studies to be used in patients with critical situation or higher probability of difficult intubation, such as obstetric patients.[10] There is still debate on whether it should be used primarily on all obstetric patients, or secondarily following a failed or difficult simple laryngoscopy.[11]

This study aimed to compare the two methods of conventional laryngoscopy and GlideScope-assisted laryngoscopy, in terms of the common complications of laryngoscopy including bradycardia, tachycardia, hypertension, damage to the tooth and soft tissue, laryngospasm, and bronchospasm up to 10 min after laryngoscopy. Our findings showed that SBP, DBP, and MAP in the MCL group 1, 3, and 5 min after laryngoscopy were significantly higher than SBP in the GSL group. In fact, in the early minutes of the intubation hemodynamic indices were all more stable in the GSL group, but only HR and tachycardia incidence were not significantly different between the two groups. In addition, the SpO2 did not differ

Table 3: Comparison of the patients' mean of heart rate and percentage of the saturation of peripheral oxygen among the two groups

Variables	Group MCL (*n*=45)	Group GSL (*n*=45)	P^a
HR (bpm)			
Baseline	90.71±7.61	89.40±8.03	0.429
Before laryngoscopy	85.20±6.64	85.11±7.26	0.952
1 min after intubation	99.44±9.37	98.53±7.16	0.605
3 min after intubation	118.44±15.53	110.11±16.68	0.016
5 min after intubation	104.87±12.89	102.13±6.62	0.209
10 min after intubation	93.49±8.54	94.47±5.17	0.513
P^b	<0.001	<0.001	
SpO_2 (%)			
Before laryngoscopy	99.00±0.48	99.16±0.47	0.124
Before injecting the drug	98.27±0.81	98.73±0.75	0.065
1 min after intubation	98.93±0.25	98.91±0.42	0.760
3 min after intubation	98.87±0.34	98.89±0.49	0.803
5 min after intubation	98.89±0.32	98.93±0.39	0.557
10 min after intubation	98.91±0.29	98.94±0.36	0.963
P^b	0.302	0.272	

[a]Significance level obtained from comparing the mean of the variables between two groups in each times, [b]Significance level obtained from comparing the mean of the variable over time up to 10 min after intubation in each of the two groups. Data are shown as means±SD. SD: Standard deviation, MCL: Macintosh laryngoscope, GSL: Glidescope laryngoscope, HR: Heart rate, SpO_2: Percentage of the saturation of peripheral oxygen

Table 4: Comparison of laryngoscopy data among the two groups

Laryngoscopy data	Group MCL (*n*=45), *n* (%)	Group GSL (*n*=45), *n* (%)	*P*
Time-to-intubation (s)	12.80±1.86	10.15±2.61	0.001
Number of intubation attempts			
1	38 (84.4)	41 (91.1)	0.003
>1	7 (15.9)	4 (0.9)	
Complication			
Hypertension	2 (4.4)	5 (11.1)	0.238
Tachycardia	1 (2.2)	3 (6.6)	0.306
Laryngospasm	2 (4.4)	1 (2.2)	0.557

Data are shown as means±SD or *n* (%). SD: Standard deviation, MCL: Macintosh laryngoscope, GSL: Glidescope laryngoscope

significantly between the two groups from the beginning of the study to 10 min after laryngoscopy. Moreover, the TTI in the MCL group was significantly longer than the TTI in the GSL group. Although not significant, lower percentage of patients undergoing GlideScope-assisted laryngoscopy was prone to success within the second or third trial. However, this happened at the cost of having a significantly longer time to intubate than when using simple laryngoscopy.

Results of a meta-analysis by Griesdale *et al*. which analyzed studies examining nonexperts, successful first-attempt intubation and time to intubation were improved using the GlideScope. These benefits were not seen with experts.[12] The confounding effect of the lack of experience was controlled by training the anesthesiology assistant.

GlideScope is an easy-to-apply video-assisted laryngoscopy device and provides excellent glottis view which can reduce difficult intubation rates. However, its price is reported a longer duration of laryngoscopy by most of the studies evaluated in a recent meta-analysis.[12] However, in the cases of the difficult tracheal intubations, it improves success rate. The increased duration of the laryngoscopy can increase hemodynamic response. Video-assisted laryngoscopy methods are in an increasing trend in usage in patients with difficult intubation, such as morbidly obese patients and obstetric subjects.[9,13,14]

In the study of Bilehjani and Fakhari it was reported that GlideScope did not have a benefit over direct laryngoscopy in terms of hemodynamic responses to the intubation process.[15] In contrast to our study, the obstetric group who underwent video laryngoscopy in the study of Arici *et al*., had a longer time of intubation than the direct laryngoscopy group, despite the better glottic view provided.[16] In a more recent article by Blajic *et al*.,[17] authors compared videolaryngoscopy with direct laryngoscopy in obstetric general anesthesia candidates. Their study reported that intubation time, first-attempt and overall success rates did not differ between the groups. However, they did not clarify the exact methodology details, for example whether the height of incubator's chest was adjusted to patients' face or not, and the also did not maneuver for obtaining a laryngeal position at the optimal level, despite the fact that this position can improve the Cormack-Lehane score at least by one point. Therefore, the findings reported by Blajic *et al*. on the nonsignificance of the difference between videolaryngoscope and direct laryngoscope might show an underestimation, and needed further precision in methodology.[18] Their findings also suggested the use of a videolaryngoscope as a primary intubation device in obstetric patients with a normal airway undergoing cesarean section.

The distinguishable strength point of this study is that despite the rather small sample size, the obtained results can be relied on as maximum effort was put into matching the data related to intubation difficulty and the effect of the lack of experience was controlled by training the anesthesiology assistant.

It can be concluded that hemodynamic stability is more strongly assured by the replacement of conventional laryngoscopy with GlideScope-aided laryngoscopy, especially within the early seconds of laryngoscopy. Since maternal health and maternal mortality are highly critical issues when considering treatment and procedural guidelines, it can be recommended that in mothers and mother with cardiovascular underlying diseases, in particular, GlideScope-assisted laryngoscopy replacing the convention laryngoscopy methods can be of paramount importance. Moreover, C-section candidates with a high risk of failure of intubation within the first trial (mothers with high intubation difficulty scores) need to be referred to centers that are equipped with GlideScope. Since using GlideScope has been proven to be perfectly safe, the authors of this study suggest that a larger study, focusing on mothers with underlying cardiovascular conditions (in contrast to the subjects of our study) be undertaken and these subjects are closely monitored in terms of hemodynamics, laryngoscopy complications, and mortality.

Conclusion

Considering that in the present study, changes in hemodynamic parameters and the TTI in the GSL group were significantly less than those of the MCL group and the frequency of the first intubation attempt in the GSL group was significantly higher than that of the MCL group, it seems that the GSL technique is a better choice to conduct laryngoscopy with more success in intubation and a higher stability of the patients' hemodynamic status.

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Conflicts of interest

There are no conflicts of interest.

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