

**Comparison of Mc Grath video laryngoscope with Macintosh laryngoscope for endotracheal intubation in surgical patients without predictors of difficult airway**

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In our study we analyzed and compared the effectiveness of Mc Grath Mac videolaryngoscope with Macintosh laryngoscope for endotracheal intubation in patients without predictors of difficult airway undergoing elective surgery.

The study included 60 patients randomly divided into two groups of 30 each: Mc Grath (MG) and Macintosh (MAC). The primary objective of our study was to determine and compare the duration of intubation and laryngeal view according to Cormack-Lehane grade (CL). Secondary objectives were: comparison of duration of laryngoscopy, first-attempt intubation success rate, number of intubation attempts, adverse events (mucosal trauma, desaturation  $spO_2 < 90\%$ , dental damage), number of failed attempts, BURP maneuver and the use of bougie.

The results of the study showed that the CL grade I was significantly more frequent in MG group compared to MAC group (80% vs 40%,  $p=0,004$ ). Duration of laryngoscopy was significantly shorter in MG group in comparison to MAC group ( $7,87 \pm 1,70$  vs  $6,00 \pm 0,95$ ,  $p < 0,001$ ). However, there was not statistically significant difference between the groups regarding duration of intubation ( $26,03 \pm 1,32s$  vs  $28,30 \pm 5,66s$  in MG and MAC, respectively,  $p=0,057$ ). Successful intubation in the first-attempt was in 96,7% of patients in MG group and in 86,7% in MAC group ( $p=0,350$ ). During laryngoscopy BURP maneuver was significantly more frequent in MAC group ( $p=0,024$ ). Regarding complications there were no significant differences between the groups.

In patients without predictors of difficult airway undergoing elective surgery Mc Grath significantly improves glottis view, reduces duration of laryngoscopy and the requirement for BURP maneuver. Regarding intubation time, rate of successful intubation within first-attempt Macintosh and Mc Grath are comparable.

**Keywords:** Mc Grath, Macintosh, video laryngoscopy, elective surgery

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**Poređenje Mc Grath videolaringoskopa i Macintosh laringoskopa u endotrahealnoj intubaciji hirurških pacijenata bez prediktora otežanog disajnog puta**

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U istraživanju smo analizirali i upoređivali efikasnost Mc Grath videolaringoskopa i Macintosh laringoskopa u endotrahealnoj intubaciji pacijenata bez prediktora otežanog disajnog puta koji se podvrgavaju elektivnim hirurškim procedurama.

Istraživanje je obuhvatilo 60 pacijenata podeljenih u 2 grupe po 30 pacijenata: Mc Grath (MC) i Macintosh (MAC) grupa. Glavni cilj bilo je je poređenje trajanja intubacije i vizuelizacije glotisa na osnovu Cormack- Lehane (CL) skale. Sporedni ciljevi bili su poređenje: trajanja laringoskopije, procenta uspešnih intubacija iz prvog pokušaja, broja pokušaja intubacije, neželjenih događaja ( trauma tkiva, desaturacija<90%, lom zuba), broja neuspešnih intubacija, BURP manevara i upotreba bužija.

Rezultati su pokazali značajno češći CL gradus I u MG grupi u odnosu na MAC grupu ( 80% vs 40%,  $p=0,004$ ). Trajanje laringoskopije bilo je značajno kraće u MG grupi u odnosu na MAC (  $7,87\pm1,70$  vs  $6,00\pm0,95$ ,  $p<0,001$ ). Međutim, nije bilo statistički značajne razlike u trajanju intubacije između grupa ( $26,03\pm1,32s$  vs  $28\ 30\ \pm5,66$  s u MG I MAC , $p=0,057$ ). Iz prvog pokušaja uspešno je intubirano 96,7% pacijenata u MG i 86,7% u MAC grupi ( $p=0,350$ ). Tokom laringoskopije BURP manevar bio je značajno češći u MAC grupi ( $p=0,024$ ). Nije bilo značajnih razlika u komplikacijama između grupa.

Kod pacijenta bez prediktora otežanog disajnog puta koji se podvrgavaju elektivnim hirurškim procedurama Mc Grath značajno poboljšava vizuelizaciju glotisa, skraćuje trajanje laringoskopije i smanjuje potrebu za BURP manevrom. Ne postoji značajna razlika u trajanju intubacije, stopi uspešnih intubacija iz prvog pokušaja i komplikacija između Mc Grath videolaringoskopa i Macintosh laringoskopa.

**Ključne reči:** Mc Grath, Macintosh, videolaringoskopija, elektivna hirurgija

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## Introduction

Direct laryngoscopy is considered the gold standard in airway management (1). From its introduction, the Macintosh laryngoscope is still the most commonly used device for direct laryngoscopy (2). For optimal glottis visualization using Macintosh it is essential to align the oral, pharyngeal and laryngeal axes (3). In cases when it is impossible anesthesiologists face with difficult laryngoscopy and intubation. Failed intubation is associated with high rate of morbidity and mortality. In patients with difficult airway, repeated attempts of laryngoscopy and intubation lead to swelling, bleeding or tissue trauma, which additionally makes each subsequent attempt of endotracheal tube (ETT) placement more difficult.

Videolaryngoscopes (VLs) are designed to overcome these "three axes problems", given that for optimal glottis view during videolaryngoscopy it is not necessary to align oral, pharyngeal and laryngeal axes. They enable anesthesiologist indirect view of the glottis due to camera on the the distal end of the blade, whereas the picture is seen on the LCD screen. Videolaryngoscopes are used in different clinical scenarios. Numerous studies have analyzed the performances of various types of VLs in emergency, trauma, difficult airway, ICU, and have shown that videolaryngoscopy improves intubation success (4,5,6). Among VLs there are differences in the design and therefore in their performances and final outcome.

The Mc Grath videolaryngoscope is small portable device with two types of blades: hyperangulated - McGrath X-blade and Macintosh -type blade ( C-MAC blade). Most of the studies that analyzed the efficacy of Mc Grath in difficult airway showed higher success rate of tracheal intubation (7,8 9). In clinical practice VLs are mostly used in the management of difficult airway and are recommended as first rescue device in difficult intubation (10). Based on previous data of its efficacy in difficult airway, the question arises whether the use of Mc Grath could further improve airway management not only in difficult but also in normal airway(11).

We compared the effectiveness of Mc Grath Mac videolaryngoscope with Macintosh laryngoscope for endotracheal intubation in patients without predictors of difficult airway undergoing elective surgery.

## Material and methods

Our randomized controlled study included 60 patients of either gender, scheduled for elective surgical procedures under general endotracheal anesthesia. Inclusion criteria were: age over 18 years, American Society of Anesthesiology (ASA) I-III grade, BMI  $\leq$  30 kg/m<sup>2</sup>, elective

surgery. Exclusion criteria were: pregnant women, ASA IV, BMI >30 kg/m<sup>2</sup>, patients with difficult or anticipated difficult airway (at least one of the criteria: Mallampati class III and IV, restricted neck movements, interincisor gap <3 cm, thyromental distance <6,5 cm, sternomental distance <12,5 cm, already known history of difficult intubation), double-lumen tube intubation, neurosurgical procedures.

After institutional ethics committee approval the study was conducted at Clinic for Anesthesia and Intensive Therapy - University Clinical Center Nis, in a period from January to February 2025. Written informed consent was obtained from all patients before recruitment. Patients were randomly divided into two groups with randomization ratio 1:1. Group MAC included patients intubated using Macintosh laryngoscope (blade size 4), while patients in MG group were intubated using Mc Grath MAC videolaryngoscope (McGrath®MAC, Aircraft Medical Ltd, 10 Edinburgh, United Kingdom; Mc Grath MAC blade size 4). Intubations were performed by two anesthesiologists with more than 200 intubations using Macintosh and 50 intubations using Mc Grath Mac. All patients underwent preanesthetic check before surgery. Standard monitoring was used intraoperatively (ECG, SpO<sub>2</sub>, heart rate and noninvasive blood pressure). Preoxygenation was performed by oxygen mask at flow 5 l/min. General anesthesia was induced with midazolam 0.05mg/kg iv, fentanyl 3µg/kg iv and propofol 2 mg/kg iv. After checking mask ventilation rocuronium-bromide was given at dose of 0,6 mg/kg iv and after achieving muscle relaxation intubation was performed using either Macintosh laryngoscope or Mc Grath videolaryngoscope. After performing laryngoscopy anesthesiologist graded glottis view according to Cormack-Lehane grade (CL) (12). Antifog solution was used for camera before intubation with Mc Grath. The choice of the size of ETT was at the discretion of anesthesiologist. The malleable ETT stylet was used during intubation in both groups. Duration of laryngoscopy was defined as time from inserting blade between the teeth until optimal glottis visualization. Duration of intubation was defined as time from inserting the blade between the teeth until confirmation of correct ETT placement by two capnographic curves and chest auscultation. Successful intubation in the first attempt was defined as correct placement of ETT in first attempt but without removing the laryngoscope out of oral cavity. Each removal of blade out of oral cavity was considered as another attempt of intubation. In case of two consecutive unsuccessful attempts of intubation, the patient was ventilated by mask and further it was proceeded according to the protocol of Clinic for Anesthesia. Time was measured by stopwatch and was recorded by the resident who was blinded to the study protocol. If intubation couldn't be performed after second attempt it was considered as failed intubation.

Additional maneuvers during intubation such as backward, upward, rightward, and posterior pressure on the larynx (BURP) and the use of bougie were recorded. Also adverse events: desaturation (  $\text{spO}_2 < 90\%$ ), mucosal trauma, bleeding, dental damage and esophageal intubation were recorded.

The primary objective of our study was to compare duration of intubation and laryngeal view by Cormack-Lehane grade (CL). Secondary outcomes were: first-attempt intubation success rate, duration of laryngoscopy, number of intubation attempts, adverse events ( mucosal trauma, desaturation  $\text{spO}_2 < 90\%$ , dental damage), number of failed attempts, BURP maneuver and the use of bougie.

Statistical analysis of data was conducted using the Statistical Package for the Social Sciences version 16 program (SPSS Inc., Chicago, IL, USA). Data are presented as arithmetic mean  $\pm$  SD, as well as absolute and relative numbers. Comparison of variables was performed using the t-test or Mann-Whitney test depending on data distribution normality. Categorical variables comparison was performed using the Chi-Square test and Fisher's test. Statistical difference was considered significant at  $p < 0,05$ .

## Results

The study included 60 patients divided into two groups of 30 each. There was no statistically significant difference regarding age, gender, ASA classification, BMI and Mallampati score between the groups ( Table 1).

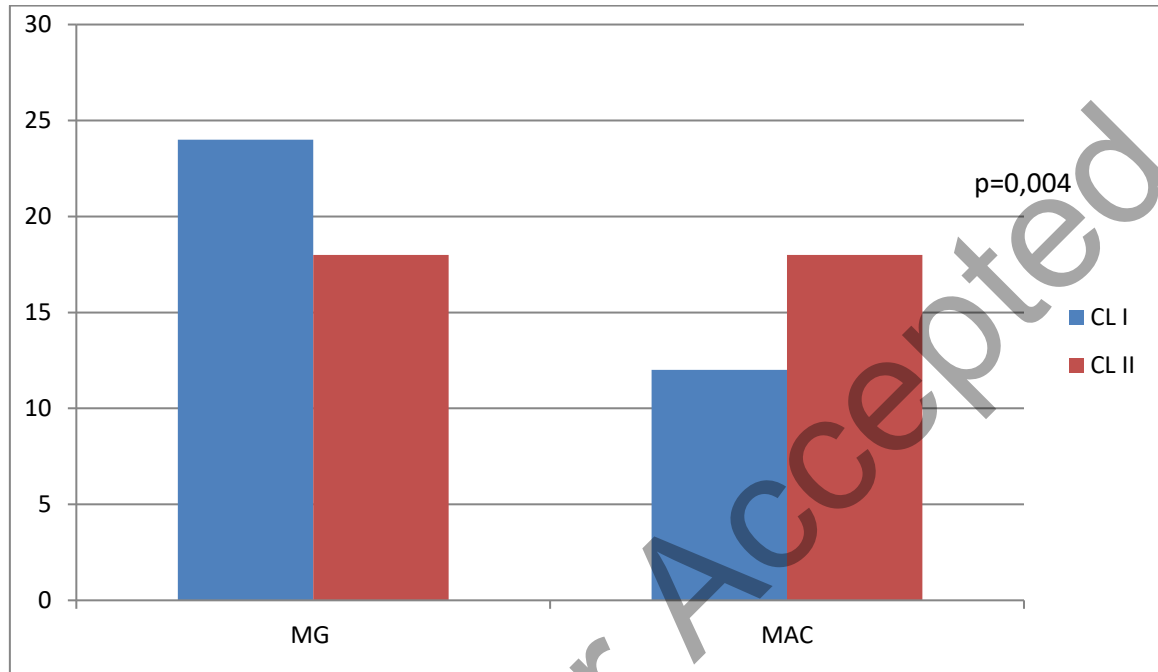
**Table 1. Patients' characteristics**

Characteristic	Group MAC (n=30)	Group MG (n=30)	p-value
Age (mean $\pm$ SD), years	54,93 $\pm$ 11,60	53,80 $\pm$ 10,68	0,695 <sup>2</sup>
Male n, (%)	14 (46,7)	15 (50)	1,000 <sup>1</sup>
Female n, (%)	16 (53,3)	15 (50)	
ASA n, (%)			0,254 <sup>1</sup>
I	9 (30,0)	7 (23,3)	
II	20 (71,4)	16 (53,3)	
III	3 (10,7)	8 (26,7)	
BMI (Mean $\pm$ SD, kg/m <sup>2</sup> )	25,29 $\pm$ 2,89	25,46 $\pm$ 3,12	0,555 <sup>2</sup>
Mallampati (n, %)			0,559 <sup>1</sup>
I	9 (30,0)	7 (23,3)	
II	21 (70)	23 (76,6)	

ASA- American Society of Anesthesiologists, BMI-body mass index,

$p < 0,05$  statistically significant, <sup>1</sup>The chi-square test, <sup>2</sup> The t-test

Duration of laryngoscopy was significantly shorter in MG group compared with MAC group (  $7,87 \pm 1,70$  vs  $6,00 \pm 0,95$ ,  $p < 0,001$ ). During laryngoscopy CL grade I was significantly more frequent in MG group compared to MAC group ( 80% vs 40%,  $p = 0,004$ ) (Figure 1).



**Figure 1.** Comparison of Cormack-Lehane (CL) grade between Mc Grath and Macintosh group

Although mean duration of intubation was shorter in MG group compared to MAC group, the difference between the groups was not statistically significant (  $26,03 \pm 1,32$  s vs  $28,30 \pm 5,66$  s;  $p = 0,057$ ). The maximal intubation time with Mc Grath was 29 s and with Macintosh 47 s.

In comparison with Macintosh the Mc Grath videolaryngoscope was associated with higher rate of successful intubations in the first- attempt : 96,7% (29/30) vs 86,7% (26/30), respectively. However, the difference was statistically comparable between the groups (  $p = 0,350$ ). There were no more than two attempts of intubation in both groups. However, there was a lesser number of second-attempts in MG compared to MAC (1 vs 4). There were no failed intubations in both groups. BURP maneuver was more frequent in MAC group compared to MG group ( 20% vs 0%,  $p = 0,024$ ). Bougie was not used in either group. Desaturation (  $spO_2 < 90\%$ ) was not observed in either group of patients ( Table 2).

With the exception of mucosal trauma no other complications were observed in either group. Mucosal trauma was present in 2 patients in MAC group, while in MG group no patient underwent

mucosal injury. There was no significant difference in complication rates between the two devices ( Table 2.) There were no esophageal intubations in either group.

**Table 2.** Comparison of outcome parameters

<b>Parameters</b>	<b>Group MAC (n=30)</b>	<b>Group MG (n=30)</b>	<b>p-value</b>
T laryngoscopy, mean±SD	7,87±1,70	6,00±0,95	<0,001 <sup>2*</sup>
T intubation, mean±SD	28,30±5,66	26,03±1,32	0,057 <sup>2</sup>
CL grade CL I	12 (40%)	24 (80%)	0,004 <sup>1*</sup>
CL II	18 (60%)	6 (20%)	
First-attempt intubation	26 (86,7%)	29 (96,7%)	0,350 <sup>1</sup>
Second-attempt intubation	4 (13,3%)	1 (3,3%)	0,605 <sup>3</sup>
Failed intubation	0 (0,0%)	0 (0%)	NA
ELM	6(20%)	0 (0%)	0,024 <sup>*</sup>
Bougie	0 (0,0%)	0 (0%)	NA
Desaturation (spO2 <100%)	0 (0,0%)	0 (0,0%)	NA
Esophageal intubation	0(0%)	0(0%)	NA
Dental damage	0(0%)	0(0%)	NA
Mucosal trauma	2 (6,7%)	0(0,0%)	0,492 <sup>1</sup>
Bleeding	0(0%)	0(0%)	NA

\*p <0,05 statistically significant, <sup>1</sup>The chi-square test, <sup>2</sup> The t-test, <sup>3</sup> Fisher test, NA/not applicable,

## Discussion

Our study showed that duration of laryngoscopy was significantly shorter in MG group compared with MAC group ( p<0, 001). Mc Grath was associated with significantly higher rate of CL I grade. The explanation is in the design of Mc Grath. Camera on the distal tip of the blade enables better glottis view and therefore shortenes laryngoscopy time. Our results are supported by previous researches ( 13,14).

However, despite the fact that Mc Grath improved glottis view, duration of intubation between MG and MAC group was comparable ( p=0,057). The results of our study suggest that improved CL grade does not neccessarily mean faster intubation even though CL grade I is considered one of the predictors of "easy" intubation. There are several reasons for this. First of all, indirect laryngoscopy requiers hand-eye coordination. Second, intubation using Mc Grath might take more time because it requires maneuvering of the ETT that should pass steep angle to enter the glottis (15). To improve intubation and facilitate the placement of ETT through the glottis in our study we used malleable stylet, and it might be the reason for shorter mean intubation time with

Mc Grath compared with Macintosh ( 26,03 vs 28,30, respectively), but still without statistical significance. Our results are in line with Kaur et al. They reported shorter mean intubation time with Mc Grath compared to Macintosh, but the difference was not statistically significant although Mc Grath improved CL grade. Also there was no difference regarding first -attempt success intubation rate (16).

Data regarding intubation time with Macintosh and Mc Grath are conflicting. In a study that compared Macintosh, Mc Grath and C-MAC Abhaynkar et al. reported superior glottis view with Mc Grath, but significantly longer time of both laryngoscopy and intubation with Mc Grath ( $p<0,0001$ ), which is opposite to our results. The authors reported fogging of camera as one of the main reasons of prolonged intubation (17). In our study anti-fog solution was used prior videolaryngoscopy and fogging was present in 1 out of 30 cases.

Walker et al. compared Macintosh with Mc Grath in patients with normal airway and reported significantly longer intubation time in Mc Grath group (18). The results of our study are not consistent with Walker et al. given that intubations in their study were performed by inexperienced anesthetists. Contrary to our results, are results of Hoshijima et al. They reported significantly longer intubation time with Mc Grath. (19) Similar results were reported by Sansone et al. (20). who compared Mc Grath with Macintosh and found that intubation time with Mc Grath was longer , but without statistical significance. However, most of providers in these studies had more clinical experience with Macintosh than with Mc Grath videolaryngoscope, which could be explanation for longer intubation time during videolaryngoscopy. Bakshi et al. concluded that expertise with direct laryngoscopy does necessarily mean expertise with VLs (21). That is because different skills are necessary to efficiently perform both videolaryngoscopy and direct laryngoscopy. All this emphasize the importance of clinicians' experience and skills in using VLs and Macintosh as well as its impact on intubation success, complications and duration of the procedure.

In our study 96,7% (29/30) of patients were successfully intubated in first -attempt using Mc Grath and 86,7% (26/30) using Macintosh. Although the difference was not statistically significant, its clinical significance should not be ignored . The results of our study are in line with results of previous studies ( 18,17, 22 ). However, in a recent study with large number of patients with normal airway Kriege et al. reported significantly higher first-pass intubation success rate with Mc Grath compared to Macintosh (23). The difference between our results and obtained in their study can be explained by the small sample size of our study.

Regarding the use of optimization maneuvers, BURP maneuver was not performed during videolaryngoscopy, but it was significantly more frequent in Macintosh group, which is supported by the fact that during direct laryngoscopy manipulation is needed to align all three axes to visualize the glottis. Our results suggest that Mc Grath improves intubation conditions by superior glottis view, shorter laryngoscopy time and less requirement for BURP. All this should contribute to less intubation attempts and therefore lead to less complications.

The importance of limiting the number of intubation attempts was highlighted in recent American Society of Anesthesiologists guideline (24). Multiple attempts of intubation are associated with tissue trauma and desaturation. In our study most of the patients were intubated in first-attempt, and a few in the second. There were no desaturation in either group. We did not find significant differences in adverse events between the groups. It has been shown that "during direct laryngoscopy in difficult airway complications are 45 times more common than in those with predicted easy airways" (25). Given that our study included patients with predicted non-difficult airway, the only trauma we reported was oral mucosal injury that happened in 2 patients intubated with Macintosh whereas in MG group no patient underwent any trauma. The injuries occurred as a result of the pressure of the blade on the gingiva. Regarding trauma we did not find statistically significant differences between Macintosh and Mc Grath, which is in line with previous researches (15,16). There is report about palatal perforation with Mc Grath, probably due to "blind period of intubation" (26). In our study no serious trauma occurred.

Our study has some limitations. First of all, the anesthesiologists who performed intubations could not be blinded to devices they used. Furthermore, this was a small sample study.

## **Conclusion**

In patients without predictors of difficult airway Mc Grath significantly improves glottis view, reduces duration of laryngoscopy and the requirement for optimization maneuvers such as BURP. Regarding intubation time, rate of successful intubation within first-attempt Macintosh and Mc Grath are comparable.

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