A comparative study of McGrath and Airtraq videolaryngoscopes for tracheal intubation

Nadeem Raza, Muazzam Hasan, Syed Moeid Ahmed, Shahjahan Bano, Manazir Athar
Department of Anaesthesiology and Critical Care, JNMC, Aligarh, Uttar Pradesh, India

Abstract

**Background and Aims:** Many cases of difficult tracheal intubation remain unrecognized until after induction of anesthesia. McGrath and Airtraq videolaryngoscopes are among the novel laryngoscopes that have an advantage over the conventional laryngoscopes in case of unanticipated difficult airway. Thus, we did a comparative study between McGrath and Airtraq videolaryngoscopes to evaluate their efficacy in routine anesthesia practice.

**Material and Methods:** Sixty anesthetized patients were divided into two groups using computer-based randomization, and tracheal intubation was performed using either McGrath or Airtraq laryngoscope. The primary outcome measures were duration and incidence of successful tracheal intubation. Hemodynamic response, glottic view (percentage of glottic opening score [POGO]), ease of intubation, and airway complications were also measured.

**Results:** Both McGrath and Airtraq groups were comparable in terms of incidence of successful tracheal intubation (93.3% vs. 96.6%), ease of intubation (70% vs. 77%), and POGO scoring. Intubation time was significantly shorter with Airtraq (13.5 vs. 17.8 s; \( P < 0.001 \)). There were statistically significant changes in the heart rate and blood pressure after tracheal intubation in both the groups (\( P < 0.001 \)); however, these parameters reached baseline within 5 min of intubation in both the groups. The incidence of injury was 10% with McGrath videolaryngoscope and 13.3% with Airtraq and was comparable.

**Conclusion:** Both Airtraq and McGrath videolaryngoscope have high success rates of intubation. Airtraq is better than McGrath laryngoscope due to shorter tracheal intubation time.

**Keywords:** Airtraq, McGrath videolaryngoscope, tracheal intubation

Introduction

Difficult airway, whether anticipated or unanticipated, still holds a great deal of concern for an anesthetist. This has stimulated the development of multiple novel laryngoscopes, each of which aims to reduce the difficulty of laryngeal visualization, particularly in the setting of difficult airway. Complications arising from difficult or failed tracheal intubation remain a leading cause of anesthetic morbidity and mortality.\(^{[1]}\) Despite a number of factors and their combinations having been identified to predict difficult tracheal intubation, none is capable of identifying all potentially difficult intubations. Consequently, many difficult intubations remain unrecognized until after induction of anesthesia.

Videolaryngoscopes are relatively recent entrants in the field of rigid laryngoscopes with the benefit of better glottic view. McGrath is a videolaryngoscope which is nonchanneled and requires a stylet to preshape the endotracheal tube (ETT) during intubation of a patient. However, Airtraq is an optical device with a channel, in which the ETT has to be installed before intubation. This gives ETT the desired curvature needed for intubation.

Both the McGrath and Airtraq videolaryngoscopes claim to have an advantage over conventional laryngoscope in...
cases of unanticipated difficult tracheal intubation.[2-5] Both requires less head and neck movement during laryngoscopy and intubation, provide a good optical view of the larynx, improve Cormack and Lehane grading, and cause decreased hemodynamic responses.

Till date, we have not been able to access any detailed randomized studies comparing the McGrath and Airtraq laryngoscopes. Therefore, we compared the performance of McGrath and Airtraq laryngoscopes in terms of intubation time, incidence of successful intubation, glottic view (percentage of glottic opening [POGO score]), hemodynamic responses, incidence of tissue injury, and ease of tracheal intubation in routine anesthesia practice.

Material and Methods

After obtaining approval from the Board of Studies of the Department and Institutional Ethical Committee, sixty patients were included in this study over a period of 1 year. The anomalies of learning curve for the use of the equipment were decreased using each equipment for tracheal intubation 20 times in manikin on separate occasions followed by ten tracheal intubations in patients in the operation theater before starting the study. All tracheal intubations were carried out by a single researcher to eliminate observer bias.

Inclusion criteria were elective surgery under general anesthesia requiring tracheal intubation, patients with the American Society of Anesthesiologist Grade I and II, 20–60 years of age, body mass index ≤30, and Mallampati Grade 1 and 2. Exclusion criteria included head and neck surgery, presence of valvular heart disease, coronary arterial disease, uncontrolled hypertension, patients with predicted difficult laryngoscopy and intubation, presence of raised intracranial pressure, cervical spine injury, and risk factors for pulmonary aspiration of gastric contents.

Patients were randomly divided into two groups, Group McGrath and Group Airtraq. Randomization was done using computer-based random number generator and the allocation concealed in sealed envelopes, which were not opened until patient consent had been obtained.

Patients’ demographic characteristics were recorded. Mallampati class, neck movements, and mouth opening were also recorded. All patients were premedicated with intravenous midazolam 0.03 mg/kg, ondansetron 0.1 mg/kg, tramadol 2.0 mg/kg, and glycopyrrolate 0.01 mg/kg. Both the groups were anesthetized by the standardized anesthetic technique. Following preoxygenation, anesthesia was induced with propofol (2–2.5 mg/kg) and muscle relaxation achieved with vecuronium bromide (0.08–0.12 mg/kg).

After obtaining complete relaxation, as reflected by train of four response, monitored using peripheral nerve stimulator, intubation was carried out as per the respective groups, and POGO score was noted.

Surgery was allowed to commence only after the collection of the last hemodynamic data at 5 min postintubation. Further management was done as per the department protocol by the anesthesiologist providing care for the patient. In the recovery room, patients were observed for 1 h and complications noted.

Failure of intubation was defined as an attempt, in which tracheal intubation failed or where it required >60 s. Tracheal intubation was attempted with each device in neutral position. If the larynx was not visualized, then the position was changed to sniffing position. Maximum of two attempts at intubation were made with each device in sniffing position. In case of failure of tracheal intubation with the above devices, Macintosh laryngoscope was used.

The time for intubation was defined as the time from insertion of the blade between the teeth until the ETT was placed through the vocal cords, as evidenced by visual confirmation by the anesthetist. POGO score was assessed and recorded by the attending anesthetist on a score of 1–4 (Score 1 = 75–100%, Score 2 = 50–75%, Score 3 = 25–50%, and Score 4 = 0–25%). Ease of intubation was graded as Grade 1 = no extrinsic manipulation of larynx is required; Grade 2 = external manipulation of larynx is required to intubate; Grade 3 = failed intubation. The incidence of successful intubation was recorded with each laryngoscope separately in both the neutral and sniffing positions.

Preinduction values of heart rate and mean arterial blood pressure were considered as the control value. Thereafter, values were recorded and compared at 1, 3, and 5 min after intubation. Immediate postoperative complications such as blood on laryngoscope, dental trauma, airway trauma, and soreness of throat were also recorded.

The sample size for a superiority trial was calculated on the basis of the primary objective of duration of intubation. A pilot study was done with ten patients in each group. The mean outcome was found to be 14.4 and 20.4 s in Airtraq and McGrath group, respectively, with a standard deviation of 7.6. The significance level was taken as 5% and power was taken as 80%. A sample size of 26 per group was calculated. We included a total of sixty patients to avoid attritions, nonconsent, and drop outs.

Demographic data and duration of intubation were analyzed using unpaired t-test. Incidence for successful
Tracheal intubation attempts, ease of intubation, number of intubation attempts, POGO score, and that regarding trauma was analyzed using Chi-square test or Fisher’s exact test. Repeated measures ANOVA was used for comparison of hemodynamic data within each group, whereas unpaired t-test was used for comparisons between the two groups. For all statistical analysis, $P < 0.05$ was considered statistically significant.

**Results**

The demographic data and preoperative airway assessment of patients were comparable between the two groups [Table 1].

The incidence and attempts of successful intubation, ease of intubation, time of intubation, and POGO scores are shown in Table 2. All these outcomes were comparable in both the groups except for the time of intubation which was significantly shorter in Airtraq group.

**Tracheal intubation failed in two patients with McGrath and in one patient with Airtraq laryngoscopes. Macintosh laryngoscope was successfully used in these patients for tracheal intubation.**

There were three cases with blood on laryngoscope blade in the McGrath group, compared with four in the Airtraq group, probably due to mucosal injury. There were no incidences of dental trauma or sore throat in the perioperative period.

There was an increase in heart rate and mean arterial blood pressure after tracheal intubation in both the groups. The increase was statistically significant at 1 and/or 3 min; reaching their baseline values or even lower after 5th min postintubation in both the groups. The intergroup analysis of these hemodynamic parameters showed that both groups were comparable [Tables 3 and 4].

**Discussion**

In the present study, we found that all the outcomes related to laryngoscopy and tracheal intubation were similar in the Airtraq and McGrath groups, except the intubation time which was significantly shorter in Airtraq group.

There are two major factors responsible for determining the success and ease of endotracheal intubation: the adequacy of laryngeal view obtained and the ease of maneuvering ETT inside glottic opening even after a proper visualization. Both Airtraq and McGrath provided a good indirect view of
larynx in this study. Other studies also reported that these devices visualize the laryngeal inlet by indirect mechanisms, obviating the need to align the oral, pharyngeal, and tracheal axes, thereby potentially making laryngeal visualization, and subsequent tracheal intubation easier to perform.\[6-12\]

Although the glottic visualization was similar in both devices, interestingly, intubation was quicker using Airtraq than McGrath laryngoscope by 4.3 s in our study. This finding may be attributed to hand–eye coordination required for using optical or videolaryngoscopes.\[8,9,11\] The hand–eye coordination required with Airtraq laryngoscope is probably less as compared to McGrath because Airtraq has a channel in which the ETT is installed before intubation. Hence, the ETT gets the required curvature and becomes properly aligned with the visualizing lens of the device.

In case of McGrath laryngoscope, laryngoscopy is done with one hand, and the stylet mounted ETT has to be directed through the glottis with the other while seeing the laryngeal view indirectly on a video screen, thus requiring proper hand–eye coordination. Although McGrath laryngoscope provided a good laryngeal view, maneuvering ETT into the trachea required more time.

In our study, we were able to intubate more than 80% of patients of both the groups in neutral position. Most of the studies also reported that with both Airtraq and McGrath laryngoscope, there is reduced need for additional maneuvers for intubation and more patients could be intubated without placing the patient in sniffing position.\[6,10,12-14\]

In our study, two patients of McGrath group and one in Airtraq group had failed intubations. Patient in Airtraq group could not be intubated because of poor visibility due to secretions and fogging of lens. The reason for failed intubation using McGrath was due to inability to manipulate the ETT through the glottis though it was visible.

We found relatively better visualization of larynx with McGrath in comparison to Airtraq; however, the difference was statistically not significant. POGO score Grade 1 was obtained in 83.3% in McGrath group compared to 80% in Airtraq group. This difference can be attributed to laryngeal view on a broad video screen with better illumination.\[15-17\]

The effects of laryngoscopy and tracheal intubation on the mean arterial pressure and on heart rate were relatively modest. Heart rate and blood pressure in patients from both the groups reached the baseline value by the 5th min. Both the devices provide a view of the glottis without a need to align the oral, pharyngeal, and tracheal axes, and therefore require less force to be applied during laryngoscopy.

Till date, McGrath is only laryngoscope to feature variable length blade for use in children more than 5 years to adults, thus single device can be used for different age groups. Furthermore, Airtraq is a single use device, whereas McGrath

### Table 3: Mean heart rate of patients at various times in two groups

| Heart rate at various times | McGrath group | Airtraq group | Unpaired t-test (P) |
|----------------------------|---------------|---------------|---------------------|
| Preinduction               | 83.0±12.5     | 83.1±10.4     | 0.973               |
| 1 min                      | 91.7±13.0     | 93.1±11.5     | 0.660               |
| 3 min                      | 88.5±12.8     | 93.6±10.7     | 0.099               |
| 5 min                      | 84.3±12.6     | 86.9±11.4     | 0.405               |

Repeated measures ANOVA (within groups) *P*<0.001

| Post hoc analysis*          | P<0.001       | P<0.001       |
|----------------------------|---------------|---------------|
| P<1 min <0.001             | P<1 min <0.001|
| P<3 min <0.001             | P<3 min <0.001|
| P<5 min =1.000             | P<5 min =0.076|

*Post hoc test compares preinduction mean heart rate with mean heart rate at 1, 3, and 5 min postintubation within each group

### Table 4: Mean arterial pressure of patients at various times in the two groups

| Mean arterial pressure at various times | McGrath group | Airtraq group | Unpaired t-test (P) |
|----------------------------------------|---------------|---------------|---------------------|
| Preinduction                           | 92.8±6.1      | 93.2±7.4      | 0.820               |
| 1 min                                  | 95.7±7.4      | 99.9±9.2      | 0.056               |
| 3 min                                  | 94.5±7.5      | 99.6±9.5      | 0.024               |
| 5 min                                  | 90.8±7.4      | 95.3±7.5      | 0.022               |

Repeated measures ANOVA (within groups) *P*<0.001

| Post hoc analysis*          | P<0.001       | P<0.001       |
|----------------------------|---------------|---------------|
| P<1 min <0.001             | P<1 min <0.001|
| P<3 min <0.017             | P<3 min <0.001|
| P<5 min =0.001             | P<5 min =0.304|

*Post hoc test compares preinduction mean arterial pressure with mean arterial pressure at 1, 3, and 5 min postintubation within each group
laryngoscope can be reused apart from the disposable blade. Thus, McGrath may be more cost-effective in long-term use.

Our study has some limitations. First, although patients were blinded to the device being used, it was impossible to blind the anesthesiologist to the device being used. Therefore, it could not be double blinded and also have some element of bias. Second, we found that the Airtraq laryngoscope allows a more rapid learning curve when used in a clinical setting, probably due to mandatory use of stylet with McGrath. Shorter learning curve of Airtraq has been reported by other researchers also.\[18,19\]

Certain measurements used in this study, such as grading of difficulty of device use, were by their nature subjective. However, there was good agreement between subjective indices of difficulty of device use and more objective measures, such as the success of tracheal intubation attempts. However, the strength of the study was that the study was prospective, randomized, and well powered.

**Conclusion**

We conclude that both the devices have high success rates of intubation; however, Airtraq is better than McGrath in terms of duration of intubation. Further studies in patients with difficult airways are necessary to confirm these initial findings.

**Financial support and sponsorship**

Nil.

**Conflicts of interest**

There are no conflicts of interest.

**References**

1. Amathieu R, Combes X, Abdi W, Housseini LE, Rezzouq A, Dinca A, et al. An algorithm for difficult airway management, modified for modern optical devices (Airtraq laryngoscope; LMA CTrach \(^\text{TM}\)): A 2-year prospective validation in patients for elective abdominal, gynecologic, and thyroid surgery. Anesthesiology 2011;114:25-33.
2. Trimmel H, Kreutziger J, Fertsak G, Fitzka R, Dittrich M, Voelkel WG. Use of the Airtraq laryngoscope for emergency intubation in the prehospital setting: A randomized control trial. Crit Care Med 2011;39:489-93.
3. Sansone P, Stumbo R, D’Arienzo S, Passavanti MB, Pace MC, Aurilio C. Airtraq laryngoscopes in patients with facial trauma. Eur J Anaesthesiol 2012;29:229.
4. Koh JC, Lee JS, Lee YW, Chang CH. Comparison of the laryngeal view during intubation using Airtraq and Macintosh laryngoscopes in patients with cervical spine immobilization and mouth opening limitation. Korean J Anesthesiol 2010;59:314-8.
5. Shippey B, Ray D, McKeown D. Case series: The McGrath videolaryngoscope – An initial clinical evaluation. Can J Anaesth 2007;54:307-13.
6. Maharaj CH, Buckley E, Harte BH, Laffey JG. Endotracheal intubation in patients with cervical spine immobilization: A comparison of Macintosh and Airtraq laryngoscopes. Anaesthesia 2007;107:53-9.
7. Lu Y, Jiang H, Zhu YS. Airtraq laryngoscope versus conventional Macintosh laryngoscope: A systematic review and meta-analysis. Anaesthesia 2011;66:1160-7.
8. Kaki AM, Almarakbi WA, Fawzi HM, Boker AM. Use of Airtraq, C-Mac, and Glidescope laryngoscope is better than Macintosh in novice medical students’ hands: A manikin study. Saudi J Anaesth 2011;5:376-81.
9. Giquello JA, Humbert S, Duc F, Monrigal JR Granry JC. Use of the Airtraq by inexperienced physicians supervised during a series of tracheal intubation in adult patient with anticipated difficult airway. Ann Fr Anesth Reanim 2011;30:804-8.
10. McElwain J, Laffey JG. Comparison of the C-MAC\(^\text{R}\), Airtraq\(^\text{R}\), and Macintosh laryngoscopes in patients undergoing tracheal intubation with cervical spine immobilization. Br J Anaesth 2011;107:258-64.
11. Di Marco P, Scattoni L, Spinoglio A, Luzi M, Cannetti A, Pietropaoli P, et al. Learning curves of the Airtraq and the Macintosh laryngoscopes for tracheal intubation by novice laryngoscopists: A clinical study. Anesth Analg 2011;112:122-5.
12. Tolon MA, Zanaty OM, Shafshak W, Arida EE. Comparative study between the use of Macintosh laryngoscope and Airtraq in patients with cervical spine immobilization. Alexandria J Med 2012;48:179-85.
13. Noppe RS, Möbus S, Heid F, Schmidtmann I, Werner C, Piepho T. Evaluation of the McGrath series 5 videolaryngoscope after failed direct laryngoscopy. Anaesthesia 2010;65:716-20.
14. Piepho T, Weinert K, Heid FM, Werner C, Noppe RS. Comparison of the McGrath\(^\text{R}\) series 5 and GlideScope\(^\text{R}\) ranger with the Macintosh laryngoscope by paramedics. Scand J Trauma Resusc Emerg Med 2011;19:4.
15. Jeon WJ, Kim KH, Yeom JH, Bang MR, Hong JB, Cho SY. A comparison of the Glidescope\(^\text{R}\) to the McGrath\(^\text{R}\) videolaryngoscope in patients. Korean J Anesthesiol 2011;61:19-23.
16. Ng I, Sim X, Williams D, Segal R. A randomised controlled trial comparing the McGrath\(^\text{R}\) videolaryngoscope with the straight blade laryngoscope when used in adult patients with potential difficult airways. Anaesthesia 2011;66:709-14.
17. Ng I, Hill AL, Williams DL, Lee K, Segal R. Randomized controlled trial comparing the McGrath videolaryngoscope with the C-MAC videolaryngoscope in intubating adult patients with potential difficult airways. Br J Anaesth 2012;109:439-43.
18. Dhonneur G, Ndoko S, Amathieu R, Housseini LE, Poncelet C, Tual L. Tracheal intubation using the Airtraq in morbid obese patients undergoing emergency cesarean delivery. Anaesthesiology 2007;106:629-30.
19. Maharaj CH, Costello JF, Higgins BD, Harte BH, Laffey JG. Learning and performance of tracheal intubation by novice personnel: A comparison of the Airtraq and Macintosh laryngoscope. Anaesthesia 2006;61:671-7.