Original Article

Does C-MAC® video laryngoscope improve the nasotracheal intubating conditions compared to Macintosh direct laryngoscope in paediatric patients posted for tonsillectomy surgeries?

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ABSTRACT

Background and Aims: C-MAC® video laryngoscope (VL) with Macintosh blade has been found to improve Cormack-Lehane (C-L) laryngoscopic view as well as intubating conditions for orotracheal intubation. However, studies done on the performance of C-MAC® VL for nasotracheal intubation (NTI) are very few in number. Hence, we compared laryngoscopy and intubating conditions between Macintosh direct laryngoscope and C-MAC® VL for NTI. **Methods:** Sixty American Society of Anesthesiologists Physical Status I, II patients, aged 8–18 years, posted for tonsillectomy surgeries under general anaesthesia with NTI were randomised, into two groups. Patients in group 1 were intubated using Macintosh direct laryngoscope and group 2 with C-MAC® VL. C-L grading, time required for intubation, need for additional manoeuvres and haemodynamic changes during and after intubation were compared between the groups. **Results:** C-L grade 1 views were obtained in 26 and 29 patients in group 1 and group 2, respectively (86.7% vs. 96.7%). Remaining patients were having C-L grade 2 (13.3% vs. 3.3%). Duration of intubation was less than a minute in group 2 (93.3%). Need for additional manoeuvres (M1–M5) were more in group 1 (97% vs. 77%). M1 (external manipulation) was needed more in group 2 compared to group 1 (53.3% vs. 30%). Magill's forceps alone (M4) and M4 with additional external manipulation (M5) were needed more in group 1 compared to group 2 (60% vs. 16%). **Conclusion:** The overall performance of C-MAC® VL was better when compared to conventional direct Macintosh laryngoscope during NTI in terms of glottis visualisation, intubation time and need for additional manoeuvres.

Key words: C-MAC® video laryngoscope, Macintosh direct laryngoscope, nasotracheal intubation

INTRODUCTION

Video laryngoscopes (VL) which work on the principles of indirect laryngoscopy have become popular in clinical practice.[1,2] They provide a significantly better view of the larynx, which may be useful in difficult tracheal intubation scenarios.[3-6] The key novel feature of these 'indirect' laryngoscopes is that they facilitate visualisation of the vocal cords without the need to align the oropharyngeal and tracheal axes.[7]

Kaplan and Berci introduced C-MAC® VL (Karl Storz, Tuttligen, Germany) in 2003. It has been found to improve Cormack-Lehane (C-L) grading by 2 to 1 grade and possibly aid easier intubation. It provides both a direct laryngoscopic view and a small digital camera view that is displayed on the video screen, in contrast

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to many previous VLs.[8] The displayed anatomy is magnified. Recognition of the anatomical structures and anomalies is easier, and manipulation of airway devices is facilitated.

Nasotracheal intubation (NTI) is often required for head and neck surgeries like tonsillectomies. Direct laryngoscopy with the Macintosh blade, with the use of Magill's forceps to direct endotracheal tube (ETT) into glottic opening, is time-consuming and may lead to trauma to surrounding structures and damage ETT cuff.

Hence, this study was conducted to assess the intubating conditions, using the conventional Macintosh laryngoscope and the Storz C-MAC® VL during NTI in paediatric patients posted for tonsillectomy surgeries.

METHODS

This prospective randomised study was conducted after obtaining approval from the Institutional Review board (IEC no. VIMS/STD.II/PG/EC/12/2012-13). Patients of either sex, aged between 8 and 18 years, belonging to American Society of Anesthesiologists physical Status I, II and Mallampati Grade I, II were included and study was conducted between January 2013 and June 2014. Parents who refused to give consent, patients with significant systemic disease and patients having contraindications for NTI were excluded from the study. A thorough pre-anaesthetic evaluation was conducted including nasal patency using spatula test. The procedure was explained to the patients and written informed consent from parent/guardian was obtained.

Patients were randomly allocated by computer generated randomisation into two groups of thirty each. Patients in group 1 underwent conventional laryngoscopy using Macintosh direct laryngoscope and group 2 underwent videolaryngoscopy using C-MAC® VL for nasal intubation. The sample size was estimated based on a pilot study carried out in 10 patients where it was found that mean intubation times for the Macintosh group, and the C-MAC® group were 55 s and 45 s respectively with standard deviation (SD) of 5 s. Based on these figures and using alpha error = 0.05 and 0.85 power of the study, we got the required sample size of 25 each. Hence, we recruited 30 into each group by increasing the sample size by 5. The investigator who performed the intubation in this study had previously performed about 100 NTI using C-MAC® VL. After connecting the routine pre-induction monitors, baseline values of systolic blood pressure (SBP), diastolic blood pressure (DBP), mean blood pressure (MBP), heart rate (HR) and oxygen saturation (SpO_2) were recorded. All patients were pre-medicated with injection glycopyrrolate 10 μg/kg, injection fentanyl 2 μg/kg and injection midazolam 10 μg/kg intravenous (IV). Oxymetazoline nasal drops were instilled into each nostril. All patients were pre-oxygenated for 3 min. Anaesthesia was induced with injection propofol 2 mg/kg IV and neuromuscular blockade achieved with injection vecuronium 0.1 mg/kg. Patients were ventilated with oxygen, nitrous oxide (33:67 ratio) and end-tidal concentration of isoflurane 0.8–1.2 as observed on the gas monitor for initial 4 min, followed by ventilation with 100% oxygen for 1 min before intubation. Isoflurane was maintained at this concentration during the rest of study. Preservative free injection lignocaine 1.5 mg/kg IV was administered 90 s before intubation. Five minutes after giving injection vecuronium, ensuring adequate muscle relaxation, lubricated appropriate sized nasotracheal ETT was inserted through the most patent nostril until its tip lay in the oropharynx. Laryngoscopy was then performed using either Macintosh laryngoscope (Blade size 2 or 3) or Storz C-MAC® VL (Macintosh blade size 2 or 3) as per the group and a view of laryngeal opening was obtained. Initially, attempt was made to pass the ETT through the vocal cords without the aid of manoeuvres (M0). If difficulty was encountered, additional external manipulations (M1) such as head flexion, rotation of tube and backwards, upwards, rightwards pressure (BURP) were used.

In case of failure to intubate using above manoeuvres, cuff of the ETT was inflated with approximately 10 ml of air and the ETT brought into view (M2) (as per study done by Baddoo HK *et al*.).[9] Once the tip of ETT was in the glottic opening, cuff was deflated; the ETT was then advanced into the trachea and then cuff was reinflated. If this failed, cuff inflation was assisted with external manipulation (M3). If this technique failed then, cuff was deflated, and Magill's forceps alone (M4) or in combination with BURP (M5) was used to position and guide the tube. The manuoevres were followed in the sequence described in Table 1. If there was failure to intubate with all the above-said manoeuvres, oral intubation was performed. Correct placement of ETT was confirmed by auscultation over the chest for bilateral equal air entry and using capnograph.

During this procedure, HR, SBP, DBP, MBP and SpO_2 were recorded every minute for the initial 5 min after induction of anaesthesia, and thereafter at 5 min intervals for next 15 min. If a decrease in saturation to 90% or lower was observed during nasal intubation then oral intubation was performed. After endotracheal intubation, subsequent anaesthetic management was continued as per the need.

Parameters noted during the study were: C-L grading, time required for intubation, intubation without any manoeuvre (M0), need for the manoeuvres, type of manoeuvre (M1–M5) used, haemodynamic changes, lowest recorded SpO_2 during or immediately after intubation attempt and occurrence of any other complications.

Duration of NTI was defined as the time taken from the insertion of the ETT through the nostril, till passage of tube through vocal cords by visual confirmation by the intubating anaesthesiologist. Duration of NTI more than 120 s, fall in SpO_2 below 90% during the procedure were considered as failed NTI. Data collected were coded, tabulated, and then analysed using Statistical Package for the Social Sciences (SPSS® 20, IBM, Armonk, NY, United States of America) computer package. Mann–Whitney U-test was used for analysing age, sex, C-L grading and for comparing the duration of intubation between both groups. Independent-*t*-test was used to compare haemodynamics with respect to HR, SBP, DBP, MBP in both groups. A difference with the adjusted $P < 0.05$ was considered statistically significant.

RESULTS

Demographic profiles were evenly distributed between both groups. In group 1, 86.7% of patients and in group 2, 96.6% had C-L grading of 1 and remaining patients had C-L grading of 2, which was not statistically significant ($P = 0.35$). Duration of intubation was significantly shorter in group 2 compared to group 1 patients. In group 1, 36.6% of patients and in group 2, 93.3% of patients were intubated within 2 min which was statistically significant $P = 0.001$ [Figure 1].

In group 1, 3.3% of patients and in group 2, 23.3% of patients were intubated successfully without the application of manoeuvres (M0). Application of optimisation manoeuvres (M1–M5) was needed more in group 1 compared to group 2 (C-MAC®) (97% vs. 77%) and was statistically significant $P = 0.001$ [Figure 2]. In group 1, 30% of patients and in group 2, 53.3% patients needed additional external manipulation (M1). Only 6.7% patients of either the groups were intubated using cuff inflation technique alone (M2). Combined use of cuff inflation with external laryngeal manipulation (M3) was not useful in both groups. Use of Magill's forceps alone (M4) and M4 with external manipulation (M5) were required more in group 1 compared to group 2 (M4-37% vs. 13%) (M5-23% vs. 3%).

After induction, haemodynamic parameters (HR, SBP, DBP and MBP) decreased in both groups when compared to pre-induction values. At the 1st min after intubation, the values increased in both groups, but there were no intergroup differences and both the parameters returned to baseline after 5 min after NTI [Table 2]. No complications (drop in SpO_2, dental trauma, etc) were observed during the procedure in both groups.

Table 1: Sequence of additional manoeuvres used in the study

M0	Intubation without manoeuvres
M1	Use of external manipulations such as tube rotation, head flexion, BURP manoeuvre
M2	Use of ETT cuff inflation alone
M3	Use of ETT cuff inflation with external manipulation (M1 + M2)
M4	Use of Magill's forceps alone
M5	Use of Magill's forceps with external manipulation (M1 + M4)

ETT – Endotracheal tube; BURP – Backwards upwards rightwards pressure

DISCUSSION

C-MAC® VL allows adequate glottic view, without the need for aligning oropharyngeal and laryngeal axes. We found no significant difference in airway assessment using C-L grading in both groups. This can be explained by the fact that both groups of patients were of similar demography and patients with airway difficulties were excluded from the study.

Duration of NTI was significantly decreased in group 2 in comparison with group 1 patients. C-MAC® VL has slim blade profile and edges are inclined, thus reducing the potential contact area of the blade with the upper incisors.[10] Thus, it provides extra space for manipulating the tube during intubation. It magnifies airway view and allows supporting staff to optimise their assistance such as applying adequate external manipulation as necessary. The anterior angulation of the blade and placement of the video camera allow the operator to see structures that would be difficult or even impossible to see under direct vision.[11] Real time recording of video sequences is also possible in this device.

The majority of patients in group 1 required different manoeuvres as per study protocol. External laryngeal manipulation (M1) was used in more number of patients in group 2 than group 1. This can be explained by the fact that there was requirement of more hand-eye coordination while viewing the glottis on VL monitor and intubating the patient even with experienced anaesthesiologists. A previous study showed that cuff inflation technique (M2) helps to lift ETT from the posterior pharyngeal wall, thus helping to bring it into view and also directs it towards the glottis.[9] This technique of cuff inflation has been described for blind nasal intubation in spontaneously breathing patients.[12] However, the technique was found to be less useful for successful intubation in this study. Combined use of cuff inflation with external laryngeal manipulation (M3) was not useful in this study.

Direct laryngoscopy requires elevation of the laryngoscope blade, moves the larynx upwards and elevates the glottis. Thus, lengthens the distance between the glottic orifice and the posterior pharyngeal wall and also makes the nasally introduced tube slide upwards and then downwards in sequence. Thus, it often requires the use of Magill's forceps to align this ETT tip with the glottic inlet and its use may sometimes lead to trauma to surrounding structures, damage to ETT cuff. Magill's forceps alone (M4) and M4 with additional external manipulation (M5) were needed more in group 1 as compared to group 2.

Similar studies conducted by Kaki *et al*.[13] and Hirabayashi and Seo[14] concluded that VLs needed lesser use of Magill's forceps for NTI. C-MAC® VL helped the supporting staff to assist intubation, using less invasive manoeuvres and thus may prevent trauma to oral cavity, damage to ETT cuff.

It was also observed that there was a positive correlation between the number of manoeuvres used and the intubation time required in both groups. Patients in group 1 required longer time (2 min) to intubate than group 2 (1.5 min) when the use of additional manoeuvres of the highest level (M5) was required.

For good glottic view, videolaryngoscopy requires the application of lesser force as compared to direct laryngoscopy to the base of the tongue.[15] Therefore, videolaryngoscopy is less likely to stimulate pressor-response and induce local tissue injury. In contrast, both groups in our study had similar intubation responses which returned to baseline

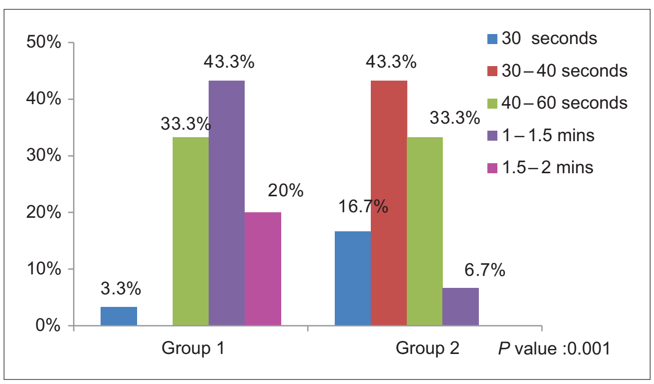

Figure 1: Comparison of intubation time between the groups

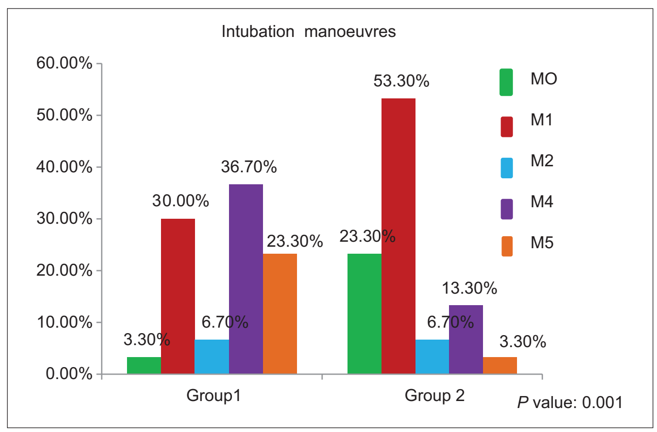

Figure 2: Comparision of intubating conditions between group1 and group 2. (M3 = Combined use of cuff inflation with external laryngeal manipulation was not useful in both the groups)

Table 2 : Comparison of haemodynamics between two groups

Duration/Haemodynamic parameters	Mean±SD							
	HR (beats/min)		SBP (mm Hg)		DBP (mm Hg)		MBP (mm Hg)	
	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2
Basal	123.13±16	123.6±20	116.43±14	121±12	73.3±14	73.73±14	86.5±13	87.57±13
At Intubation	109.9±11	102.9±12	89.33±12	89.23±6	47.77±13	41.93±5	59.6±12	57.27±4
1 min	129.5±13	124.3±18	128.4313	134.7±15	79.07±16	84.77±12	94.97±12	102.13±11
2 min	131.43±15	123.1±17	131.23±19	125.13±9	80.3±15	71.77±10	96.27±16	90.07±8
5 min	119.63±13	113.83±15	112.33±11	117.67±11	61.77±7	62.97±9	79.73±9	81.67±8
10 min	113.67±12	108.6±15	105.2±8	112.5±11	57.2±6	59±9	72.37±6	76.37±7

P>0.05. HR – Heart rate; SBP – Systolic blood pressure; DBP – Diastolic blood pressure; MBP – Mean blood pressure; SD – Standard deviation after 5 min. The difference between both groups preoperatively, before induction and after intubation was statistically insignificant.

This study was carried out in paediatric patients with normal airway. Hence, findings of this study cannot be extrapolated to adult patients. Further studies are required to know its utility in paediatric patients with difficult airways as well as in adult patients posted for nasal tracheal intubation.

Limitation of this study was that anaesthesiologist could not be blinded to the type of device being used for NTI. The study was limited to only sixty patients considering intubation time as the primary outcome parameter. Larger number of enrolled cases are required to assess other parameters of the nasotracheal intubating conditions.

CONCLUSION

Storz C-MAC® VL provided better glottis visualisation as compared to conventional Macintosh direct laryngoscope. Lesser time was required for intubation and there was lesser need for Magill's forceps during NTI. However, requirement of additional external manipulations (M1) was more with the C-MAC® VL group. Thus, C-MAC® VL improves the nasotracheal intubating conditions and can be superior alternative to Macintosh laryngoscope in clinical practice in paediatric patients.

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Conflicts of interest

There are no conflicts of interest.

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