

## The McGrath Series 5 video laryngoscope versus the Macintosh laryngoscope: a randomized trial in obstetric patients

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**Background/aim:** Anesthesiologists have encountered various difficulties in securing the airway. Therefore, we compare the intubation times and hemodynamic changes between the McGrath Series 5 video laryngoscope and the Macintosh laryngoscope.

**Materials and methods:** A total of 80 obstetric patients were divided into 2 groups, orotracheally intubated with either the McGrath video laryngoscope or the Macintosh laryngoscope. The intubation times, Cormack–Lehane grade, percentage of glottic opening, mean arterial blood pressure, and heart rates were compared among the groups.

**Results:** Intubation time in the McGrath video laryngoscope group was significantly longer than in the Macintosh laryngoscope group ( $P < 0.01$ ). The percentage of glottic opening was found to be higher in the McGrath video laryngoscope group ( $P = 0.002$ ).

**Conclusion:** The McGrath Series 5 video laryngoscope provides excellent views during orotracheal intubation in obstetric anesthesia with normal airways.

**Key words:** Laryngoscope, intubation, endotracheal, anesthesia, obstetric

### 1. Introduction

Airway management is a vital part of the anesthesia procedure. Since tracheal intubation was first achieved in 19th century, anesthesiologists have encountered various difficulties in securing an airway with tracheal intubation. Moreover, these limitations in direct laryngoscopy have led to the development of intubating devices that do not require a direct glottic view. The search for new devices to be employed in difficult intubation conditions has resulted in the development of video laryngoscopes. Such video laryngoscopes are now widely used for airway management techniques that have taken place in the difficult airway algorithm (1–4).

The McGrath Series 5 video laryngoscope (Aircraft Medical Ltd, Edinburgh, UK) is one of these intubation devices, which has a high-resolution video camera, an angulated blade with adjustable length, and a light source at the cone end of the blade. Moreover, it provides a better view compared to the Macintosh laryngoscope (5,6).

In addition, various studies and case reports have demonstrated that the McGrath Series 5 video laryngoscope has several advantages, such as improved

view of the glottis, low incidence of injury, and ease of use as an alternative to direct laryngoscopy (5,7–9).

Unexpected difficulty in managing airways is a common challenge, especially in pregnant women. Pregnancy involves anatomic and physiological changes, including weight gain and oropharyngeal edema related to fluid retention, which may result in difficult intubation. Recently, difficult intubation has been reported to occur in from 1.3% to 16.3% of obstetric intubations (10). Therefore, the McGrath video laryngoscope has emerged as an alternative option to manage and secure the airway in the obstetric field.

There are several video laryngoscopes in clinical use; however, only limited comparative studies have been conducted to evaluate the exact performance of these devices (5–9,11–17). Hence, we compared the McGrath Series 5 video laryngoscope and the Macintosh laryngoscope in patients who underwent cesarean section.

### 2. Materials and methods

After approval was received from the Gaziosmanpaşa University Ethics Committee, the study was performed.

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Pregnant patients undergoing cesarean section surgery under general anesthesia in the Department of Gynecology and Obstetrics over a period of about 18 months were included in the study. Written informed consent was obtained before the administration of anesthesia. Demographic data such as age, weight, height, and American Society of Anesthesiologists (ASA) score were recorded. The presence of cardiovascular, hepatic, renal, or neuromuscular diseases; noncooperation; restricted neck movements; retrognathia; ASA score of III and IV; Mallampati score of IV; history of airway-related surgery; and emergency surgery were the exclusion criteria. Additionally, patients who had more than 2 of the following criteria were excluded: a Mallampati score of III, maximal mouth-opening capacity below 35 mm, and thyromental distance below 65 mm. The study was designed prospectively, and patients were randomized using the sealed-envelope technique (based on computer-generated random numbers) into 2 groups where the Macintosh laryngoscope or McGrath video laryngoscope would be used [Group Macintosh laryngoscope (M),  $n = 40$ ; Group McGrath video laryngoscope (MG),  $n = 40$ ].

Patients were monitored through electrocardiogram, peripheral oxygen saturation ( $SpO_2$ ), and noninvasive arterial blood pressure in the operating room. After preoxygenation, anesthesia induction was provided by thiopental sodium 5 mg/kg intravenous (iv) and rocuronium bromide 0.6 mg/kg iv. Thereafter, the patient was ventilated using a standard facemask for 90 s and was intubated with either a Macintosh laryngoscope or McGrath video laryngoscope. Direct laryngoscopy was performed using a regular Macintosh blade size 3 or 4. A stylet was always inserted into the tracheal tube to guide the tube during video laryngoscopy. The laryngoscopic view was assessed using the Cormack–Lehane grade and the percentage of glottic opening (POGO) (18). The intubation time was defined as the time from the anesthesiologist taking the laryngoscope in his hand until the first upward deflection on the capnograph after the connection of the anesthetic ventilation system to the tracheal tube. Capnography was used to eliminate uncertainty of tube placement. Prolonged intubation time was specified as over 70 s. Complications associated with intubation and laryngoscopy, such as oropharyngeal injury, bleeding, and dental trauma, were recorded using a standardized documentation sheet. Hemodynamic parameters (heart rate, systolic and diastolic blood pressure,  $SpO_2$ ) were recorded every minute for the first 10 min and thereafter every 5 min until the 30th minute.

### 2.1. Statistical analysis

Normality and variance were tested using the one-sample Kolmogorov–Smirnov test, skewness, kurtosis, and histograms for each variable. Quantitative data

were presented as mean and standard deviation, and qualitative data were presented as frequency and percentage. Depending on these results, nonparametric analysis was undertaken for each variable. Age, weight, height, body mass index (BMI), thyromental distance, maximum mouth opening, intubation time, and POGO value differences among the groups were analyzed using the Mann–Whitney U test. ASA, Mallampati, Upper Lip Bite Test, and Cormack–Lehane grade value differences between the groups were analyzed using the chi-square test. Analyses were conducted using SPSS 20.0 (SPSS Inc., Chicago, IL, USA). Statistical significance for all analyses was set at  $P < 0.05$ .

A pilot study was performed in 10 patients from the McGrath group to calculate the sample size. The mean value of total intubation time in the sample group was  $53.80 \pm 15.74$ . In order to find a significant difference between intubation times, a 2-sided type I error of 0.05 and a power of 0.90 were needed for data from 33 patients per group, assuming an equal standard deviation.

### 3. Results

A total of 80 patients were included in this study. There was no significant difference in the demographic data and preprocedural intubation conditions between the groups (Table 1). Peripheral oxygen saturation was maintained at over 95% in all patients during the intubation process and surgery. All surgical procedures were completed without any complication. No palatoglossal arch or dental injuries occurred in any patient.

Intubation was achieved successfully on the first attempt in all patients. Intubation time in MG was significantly longer than in M (Table 2,  $P < 0.01$ ). The percentage of glottic opening was found to be higher in MG (Table 2,  $P = 0.002$ ). A comparison of Cormack–Lehane grading in M and MG revealed no difference (67.5% and 82.5% in grade I, respectively). The mean arterial blood pressure and the mean heart rate values are presented in Figures 1 and 2, respectively. Mean arterial blood pressure for the 1st minute were found to be higher in MG compared to M ( $P = 0.037$ ), while at the 20th and 25th minutes, it was higher in M compared to MG ( $P < 0.01$  and  $P < 0.01$ , respectively). In addition, intragroup comparison of mean arterial blood pressure revealed significant increases between the following parameters: after induction and during intubation, at the 15th and 20th minutes, and at the 20th and 25th minutes in M ( $P = 0.024$ ,  $P = 0.002$ , and  $P = 0.002$ , respectively); and after induction and during intubation, and at the 20th and 25th minutes in MG ( $P = 0.005$  and  $P = 0.029$ , respectively). On the other hand, comparison of mean arterial blood pressure between the following parameters showed a significant decrease: during intubation and at the 1st minute, and the 6th and

**Table 1.** Demographic data and preprocedural intubation conditions.

	Group M (n = 40)	Group MG (n = 40)
Age (years)	29.25 ± 4.41	27.55 ± 3.82
Weight (kg)	72.32 ± 9.82	77.90 ± 13.71
Height (cm)	160.80 ± 6.00	162.90 ± 6.15
ASA		
n (I / II)	24 / 16	28 / 12
%	60 / 40	70 / 30
BMI (kg/m <sup>2</sup> )	27.98 ± 3.22	29.45 ± 5.60
Thyromental distance (cm)	6.38 ± 0.55	6.68 ± 0.89
Maximum mouth opening (mm)	41.85 ± 4.04	44.72 ± 6.61
Mallampati		
Mean ± SD	1.47 ± 0.50	1.57 ± 0.59
n (I / II / III)	21 / 19 / 0	19 / 19 / 2
Upper Lip Bite Test		
n (I / II / III)	25 / 13 / 2	29 / 11 / 0

ASA: American Society of Anesthesiologists.

**Table 2.** Assessment of intubation measurements.

	Group M (n = 40)	Group MG (n = 40)	P
Intubation time (s, mean ± SD)	32.20 ± 6.58	47.25 ± 14.92	<0.001†*
Cormack–Lehane grade			
n (I / II / III / IV)	27 / 13 / 0 / 0	33 / 5 / 2 / 0	0.121 <sup>‡</sup>
% (I / II / III / IV)	67.5 / 32.5 / 0 / 0	82.5 / 12.5 / 5 / 0	
POGO (%; mean ± SD)	84.37 ± 17.10	94.50 ± 8.82	0.002†*

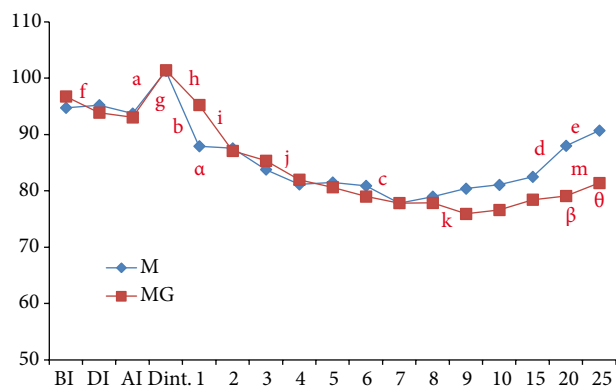
\*P < 0.01, †Mann–Whitney U test, ‡chi-square test.

POGO: Percentage of glottic opening.

7th minutes in M (P < 0.01 and P < 0.041, respectively); before induction and during induction, during intubation and at the 1st minute, the 1st and 2nd minutes, the 3rd and 4th minutes, and the 8th and 9th minutes in MG (P = 0.014, P = 0.002, P < 0.01, P = 0.034, and P = 0.03, respectively).

Mean heart rate values at just after induction and at the 1st, 3rd, 9th, and 10th minutes in MG were found to be significantly higher than those in M (P = 0.006, P = 0.017, P = 0.011, P = 0.044, and P = 0.038, respectively). The intragroup comparison of mean heart rate values showed a significant increase between the following parameters:

before induction and during induction, at the 10th and 15th minutes, and at the 20th and 25th minutes in M (P < 0.01, P < 0.01, and P < 0.01, respectively); before induction and during induction, and during induction and after induction in MG (P = 0.007 and P < 0.01, respectively). In contrast, intragroup comparison of mean heart rate values showed a significant decrease between the following parameters: at the 2nd and 3rd minutes, and at the 5th and 6th minutes in M (P = 0.029, P = 0.006, respectively); and at the 1st and 2nd minutes, at the 3rd and 4th minutes, and at the 4th and 5th minutes in MG (P = 0.018, P = 0.002, and P = 0.004, respectively).



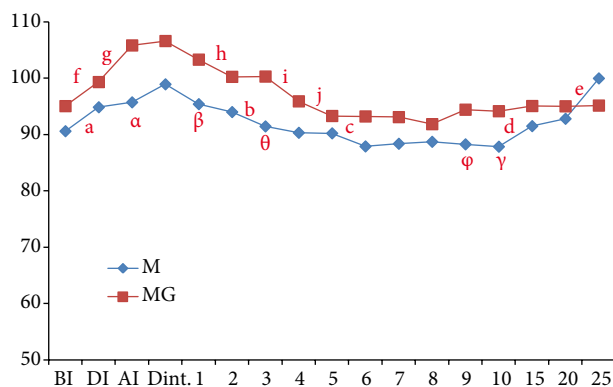
**Figure 1.** Mean arterial blood pressure values. BI: Before induction; DI: during induction; AI: after induction; Dint: during intubation. Significant differences for intergroup comparisons:  $\alpha$ :  $P = 0.037$ ,  $\beta$ :  $P < 0.01$ ,  $\theta$ :  $P < 0.01$ . Significant differences for intragroup comparisons (M): a: AI–Dint ( $P = 0.024$ ), b: Dint–1st minute ( $P < 0.01$ ), c: 6th–7th minutes ( $P = 0.041$ ), d: 15th–20th minutes ( $P = 0.002$ ), e: 20th–25th minutes ( $P = 0.002$ ). Significant differences for intragroup comparisons (MG): f: BI–DI ( $P = 0.014$ ), g: AI–Dint ( $P = 0.005$ ), h: Dint–1st minute ( $P = 0.002$ ), i: 1st–2nd minutes ( $P < 0.01$ ), j: 3rd–4th minutes ( $P = 0.034$ ), k: 7th–8th minutes ( $P = 0.03$ ), m: 20th–25th minutes ( $P = 0.029$ ).

#### 4. Discussion

The current study has demonstrated that the McGrath video laryngoscope provides a better glottic view associated with higher POGO value and Cormack–Lehane grade. Mean intubation time in MG was higher compared to M. Mean arterial blood pressure and heart rate revealed an increase for both laryngoscopes during the intubation process.

Pregnancy may lead to substantial anatomical changes, especially in the upper airway; this can create a challenge for anesthesiologists (19). These changes consist of mucosal edema of the tongue, nasal and oral pharynx, larynx, and trachea, which can impair visualization during direct laryngoscopy and obstruct the route of the endotracheal tube; breast enlargement; excessive weight gain; cephalad displacement of the diaphragm; decreased functional residual capacity; increased oxygen consumption; and increased risk of aspiration (20,21). Appropriate management of the airway in a pregnant patient potentially saves 2 lives, as maternal complications are the leading cause of fetal injury or death (22). Proper understanding of the anatomic and physiological changes in pregnancy paired with adequate preparation for airway management may minimize the risk of morbidity and mortality in these patients.

The previously mentioned changes become more evident in the later stages of pregnancy (23). Difficult or failed intubation in cesarean delivery remains the major contributing factor of anesthesia-related maternal



**Figure 2.** Mean heart rate values. BI: Before induction; DI: during induction; AI: after induction; Dint: during intubation. Significant differences for intergroup comparisons:  $\alpha$ :  $P = 0.006$ ,  $\beta$ :  $P < 0.017$ ,  $\theta$ :  $P < 0.011$ ,  $\phi$ :  $P = 0.044$ ,  $\gamma$ :  $P = 0.038$ . Significant differences for intragroup comparisons (M): a: BI–DI ( $P < 0.01$ ), b: 2nd–3rd minutes ( $P = 0.029$ ), c: 5th–6th minutes ( $P = 0.006$ ), d: 10th–15th minutes ( $P < 0.01$ ), e: 20th–25th minutes ( $P < 0.01$ ). Significant differences for intragroup comparisons (MG): f: BI–DI ( $P = 0.007$ ), g: DI–AI ( $P < 0.01$ ), h: 1st–2nd minutes ( $P = 0.018$ ), i: 3rd–4th minutes ( $P = 0.002$ ), j: 4th–5th minutes ( $P = 0.004$ ).

complications (24). Failed airway management may result in severe physical and psychological outcomes for both the mother and the baby. A national study of anesthesia-related maternal mortality in the United States revealed that 73% of deaths were specifically caused by airway management problems during general anesthesia; these included aspiration, induction/intubation problems, inadequate ventilation, and respiratory failure (25). In addition, a 2003 analysis of the ASA Closed Claims database revealed that respiratory events associated with obstetric anesthesia were involved in 45% of cases where general anesthesia was performed (26). Consequently, airway management inevitably has an important role for anesthesiologists when administering general anesthesia in obstetrics.

As previously described, it was reported that the frequency of respiratory complications in obstetrics has decreased over time, which may be due to the availability of alternative airway devices for clinical use. Therefore, recent studies have focused on video laryngoscopes, particularly the McGrath video laryngoscope, which was the target point of this research.

The present study revealed an intubation time of 47.25 s for the McGrath video laryngoscope; however, in another recent study, Taylor et al. reported the mean time to intubation using the McGrath video laryngoscope was 35.8 s. Moreover, Shippey et al. showed a median time of 24.7 s, whereas Walker et al. found that it was 47 s with a McGrath video laryngoscope. A direct comparison is difficult to achieve, as the definition of intubation time varies

among studies (6,9,12). While conducting an orotracheal intubation with the McGrath video laryngoscope, a stylet has to be used for the orotracheal tube. The distal tip of the stylet must be angled upwards by 60°–70° according to the shape of the blade, which has a greater angle than the Macintosh laryngoscope, to achieve a successful intubation of the trachea. However, the shape of the stylet may hinder its removal and cause longer intubation times. In addition, a recent study showed that intubation times with video laryngoscopes can be decreased with proper preparation of the stylet and tracheal tube (7,27).

Several studies have indicated that the glottic view is better with the McGrath video laryngoscope than the Macintosh laryngoscope (4,6,15,28). Shippey et al. showed that 88.9% of cases where a McGrath video laryngoscope was used were of Cormack–Lehane grade I, while Jeon et al. reported a Cormack–Lehane grade I of 96.3% (9,14). Similar to these studies, the current research revealed higher POGO and Cormack–Lehane grade I values (94.5% and 82.5%, respectively) with the McGrath video laryngoscope. These results suggest that the McGrath video laryngoscope may provide a good view of the glottic opening as the blade angle of the McGrath video laryngoscope is relatively close to the axis of the tracheal aperture.

Various studies indicated that laryngoscopy may cause an undesirable increase in blood pressure and heart rate in anesthetized patients (29–35). Various video laryngoscopes have been studied to elucidate the hemodynamic changes during orotracheal intubation;

however, there has been no study comparing the hemodynamic response to orotracheal intubation of the McGrath Series 5 video laryngoscope and the Macintosh laryngoscope (36–39). Moreover, in one study, Jeon et al. reported that the McGrath video laryngoscope led to a significant increase in systolic arterial blood pressure and heart rate compared to baseline (14). Similar to this result, the present study revealed a substantial increase in mean arterial pressure and heart rate during laryngoscopy with either the McGrath Series 5 video laryngoscope or the Macintosh laryngoscope.

This study has several limitations. All intubations were performed by an experienced anesthesiologist; therefore, the obtained data may differ from those of less experienced users. In addition, the time to view the glottic opening was not recorded; thus, the longest part of the intubation process was not considered. Finally, the study population included only elective surgical patients with normal airways. Therefore, conclusions cannot be reached for patients in whom difficult intubation is expected.

In conclusion, the need for specific equipment, especially video laryngoscopes, is an element in administering obstetric anesthesia while conducting orotracheal intubation. The McGrath Series 5 video laryngoscope provides excellent views during intubation in obstetric anesthesia with normal airways. However, randomized, controlled trials are needed to compare the effectiveness of this device with that of other video laryngoscopes.

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