

Comparison of performance characteristics of C-MAC video, McCoy, and Macintosh laryngoscopes in elective cervical spine surgery

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Abstract

Background and Aims: To compare the performance characteristics of C-MAC video, McCoy, and Macintosh laryngoscopes in elective cervical spine surgery. The primary objective was to assess the ease of intubation with the three study devices. The secondary objectives were the time to intubation and hemodynamic responses during intubation.

Material and Methods : The prospective observational comparative study was conducted in a tertiary care hospital. Adult ASA 1 and 11 patients who underwent elective cervical spine surgery were included in the study. Patients with unstable spine and trauma were excluded. The analysis of variance, Bonferroni test, Chi square test and multiple comparison tests were used to compare the performance characteristics of laryngoscopes.

Results: The C-MAC video laryngoscope improved glottis view by improving the modified Cormack–Lehane (CL) score and the percentage of glottis opening (POGO) score compared to McCoy and Macintosh laryngoscopes. The ease of intubation was better with the C-MAC video laryngoscope compared to the McCoy and Macintosh laryngoscopes. The time to intubation was comparable between the three laryngoscopes. The C-MAC video and McCoy laryngoscopes had 100% successful first attempt intubations while it was 90% for the Macintosh laryngoscope. Hemodynamic variables observed during intubation were comparable between the three groups.

Conclusion: The use of C-MAC video laryngoscope resulted in better visualization of the glottis and easier tracheal intubation as compared to the Macintosh and McCoy laryngoscopes in cervical spine surgery. Both C-MAC video and McCoy laryngoscopes had 100% successful first attempt intubation.

Keywords: Cervical spine surgery, C-MAC Video McCoy and Macintosh laryngoscopes, intubation time, performance characteristics

Introduction

Endotracheal intubation in patients with limited neck extension due to cervical spine pathology is challenging with high incidence of complications.^[1] Failed tracheal intubations can lead to serious and life-threatening complications.^[2] To avoid

such complications, it is necessary to understand the advantages of different tracheal intubation devices available. Though there are many newly developed tracheal intubation devices, the conventional direct laryngoscopes are still widely utilized.^[3] Since the last decade, individual and comparison studies on the performance of different laryngoscopes were carried out for improved and efficient tracheal intubation.^[4,5] Majority of

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these studies were focused on the Macintosh and C-MAC video laryngoscopes.^[6-8]

Studies on the comparison of the performance of the three commonly used laryngoscopes (C-MAC Video, McCoy and Macintosh) in cervical spine surgery are sparse to date. Against this backdrop, the present study attempts to compare the performance characteristics, time to intubation and the hemodynamic changes associated with airway management between the three laryngoscopes during elective cervical spine surgery.

Material and Methods

The study was conducted in a tertiary care center after obtaining the approval from the Institutional Ethical Committee and patients' consent. All the ASA PS 1 and 11 patients belonging to the age group of 18–70 years posted for elective cervical spine surgery other than trauma and had given consent were included in this study. Patients with ASA PS 111 and IV, obesity, pregnancy, psychiatric illness, and history of difficult intubation were excluded from the study.

A prospective observational comparative study design was adopted. The consented patients were assigned to three groups (VL- C-MAC Video, MC- McCoy, and MA- Macintosh) based on the laryngoscope used for intubation. To avoid observational bias, the anesthesiologist doing preoperative airway assessment and the person noting down the data were blinded to group allocation. Once the patients were inside the operating room, the preinduction monitors were connected and cervical spine was stabilized with a Philadelphia collar. Though the collar makes intubation difficult compared to manual in line stabilization, it was used for uniformity. It is also a practice in our institute to use cervical collar when turning patients for cervical spine surgery to prone position. All patients were given a standardized induction sequence of 2 mg midazolam, 0.2 mg glycopyrrolate, fentanyl 2 mcg/kg, etomidate 0.3 mg/kg, and vecuronium 0.1 mg/kg. All intubations were performed by single experienced anesthesiologist who had been regularly using all the three laryngoscopes (C-MAC Video, McCoy, and Macintosh). If the first intubation attempt failed, a next attempt was made after mask ventilation for 1 minute. In each group, tracheal intubation was considered a failure if it could not be accomplished in three attempts. The study was conducted during the period of September 2017 to August 2019.

The time to intubation is defined as the time from the passage of the blade between the teeth to the endotracheal placement of the tube and the appearance of an end-tidal CO₂ waveform.^[9] Percentage Of Glottic Opening (POGO) Score and Cormack–Lehane (CL) grading were used to

assess the glottis view. POGO score (0 to 100%, 100 = full view of glottis from anterior commissure to the inter-arytenoid notch, 0 = even inter-arytenoid notch is not seen) was used in addition to CL for glottis exposure as it is not included in the Intubation Difficulty Scale (IDS) Score [Figure 1].

To assess the ease of intubation, Adnet's IDS score was used.^[10] The score is derived from seven variables. N1 represents the number of additional intubation attempts; the score is 0 for a first attempt. N2 represents the number of additional operators; the score is 0 if there is a successful intubation by the first operator. N3 is the number of alternative intubation techniques like using of a bougie; the score is 0 if there is no alternative intubation technique. N4 represents the laryngoscopic view, as defined by Cormack and Lehane: grade 1 = score 0, grade 2 = score 1, grade 3 = score 2, and grade 4 = score 3. N5 is the lifting force applied during laryngoscopy: score 0 if there is no lifting force and score 1 if lifting force is used. N6 is the external laryngeal pressure used to improve glottic exposure: score 0 if there is no external pressure and score 1 if external laryngeal pressure is used. N7 represents vocal cord mobility: score 0 for abducted cords and score 1 for adducted cords. The IDS score is the sum of N1 through N7.^[7] The total IDS score ranges from zero to infinity. Intubation difficulty was classified into four groups, IDS = 0, IDS = 1 to 5, IDS ≥6, and IDS = ∞ denoting easy, mild difficulty, moderate to major difficulty and impossible intubation, respectively.

Hemodynamic parameters (BP and HR) were recorded before induction and following 1, 3, 5, 7 and 10 min after endotracheal intubation. Any episode of hypotension (MAP <20% of baseline), bradycardia (HR <40), hypertension (MAP >20% of baseline), cardiac arrhythmia, or hypoxemia (SpO₂ <90%) was noted. Complications occurring during intubation like mucosal and dental injury and intraoral bleeding were also noted.

The statistical analysis was done using the IBM SPSS version 20.0 software (IBM SPSS, USA) and Minitab 15.0 (Minitab Inc., USA) statistical packages for windows. One way ANOVA test was used to compare the mean time to

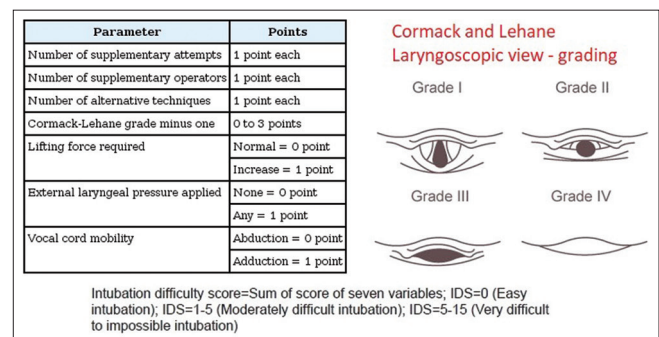


Figure 1: Intubation Difficulty Scale (IDS) score

intubation and the mean score of hemodynamic changes for the three devices under study and multiple comparisons were done by the Bonferroni method. Chi square test was employed to assess the statistical significance of the difference in the number of intubation attempts between the groups. The tests were all 2-sided with an evaluation criterion of 95% confidence interval for which $P < 0.05$ was considered to be statistically significant.

Results

Ninety patients who underwent cervical spine surgery in a tertiary care center were included in the study. A sample size of 90 was arrived based on a previous study comparing three different laryngoscopes (Bharti *et al.*^[11] Comparison of McCoy, Macintosh, and Truview laryngoscopes) and by applying 95% confidence and 80% power.

There was no significant difference in the age of patients in the three groups. The number of male patients who underwent cervical spine surgery was higher than female patients (VL- M/F - 28/2, MC- 21/9, and MA- 22/8). The Body Mass Index (BMI) was comparable in all the groups and was between 25–27 kg/m². The mean time to intubation was 32.83, 33.43, and 31.13 seconds in the VL, MC and MA groups, respectively. There was no significant difference in the time to intubation between the three laryngoscope groups [Table 1].

Glottis view was assessed using POGO score and CL grading. The POGO score showed a higher percentage of glottic opening in the VL group (86 ± 19%) compared to the MA and MC groups [(58 ± 18) and (59 ± 22), respectively] [Table 1]. The CL grading was similar for both MC and MA groups but significantly differed from the VL group [Table 1]. In the MA group 7, 18 and 5 patients had CL- 1, 2 and 3 grades while in the MC group 9, 18 and 3 patients had CL 1, 2 and 3 grades, respectively. But in the video laryngoscope group 17 patients had CL 1 and 13 patients had CL 2 grading [Figure 2]. The IDS score was zero in 50% of VL group, 30% of MC group and

20% of MA group respectively. An IDS score of 1–3 was found in 50% of group VL, 96.7% of group MC and 80% of MA groups. None of the patients had an IDS score >6 indicating moderate to major difficulty in intubation [Figure 3] The IDS score showed statistically significant difference between the C-MAC and the Macintosh groups (P value 0.015) and between the C-MAC and McCoy (P value 0.001) groups, while there was no significant difference between the McCoy and Macintosh laryngoscopes. Tracheal intubation was successful at the first attempt in all 30 patients (100%) of the VL and MC groups, while it was only in 27 patients (90%) of the MA group [Table 1 and Figure 4].

The variation in heart rate [Figure 5] and mean arterial pressure [Figure 6] in response to intubation was transient and did not show any statistical difference between the groups. Mucosal injury occurred in one patient with C-MAC laryngoscope which needed suturing. One tooth of a patient came out during intubation with a McCoy laryngoscope.

Discussion

The risk of spinal cord injury during intubation is largely due to the mechanical compression and ischemia produced by

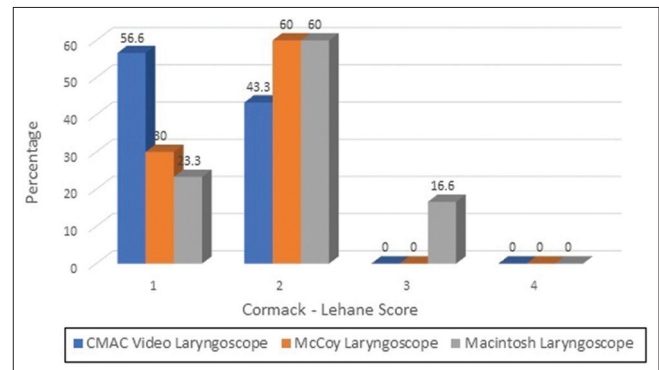


Figure 2: Comparison of Cormack-Lehane grade percentage between the three laryngoscope groups

Table 1. Characteristics, time, and success rate of intubation with Video, McCoy and Macintosh laryngoscopes.

	C-MAC Video group (n=30)	McCoy group (n=30)	Macintosh group (n=30)	P
Age (y)	57.67±15.24	55.2±16.48	53.53±11.64	0.546
Gender (male/female) (n)	28/2	21/9	22/8	
BMI (kg/m ²)	25.12 (2.03)	27.04 (5.23)	25.69 (2.42)	0.102
ASA (1/2/3) (n)	5/25/0	8/22/0	8/22/0	0.581
Mallampati airway 1/2/3/4	3/23/1/3	3/23/4/0	4/21/5/0	0.759
Time to intubation (s)	32.83±2717	33.43±2657	31.13±28.87	0.769
Intubation attempts, 1/>2, n (%)	30/0 (100/0)	30/0 (100/0)	27/3 (90/10)	0.045
Cormack-Lehane score 1/2/3/4	17/13/0/0	9/18/3/0	7/18/5/0	0.000
Percentage of glottic opening (%)	86±19	58±18	59±22	0.000

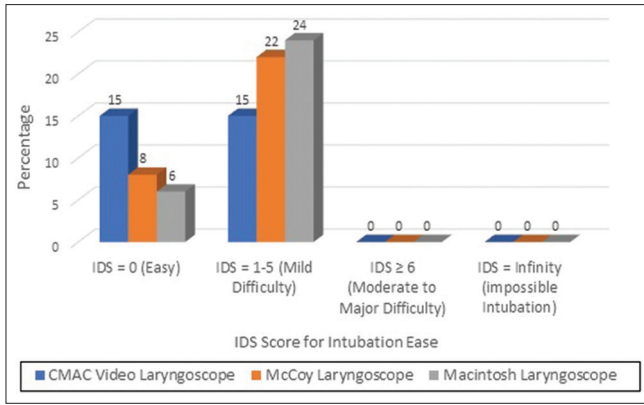


Figure 3: Comparison of Intubation Difficulty Scale score between three laryngoscope groups

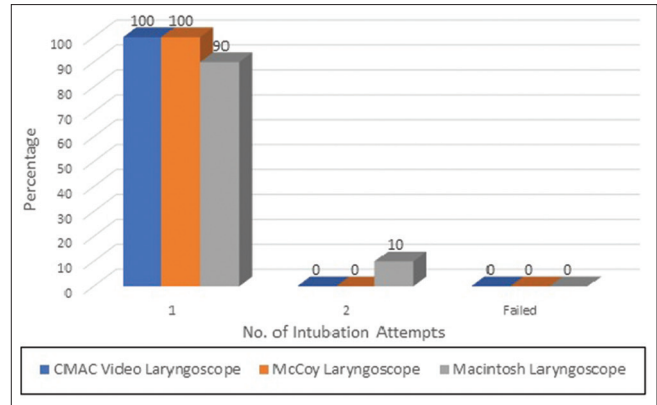


Figure 4: Comparison of number of intubation attempts between three laryngoscope groups

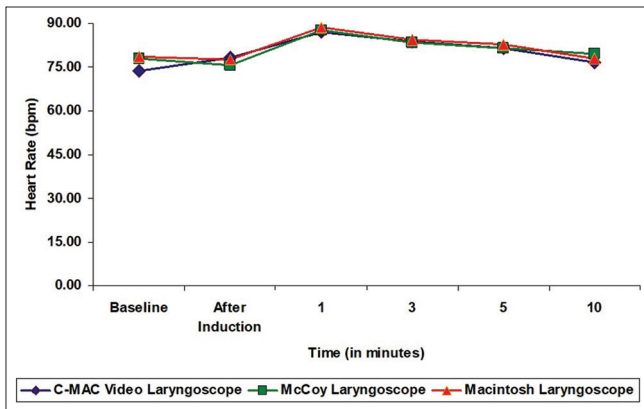


Figure 5: Comparison of variation in heart rate between three laryngoscope groups

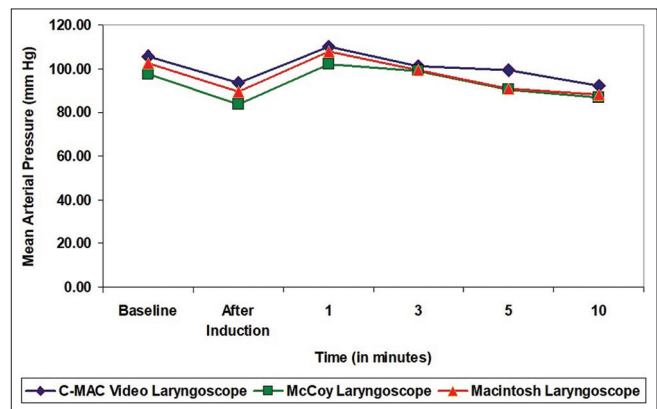


Figure 6: Comparison of variation in mean arterial p pressure (MAP) between three laryngoscope groups

movement of the cervical spine. The presence of a rigid collar reduces the chances of neurological trauma during airway management and positioning of the patient but can worsen the laryngoscopic view. The use of cervical collar prevents head extension and neck flexion necessary for the optimal alignment of the three airway axes leading to poor exposure of vocal cords. Cervical collar reduces the mobility of cervical spine by 30–50%.

Most of our patients belonged to the age group of 50–60 years and among them 78% were males and only 22% females. In our study population, a higher incidence of cervical spine diseases was found in males than in females (M:F ratio 3.3:1) which shows a higher incidence of cervical diseases in males.^[12]

The Cormack–Lehane grading system is used to grade the laryngoscopic view during direct laryngoscopy. There is no definitive grading system for video laryngoscopes. So we have also included the POGO score to study the glottis exposure. In our study, the C-MAC video laryngoscope improved the POGO score and CL grading and gave the best glottis exposure. Glottis exposure with video laryngoscope was found

to be better than McCoy laryngoscope in a previous study by Jain *et al.*^[13] With both Video and McCoy laryngoscopes all patients (100%) could be intubated in the first attempt. The hinged tip of the McCoy blade aids in improving the CL laryngoscopic view. A similar study by Bilgin *et al.*^[14] showed 100% intubation success rates with C-TRAC (100%) and McCoy (100%). The time to intubation was comparable between the three groups (VL- 32.83, MC -33.43 and MA- 31.13 seconds). Bharti *et al.*^[11] also did not find a significant difference in the time to intubation between Truview, McCoy and Macintosh laryngoscopes (36.2 ± 7.5, 33.8 ± 8.2, and 29.6 ± 11.4 seconds, respectively). Most of the studies show that video laryngoscopes take more time to intubate than direct laryngoscopes. The difference in our study may be because the anaesthesiologist who did the intubation in our study had been regularly using the C-MAC video laryngoscope. The ease of intubation was assessed by using Adnet’s IDS score. In our study, the video laryngoscope improved the IDS score compared to the other two laryngoscopes. 50% of patients in the VL group had easy intubation and another 50% had mild difficulty. No patients in the study group have moderate to difficult

intubation. Hosali *et al.*^[15] who compared Airtraq with direct laryngoscope had similar results. Since CL grading is included in the IDS score it may not be very useful for indirect laryngoscopy. The effect of laryngoscopy on HR and BP were transient. The HR and BP increased after intubation in all the groups. There was no significant difference in the hemodynamic parameters among the three groups at any time which was comparable to the results of Bilgin *et al.*^[12] and Xue *et al.*^[16] There were no major complications during intubation with the different laryngoscopes.

The results of our study demonstrated that C-MAC video laryngoscope improves the glottic exposure as shown by the CL and POGO scores. The C-MAC Video laryngoscope also improved the ease of endotracheal intubation in comparison to the McCoy and Macintosh laryngoscopes in patients having neck stabilization with the rigid cervical collar. There was no difference in ease of intubation between the McCoy and Macintosh laryngoscopes. Time to intubation did not show any statistical difference between the three laryngoscope groups.

The main limitation of this prospective observational study is the potential for observer bias as it is impossible to blind the anesthesiologist to the device being used. To avoid observer bias, the anaesthesiologist doing preoperative airway assessment and the person noting down the data were blinded to the group allocation. Another limitation of the study is using the IDS score to compare the ease of intubation between the direct and indirect laryngoscopes. The IDS score performs less well with indirect laryngoscopes than with direct laryngoscope.^[17] So the results of comparison should be used with caution.

Conclusions

The present study compared the C-MAC video, McCoy and Macintosh laryngoscopes for their performance efficiencies in elective cervical spine surgery. The C-MAC video laryngoscope gave the best glottic view and ease of intubation compared with the other two laryngoscopes. The intubation time and hemodynamic variables were comparable between the three laryngoscopes. The study shows that the C-MAC video laryngoscope is superior to McCoy and Macintosh laryngoscopes in performance efficiency in elective cervical spine surgery when the neck is stabilized with a cervical collar.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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