

McGrath Series 5 videolaryngoscope vs Airtraq DL videolaryngoscope for double-lumen tube intubation

A randomized trial

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Abstract

Background: Many studies have shown Airtraq videolaryngoscope provided faster tracheal intubation and a higher success rate than other videolaryngoscopes. Recently, different types of videolaryngoscopes have been reported for use in double-lumen tube (DLT) intubation. However, the advantages and disadvantages between them remain undetermined for DLT intubation. In this study, we compared the Airtraq DL videolaryngoscope with the McGrath Series 5 videolaryngoscope for DLT intubation by experienced anesthesiologists.

Methods: Ninety patients with expected normal airways were randomly allocated to either the Airtraq or McGrath group. The primary outcome was DLT intubation time. The secondary outcomes were glottic view, success rate, subjective ease of intubation (100-mm visual analog scale, 0=easy; 100=difficult), incidence of DLT malposition, and postoperative intubation-related complication.

Results: The airway characteristics were comparable between the 2 groups. Cormack and Lehane grades significantly improved with the use of the McGrath and Airtraq videolaryngoscopes, compared with the Macintosh laryngoscope. The intubation success rate on the first attempt was 93% in the Airtraq group and 95% in the McGrath group ($P > 0.05$). The intubation time in the McGrath group is longer than that in the Airtraq group (39.9 [9.1]s vs 28.6 [13.6]s, $P < 0.05$). But intubation difficulty score, the incidence of DLT malposition and intubation-related complication were comparable between groups ($P > 0.05$).

Conclusions: When using videolaryngoscopes for DLT intubation, the Airtraq DL is superior to the McGrath Series 5 in intubation time, but it does not decrease intubation difficulty.

Abbreviations: ASA = American Society of Anaesthesiologists, DLT = double-lumen tube, FOB = fiberoptic bronchoscopy, SARI = simplified airway risk index, SLT = single-lumen tube.

Keywords: double-lumen tube, intubation, thoracic anesthesia, videolaryngoscope

1. Introduction

A double-lumen tube (DLT) is commonly used in thoracic surgery to achieve one-lung ventilation and isolation. Since it is larger and more complex than conventional endotracheal tubes, intubation is more difficult.

Editor: Kazuo Hanaoka.

LW, ML, and LL contributed equally to this study.

Funding: Supported by grants from the National Natural Science Foundation of P.R. China (no. 81000476 to W. L. Yao).

The authors have no conflicts of interest to disclose.

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Medicine (2016) 95:51(e5739)

Received: 23 November 2016 / Received in final form: 30 November 2016 /

Accepted: 1 December 2016

<http://dx.doi.org/10.1097/MD.0000000000005739>

The role of videolaryngoscopes is becoming increasingly important in airway management.^[1,2] They can provide good visualization of the laryngeal structures without alignment of oral, pharyngeal, and laryngeal axes. In addition, they are also useful for training novices in tracheal intubation.^[3,4] Furthermore, videolaryngoscopes are recommended in cases of unexpected and expected difficult airway management.^[5,6] Recently, many different types of video devices have been reported for use in DLT intubation including the GlideScope,^[7-11] McGrath Series 5,^[12,13] Airtraq,^[14,15] CEL-100,^[16,17] Pentax Airway Scope,^[18] videolaryngoscopes with MAC blade,^[19] video stylet,^[20,21] and VivaSight-DL.^[22,23]

Generally, videolaryngoscopes can be classified into 2 categories^[24]: those with a channel that guides the endotracheal tube through the glottis, such as the Airtraq and the Pentax Airway Scope, and those for which the endotracheal tube must be pre-shaped with a stylet and steered by the operator, such as the Glidescope and the McGrath videolaryngoscopes.

Many studies have compared different videolaryngoscopes for standard tracheal intubation in manikin and simulated difficult airways.^[25-28] They found Airtraq provided faster tracheal intubation and higher success rate than other devices. However, the advantages between the Airtraq and other videolaryngoscopes for DLT intubation have not yet been determined.

Our previous studies report successful utilization of the McGrath Series 5 videolaryngoscope for DLT intubation in

normal airways and patients with poor glottic exposure.^[12,13] Therefore, we compared the McGrath Series 5 (Aircraft Medical, Edinburgh, UK) with the Airtraq DL (ProdolMeditec, Viscaya, Spain) for DLT intubation by experienced anesthesiologists. The outcomes will be guided for choosing a videolaryngoscope for DLT intubation in cases of failed intubation with the Macintosh laryngoscope.

2. Methods

The study was conducted in Tongji Hospital, Tongji Medical College, Huazhong University of Science and Technology from January 2015 to May 2016. The study protocol was approved by the Ethics Committee of Tongji Hospital and it was registered with ClinicalTrials.gov (ref: NCT02329041). After written consent, patients aged 18 to 70 years with an American Society of Anaesthesiologists (ASA) physical status of 1 to 3 and scheduled for thoracic surgery requiring DLT intubation were enrolled. The exclusion criteria included the following: anticipated difficult airways according to a simplified airway risk index score ≥ 4 ,^[29] ASA physical status ≥ 4 , a high risk of aspiration, and postoperative tracheostomy (Fig. 1).

Airway assessments were performed the day before surgery. Patients were randomly allocated to either the McGrath or Airtraq group using a computer-generated random code enclosed within a sealed opaque envelope. Generally, a 35-F or 37-F left-sided DLT was used for women and a 37-F or 39-F tube for men. All intubations were performed by 3 experienced anesthesiologists. Each of them has ever performed DLT intubation in >200 cases with Macintosh laryngoscope, and in 30 cases with either McGrath Series 5 or Airtraq videolaryngoscope.

Patients were positioned supine and underwent routine monitoring including electrocardiogram, blood pressure, pulse oximetry, and capnography. Anesthesia was induced with propofol and sufentanil. Rocuronium was administered after loss of consciousness. Anesthesia was maintained with continuous infusion of propofol and remifentanyl. Train-of-four stimulation was used to monitor neuromuscular blockade.

After unremarkable difficulty in mask ventilation, the modified Cormack and Lehane classification was initially evaluated with the Macintosh laryngoscope in all patients.^[30] This was the basis for the comparison between the 2 groups. Following this, oxygenation was resumed by mask ventilation.

In the McGrath group, DLT intubation was performed as previously reported.^[13] Briefly, the DLT were lubricated and pre-curved with a malleable stylet.^[9,31] After the distal tip of the DLT

entered the glottis, the stylet was removed. Following this, sequential rotation or a “left-to-right” rotation was used to advance the tube pass through the glottis.^[11,16] Then, it was further rotated to guide the bronchial tip of the DLT into the appropriate bronchus.

In the Airtraq group, DLT intubation was performed as previously reported.^[14,15] Briefly, the original stylet inside the tube was removed. The DLT were lubricated and preloaded in the adjacent channel. Once the bronchial cuff passed through the vocal cords, the DLT was turned 90° counterclockwise and further advanced to enter the left main bronchus.

After DLT insertion, the position of the DLT was checked by auscultation and fiber-optic bronchoscopy. Unsuccessful DLT intubation after 3 attempts was defined as failure using either of the videolaryngoscopes. A rescue method was followed as presented in Fig. 2. If the initial Cormack–Lehane grade was 1 or 2a, DLT intubation was attempted with the Macintosh laryngoscope. If the initial Cormack–Lehane grade was greater than 2a, the patient was intubated with a single-lumen tube under videolaryngoscope or fiber-optic bronchoscopy.

The primary outcome was DLT intubation time, measured as the time from the insertion of the videolaryngoscope until the completion of intubation by an independent observer. The secondary outcomes comprised glottic view, success rate of DLT intubation at first attempt, exposure time (measured as the time from the insertion of the videolaryngoscope to observe a clear glottic view), and the incidence of DLT malposition (defined as the bronchial cuff of left-sided DLT in the right main bronchus).^[32] The grade of intubation difficulty was measured using a visual scale^[33] (from 0=very easy to 100=very difficult). The difficulty of advancing the tube was classified as follows: 0=easy, 1= slightly difficult, or 2=very difficult. On the first postoperative day, hoarseness or sore throat was recorded by a blinded anesthetist.

The primary aim of this study was to compare intubation times between the 2 devices. Assuming that a clinical difference in mean intubation time between groups was 10 s (standard deviation, 15 s), we calculated that 37 patients were required in each group to detect a difference with 80% power, at 5% significance level. Therefore, 45 patients were recruited per group to allow for a 20% dropout.

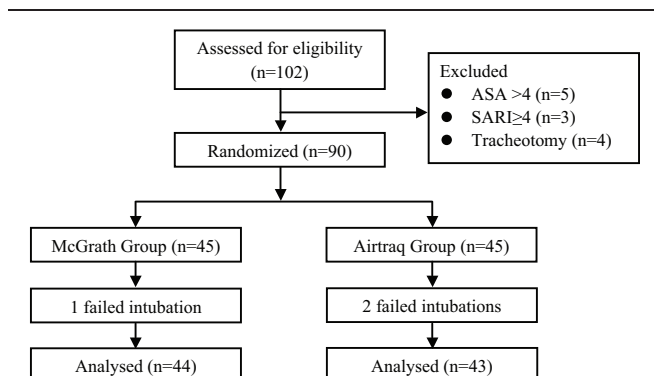


Figure 1. CONSORT flow diagram of the study. ASA=American Society of Anaesthesiologists, SARI=simplified airway risk index.

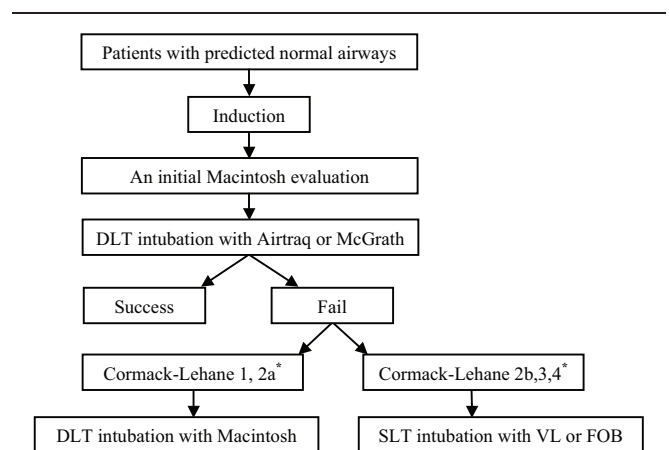


Figure 2. Flowchart and rescued methods. *The modified Cormack–Lehane Classification from an initial Macintosh evaluation. DLT=double-lumen tube, FOB=fibreoptic bronchoscopy, SLT=single-lumen tube.

Table 1**Patient and airway characteristics. Values are number (proportion) or mean (SD).**

	Airtraq (n = 43)	McGrath (n = 44)	P
Sex, men/women	32/11	35/9	0.570
Age, y	48 (14)	52 (11)	0.148
Height, cm	167 (8)	168 (7)	0.587
Weight, kg	63 (12)	66 (10)	0.259
Body mass index, kg m ⁻²	22 (3)	23 (3)	0.281
ASA physical status			
1	22 (51%)	24 (55%)	0.776
2	15 (35%)	16 (36%)	
3	6 (14%)	4 (9%)	
Mouth opening, cm	4.2 (0.5)	4.1 (0.4)	0.702
Thyromental distance, cm	7.2 (0.5)	7.3 (0.6)	0.193
Mallampati score			
1	29 (67%)	25 (57%)	0.590
2	12 (28%)	16 (36%)	
3	2 (5%)	3 (7%)	
Tube size (Fr)			
35	13 (30%)	8 (18%)	0.121
37	20 (47%)	17 (39%)	
39	10 (23%)	19 (43%)	

ASA = American Society of Anesthesiologists, SD = standard deviation.

SPSS 17.0 software (Chicago, IL) was used for statistical analyses. Student's *t* test (normal distribution) or Mann–Whitney *U* test (non-normal distribution) was used for comparison of quantitative data. The chi squared test or Fisher's exact test was used for comparison of qualitative data. Differences were considered statistically significant if the *P*-value was less than 0.05.

3. Results

There was 1 failed DLT intubation using the McGrath videolaryngoscope and 2 with the Airtraq videolaryngoscope (2.2% vs 4.4%, *P* = 1.000). Therefore, 44 patients in the McGrath group and 43 patients in the Airtraq group completed the study. (Fig. 1)

The patient details and basis of airway characteristics were comparable between the 2 groups (shown in Table 1). Initial Macintosh examination showed 7 patients (16%) in the Airtraq group and 6 patients (14%) in the McGrath group were Cormack–Lehane grade 2b or 3. Compared with the Macintosh

laryngoscope, the glottic view significantly improved using both the McGrath and Airtraq videolaryngoscopes. Although the intubation time was longer in the McGrath group compared with the Airtraq group (39.9 [9.1]s vs 28.6 [13.6]s, *P* < 0.05), glottic exposure time, success rate on the first attempt, incidence of DLT malposition, intubation difficulty score, and the incidence of intubation-related complications were comparable between the McGrath and the Airtraq group (Table 2).

The 3 patients with DLT intubation failure did not present difficult airway characteristics. By 3 attempts, the DLT was hampered at the level of the glottis cord and could not further pass through the glottis under videolaryngoscope, although a sequential rotation manoeuvre was applied. Since the initial Macintosh examination revealed a Cormack–Lehane grade of 1 or 2a, we attempted to intubate the DLT with the Macintosh laryngoscope and succeeded.

4. Discussion

Videolaryngoscopes are often classified according to the presence of a guiding channel. In this study, we compared 1 videolaryngoscope with a guiding channel (Airtraq DL) with another videolaryngoscope without a guiding channel (McGrath Series 5) for DLT intubation by experienced anesthesiologists. Our results showed both the McGrath and Airtraq videolaryngoscopes can improve glottic view, compared with the traditional Macintosh laryngoscope. Airtraq videolaryngoscope provided shorter intubation time than McGrath, but the intubation difficulty score and intubation-related malposition of DLT and complication was not decreased. Inconsistent with previous studies about the advantages of Airtraq videolaryngoscope in standard tracheal intubation^[25,26,28], this study indicate that the Airtraq videolaryngoscope is comparable to the McGrath for DLT intubation, except for intubation time.

Previous study^[34] reported that the Airtraq had a shorter intubation time for DLT intubation than the Glidescope. In support, our study found that the Airtraq DL is superior to the McGrath Series 5 with regard to intubation time, although there were no differences in glottic exposure time between the 2 groups. This can be explained by the utilization of a steering technique and sequential rotation with the McGrath that increased the intubation time. The Airtraq videolaryngoscope has a guiding channel through which the DLT can be preloaded and easily inserted into the vocal cords. Although the McGrath resulted in a

Table 2**Intubation parameters. Values are number (proportion) or mean (SD).**

	Airtraq (n = 43)	McGrath (n = 44)	P
Initial glottic view with Macintosh, 1/2a/2b/3	23/13/4/3	21/17/3/3	0.860
Glottic view with study videolaryngoscope, 1/2a/2b/3	40/3/0/0	39/5/0/0	0.713
Exposure time, s	8.3 (3.1)	8.4 (2.2)	0.824
Mean difference, 95% CI	−0.1 (−1.3 to +1.0)		
Intubation time, s	28.6 (13.6)	39.9 (9.1)	0.000
Mean difference, 95% CI	−11.4 (−16.3 to −6.4)		
Success rate at first attempt	40 (93%)	42 (95%)	0.676
Malposition of double-lumen tube	6 (14%)	10 (23%)	0.291
Difficulty score	7.9 (11.4)	5.7 (10.7)	0.422
Easy advancement, 0/1/2	31/6/6	30/10/4	0.495
Hoarseness	7 (16%)	8 (18%)	0.814
Sore throat	8 (19%)	5 (11%)	0.344

SD = standard deviation.

greater intubation time than the Airtraq, it is also acceptable in clinical situations.

DLT intubation involved 3 steps: laryngeal exposure, delivering the tube into the glottis, and advancing the tube into the appropriate main bronchus. In contrast with the C-MAC, the Airtraq and McGrath Series 5 have an angled blade. Even with a good glottic view, resistance was frequently encountered when advancing the tube into the appropriate main bronchus. The tube should be lubricated well and a sequential rotation manoeuvre was often suggested. In this study, we experienced difficulties with DLT advancement in 12 patients in the Airtraq group and 14 patients in the McGrath group. Our results showed the success rate on the first attempt and subjective difficulty score were comparable between the 2 devices. These indicated that both Airtraq and McGrath videolaryngoscopes improved the glottis view, but they did not decrease the difficulty of advancing DLT into the appropriate main bronchus.

A videolaryngoscope provides a good glottic view; however, this does not necessarily imply an easy intubation of single-lumen tube. Failed tracheal intubation occurs in approximately 5% to 20% of patients with the McGrath Series 5,^[15] Airtraq^[35] and C-MAC.^[36] Similarly, in our study, DLT intubation failure occurred in 2 patients in the Airtraq group and in 1 patient in the McGrath group. In these 3 patients, there was a good glottic view with the initial Macintosh laryngoscope and videolaryngoscope. However, the tube did not advance further once the tip of the DLT entered the glottis after 3 attempts, even when a sequential rotation manoeuvre was performed. Eventually, these patients were rescued with the Macintosh laryngoscope and successfully intubated. Therefore, our results demonstrate that a videolaryngoscope cannot guarantee a 100% success rate for DLT intubation in patients with good glottic views.

Misplacement of the left-sided DLT into the right mainstem bronchus occurred in 4.2% patients under blind advancement.^[37] The risk factors included women, short stature, narrow tracheal and bronchial diameter, and small DLT. A previous study showed that the McGrath Series 5 increased the incidence of DLT malposition.^[12] In the present study, we found there was no significant difference in the incidence of DLT malposition between the 2 groups (6 patients in the Airtraq group and 10 patients in the McGrath group). Actually, DLT malposition was not an issue when using a videolaryngoscope in DLT intubation because fibre-optic bronchoscopy was routinely used for checking the position of the DLT.^[32]

Some research indicates that videolaryngoscopes cannot reduce intubation-related complications.^[38,39] Wasem et al^[15] reported that the Airtraq videolaryngoscope increased the incidence of hoarseness during DLT intubation. In our study, several maneuvers were utilized to reduce intubation-related complications. First, the DLT was lubricated well. Second, the DLT was advanced under direct vision. Third, the operators were highly experienced; sequential rotation was used and brute forces were avoided when encountering resistance. Fourth, we used a relatively small DLT tube. Our results show that the incidence of postoperative hoarseness and sore throat was comparable between the Airtraq and McGrath groups.

Our study has several limitations. First, the operators were highly experienced in the use of videolaryngoscopes. However, this conclusion cannot be extrapolated for novices. Based on clinical practice, the Airtraq DL videolaryngoscope may be easier for a beginner than the McGrath Series 5. Second, we applied a

simplified airway risk index score ≥ 4 to exclude patients with severe difficult airways in this study, so the differences of videolaryngoscopes for DLT intubation in difficult airways could not be fully determined. However, we found there were about 15% patients with a Cormack–Lehane grade 2b or 3 by Macintosh examination in both groups. Their glottic views were improved and they were successfully intubated under videolaryngoscopes.

In conclusion, this study indicates that the Airtraq DL videolaryngoscope is superior to the McGrath Series 5 in intubation time, but it does not decrease the difficulty for DLT intubation.

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