Original Article

A randomized controlled trial comparing McGRATH series 5 videolaryngoscope with the Macintosh laryngoscope for nasotracheal intubation

Reshma Ambulkar, Priya Ranganathan, Sukhada Savarkar, Jigeeshu V. Divatia

Department of Anaesthesia Critical Care and Pain, Tata Memorial Centre, Dr Ernest Borges Road, Parel, Mumbai, Maharashtra, India

Abstract

Background and Aims: The aim of this study was to compare the efficacy of McGRATH series 5 videolaryngoscope (VL) with Macintosh laryngoscope for nasotracheal intubation (NTI) in patients without anticipated difficult airways undergoing head and neck cancer surgeries.

Material and Methods: We randomized 60 adult patients for NTI by experienced anesthetists with either Macintosh laryngoscope or McGRATH series 5 VL (VL group). The primary objective was to compare time taken for intubation (TTI). The secondary objectives included success rates, number of attempts, need for optimization maneuvers, Cormack and Lehane (CL) grade, and percentage of difficult intubations.

Results: The mean TTI in the VL group was 43 (±10.6) versus 75 (±38.0) s in the Macintosh group (99% CI: 12.5; –51.6 s; $P < 0.001$). The overall intubation success rate was 100% in both groups. All 29 (100%) patients in the VL group were intubated in the first attempt versus 26 (86%) patients in the Macintosh group (99% CI –5; 33%; $P = 0.11$). In the Macintosh group, 20 (66%) patients needed optimization maneuver versus none in the VL group (99% CI 40; 91%; $P < 0.001$). In the VL group, 28 (96%) patients had a CL grade 1 view versus 9 (31%) in Macintosh group (99% CI 38; 92%; $P < 0.001$). There were no difficult intubations in the VL group versus 3 (10%) in the Macintosh group (99% CI: 7; 28%; $P = 0.237$). There was no trauma to oropharyngeal structures in either group.

Conclusion: The McGRATH series 5 VL has faster TTI, better glottic visualization, and less need for optimization maneuvers than the Macintosh laryngoscope for NTI in patients with unanticipated difficult airways, when performed by experienced anesthetists.

Keywords: Macintosh laryngoscope, McGRATH series 5 videolaryngoscope, nasotracheal intubation

Introduction

Nasotracheal intubation (NTI) is frequently indicated for maxillofacial trauma surgery and head and neck oncosurgery. The use of NTI precludes the need for a shared airway and also facilitates retention of the tube in the postoperative period, in case delayed extubation is planned. In patients whose airway is not predicted to be difficult, the standard technique of NTI is to use a Macintosh laryngoscope to visualize the glottic opening and to guide the endotracheal tube into the glottis, using Magill's forceps. The role of videolaryngoscopes (VLs) in airway management is now well established.[1] The McGRATH series 5 is one such VL which offers excellent laryngoscopic views and increases

Address for correspondence: Dr. Reshma Ambulkar, Department of Anaesthesia Critical Care and Pain, Tata Memorial Centre, Dr Ernest Borges Road, Parel, Mumbai - 400 012, Maharashtra, India.
E-mail: rambulkar@hotmail.com

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the success rate of orotracheal intubation in patients with both normal and difficult airways.[2-6] With the VL, it is not necessary to align the oropharyngeal, laryngeal, and tracheal axes to visualize the vocal cords, resulting in ease of visualization and improved Cormack–Lehane (CL) grades compared to direct laryngoscopy using the Macintosh blade.[7] However, when using a VL with a nonchanneled blade, it may be more difficult to insert an orotracheal tube as it has to "get around the bend," often necessitating the use of a shaped stylet. Therefore, for orotracheal intubation, studies have found that compared to direct laryngoscopy, videolaryngoscopy may result in a longer intubation time and greater use of stylets.[6-9] On the contrary, when the tracheal tube is introduced via the nose, it follows the natural passage from the nose through to the larynx. This creates a more direct route from the nasopharynx to the trachea, which may lead to less tube manipulation and consequently, easier, and quicker nasal intubation.[10]

Very few studies have examined the role of a VL in NTI.[10-14]

The aim of this study was to compare the efficacy of the McGRATH series 5 VL with the Macintosh laryngoscope for NTI in patients undergoing head and neck cancer surgeries, who did not have an anticipated difficult airway. Our hypothesis was that given the superior laryngeal exposure and the natural path that the tracheal tube would take during its passage from the nose to the trachea, the McGRATH series 5 VL would be superior to the Macintosh laryngoscope in terms of time taken for intubation (TTI), success rate, and ease of intubation.

The primary endpoint was to compare the TTI using the two devices. Secondary endpoints were to compare overall success rates, number of attempts, need for optimization maneuvers, CL grade and percentage of difficult intubations in the two groups of patients.

Material and Methods

This was a parallel-group randomized controlled study carried out at a tertiary-referral cancer center at Mumbai, India. The study was approved by the Institutional Ethics Committee on 24.01.2014 and registered with the Clinical Trials Registry of India (CTRI/2014/03/004481). We obtained written informed consent from all the patients included in this study. We included adult patients of either gender (18 years and above), ASA status I – II, undergoing elective head and neck cancer surgery needing NTI. Our exclusion criteria were: Refusal of consent, patients having risk factors for gastric aspiration, patients with previously documented difficult tracheal intubation, patients who had undergone previous head and neck surgery and patients with an anticipated difficult airway [Appendix I].

Patients were allocated on the morning of surgery to either the control group (NTI using standard Macintosh blade) or intervention group (NTI using McGRATH series 5 VL). Randomization was carried out as per a computer generated block randomization sequence with allocation concealment using opaque sealed envelopes and one of the three operators chosen by convenience.

Conduct of anesthesia

Monitoring, induction, and maintenance of anesthesia were standardized in both the groups. In the operating room, patients were monitored with *Philips* Intellivue *MP series* cardioscope, and ECG, pulse oximetry and noninvasive blood pressure instituted. The nostrils were prepared by instilling 0.1% xylometazoline drops using the dropper and 2% lignocaine jelly via the nozzle. After preoxygenation with 100% oxygen for 3 min, induction of anesthesia was carried out using intravenous Fentanyl 2 mcg per kg and intravenous Propofol titrated to loss of response to verbal command. After confirming ability to manually ventilate, the lungs by bag and mask intravenous Injection Vecuronium 0.1 mg per kg was given and mask ventilation continued. The adequacy of neuromuscular blockade before intubation was assessed before intubation using a peripheral nerve stimulator. Intubation was attempted 30 s after disappearance of all responses to train-of-four stimulation. Laryngoscopy was attempted with blade size according to actual body weight. In patients with body weight equal to or less than 70 kg, laryngoscopy was performed with size 3 Macintosh blade, whereas in those with body weight above 70 kg, a size 4 Macintosh blade was used. McGRATH series 5 videolaryngocope has an adjustable curved MAC blade (sizes 3 to 5). Size 3 and 4 were used for laryngoscopy in patients weighing less than 70 kg and more than 70 kg, respectively.

The NTIs with either size 7 or size 7.5 tubes were performed by three experienced anesthesiologists who were familiar with the use of both devices. Experienced anesthesiologists were defined as having at least 3 years' experience in anesthesia and had performed at least 25 intubations with each device.[15] In both the groups, the use of Magill's forceps was left to the discretion of the intubating anesthesiologists and this data was captured.

A maximum of three intubation attempts with the study device were permitted. Removal and re-insertion of the laryngoscope into the mouth was considered an attempt. Mask ventilation was allowed between attempts if the attending anesthesiologist deemed it necessary or according to our institution protocol

for mask ventilation if the Sp02 drops below 95% during intubation. All outcomes were recorded by an independent observer in the respective operation theatre, who was not a part of the study.

The primary outcome was the time to intubation (TTI). This was defined as the time from insertion of laryngoscope into the mouth until registration of first expired CO_2. TTI was measured in seconds using a stopwatch. In case of repeated attempts, the stop watch continued to run during and between attempts until successful endotracheal intubation was confirmed.

Secondary outcomes included:

1. Rate of successful intubation: Successful intubation was defined as successful placement of the tube in the trachea within three attempts. Inability to intubate within three attempts was considered a failed intubation, after which choice of further intubation techniques and devices was at the discretion of the attending anesthesiologist
2. Number of attempts needed for successful intubation
3. Need for use of optimization maneuvers (the use of backward, rightward, upward pressure [BURP])
4. The CL grade at laryngoscopy[16,17]
5. Percentage of difficult intubations in each group: The difficulty of intubation was graded as per the Intubation Difficulty Score (IDS) proposed by Adnet[16] and a score of 5 and above suggested moderate to major difficulty.[18]

The independent observer also recorded the incidence of any obvious oropharyngeal trauma in both groups

Sample size calculation

Sample size was calculated based on a pilot study carried out at our institution, in which mean TTI was 77.8 s in the Macintosh group and 61.8 s in the McGRATH series 5 group with estimated group standard deviation of 13.8 and 16.2 s, respectively. Hence, a sample size of 28 in each group was needed to achieve 90% power to detect a difference of 16.0 s in TTI between the two groups with a significance level (α) of 0.01 using a two-sided two-sample *t* test. Type 1 error was set at 0.01 to adjust for multiple comparisons between the groups. To account for protocol deviations, we accrued 30 patients in each group.

Statistical analysis

Data were analyzed using the statistical software (SPSS 18.0) on an intention-to-treat basis. Continuous data were analyzed using the unpaired *t* test, whereas categorical data were compared using the Chi-square test or Fisher's exact test. A value of $P < 0.01$ was considered statistically significant for all comparisons.

Results

Of 137 patients who were assessed for eligibility, 60 patients (30 in each group) were enrolled in this study [Figure 1]. One patient in the McGRATH series 5 VL group was withdrawn from analysis after randomization due to protocol deviation. No differences in patient characteristics were observed between the two groups [Table 1]. Airway assessment of the patients included in both the groups showed no meaningful differences [Table 2]. The mean TTI in the McGRATH series 5 VL group was 43 s (±10.56) as compared to 75 s (±38) in Macintosh group (difference 32 s, 99% CI for difference –51.60 to –12.5 s, $P < 0.001$). Table 3 summarizes the results for the secondary outcome. The VL group had significantly higher percentage of CL 1 views and significantly less need for BURP maneuver. In the Macintosh group 9 of 30 patients (30%) needed the use of Magills' forceps versus none in the McGRATH

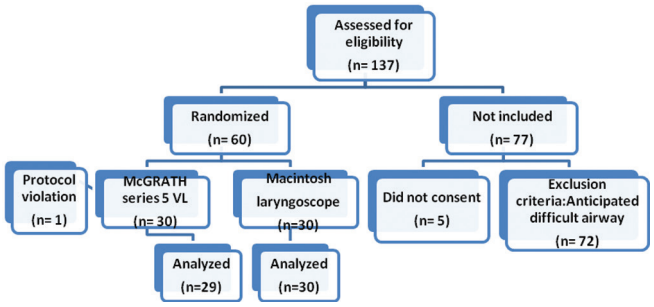

Figure 1: Flow diagram - Recruitment of patients

Table 1: Patients' baseline characteristics

	McGRATH series 5 VL (*n*=29)	Macintosh laryngoscopes (*n*=30)
Age (yrs)	53 (10.7)	48.5 (9.69)
Gender Male	24	27
Gender Female	5	3
BMI (kg.m^2)	21 (3.36)	21 (±3.61)
ASA I	24	18
ASA II	5	12

Table 2: Airway assessment

	McGRATH series 5 VL (*n*=29)	Macintosh laryngoscope (*n*=30)
Thyromental distance <6 cm	0	-0
Mallampatti classification III or IV	2	3
Inter-incisor distance <4 cm	4	4
Previous radiotherapy	1	1
Neck extension <90 degrees	0	0
Limited tongue protrusion	0	1
Buck teeth/missing incisors	2	2
Nil	20	19

Table 3: Comparison between the McGrath VL and Macintosh laryngoscopes

	McGRATH series 5 VL (*n*=29)	Macintosh Laryngoscopes (*n*=30)	*P*	99% confidence Interval
Time to intubation secs (SD)	43 secs (±10.56)	75 secs (±38)	*P*=<0.001	-32.05 (-51.60, -12.5)
Successful intubation	29 (100%)	30 (100%)	(*P*=1)	0 (-3%, 3%)
Difficulty of intubation	0	3 (10%)	(*P*=0.237)	1% (-7%, 28%)
Intubated in Ist attempt	29 (100%)	26 (86%)	(*P*=0.11)	14% (-5%, 33%)
Optimization maneuver	0	20 (66%)	(*P*<0.001)	66% (40%, 91%)
Laryngoscopic view CL grade I	28 (96%)	9 (31%)	(*P*<0.001)	65% (38%, 92%)

CL- Cormack-Lehane, secs - Seconds

series 5 VL group for intubation. There was no incidence of trauma to oropharyngeal structures in both the groups.

Discussion

In this randomized study, we found that that the use of McGRATH series 5 VL for NTI resulted in significantly shorter TTI, more grade-1 laryngoscopic views, and decreased need for optimization maneuvers as compared to the Macintosh laryngoscope. The VL group also had higher first-attempt intubation success rate and fewer difficult intubations, though these results did not reach statistical significance.

NTI is frequently indicated for head and neck cancer surgery and offers several advantages: First, it allows unhindered access to the oral cavity for surgery. Second, because the airway is no longer shared with the surgeon, there are less chances of tube kinking or accidental extubation. Finally, if the endotracheal tube needs to be retained post-operatively due to airway edema, nasotracheal tubes are better tolerated by patients as compared to orotracheal tubes. NTI is an effective and safe technique; however, it is technically more difficult and needs training as it is performed less frequently than orotracheal intubation.[19] The complications associated with NTI include prolonged laryngoscopy, failure to visualize and/or intubate the glottis and trauma to surrounding structures. VLs, via their indirect image, can potentially decrease many of these complications.

Although several studies have compared VLs either to each other or to direct laryngoscope for orotracheal intubation[20] there are only few studies which have looked at the efficacy of VLs, especially the McGRATH series 5, for NTI.[10-12,14,21-24]

A case series showed that NTI using the McGRATH series 5 had an excellent first attempt success rate with good glottic views, short TTI and low incidence of complications.[21]

Kwak carried out a randomized study which showed that the McGRATH series 5 VL was superior to the Macintosh direct laryngoscope for NTI in maxillofacial surgery in terms of faster TTI, better glottic exposure and less need for use of Magill's forceps.[10] Clinical trials by Lili[22] (in patients with ankylosing spondylitis), Jones,[12] Tseng[11] and Fushan Xue[23] compared the Glidescope to the Macintosh laryngoscope for NTI. All four studies concluded that the Glidescope had better performance characteristics than the Macintosh scope. Kim *et al*. compared Glidescope versus Macintosh for NTI in pediatric patients.[24] They found comparable TTI, glottic view and difficulty. The TTI was faster in the direct laryngoscopy group in the initial part of the study with no difference later suggesting that there is a learning curve to achieve competence with use of the Glidescope.

The results of our study corroborate the findings of earlier studies and suggest that for NTI in patients with no anticipated airway difficulties, the McGrath series 5 VL offers superior performance characteristics as compared to direct laryngoscopy.[13,14] The mean TTI in the McGRATH series 5 group in our study (43 s) was similar to that of Glidescope – 43 s in Jones,[12] but differ from other studies with VLs: McGRATH series 5, 34 s in Das,[21] 35 s in Kwak.[10] The reasons could be that Das used a directional stylet and Kwak used smaller size tubes (6.0 for females, and 6.5 for males).

In our study, the use of the McGRATH series 5 improved CL grades, and required fewer optimization maneuvers to attain a good glottic view. This is similar to the findings of Jones,[12] Kwak,[10] and Lilli.[22] The utility of CL grading in assessing intubation difficulty with VLs is debatable; as these devices provide an indirect view of the cords, they almost always provide an improved CL grading which may not always result in easier intubation. An alternative which has been suggested is the POGO system (percentage of glottic opening). However, like CL grading, POGO also informs about glottic visualization and does not give an idea about difficulty of intubation. There are different scales used in various studies comparing the intubation difficulty using multiple devices. Jones used the VAS (0-100), Kwak used a simpler scale easy/moderate/difficult, and we used IDS, as it objectively compares the complexity of intubation.

Similar to other studies[12,22] we too found that patients in the McGRATH series 5 group had lower IDS with no patient

being classified as difficult (as compared to three patients in the Macintosh group). Kim found no difference in glottic view, need for optimization maneuvers or difficulty of intubation between the groups in their study.[24] However, their study was performed in the pediatric population, and differences in airway anatomy between pediatric and adult patients could explain the discrepancy in findings.

Studies have found that the VL group needed less use of Magill's forceps than the control group.[10,12-14] In our study, we had left the choice of using Magill's forceps to the attending anesthesiologist and found similar results although we did not use this parameter as an outcome measure. As VLs provide an indirect view of the glottis, the manufacturer often recommends use of a stylet (for orotracheal intubations) or a Magill's forceps (for NTIs) with these devices. The biggest concern with the use of Magill's forceps is trauma to surrounding structures. In our study, we found no difference in the incidence of trauma to oropharyngeal structures between groups. It is possible that as the anesthesiologists who were intubating patients in our study were experienced, there was very little trauma. We also did not study the incidence of postoperative sore throat and as all patients were either intubated overnight or had a tracheostomy performed intra-operatively and were sedated with opioids. Therefore, it would have been impossible to assess the incidence of sore throat related to the laryngoscopy and to differentiate it from surgical pain.

The strength of our study is that it was a pragmatic randomized trial with well-balanced groups and a clearly defined and clinically valid primary outcome. The ideal endpoint for assessing efficacy of a VL is debatable. Many studies have used overall success of intubation as an endpoint. However, as the NAP4 has shown, the incidence of failed intubation is very low (1 in 2000) and extremely large studies would be needed to detect any change from this number.[25] However, TTI is probably the most reliable measure of efficacy: It is objective, it is influenced by glottic view and ease of intubation, it also has clinical significance because a prolonged TTI would affect hemodynamics and oxygenation.

Our study had certain limitations. First, the anesthesiologists in our study all had experience with both direct and McGRATH series 5 videolaryngoscopy. Therefore, the results of this study may not apply to novices or trainees with inadequate experience. The results of other studies suggest that in inexperienced hands, the use of VLs may actually increase TTI.[24,26] Second, we could not blind the operator or the assessor to the type of device used. This is a common challenge in all VL-related clinical trials and is a potential source of bias. We attempted to reduce this bias by using objective endpoints. As the intubation was being timed, this could have led to better clinical performance (the Hawthorne effect); however, any improvement would be equally distributed between both the groups. Our study was conducted using only one VL (McGRATH series 5) which has a hyper angulated blade, hence the results of the study cannot be extrapolated to other VLs, especially those with a Macintosh type blade. However, considering that the principles of videolaryngoscopy are similar across devices and that our study results mirror those studies with other types of VLs, it is fair to assume that one might find similar success with other VLs with an angulated blade.[14]

Hence, we conclude, in the hands of experienced anesthetists, McGRATH series 5 VL has faster TTI, better glottic visualization and less need for optimization maneuvers than the Macintosh laryngoscope for NTI in patients with unanticipated difficult airways.

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Conflicts of interest
There are no conflicts of interest.

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Appendix I: Criteria for Difficult Airway

Possession of at least two of the following criteria: Excluded from study

a. Thyromental distance less than 6 cm
b. Mallampatti classification III or IV
c. Inter-incisor distance less than 4 cm
d. Jaw subluxation 0 or -1
e. Neck extension less than 90 degrees
f. Radiotherapy/surgery - head or neck region
g. Limited tongue protrusion
h. Obesity – BMI more than 35
i. Buck teeth/missing incisors