

Comparison of Hemodynamic Response during Tracheal Intubation between C-MAC Videolaryngoscope and Conventional Direct Laryngoscope in Normotensive Patients: A Randomized Controlled Study

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Abstract

Background: Hemodynamic change during induction of anesthesia and intubation is very crucial particularly in high risk patients. Variety of videolaryngoscopes have been currently launched to provide a good glottic visualization which allows less pressure on the laryngeal area. Aim of this study is to compare the hemodynamic effect of C-MAC videolaryngoscope with conventional direct laryngoscope.

Methods: This prospective, double-blinded, parallel group, randomized controlled trial enrolled 114 normotensive patients who underwent elective surgery that required orotracheal intubation. They were randomly allocated into two groups which were 57 patients equally for direct laryngoscope (DL) and C-MAC videolaryngoscope (C-MAC). Mean arterial pressure (MAP) and heart rate (HR) were measured before induction (baseline), after induction (T_0),

after intubation (T_1), and then every minute for five minutes following intubation. Other intubating parameters were recorded.

Results: No significant difference in mean difference MAP and HR were detected for both groups. Intubation time was significantly faster in direct laryngoscope group (14.6 ± 4.4 seconds) when compared with C-MAC group (18.9 ± 6.3 seconds) $p < 0.001$. The occurrence of postoperative sore throat was lower in C-MAC group (7%) with a statistically significant difference ($p = 0.021$).

Conclusions: There was no benefit of using C-MAC videolaryngoscope for intubation in terms of hemodynamic stability, but C-MAC videolaryngoscope should be considered advantageous over DL for attenuating risk of postoperative sore throat.

Keywords: C-MAC, endotracheal intubation, hemodynamics, laryngoscope

Trial registration: Thai clinical trials Registry. TRTC 20201209003, 9 December 2020.

Introduction

Hemodynamic changes during induction of anesthesia and intubation is associated with adverse outcomes, particularly in high risk patients.¹ Pressure on supraglottic area by the force required to perform laryngoscopy may be a major cause of sympathetic response along with other possible factors including the intubation time and the number of attempts for intubation as well.^{2,3}

Direct laryngoscopy is the most common equipment that used for tracheal intubation. In recent decades, videolaryngoscope has been developed and provide a better laryngoscopic view. These devices also claimed that because of lower lifting force, it would generate a less hemodynamic response during intubation period.^{4,5}

However, there are several different videolaryngoscopes in the market consist of many types of blades such as the hyperangulated blade, channeled blade and Macintosh-type blade.^{6,7} A comparison of utility among these devices is a great importance and could suggest the appropriate choice of device to be chosen in some particular circumstances.^{8,9}

Therefore, the aim of this study is to compare hemodynamic effect of C-MAC videolaryngoscope with the conventional direct laryngoscope.

Materials and Methods

The protocol of this study and informed consent were approved from institutional ethics committee protocol number 77/2562 at

Hatyai Regional Hospital, Thailand. The study was registered for Thai Clinical Trials Registry, TCTR 20201209003. This prospective, double-blinded, parallel group, randomized control trial enrolled 114 patients, 18-65 years old who were scheduled for elective surgery and required intubation for general anesthesia. American Society of Anesthesiologist (ASA) physical status I and II with normotensive patients were recruited for this study. The exclusion criteria were known underlying hypertension, on beta-blocker drug for any reasons, suspected difficult intubation, body mass index (BMI) $>32 \text{ kg/m}^2$ and pregnancy. Moreover, a failed intubation was defined as the time taken for intubation was longer than 60 seconds at each attempt and unable to intubate within three attempts.

All patients were allocated into two groups, 57 patients equally by computer generated random numbers and sealed in opaque envelopes. These groups were Group M using Macintosh blade size 3 and Group C using C-MAC[®] (Storz, Tuttlingen, Germany) videolaryngoscope Macintosh blade size = 3).

All laryngoscopy and orotracheal intubation were performed by nurses anesthetist who have more than 3 years experience in anesthesia and also have experience in using the videolaryngoscope.

Preoperative data were recorded such as age, gender, Mallampati score, ASA, BMI, baseline mean arterial blood pressure (MAP), and heart rate (HR) (before induction).

General anesthesia was induced with fentanyl $1 \mu\text{g/kg}$, and all patients were preoxygenated with 100% oxygen through a face mask for three minutes. Standard monitoring included

noninvasive blood pressure, electrocardiogram (ECG), peripheral oxygen saturation (SpO_2) were applied to all patients. An appropriate cuff size was selected for measuring patient's blood pressure and all vital signs were recorded by GE[®] monitor (B40 GE[®]Healthcare, Milwaukee, WI, USA). Propofol 1.5 mg/kg was given intravenously for induction and then followed by succinylcholine 1.5 mg/kg for facilitating intubation. One minute later, laryngoscopy was performed. The PVC tracheal tube with internal diameter of 7.5 and 8.0 mm were used for the female and male patients respectively. We standardized the technique of intubation by using an intubating stylet in both groups.

MAP and HR were recorded at intervals as follow : T_0 (after administering the completed dosage of propofol), T_1 (time that laryngoscope was removed from oral cavity), T_2 (one minute later from T_1), T_3 , T_4 and T_5 (interval of 1 minute). A second blinded observer acted as time keeper and recorded all data such as number of attempts, intubation time which was started from applying laryngoscope into the oral cavity up to the time that tracheal tube was passed through vocal cord. Glottic view (Cormack Lehane grade) was assessed by intubator. It was impossible to blind the nurse anesthetists to which laryngoscope in their hands, but we could blind the recorders and assessors properly.

Postoperative sore throat was assessed before discharging from the recovery room by a third observer blinded to the intubating devices.

Power of study suggested that a simple size of 57 patients for each group was required to achieve a power of 80% at 0.05 level of significance for detection of 20 mmHg (MAP) or 20

beats/minute difference in paired hemodynamic data. The statistical analysis was performed by Programme R version 3.6.3 (R Foundation for Statistical Computing, Vienna, Austria).

The categorical variables in the two groups were analyzed by using chi-square test or Fisher's exact test as appropriate. The unpaired t-test and linear mixed-effect Model were used to test the mean difference of hemodynamic variable.

Results

Table 1 Demographic data

Data	DL (n=57)	C-MAC (n=57)	p-value
Sex (n,%)			
Male	18 (31.6)	16 (28.1)	0.838
Female	39 (68.4)	41 (71.9)	
ASA-PS (n,%)			
I	24 (42.1)	17 (29.8)	0.242
II	33 (57.9)	40 (70.2)	
Mallampati classification (n,%)			
1	18 (31.6)	7 (12.3)	0.026*
2	38 (66.7)	47 (82.5)	
3	1 (1.8)	3 (5.3)	
Age (mean±SD)	40.5±12.2	42.3±10.6	0.392
BMI (mean±SD)	23.3±3.7	23.7±3.5	0.522
MAP baseline (mean±SD)	93.7±8.3	90.2±9.4	0.037*
HR baseline (mean±SD)	80.4±14	75.8±12.6	0.064

ASA-PS = American Society of Anesthesiologist Physical Status classification

Both groups were classified for age, sex, BMI, ASA, Mallampati, MAP baseline and HR baseline in table 1. There were significant differences in Mallampati classification and MAP baseline between the groups.

Table 2 Comparison of mean difference ($\text{MAP}_T - \text{MAP baseline}$) in hemodynamic change

Variable	DL (n=57)	C-MAC (an=57)	p-value
MAP baseline (mean $\pm$ SD)	93.7 $\pm$ 8.3	90.2 $\pm$ 9.4	0.037*
MAP (mean difference $\pm$ SD)			
• T_0	-6.6 $\pm$ 9.2	-4.6 $\pm$ 10.4	0.315
• T_1	21 $\pm$ 19.5	24.1 $\pm$ 19.5	0.392
• T_2	0.6 $\pm$ 14.4	2.9 $\pm$ 12.7	0.353
• T_3	-8.7 $\pm$ 12.5	-5.9 $\pm$ 10.7	0.208
• T_4	-15.3 $\pm$ 11.1	-13.3 $\pm$ 10.7	0.051
• T_5	-19.2 $\pm$ 10.3	-17.4 $\pm$ 10.2	0.064
HR baseline (mean $\pm$ SD)	80.4 $\pm$ 14	75.8 $\pm$ 12.6	0.064
HR at (mean difference $\pm$ SD)			
• T_0	-3.1 $\pm$ 12.7	-0.6 $\pm$ 9.9	0.24
• T_1	14.9 $\pm$ 15.8	16.4 $\pm$ 15.4	0.298
• T_2	4.8 $\pm$ 16	6.7 $\pm$ 13.3	0.501
• T_3	0.2 $\pm$ 14.9	2.2 $\pm$ 11.6	0.418
• T_4	-3.8 $\pm$ 14.3	-0.9 $\pm$ 11.9	0.242
• T_5	-6.6 $\pm$ 14.5	-3.6 $\pm$ 9.12	0.228

T_0 = time after full dosage of propofol, T_1 = time that laryngoscope was removed from oral cavity, T_2 = one minute later from T_1 , T_3 , T_4 , T_5 (interval of one minute).

Table 2 showed the comparison of hemodynamic change during intubation period for both groups. To adjust the difference of baseline of MAP among two groups, the MAP data were compared in MAP changed from baseline of each group ($\text{MAP } T_{0-5} - \text{MAP baseline}$). After intubation, no significant difference was found in the mean difference of MAP and HR for both groups in the first five minutes.

Figure 1 and 2 illustrated MAP and HR (mean $\pm$ SD) changed in various times. The hemodynamic change was extremely observed at one minute after intubation and gradually declined to baseline within five minutes afterwards for both groups.

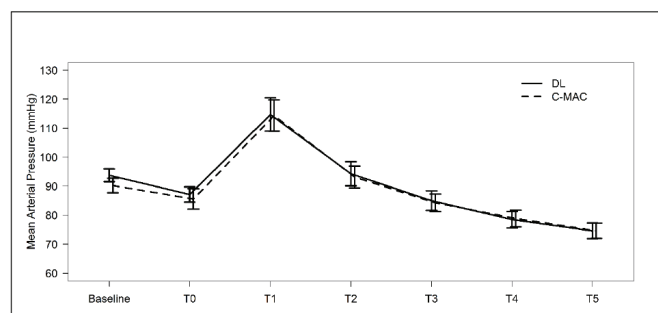
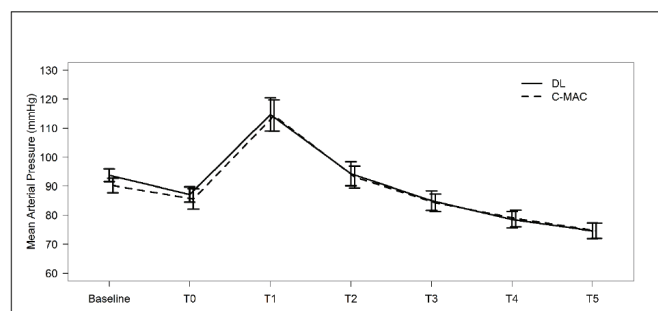
**Figure 1** Mean arterial pressure (mean + SD) for each group**Figure 2** Heart rate (mean + SD) for each group

Table 3 Intubation data

Variable	DL (n=57)	C-MAC (n=57)	p-value
Intubation time (seconds) (mean±SD)	14.6±4.4	18.9±6.3	<0.001*
Intubation attempt (n,%)			
1	57(100)	57(100)	1.0
Cormack Lehane grade (n,%)			
1	27(47.4)	38(66.7)	0.102
2	26(45.6)	18(31.6)	
3	4(7)	1(1.8)	
Postoperative sore throat (n,%)			
Yes	14(24.6)	4(7)	0.021*

Table 3 showed intubating conditions including intubating time, number of attempts, Cormack Lehane grade (CL grade) and postoperative sore throat in the recovery room. Time taken to intubate with direct laryngoscope (DL) was significantly faster than C-MAC videolaryngoscope ($p < 0.001$). But it shows no clinically significant. Both groups were 100% successful in achieving first attempt of intubation. No failure of intubation was documented.

According to the laryngoscopic view, CL grade was used for visualizing the glottic opening. The C-MAC group provided a better CL grade (grade 1) which was 66.7% when compared with DL group, but there was no statistical significance. Neither group showed CL grade 4 for glottic visualization.

Less patient had sore throat when using C-MAC videolaryngoscope for intubation compared with DL group which was statistically significantly different ($p = 0.021$).

Discussion

Laryngoscopy and tracheal intubation can lead to extremely sympathetic response especially adverse effect on cardiovascular system, which is commonly manifested as hypertension, tachycardia and arrhythmia.¹⁰

In our study, we chose C-MAC (Macintosh blade) videolaryngoscope which is very similar to a conventional laryngoscope that we normally use in daily practice. The reason for this is to exclude the unfamiliarity factor and proper handling of curved blades which required a significant time training.^{5,11}

From our present study, we found that there were no statistical significances in mean difference MAP and HR between two groups in the first five minutes of intubation. Moreover, this also showed that the time taken in C-MAC videolaryngoscope (Macintosh type blade) was significantly longer than DL group, but it clinically provided a better glottic view (CL grade 1).

However, many previous studies indicated different outcomes. For instance, Xue FS et. al¹² from China reported correlative results to our study that showed no significant difference was found in hemodynamic data of both glidescope® (Verathon, Bothell, WA, USA) and conventional group, while the glidescope® took a longer time to perform. Whereas, Mona Mohamed M et. al¹³ indicated a different finding that videolaryngoscope (D blade C-MAC® and King Vision® (Ambu, Copenhagen, Denmark)) maintained better hemodynamic stability during intubation than conventional laryngoscope. Another report by Faiza SB et. al¹⁴ which was contrary to previous study, revealed that C-MAC videolaryngoscope has a greater hemodynamic response than

conventional Macintosh and McCoy laryngoscope, but this C-MAC was a D blade type.

The other rational support that duration of laryngoscopy also plays an important role in cardiovascular responses to tracheal intubation.¹⁵ When comparing to intubation time, some studies reported that the intubation time was prolonged with various types of videolaryngoscope and some of them did not affect the hemodynamic parameter change.^{16,17} In addition, Hiteshi A et. al¹⁸ also supported that the time taken was the longest with C-MAC videolaryngoscope without attenuation of hemodynamic response to laryngoscope. Therefore, the possible explanation of these reverse results in terms of hemodynamic change could be the longer time taken in C-MAC group results in exaggerated hemodynamic response to tracheal intubation, which compensates the effect of reducing the upward lifting force for glottic exposure. Time taken in C-MAC group was significantly longer suggesting that the advantage of reducing hemodynamic change could be possibly present if intubation time declined in videolaryngoscope group.

Regarding successful intubation, although all videolaryngoscopes commonly provide a better laryngoscopic view, they would not confirm an easy and successful intubation.¹⁹ However, our study showed 100 percent of the first attempt of intubation were successful in both groups. Moreover, we also assessed the incidence of postoperative sore throat in the recovery room. There was significantly less incidence of sore throat in the C-MAC group, which is clinically concerned with statistical significance. In agreement with the study of Ali QE, et. al²⁰ that reported less airway trauma when

using videolaryngoscope for tracheal intubation. There are some limitations of our study. Firstly, there were statistical differences in Mallampati classification 1 which randomly allocated in DL group more than C-MAC group and baseline MAP which were also higher in DL group. Secondly, the intubators had a variety of experience in terms of the using videolaryngoscope, which could affect the results as a confounding factor. Finally, ideally invasive BP monitoring should be documented to measure beat to beat BP reading. However, invasive monitoring was not possible in our patients. Further comparative studies are needed for overcoming the limitations of this study.

Conclusion

In patients who have normal airway and normotension, C-MAC videolaryngoscope did not provide any definitely beneficial over conventional direct laryngoscope in terms of attenuating of hemodynamic change after tracheal intubation. Although C-MAC videolaryngoscope needed statistically significantly longer time to perform, but it was not clinically significant. Consequently, C-MAC videolaryngoscope should be considered for clinical benefit of reducing postoperative sore throat.

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Conflict of interest

There are no conflicts of interest.

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