Hemodynamic Responses to laryngoscopy and intubation: Comparison between Macintosh and McCoy laryngoscope

Pankaj Joshi, Shailendra Sigdel, Amit Sharma Bhattarai and Bishwas Pradhan

Department of Anesthesia, Tribhuvan University Teaching Hospital, Institute of Medicine, Kathmandu, Nepal

ABSTRACT

Introduction: Laryngoscopy causes exaggerated hemodynamics such as tachycardia, hypertension, arrhythmias and may have deleterious respiratory, neurological and cardiovascular effects. Very few studies have compared the effects of various types of laryngoscope blades on hemodynamic response to laryngoscopy and intubation.

Methods: A prospective randomized study was done to compare the hemodynamic response to using McCoy and Macintosh laryngoscope. Hundred patients, belonging to ASA grade I and II, between 15 - 65 years, requiring general anesthesia with intubation were included. Standard anesthesia technique was used. Both groups (n = 50) were matched demographically. Mallampati grading, laryngoscopy and intubation time, laryngeal visualization grades, and hemodynamic variables were compared.

Results: Following laryngoscopy there was significant rise in heart rate, systolic, diastolic and mean arterial pressures. The maximum change in HR compared to baseline was 20.45 ± 9.29 vs 12.36 ± 7.28 ($p < 0.001$) in Macintosh and McCoy groups. As compared to baseline maximum change in SBP (Mean) was 7.92 ± 10.53 vs 2.80 ± 6.73 ($p = 0.005$), the maximum change in DBP (Mean) was 9.28 ± 14.74 vs 5.72 ± 7.37 ($p = 0.130$), the maximum percentage change in MAP (Mean) was 8.62 ± 12.07 vs 4.36 ± 7.83 ($p = 0.039$) in Macintosh and McCoy group respectively. Compared to variables just before insertion of the laryngoscope, maximum percentage rise in mean HR was 22.74 ± 10.88 vs 16.40 ± 7.43 ($p = 0.001$), maximum percentage rise in SBP (Mean) was 28.31 ± 13.22 vs 19.41 ± 6.82 ($p < 0.001$), maximum percentage rise in DBP (Mean) was 30.00 ± 15.25 vs 24.64 ± 12.21 ($p = 0.003$), maximum percentage rise in MAP (Mean) was 28.89 ± 11.55 vs 22.31 ± 11.34 ($p = 0.05$) in Macintosh and McCoy group respectively.

Conclusions: The hemodynamic response to laryngoscopy and intubation with McCoy laryngoscope was significantly less than with Macintosh laryngoscope.

Key Words: hemodynamic response, laryngoscopy, intubation

Correspondence: Dr Amit Sharma Bhattarai, Dhumbarahi, Kathmandu-4. Email: amitsbhattarai@gmail.com

DOI: 10.3126/mjsbh.v21i1.42382

Submitted on: 2022-01-14

Accepted on: 2022-05-09

INTRODUCTION

Laryngoscopy is a medical procedure that is used to obtain a view of vocal folds and glottis. A laryngoscope is a device most commonly used to view the larynx and adjacent structures for the purpose of inserting a tube into the tracheobronchial tree.[1] The pathophysiological effects and complications of laryngoscopy and intubation are multisystemic like hypertension, tachycardia, hypoxia, hypercarbia, laryngeal spasm, bronchospasm, intracranial hypertension, cerebral hemorrhage, etc.[2-4] The precise mechanism of intubation response is elusive but it has been established that it has both sympathetic and parasympathetic elements.[4]

Though the hemodynamic response to laryngeal and endotracheal intubation is of little concern in healthy people, in patients with coronary artery disease, hypertension and raised intracranial pressure, it may be associated with grave consequences such as myocardial infarction or ischemia, arrhythmias, cardiac failure, pulmonary edema, and cerebral hemorrhage.[5] If no specific measures are taken to prevent a hemodynamic response, the heart rate can increase from 26-66% depending upon the method of induction, and SBP can increase from 36-45%.[6-9]

Numerous agents have been used to blunt this pressor response, including lidocaine,[10] Verapamil,[11] and esmolol.[12] But these drugs are associated with additional costs and side effects pertaining to each drug. There are very few studies that have compared the effects of various types of laryngoscope blades on hemodynamic response to laryngoscopy and intubation. Hence, this study was conceptualized to do the comparative effects of hemodynamic responses between two methods of Macintosh and McCoy laryngoscope intubation.

METHODS

A prospective, randomized study was conducted after taking ethical clearance from the institutional review board and Institute of Medicine. The study was conducted in the operating rooms of Tribhuvan University Teaching Hospital from May 2013 to October 2013. Patients between age group 15 to 65 years with ASA PS I and II posted for elective surgery requiring GA with endotracheal intubation and Mallampati grading I and II were included in the study. The patients that were not willing to take part in the study, patients bucking and coughing on intubation, patients requiring more than one attempt, patients requiring optimal external laryngeal manipulation, patients with restricted mobility of neck and mandible, patients with laryngeal mass or tumor in the facial or cervical region and those with BMI > 30 were excluded from the study. Pre-anesthetic checkup was done a day before the operation and written informed consent was taken. During intubation, the height of the table was adjusted such that the patient's airway was at the level of the anesthesiologist's xiphoid cartilage. Monitors were attached and the following parameters were monitored continuously: ECG, HR, SBP, DBP, MAP and SP02. Random assignment of the patients to the following groups was done using the sealed enveloped technique: Group A (n = 50): Macintosh (blade size 3 or 4) and Group B (n = 50): Mc Coy (Blade size 3 or 4). Laryngoscopy and intubation were done by residents having at least 1 year of experience in anesthesia. Standard anesthetic technique was employed in both groups. For analgesia injection fentanyl 2 mcg / kg IV was given. Induction was done with injection propofol in titrated dose. After checking for adequate bag and mask ventilation, injection vecuronium 0.1 mg / kg IV was given. After 3 minutes of giving muscle relaxant, laryngoscopy and endotracheal intubation were done. Maintenance of anesthesia was done with oxygen, isoflurane, and intermittent positive pressure ventilation. Intubation was done with a 7 mm ID cuffed tube for females and an 8 mm ID cuffed tube for males. Time was recorded in seconds and calculated from the time of insertion of the laryngoscope to the time the blade was removed from the mouth after successful intubation. Hemodynamic parameters like SBP, DBP, MAP, HR were recorded at baseline (TB), pre-induction at the operation theatre, before insertion of laryngoscope, after three minutes of giving muscle relaxant, 0, 1 and 3 minutes after intubation (T0, T1, T3). Size, type of the laryngoscope blade, size of ET tube, time taken for laryngoscopy and intubation were recorded. Data were compiled and analyzed using SPSS windows program version 17. Chi-Square test was used to compare and analyze categorical variables like sex, ASA-PS, mouth opening, Mallampati, Thyromental distance (TMD), and Cormack-Lehane (CL) grading between Macintosh and Mc Coy groups. An independent t-test was used to compare age, BMI, size of laryngoscope blade, size of ETT, time taken for laryngoscopy and intubation, and baseline hemodynamic parameters (TB) between two groups. A P-value of 0.05 or less was considered statistically significant.

Table 1. Comparison of the distribution of the sex, ASA-PS, mouth opening, TMD and CL Grading between two groups

Parameters	Macintosh	Mc Coy	P Value
SEX F	34	33	0.832
M	16	17	
ASA-PS I	37	39	0.64
ASA-PS II	13	11	
MOUTH OPENING > 3 FINGERS	49	50	1.0
MOUTH OPENING = 3 FINGERS	1	0	
MALLAMPATI 1	43	47	0.182
MALLAMPATI 2	7	3	
TMD > 6.5CM	49	50	1.0
TMD = 6.5 CM	1	0	
CL GRADING 1	36	36	1.0
CL GRADING 2	14	14	

Table 2. Baseline parameters in both groups

	Macintosh (Mean ± SD)	Mc Coy (Mean ± SD)	p-value
Age in years	41.84 ± 10.96	41.10 ± 11.03	0.737
BMI (kg / m2)	23.39 ± 2.09	24.28 ± 2.49	0.055
Size of the laryngoscope blade	3.00	3.00	
Size of ET tube (ID in mm)	7.32 ± 0.47	7.35 ± 0.48	0.7520
Time taken for laryngoscopy and intubation (Seconds)	11.92 ± 1.48	12.18 ± 1.38	0.366

RESULTS

There was no significant difference between the two groups in terms of sex, ASA-PS, mouth opening, TMD and CL Grading as shown in table 1.

Table 3. Hemodynamic parameters at baseline and just before laryngoscopy

	Macintosh (Mean ± SD)	McCoy (Mean ± SD)	p-value
TB HR (Beats / min)	79.20 ± 11.47	79.02 ± 10.58	0.935
TB SBP (Mm of Hg)	123.84 ± 10.35	126.36 ± 8.08	0.178
TB MAP (mm of Hg)	92.98 ± 9.33	94.84 ± 7.10	0.265
TB DBP (mm of Hg)	78.08 ± 8.24	79.66 ± 6.72	0.296
TE HR (beats/ min)	77.92 ± 12.48	76.30 ± 10.45	0.483
TE SBP (mm of Hg)	104.32 ± 10.98	108.78 ± 7.84	0.021
TE MAP (mm of Hg)	78.18 ± 8.18	81.14 ± 7.70	0.065
TE DBP (mm of Hg)	64.12 ± 7.95	67.80 ± 6.84	0.015

Table 4. Comparison of mean HR, mean SBP, mean MAP, mean DBP between Macintosh and McCoy groups.

HR (beats/min)	Macintosh	McCoy	p-value
TB	79.2	79.0	0.935
TE	77.9	76.3	0.483
T0	94.9	88.4	0.002
T1	91.1	85.1	0.006
T3	86.3	81.7	0.030
SBP (mm of Hg)			
TB	123.8	126.4	0.178
TE	104.3	108.7	0.021
T0	133.3	129.6	0.127
T1	125.8	123.4	0.310
T3	119.0	118.5	0.834
MAP (mm of Hg)			
TB	93.0	94.8	0.265
TE	78.2	81.1	0.065
T0	100.4	98.8	0.392
T1	94.8	94.5	0.874
T3	88.9	88.5	0.816
DBP (mm of Hg)			
TB	78.1	79.7	0.296
TE	64.1	67.8	0.015
T0	84.7	84.1	0.718
T1	79.2	79.3	0.953
T3	74.4	74.8	0.815

Table 5. Average percentage change in mean HR, SBP (Mean), MAP (Mean), DBP (Mean) from baseline value at T0, T1, T3..

		T0	T1	T3
Macintosh	Mean HR ± SD	20.45 ± 9.29	15.54 ± 7.98	9.57 ± 9.86
McCoy	Mean HR ± SD	12.36 ± 7.28	8.06 ± 6.14	3.71 ± 7.49
p-value		< 0.001	< 0.001	0.001
Macintosh	SBP (Mean) ± SD	7.92 ± 10.53	1.88 ± 10.74	-3.87 ± 11.01
McCoy	SBP (Mean) ± SD	2.80 ± 6.73	-2.05 ± 7.47	-5.99 ± 7.47
p-value		0.005	0.036	0.222
Macintosh	MAP (Mean) ± SD	8.62 ± 12.07	2.49 ± 11.68	-4.01 ± 11.65
McCoy	MAP (Mean) ± SD	4.36 ± 7.83	-0.08 ± 8.57	-6.46 ± 9.01
p-value		0.039	0.212	0.242
Macintosh	DBP (Mean) ± SD	9.28 ± 14.74	1.94 ± 12.46	-4.35 ± 11.79
McCoy	DBP (Mean) ± SD	5.72 ± 7.37	-0.21 ± 7.89	-5.79 ± 9.41
p-value		0.130	0.306	0.501

There was no significant difference in baseline hemodynamic parameters between the two groups except for SBP and DBP which were significantly high in the McCoy group just before insertion of laryngoscope (TE) as shown in table 3.

As shown in table 4, the mean heart rate was significantly less in the McCoy group as compared to the Macintosh group at 0, 1, and 3 minutes after intubation but there was no significant difference in mean SBP, mean MAP, and mean DBP between the two groups at 0, 1 and 3 minutes after intubation. The mean SBP and mean DBP were significantly less in the McCoy group at TE.

As shown in Table 5, following laryngoscopy there was a significant rise in all the variables in both the groups. Compared to baseline heart rate, the percentage rise in mean heart rate was significantly less in the McCoy group at T0, T1 and T3.

Table 6. Average percentage change in mean HR, SBP (Mean), MAP (Mean), DBP (Mean) compared to values after insertion of laryngoscope at T0, T1, T3.

		T0	T1	T3
Macintosh	Mean HR ± SD	22.74 ± 10.88	17.81 ± 10.19	11.61 ± 10.52
McCoy	Mean HR ± SD	16.40 ± 7.43	11.94 ± 6.27	7.52 ± 9.24
p-value		0.001	0.001	0.042
Macintosh	SBP (Mean) ± SD	28.31 ± 13.22	20.82 ± 9.51	14.16 ± 9.24
McCoy	SBP (Mean) ± SD	19.41 ± 6.82	13.54±3.59	9.03 ± 5.19
p-value		< 0.001	< 0.001	0.001
Macintosh	MAP (Mean) ± SD	28.89 ± 11.55	21.46 ± 9.43	13.67 ± 9.03
McCoy	MAP (Mean) ± SD	22.31 ± 11.34	16.96 ± 9.89	9.48 ± 9.62
p-value		0.05	0.022	0.027
Macintosh	DBP (Mean) ± SD	33.00 ± 15.25	23.96 ± 11.29	16.24 ± 10.51
McCoy	DBP (Mean) ± SD	24.64 ± 12.21	17.41 ± 9.07	10.80 ± 10.05
p-value		0.003	0.002	0.01

In the Macintosh group, the rise in SBP was seen up to 1 minute following intubation and at 3 minutes there was a decrease in SBP as compared to baseline SBP. In the McCoy group, the rise in SBP as compared to the baseline variable was seen only immediately after intubation, rather there was a decline in SBP at 1 and 3 minutes. On intergroup comparison, the percentage rise in SBP was significantly less in the McCoy group immediately after intubation and at 1 minute. The percentage change in MAP was not significantly different between the two groups except at T0 where it was significantly less in the McCoy group. Though the rise in DBP was less in the McCoy group it was not statistically significant.

As shown in table 6 on intergroup comparison percentage rise in mean HR, SBP (Mean), MAP (Mean), DBP (Mean) were all significantly less in the McCoy group at 0, 1, and 3 minutes. Rhythm disturbances

(Premature atrial or ventricular complexes) or ST-segment changes (Elevation or depression) or hypoxia were not seen in any of the groups during the study period.

DISCUSSION

This study showed that the hemodynamic responses to laryngoscopy and intubation are less with McCoy laryngoscope than Macintosh laryngoscope. There is significantly less rise in HR, SBP, DBP, MAP with McCoy laryngoscope. Though various pharmacological methods have been used to blunt the cardiovascular responses, there is limited literature available regarding the influence of the type of laryngoscope blade on hemodynamic response to laryngoscopy and intubation. The amount of force exerted during laryngoscopy and intubation is the key determinant for the mechanical stimulation of stretch receptors present in the respiratory tract. McCoy laryngoscope which was developed as an aid to difficult laryngoscopy requires less force for performing laryngoscopy and, as a result, may alter the associated hemodynamic response.[13]

Analgesic like fentanyl and a large induction dose of propofol can increase the depth of anesthesia which can indirectly influence this hemodynamic response to laryngoscopy and intubation.[14,15] In our study fixed dose of fentanyl (2 mcg / kg) was used and propofol was titrated to achieve loss of verbal response in both groups to avoid this bias. The response to laryngoscopy is also dependent on the duration of laryngoscopy, peaking at 45 seconds.[16,17] In this study, the mean duration of laryngoscopy and intubation was 11.92 ± 1.48 seconds in Macintosh and 12.18 ± 1.38 seconds in McCoy ($p = 0.36$) which was comparable. This finding is similar to findings in another study in which the time taken to intubation was 12.90 ± 3.41 seconds in Macintosh and 12.12 ± 4.00 seconds in McCoy ($p > 0.05$).[18] But in the study done by Haidry et al, the time taken for laryngoscopy and intubation was higher in the McCoy group (22.8 ± 4.1 seconds) than in Macintosh (16.6 ± 4 seconds).[19]

In our study maximum rise in HR from baseline value was 20.5% in the Macintosh group at T0 and 12.4% in the McCoy group at T0 ($p < 0.001$) which is similar to previous studies.[19-21] Such variation in HR was not seen in the study by Roman et al.[22] Similarly, the rise in SBP and DBP is also similar to other studies done in the past[18-20,23,24] but in contrast to Roman et al.[22]

The maximum rise in MAP from baseline value was 8.62% and 4.36% in Macintosh and McCoy group respectively at T0 ($p=0.039$) while it was 28.89% and 22.31% ($p=0.05$) when compared to the values just before laryngoscopy in Macintosh and McCoy group respectively in our study. The maximum rise was seen immediately after intubation. These findings are in concordance with the studies in the past.[18,19,21,23] Such findings similarities would be explaining the differences in hemodynamic responses to the two types of blades and the discrepancies with previous results should be explained by the different study set ups.

Our study is not without any limitations. It is a single-center study with a limited number of the study population. We didn't measure the degree of muscle relaxation at the time of tracheal intubation which may have affected the hemodynamic responses.

CONCLUSIONS

Our study showed that hemodynamic responses to laryngoscopy and intubation are significantly higher with Macintosh laryngoscope compared to McCoy laryngoscope i.e. there is significantly less rise in HR, SBP, DBP and MAP with McCoy laryngoscope. As McCoy laryngoscope causes less rise in hemodynamic parameters as compared to Macintosh laryngoscope it can be utilized as an additional tool along with pharmacological interventions for obtunding this reflex response. However, further multi-center studies involving a larger population of various disease categories may be helpful to justify the result of the study.

ACKNOWLEDGEMENT

Researcher and team would like to acknowledge all the medical and nursing students of Tribhuvan University Teaching Hospital who actively participated in this study. I am very thankful to all the authors of the references used in the article.

To cite this article: Joshi P, Sigdel S, Bhattarai AS, Pradhan B. Hemodynamic Responses to laryngoscopy and intubation: Comparison between Macintosh and McCoy laryngoscope. MJSBH. 2022;21(1):74-80.

Conflict of Interest: None declared

REFERENCES

1. Dorsch JA, Dorsch SE. Understanding Anesthesia Equipment. Fifth ed. Philadelphia: LWW; 2008. Chapter 18. Laryngoscopes; 521-60. DOI :10.1007/bf03021501

2. Fox E, Sklar G, Hill C, Villanueva R, King B. Complications Related to the Pressor Response to Endotracheal Intubation. Anesthesiology. 1977;47(6):524-525. DOI: 10.1097/00000542-197712000-00013

3. King B, Harris L, Greifenstein F, Elder J, Dripps R. Reflex circulatory responses to direct laryngoscopy and tracheal intubation performed during general anesthesia. Anesthesiology. 1951;12(5):556-566. DOI: 10.1097/00000542-195109000-00002

4. Kovac A. Controlling the hemodynamic response to laryngoscopy and endotracheal intubation. J Clin Anesth. 1996;8(1):63-79. DOI: 10.1016/0952-8180(95)00147-6

5. Hassan HG, el-Sharkawy TY, Renck H, Mansour G, Fouda A. Hemodynamic and catecholamine responses to laryngoscopy with vs. without endotracheal intubation. Acta Anaesthesiol Scand. 1991 Jul;35(5):442-7. doi: 10.1111/j.1399-6576.1991.tb03325.x.

6. Wilson I, Meiklejohn B, Smith G. Intravenous lignocaine and sympathoadrenal responses to laryngoscopy and intubation. Anaesthesia. 1991;46(3):177-180. DOI: 10.1111/j.1365-2044.1991.tb09403.x

7. Singh H, Vichitvejpaisal P, Gaines G, White P. Comparative effects of lidocaine, esmolol, and nitroglycerin in modifying the hemodynamic response to laryngoscopy and intubation. J Clin Anesth. 1995;7(1):5-8. DOI: 10.1016/0952-8180(94)00013-t.

8. Helfman S, Gold M, Delissre E, Herrington C. Which Drug Prevents Tachycardia and Hypertension Associated with Tracheal Intubation. Anaesth Analg. 1991;72(4):482-486.

9. Chraemmer-Jørgensen B, Høilund-Carlsen PF, Marving J, Christensen V. Lack of effect of intravenous lidocaine on hemodynamic responses to rapid sequence induction of general anesthesia: a double-blind controlled clinical trial. Anesth Analg. 1986 Oct;65(10):1037-41. PMID: 3530049.

10. Hamill J, Bedford R, Weaver D, Colohan A. Lidocaine before Endotracheal Intubation. Anesthesiology. 1981;55(5):578-580. DOI: 10.1097/00000542-198111000-00016

11. Yaku H, Mikawa K, Maekawa N, Obara H. Effect of verapamil on the cardiovascular responses to tracheal intubation. Br J Anaesth. 1992;68(1):85-89. DOI: 10.1093/bja/68.1.85

12. Vucevic M, Purdy G, Ellis F. Esmolol hydrochloride for management of the cardiovascular stress responses to laryngoscopy and tracheal intubation. Br J Anaesth. 1992;68(5):529-530. DOI: 10.1093/bja/68.5.529

13. McCoy E, Mirakhur R. The levering laryngoscope. Anaesthesia. 1993;48(6):516-519.DOI: 10.1111/j.1365-2044.1993.tb07075.x

14. Fassoulaki A, Melemeni A, Paraskeva A, Petropoulos G. Gabapentin attenuates the pressor response to direct laryngoscopy and tracheal intubation. Br J Anaesth. 2006;96(6):769-773..DOI: 10.1093/bja/ael076

15. Memiş D, Turan A, Karamanloğlu B, Şeker Ş, Türe M. Gabapentin reduces cardiovascular responses to laryngoscopy and tracheal intubation. Eur J Anaesthesiol. 2006;23(8):686-690. DOI: 10.1017/s0265021506000500

16. Fassoulaki A, Kaniaris P. Intranasal administration of nitroglycerine attenuates the pressor responsive to laryngoscopy and intubation of the trachea. Br J Anaesth. 1983;55(1):49-52. DOI: 10.1093/bja/55.1.49

17. Puri G, Batra Y. Effect of nifedipine on cardiovascular responses to laryngoscopy and intubation. Br J Anaesth. 1988;60(5):579-581. DOI 10.1093/bja/60.5.579:

18. Rajasekhar M, Yadav M, Kulkarni D, Gopinath R. Comparison of hemodynamic responses to laryngoscopy and intubation using Macintosh or McCoy or C-MAC laryngoscope during uniform depth of anesthesia monitored by entropy. J Anaesthesiol Clin Pharmacol. 2020 Jul-Sep;36(3):391-397. doi: 10.4103/joacp.JOACP_281_19. Epub 2020 Oct 16. PMID: 33487909; PMCID: PMC7812944.

19. Khan F, Haidry M. Comparison of hemodynamic response to tracheal intubation with Macintosh and McCoy laryngoscopes. J Anaesthesiol Clin Pharmacol. 2013;29(2):196.

20. Kaur S, Gupta A. Intubating Conditions and Stress Response to Laryngoscopy: Comparison Between Macintosh and Levering (McCoy's Type) Laryngoscope. J Anaesth Clin Pharmacol. 2009;25(3):333-336

21. McCoy E, Mirakhur R, McCloskey B. A comparison of the stress response to laryngoscopy. Anaesthesia. 1995;50(11): 943-946.DOI: 10.1111/j.1365-2044. 1995.tb05924.x

22. Roman J, Beltran de Heredia, Garcia-Velasco P, Parramon F, Garcia R, Vilaplana J et. al. Hemodynamic response to intubation with Macintosh and McCoy blades. Rev Esp. Anestesiol Reanim.1996;43:177-9.

23. Nishiyama T, Higashizawa T, Bito H, Konishi A, Sakai T. Which laryngoscope is the most stressful in laryngoscopy; Macintosh, Miller, or McCoy? Masui. 1997; 46:1519-2. PMID: 8753922

24. Tewari P, Gupta D, Kumar A, Singh U. Opioid sparing during endotracheal intubation using McCoy laryngoscope in neurosurgical patients: the comparison of haemodynamic changes with Macintosh blade in a randomized trial. J Postgrad Med. 2005 Oct-Dec;51(4):260-4; discussion 264-5. PMID: 16388166.