Original Article

McGrath MAC video laryngoscope versus direct laryngoscopy for the placement of double-lumen tubes: A randomised control trial

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ABSTRACT

Background and Aims: Role of video laryngoscopes (VLs) in the management of difficult airway with single-lumen tubes (SLTs) is established. VLs provide improved glottis view but are associated with longer time to intubate (TTI). We aimed to compare the TTI for double-lumen tube (DLT) insertion using the McGrath® MAC VL versus direct Macintosh laryngoscope (DL). **Methods:** Eleven senior anaesthesiologists experienced in SLT insertion, but not DLT insertion with VL participated. Seventy-four adults belonging to American Society of Anesthesiologists physical status I–II posted for elective surgery needing lung isolation were randomised to both intubator and laryngoscope (VL/DL). Primary endpoint was TTI; secondary endpoints included glottic view assessed by the Cormack and Lehane (CL) grade, need for external laryngeal manipulation, ease of intubation [scored using Numeric Rating Scale (1 – easiest, 10 – most difficult)] and associated complications. TTI was compared using Student's *t*-test. **Results:** No difference was found in TTI with DL and VL [(56.6 ± 14) s vs (64.4 ± 24) s, $P = 0.104$] as well as ease of use of laryngoscope [median score of 2 (1–3) in both]. Use of VL resulted in more patients with CL I glottic view – 86.0% versus 58.0% ($P = 0.007$). Fewer patients required external laryngeal manipulations (19% vs 47%, $P = 0.013$), and complications were fewer in the VL group (5% vs 24%, $P = 0.023$). **Conclusion:** TTI for DLT insertion was similar with VL and DL. However, VL was associated with better glottis visualisation, reduced need of external laryngeal manipulation and fewer complications.

Key words: Double-lumen tubes, McGrath® MAC video laryngoscope, reshaped endotracheal tubes

INTRODUCTION

Video laryngoscopes (VLs) have been shown to enhance intubation success rates of tracheal intubation, in patients with difficult airways,[1] and they have a definite role in difficult airway management.[2] However, passage of the endotracheal tube (ETT) may be difficult despite a good glottis view and a pre-shaped stylet may be required.[3] Fogging and secretions may obscure the view.[3] Also, different techniques of laryngoscopy and intubation with different makes and models of VLs need a separate learning curve for each variety.[3]

Double-lumen tubes (DLTs) are considered the technique of choice for lung separation in thoracic surgery.[4] Due to its configuration, placement of DLT may be difficult even in patients with a normal airway.[5] Often in the absence of standard guidelines for lung isolation in difficult airways, single-lumen tubes (SLTs) with bronchial blockers have been a feasible alternative.[4] There are few randomised

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clinical trials comparing VLs with direct Macintosh laryngoscope (DL) for DLT insertion.[6-8] While some studies favor the use of VL, difficulty in fitting the device and DLT into patients' mouth and difficulty in manipulating the DLT in the mouth or beyond the teeth have been reported while using the angulated blade GlideScope™.[7] A recent meta-analysis is inconclusive as to whether VLs have any advantages in DLT intubation specifically for the inexperienced operator.[5]

The McGrath® MAC VL is a portable device with the blade retaining the same shape and curvature of the Macintosh blade. The advantage of this design is that it affords an appropriate curve and provides the necessary space for control of the trajectory of the DLT and easy placement while offering a clear image of the glottic opening on the screen.[9] This study was designed with the aim of evaluating the role of McGrath® MAC VL in placement of DLTs by anaesthesiologists experienced in inserting of SLTs by VLs, but not experienced in the use of VLs for DLT insertion.

METHODS

The study was undertaken after obtaining approval from the Institutional Review Board, and after the trial was registered with Clinical Trial Registry of India (CTRI/2014/07/004763). Eleven anaesthesiologists experienced with the use of McGrath® MAC VL with SLT but inexperienced with the use of VL in for DLT placement (nonexperts) were included after consent for participation. DL was used for DLT insertion in our hospital. Since insertion of a DLT with a VL was not a routine practice, all the intubators were allowed five successful placements of the DLT into the trachea using McGrath® MAC VL on the Laerdal Airway Management Trainer (Laerdal Medical, Stavanger, Norway) prior to the start of the trial.

Seventy-four adult patients with American Society of Anesthesiologist physical grading I–II, posted for elective surgery needing lung isolation, were enrolled into the study after obtaining written informed consent. Exclusion criteria included history of or anticipated difficult airway on clinical examination [including Mallampati Class (MPC) III and IV, thyromental distance less than 6.5 cm, sternomental distance less than 12.5 cm, interincisor gap less than 3 cm, body mass index (BMI) >30 kg/m^2] and presence of indications for rapid sequence induction of anaesthesia. Patients were randomised at two levels: first, the intubator, following which the scope (VL/DL) to be used was decided by opening sealed envelopes. The randomisation order and envelopes, with laryngoscope details, were prepared using a computer-generated chart ensuring that each intubator performed nearly equal numbers of intubations with both the laryngoscopes.

All patients underwent preoperative airway assessment, and the MPC score, interincisor gap, sternomental distance and thyromental distance were documented. After attaching appropriate monitors and checklist, the patients' lungs were preoxygenated with 100% oxygen at a fresh gas flow of 6 L/min for 3 min through a closely applied facemask. Intravenous line was secured for all patients and Ringer's lactate fluid was started. General anaesthesia was then administered with intravenous fentanyl 2 μg/kg followed by intravenous (IV) propofol 2–3 mg/kg. After loss of consciousness, IV rocuronium 1 mg/kg or vecuronium 0.1 mg/kg was administered and manual bag/mask ventilation was continued for 3 min. The appropriate DLT (size and side) was inserted as clinically indicated based on patient's height and gender;[10] single-use Portex™ DLTs were used in the study (Portex® Blue Line®). The tube was lubricated well. The anaesthesiologist inserted the respective laryngoscope as recommended. McGrath® MAC VL was introduced along the midline of the tongue, and the DL was inserted from the right angle of the mouth and brought to the centre along with the tongue. Once the best glottic view was seen, the DLT was inserted into the patient's mouth from the right side. When the distal tip of the tube was seen to enter the trachea between the vocal cords, the stylet was removed and the tube was rotated 90°, either clockwise or anticlockwise depending on the side of the tube. The DLT was then advanced and the blade removed from the patient's mouth. Immediately after insertion of the DLT, an assistant inflated both cuffs with air and mechanical ventilation was started.

Time taken for visualisation of cord (TTV) was defined as time from advancement of laryngoscope from dental arches to visualisation of the glottis. The total time to intubate (TTI) was defined as the time from advancement of laryngoscope from dental arches to first deflection of capnograph. A total of two attempts were allowed for each intubator; each attempt was limited to 120 s, or fall of saturation to 90%, whichever was earlier. In between each attempt, patient was mask ventilated with 100% oxygen. The TTI was taken as the sum of durations of each intubation attempt. A failed intubation was defined when the intubator could not

intubate the patient's trachea after two attempts. In that case, the airway was managed as per All India Difficult Airway Association airway guidelines.[2] Also, in cases of failure to intubate in two attempts, the event was recorded as a failure, and the TTI was not considered in the analysis for primary endpoint.

Once tracheal intubation was accomplished successfully, the intubators scored the glottic view as per Cormack and Lehane (CL) grade and also scored the ease of use of the laryngoscope for intubation on Numeric Rating Scale, *ranging from 1 for extremely easy to 10 for extremely difficult*. Subsequently, correct positioning of the DLT was determined clinically by auscultation of both lungs before and after selective clamping of the tracheal and bronchial lumens, and with fibreoptic bronchoscope (FOB) with the patient in the supine position.

The primary outcome measured was the TTI for DLT insertion. Secondary outcomes were TTV, success rate of intubation, ease of intubation, number of attempts at intubation, glottic view, need for external laryngeal manipulation to aid glottis visualisation and complications at intubation. In cases of failure to intubate, the data were not analysed for TTI/TTV and other intubation-related variables such as number of attempts, glottic view at intubation and manipulation needed for DLT. However, all complications at intubation and intubator's feedback were recorded and analysed.

The complications included mechanical damage to the tube, trauma (injury to the lip or oral mucosa, presence of blood on laryngoscope blade) and presence of bronchospasm (wheeze on auscultation). Since the anaesthesiologist was permitted to give additional doses of opioid and fentanyl in response to intubation, haemodynamic parameters were not compared.

Manipulation of DLT under FOB guidance was noted in all patients. Following surgery, the patients were evaluated once in the postanaesthesia care unit for symptoms of sore throat and hoarseness on a scale of 0 (none) to 10 (very severe) by an independent observer at around 24 h after surgery. The scores were entered as categories (1–3: mild, 4–6: moderate, 7–10: severe) and analysed.

Parametric data such as TTI, time to visualise the cords, age, weight, height, BMI and vital parameters (heart rate, blood pressure, oxygen saturation) were analysed using Student's *t*-test. Ease of intubation scores was analysed using Mann–Whitney *U*-test. Categorical data were analysed using Chi-square test or Fisher's exact test. All the analyses were done using IBM® SPSS V. 21 and results with a P value <0.05 were considered as statistically significant.

Based on available literature,[11] TTI with DL and a DLT in normal airways was taken as 62.5 (±29.7) s. As time for tube advancement may be more with a VL,[12,13] a difference of 20 s in TTI was considered acceptable.[14] Using noninferiority test for the difference of two means, group sample sizes of 37 each, achieved an 81% power to detect noninferiority using a one-sided, two-sample *t*-test, with level of significance (alpha) of the test as 0.025.

RESULTS

Ninety patients were screened for eligibility and 74 patients were randomised in the trial [Figure 1]. There was one case of failed intubation with DL where resistance to passage of 35 Fr DLT was encountered in the subglottic area, hence airway was managed with a 7 no. SLT and lung isolation was achieved by a bronchial blocker. The data for that case were not analysed for TTI or TTV, but were analysed for all secondary endpoints. With McGrath® MAC VL, all intubations were successful. Therefore, 36 patients in DL group and 37 patients in VL group completed the study. The two groups were comparable with respect to baseline characteristics [Table 1].

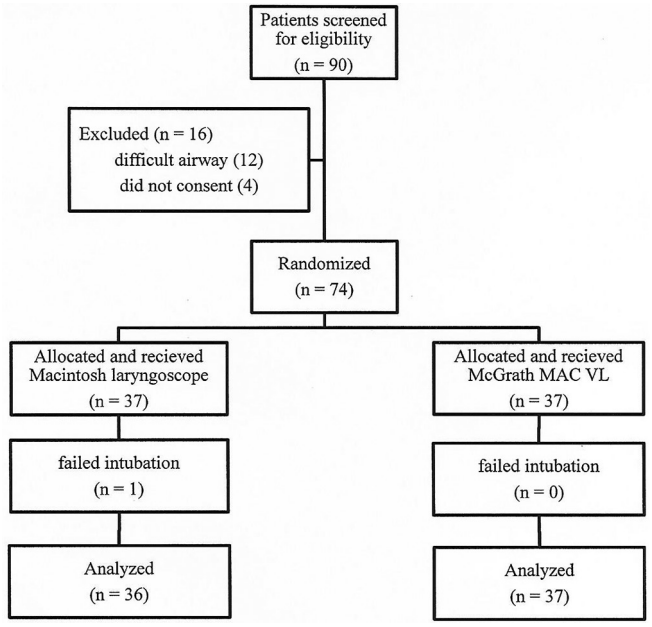

Figure 1: Consort flow chart for randomisation

Though TTI with McGrath® MAC VL (64.4 ± 24 s) was similar to that with DL (56.6 ± 14, $P = 0.104$). It was within the 20 s acceptable difference in TTI between the two laryngoscopes. There was no significant difference between the two laryngoscopes with respect to the TTV [Figure 2]. The glottic view was significantly better and the need for external laryngeal pressure was significantly lower with the McGrath® MAC VL [Table 2]. The number of attempts taken and the ease of intubation were found to be similar for both the laryngoscopes. Complication was fewer with McGrath® MAC VL. There was no case of DLT cuff damage in the study. There were two cases of malplacement of the DLT to the opposite side, one with each laryngoscope, and the need for manipulation of DLT under FOB guidance was similar in both groups, $P = 0.39$. There was no statistical difference in postoperative sore throat and hoarseness between the two groups [Table 2].

Table 1: Patient demographics

Characteristic	McGrath® MAC (*n*=37)	Macintosh (*n*=37)	*P*
Age (years)	46.9 (±17)	49.8 (±16)	0.45
Sex (male/female)	25/12	23/14	0.81
Weight ; (kg)	57.9 (±10)	59.9 (±13)	0.46
Height (cm	162.7 (±9)	160.9 (±10)	0.43
BMI (kg/m^2)	21.8 (±3)	23.0 (±3)	0.07
MPC score (I/II)	29/8	23/14	0.20
DLT side (left/right)	34/3	36/1	0.62
DLT size (35/37/39 Fr)	10/13/14	11/17/9	0.43

BMI–Body mass index; MPC–Mallampati Class; DLT–Double-lumen tube

Table 2: Intubating characteristics and performance of the McGrath® MAC video laryngoscope compared with the Macintosh laryngoscope

Characteristic	McGrath® MAC	Macintosh	*P*
Glottic view (CL I/II*)	32/5	21/15	0.007
Need for external laryngeal manipulation*	7 (19%)	17 (47%)	0.013
No. of attempts (1/2*)	36/1	35/1	1.0
Manipulation required after FOB (Y/N*)	31/6	27/9	0.39
Ease of intubation (1 – extremely easy, 10 – extremely diffi cult)	2 (IQR 1-3)	2 (IQR 1-3)	0.21
Complications during intubation	2	9	0.023
Bleeding from lips/gums/oral mucosa	2	6	0.15
Blood on laryngoscope blade	Nil	2	0.49
Bronchospasm	Nil	2	0.49
Sore throat (none/mild/moderate/severe)	0/37/0/0	2/34/1/0	0.21
Hoarseness (none/mild/moderate/severe)	0/35/1/1	2/32/3/0	0.28

CL–Cormack and Lehane; FOB–Fibreoptic bronchoscope; IQR–Interquartile range *As we had one case of failure in the Macintosh group, the total number of cases included in the Macintosh group for the first four variables is 36 patients only. For all other variables, the total number of cases remains 37 in each group

DISCUSSION

In this study, comparing the use of McGrath® MAC VL versus DL for placement of DLTs in patients with normal airway, we found no difference in TTI, TTV, number of attempts and ease of insertion of laryngoscope. The need for external laryngeal manipulation and complications at intubation were fewer in the VL group with more patients with CL I view when compared to DL.

Previous studies have also shown favorable result with the use of VL for DLT placement. Hsu *et al.* compared DLT insertion using GlideScope™ versus standard laryngoscope in 60 patients with normal airways.[11] All intubations were done by two experienced anaesthesiologists, expert in the device and technique. The use of GlideScope™ resulted in shorter intubation time. Also in the VL group, external laryngeal manipulation was not required which was attributed to better glottic view. However, a year later, Russell *et al.* in their clinical trial comparing the GlideScope™ type VL and the Macintosh laryngoscope for DLT insertion found that the GlideScope™ type VL was more difficult to use compared with the Macintosh laryngoscope.[7] In their study, 30 anaesthesiologists who were experienced with the use of GlideScope™ for SLT insertion but not with DLT performed the intubations. They thus concluded that the use of VL with DLT is not recommended routinely in patients who are predicted to have a normal airway. An important question that arises from two such similarly designed trials is that results from a small group of expert anaesthesiologists may not be applicable to a larger group with varied experience with the same technique.

In a recent trial done by Yao *et al.* comparing McGrath® series 5 VL and Macintosh laryngoscope

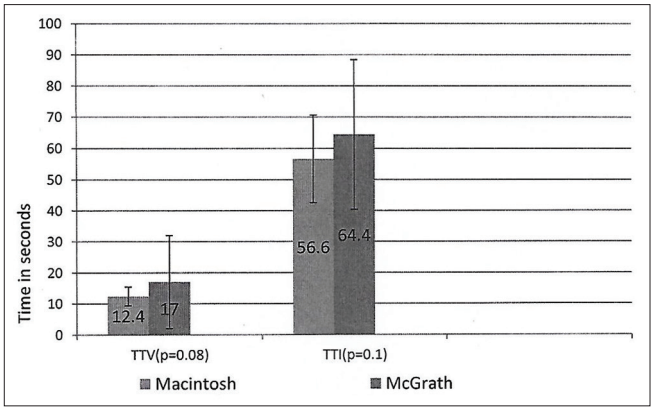

Figure 2: Comparison of intubation time in both laryngoscopes

for DLT insertion in anticipated low airway risk index score using a randomised study design found that McGrath® series 5 VL for DLT insertion was better than Macintosh laryngoscope as the TTI the trachea was significantly lower with the VL.[8] However, in this study, all the intubations were done by three experienced anaesthesiologists. In our study, there were 11 anaesthesiologists who were well versed with the use of VLs for SLT insertion, but not for DLT insertion. Hence, the results of our study reflect the experience of a larger group of anaesthesiologists. None of the participating anaesthesiologists performed more than five DLT insertions using VL during the course of the study, and hence did not cross the threshold of the learning curve previously described for VL for single-lumen tube insertion.[15] Our results are thus most applicable to anaesthesiologists who are well versed with the use of VLs for SLT insertion, but not for DLT insertion.

We found that there was no significant difference between the two laryngoscopes for TTI and TTV. The glottic view was significantly better and the need of external laryngeal manipulation significantly lower with the McGrath® MAC VL as seen in the other studies.[16,17] There was no significant difference between either of the laryngoscopes for the number of attempts taken to successfully intubate the trachea with a DLT with only one case in each group requiring two attempts at intubation.

Complications related to the intubation procedure were higher in the DL group with more airway injuries. This could probably be related to the force which is inevitably applied to make the glottic view better. Similar injuries have also been reported in other studies.[18] There were no airway injuries requiring active intervention and there was no incidence of dental trauma.

The study has its own limitations.This study was restricted to patients with normal airways. We are also studying the role of McGrath® MAC in placing DLT in patients with limited glottic view (CTRI/2014/11/005226).

CONCLUSION

This study shows that TTI and ease of use of McGrath® MAC VL for DLT placement are at par with Macintosh laryngoscope. However, McGrath® MAC VL was associated with better glottis visualisation, reduced need of external laryngeal manipulation and fewer complications.

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Conflicts of interest

There are no conflicts of interest.

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