Journal of Chitwan Medical College 2019;9(30):47-51
Available online at: www.jcmc.cmc.edu.np

ORIGINAL RESEARCH ARTICLE

HEMODYNAMIC RESPONSES TO LARYNGOSCOPY AND INTUBATION USING MACINTOSH, MILLER AND MCCOY BLADES

Gopendra Prasad Deo[1,*], Suresh Gautam[1], Indra Narayan Shrestha[1], Bharati Sharma Regmi[1], Subin Shrestha[1], Nabin Krishna Yadav[1]

[1]Department of Anaesthesiology and Critical Care, Chitwan Medical College, Bharatpur, Chitwan, Nepal.

Received: 1 Nov, 2019

Accepted: 19 Dec, 2019

Published: 27 Dec, 2019

Key words: Haemodynamic Response; Laryngoscope Blade; Macintosh; McCoy; Miller.

***Correspondence to:** Gopendra Prasad Deo, Department of Anaesthesiology and Critical Care, Chitwan Medical College, Bharatpur, Chitwan, Nepal.*
Email: **gopendradeo@gmail.com**

*DOI:*https://doi.org/10.3126/jcmc.v9i4.26901

Citation

Deo GP, Gautam S, Shrestha IN, Regmi BS, Shrestha S, Yadav NK. Hemodynamic responses to laryngoscopy and intubation using Macintosh, Miller and Mccoy blades.2019;9(30):47-51.

CC BY

Peer Reviewed

ABSTRACT

Background: Direct Laryngoscopy and endotracheal intubation are essential components of administration of general anaesthesia but trigger major stress response, in the form of increased catecholamines leading to tachycardia and hypertension. This study is designed to compare the haemodynamic stress response with the Macintosh, McCoy and Miller blades.

Methods: This prospective comparative study was conducted in 150 ASA grade I and II patients, undergoing laparoscopic cholecystectomy under general anaesthesia from March 2017, were randomly divided into three groups using Macintosh, McCoy and Miller blade for endotracheal intubation respectively.

Results: The groups were also comparable in respect to gender, mean age, ASA grade, Cormack and Lehane grade, Laryngoscopic intubation time, baseline heart rate, heart rate before laryngoscopy, baseline mean arterial pressure and Mean Arterial Pressure before laryngoscopy. The mean heart rates at end of 1, 3 and 5 minute were 93.58±13.11, 88.28±11.57 and 83.64±10.94 bpm with Macintosh blade; 93.08±12.09, 94.54±11.87 and 87.50±10.72 bpm with McCoy blades; 108.20±13.94, 95.18±12.75 and 93.22±12.32 bpm with Miller blades. Rise in heart rate as well as mean arterial pressure following intubation was greatest with Miller blade, followed by Macintosh blade and least with McCoy blade and was statistically significant (P< 0.01).

Conclusions: Miller blade produced maximum haemodynamic stress response, followed by Macintosh blade and McCoy blade produced the least haemodynamic response, hence the latter is preferable when less haemodynamic response is desired.

INTRODUCTION

Direct Laryngoscopy and endotracheal intubation are essential components of administration of general anaesthesia. Direct laryngoscopic view is best attained in sniffing position obtained by placing a pillow under the occiput of the patient and subsequent extension of the head at the atlanto-occipital joint. This brings the oral, laryngeal and pharyngeal axes into alignment, improves glottic view and reduces haemodynamic response to intubation.[1]

Direct laryngoscopy and endotracheal intubation increases the safety of general anaesthesia administration, but it can provoke adverse responses in different systems particularly in cardiovascular system.[2]

Hypertension, tachycardia, increase in intracranial and intraocular pressure and dysrhythmias during intubation have been reported since 1940.[3,4] These changes occur from reflex sympatho-adrenal discharge in response to laryngo-tracheal stimulation. Though a healthy person can tolerate these changes very well but in a patient with a compromised cardiovascular system like hypertension or ischaemic heart disease, these responses may prove potentially hazardous.

Various techniques including prophylactic drugs have been tried to attenuate these pressor responses with variable success rate. These includes deepening the depth of anaesthesia, topical anaesthesia, use of opioids, antihypertensive agents like alpha-adrenergic agonists, beta blockers, sodium nitroprusside, nitroglycerine, calcium channel blockers, magnesium sulphate, esmolol, clonidine, dexmedetomidine, oral gabapentin[5] but all these have undesirable side effects like sedation, cardiovascular effects, or respiratory depression.

Laryngoscopic blades of different shapes have been designed and studied. In 1941, Robert Miller first described the straight laryngoscope blade while in 1943, RR Macintosh developed the first curved laryngoscope blade, which was found to be much easier to use. In 1993, the McCoy modified standard Macintosh blade, called flexitip blade. The hinged tip with a lever attached to the proximal end, is placed in the epiglottic vallecula, pressing on the lever causes the tip to act on the hyoepiglottic ligament which lifts the epiglottis out of view to expose more of the glottis.[6]

This study was planned to change the instrumental technique of laryngoscopy by comparing Macintosh blade, McCoy blade and Miller blade in an attempt to find the best laryngoscope blade having lesser stress response of direct laryngoscopy and intubation.

METHODS

This prospective randomised comparative study was conducted in patients undergoing elective laproscopic cholecystectomy under general anaesthesia at Chitwan Medical College (CMC) after obtaining ethical clearance from CMC- institutional Review committee. The study was conducted in 150 patients of both sexes between 18 – 60 years, who gave informed consent, of ASA physical status class I and II, Mallampati class I and II undergoing laparoscopic cholecystectomy under general anaesthesia in the operation theatre of Chitwan Medical College. The study was conducted from March 2017 to September 2017.

Patients on antihypertensives, pregabalin, gabapentin, antianginal drugs, morbid obesity, difficult mask ventilation, anticipated difficult airway, Cormack Lehane view of 3 or/and above and laryngoscopy time more than 20 seconds were excluded from the study.

Written informed consent was obtained from all the patients. Fasting instructions were explained to the patients and were given tab alprazolam 0.25mg a night before surgery.

On the day of surgery, patients were randomly allocated into the three groups using computer generated random numbers table.

Group A (Laryngoscopy and intubation using Macintosh blade)

Group B (Laryngoscope and intubation using McCoy blade)

Group C (Laryngoscope and intubation using Miller blade)

On arrival in the operation theatre, standard monitoring with non-invasive blood pressure (NIBP), oxygen saturation (SpO2), electrocardiography (ECG) were done. After obtaining intravenous line, ringer lactate infusion of 6-8ml/kg was started. All patients were premedicated with Inj. midazolam 0.03mg/kg, Inj. fentanyl 1mcg/kg and Inj ondansetron 4 mg intravenously.

Standard general anaesthesia technique was used with patients being preoxygenated with 100% oxygen for three minutes prior to induction which was done with the injection propofol 2mg/kg I.V which was followed by injection rocuronium 0.5mg/kg I.V.

After 90 seconds, intubation was done using direct laryngoscope with one of these three types of blades, with appropriately sized cuffed oral endotracheal tube. Extent of glottic exposure was noted according to Cormack and Lehane score. Laryngoscopy & intubation time were noted and taking more than 20 seconds were excluded from the study.

Maintenance of anaesthesia was attained with oxygen, sevoflurane (1-2%), and Inj. vecuronium for maintenance of muscle paralysis and other top up doses as required. Recording of pulse rate and Mean Arterial Blood Pressure (MAP) being done before induction i.e. baseline (T_{BL}), before laryngoscopy (T_0), and then at 1 minute (T_1), 3 minutes (T_3) and 5 minutes (T_5) interval after the laryngoscopy and intubation.

At the end of surgery, residual neuromuscular blockade was reversed using Inj. neostigmine 0.05mg/kg and Inj. glycopyrrolate 0.01mg/kg. Extubation was performed after adequate recovery of muscle power. Anaesthesiologist attempting laryngoscopy also mentioned the Cormack Lehane view which is the view of the glottic opening with structures seen during the direct laryngoscopy.

Cornack Lehane view:

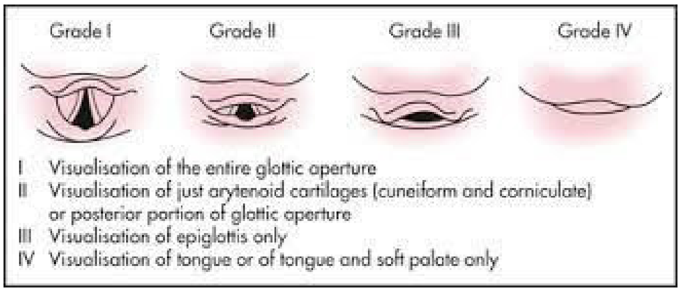

Figure 1: Cornack Lehane View

Macintosh Blade: It is the most widely used curved laryngoscope blade with three basic parts which includes handle, light, blade. The tip of this blade is positioned in the vallecula, anterior to epiglottis, lifting it out of the visual pathway (Figure 2A).

McCoy Blade: The levering laryngoscope blade differs from the standard Macintosh blade in four aspects, one it has a hinged tip, the proximal lever, the spring -loaded drum and the connecting shaft (Figure 2B).

Miller Blade: The miller blade is most popular style of straight blade. The tip of the laryngoscope is positioned posterior to the epiglottis, trapping it while exposing the glottis and vocal cord (Figure 2C).

Figure 2A: Macintosh Blade

Figure 2B: Miller blade

Figure 2C: McCoy Blade

Figure 2: Laryngoscopic Blades

Using Research Randomizer (a computer-based random number generator), three sets of random numbers for three blades were generated. Each set contained 50 random numbers. Data was entered into Microsoft Excel, and analyzed with SPSS version 20.0. Statistical analysis included one-way ANOVA for comparing the mean (SD) and unpaired 't' test was applied for the continuous parametric data. p-value less than 0.05 was considered significant.

RESULTS

The study included 150 patients which completed the study and were divided equally into the three groups. All three groups were comparable in terms of demographic date (Table 1). There was no statistically significant difference in the distribution among groups in CL grade and LI time (Table 2).

Table 1: Demographic data

Demographic data	Group A (Macintosh) (N=50)	Group B (McCoy) (N=50)	Group C (Miller) (N=50)
Sex (Male: Female)	16:34	9:41	12:38
Age(Mean± SD)	44.64±9.29	41.52±9.73	39.54±10.10
p = 0.033			
ASA Grade (1:2)	28:22	35:15	37:13
X2 = 4.02, p = 0.134			

Table 2: Comparison of Cormack and Lehane (CL) grade, Laryngoscopic Intubation (LI) Time

		Laryngoscopic Blades		
		Group A (Macintosh)	Group B (McCoy)	Group C (Miller)
CL Grade	I	30(60%)	27(54%)	21(42%)
	II	20(40%)	23(46%)	29(58%)
	Total	50	50	50
	X2= 3.365, p = 0.186 (applying chi-square test for association at 5% level of significance)			
LI Time (second)	Mean ± SD	11.78±4.007	12.18±3.91	12.08±4.16
	p=0.064 (applying one way ANOVA test at 5% level of significant)			

Comparison of heart rate

Table 3 shows comparison of mean heart rates among the groups as per laryngoscopic blades for intubation. There was no statistically significant variation in mean heart rate at baseline TBL (HR) and before laryngoscopy T0 (HR) across the groups. At 1 minute after laryngoscopy, heart rate was increased in all the three groups with mean of 91.96±13.82 bpm for Macintosh, 84.60±12.56 bpm for McCoy and 103.42±16.21bpm for Miller blades respectively.

At 3 minutes after laryngoscopy, heart rate was increased in all the three groups with mean of 82.60±12.59 bpm for Macintosh, 82.04±11.60 bpm for McCoy and 92.20±15.27 bpm for Miller blades respectively. At 5 minutes after laryngoscopy, heart rate was increased in all the three groups with mean of 74.80±11.48 bpm for Macintosh, 78.10±11.83 bpm for McCoy and 87.62±14.23 bpm for Miller laryngoscopic blades respectively.

Rise in heart rate following intubation was greatest with Miller blade, followed by Macintosh and least with McCoy blade in 1 minute, 3 minute and also in 5 minute after intubation which was found to be statistically significant ($p< 0.01$) (Table 2).

Comparison of Mean Arterial Pressure (MAP)

Comparison of mean arterial pressure (MAP) expressed as mmHg between the groups was comparable at base line and Pre laryngoscopy. (P value > 0.05)

At the end of 1 minute after laryngoscopy, the MAP in Macintosh group rose to 93.58±13.11 mmHg and then gradually fell to 88.28±11.57 at 3 minutes and 83.64±10.94 at 5 minutes after laryngoscopy and intubation. Similar findings were seen in both McCoy and Miller blade groups. The rise of MAP was more in Miller group (26.69%), followed by Macintosh (14.96%) and McCoy (9.63%) groups respectively, which was statistically significant. Similar significant results were obtained at 3 and 5 minutes after laryngoscopy and intubation (Table 4).

Table 3: Comparison of mean heart rate (bpm) changes between the groups

Time	Laryngoscopic Blades						p-value (one-way ANOVA)
	Group A (Macintosh)		Group B (McCoy)		Group C (Miller)		
	Mean ± SD	% Change	Mean ± SD	% Change	Mean ± SD	% Change	
$T_{BL(HR)}$	71.36±11.03		73.04±10.93		73.58±12.03		0.595
$T_{0\ (HR)}$	69.06±11.69	-3.2%	71.12±12.42	-2.62%	69.90±11.65	-5.01%	0.687
$T_{1\ (HR)}$	91.96±13.82	28.86%	84.60±12.56	15.82%	103.42±16.21	40.55%	<0.001*
$T_{3\ (HR)}$	82.60±12.59	15.7%	82.04±11.60	12.32%	92.20±15.27	25.30%	<0.001*
$T_{5\ (HR)}$	74.80±11.48	4.82%	78.10±11.83	6.92%	87.62±14.23	19.08%	<0.001*

** denotes statistically significant at 5% level of significant (Applying one way ANOVA test at 5% level of significance)*

Table 4: Comparison of MAP (mmHg) changes between the groups

Time	Laryngoscopic Blades						p-value
	Group A (Macintosh)		Group B (McCoy)		Group C (Miller)		
	Mean ± SD	% Change	Mean ± SD	% Change	Mean ± SD	% Change	
$T_{BL(MAP)}$	81.40±10.98		84.90±10.72		85.40±11.54		0.149
$T_{0(MAP)}$	78.26±10.33	-3.85%	82.16±10.59	-3.22%	82.48±11.41	-3.41%	0.97
$T_{1(MAP)}$	93.58±13.11	14.96%	93.08±12.09	9.63%	108.20±13.94	26.69%	<0.001*
$T_{3(MAP)}$	88.28±11.57	8.45%	94.54±11.87	11.35%	95.18±12.75	11.45%	0.008*
$T_{5(MAP)}$	83.64±10.94	2.75%	87.50±10.72	3.06%	93.22±12.32	9.15%	<0.001*

**denotes statistically significant at 5% level of significant (Applying one way ANOVA test at 5% level of significance)*

DISCUSSION

Laryngoscope blades of different shapes have been designed to aid and ease the process of intubation. The shape of a laryngoscope blade affects the degree of exposure of the larynx, while the amount of force exerted by the operator in attempts to achieve satisfactory exposure of the glottis during laryngoscopy. Laryngoscopy and endotracheal intubation trigger major stress response, in the form of increased catecholamines leading to tachycardia and hypertension

Reid & Brace were the first to report the effects of laryngoscopy and endotracheal intubation in the year 1940. It was found that laryngoscopy produced pressor response causing tachycardia and rise in BP which was augmented by intubation, producing cardiac arrhythmias. They concluded that cardiac reflexes occur due to variation in the balance of sympathetic and parasympathetic outflow or receptor hypersensitivity. These changes may affect perioperative morbidity through the extent of end organ damage, like myocardial ischemia or cerebral haemorrhage.[3]

Investigations by Burstein et al in 1950 showed that 43 out of 109 patients developed sinus tachycardia, 1 had atrial fibrillation & 2 developed ventricular tachycardia at the time of intubation. This was attributed to reflex stimulation of sympatho-adrenal system.[4]

The use of certain types of laryngoscope blades can help in achieving reduction in the amount of force required for exposure and thus, lower the stimulation of stretch receptors and reduce haemodynamic response.

In this prospective randomized study, we found that the haemodynamic response was maximum with Miller, followed by Macintosh and least with McCoy blades. Our study was supported by Nishiyama T et al and they also concluded that the stress response during laryngoscopy without intubation is highest with the Miller blade and the least with the McCoy blade.[7] Similarly, a comparative study conducted by G. Venkatesan et al showed that the haemodynamic stress response was least with the McCoy, greatest with Miller and intermediate with Macintosh blade.[8]

McCoy EP, Mirakhur RK et al compared the stress response to laryngoscopy using the Macintosh and McCoy blade by measuring clinical cardiovascular parameters and catecholamine concentrations and concluded that the stress response to laryngoscopy is less marked with McCoy blade and that it is probably due to lesser magnitude of force necessary to obtain a clear view of the larynx.[9] The LI time in our study was 11.78?4.007 seconds with Macintosh, 12.18?3.91 seconds with McCoy and 12.08?4.16 seconds with Miller blades and were comparable.

In a study by Mukta J et al, the laryngoscopy and intubation time was 10.80 ± 1.74 seconds and 10.38 ± 1.69 seconds with Macintosh and McCoy blades respectively. They also found statistically significant rise in heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure and rate pressure product in both the groups and increase in hemodynamic variables was statistically significant with Macintosh laryngoscope as compared to McCoy laryngoscope and lasted for lesser duration in McCoy group.[10]

In a study by Gotiwale K, systolic and diastolic blood pressure were significantly higher with Macintosh than McCoy group and time required for intubation was significantly higher in Macintosh group (19.5±70 seconds) than MccCoy group (16.1±2.61 seconds) respectively.[11]

The results we obtained reinforce findings of earlier studies and show that the McCoy blade elicited the least haemodynamic response, followed by Macintosh blade and the Miller blade produced the greatest haemodynamic response.

The limitation of this study were having a smaller number of cases and use of non invasive blood pressure. Serum catecholamines level would have been better indicator of haemodynamic stress response.

CONCLUSION

It was concluded that McCoy blades has lesser effect on haemodynamic stress compared to Macintosh and Miller laryngoscopic blades.

CONFLICT OF INTEREST

None

FINANCIAL DISCLOSURE

None

REFERENCES:

1. Miller RD: Endotracheal intubation, Anaesthesia, 7th edition. Edited by Miller RD. Philadelphia, Churchill Livingstone, 2000, pp 1426-36.
2. Miller RD. Miller's Anaesthesia. 7th Ed, Philadelphia: Churchill Livingstone Elsevier; 2010;50:1599-1600.
3. Reid LC, Bruce DE. Initiation of respiratory tract reflexes and its effects on heart. Surgy. Gynae. Obstretrics. 1940;70:157.
4. Burstein CL, Lopinto FJ, Newman W. Electrocardiographic studies during endotracheal intubation. I. Effects during usual routine technics. Anesthesiology: The Journal of the American Society of Anesthesiologists. 1950;11(2):224-37.
5. Davies NJ, Cashman JN. Lee's synopsis of anaesthesia 13th Ed, Oxford: Butterworth- Heineman Elsevier. 2006;2(6):218-219.
6. Samel S, Patil MB, Roy A . Comparison of Glottic View and Haemodynamic Stress Response Associated with Laryngoscopy using the Macintosh, McCoy and Miller Blades in Adult Patients. International J of Contemporary Medical Research. 2019;6(9):111-116.
7. Nishiyama T, Higashizawa T, Bito H, Konishi A, Sakai T. Which laryngoscope is the most stressful in laryngoscopy; Macintosh, Miller, or McCoy?. Masui. The Japanese journal of anesthesiology. 1997;46(11):1519-24.
8. Venkatesan G, Renganathan T. A comparative study of haemodynamic stress response to laryngoscopy- With the McCoy, the Macintosh and the Miller laryngoscope blades. J. Evid. Based Med. Healthc. 2017;4:1794-8.
9. McCoy EP, Mirakhur RK, Rafferty C, Bunting H, Austin BA. A comparison of the forces exerted during laryngoscopy: The Macintosh versus the McCoy blade. Anaesthesia. 1996;51(10):912-5.
10. Jitendra M, Sharma S, Katoch M, Gulati S, Gupta H. Comparison of hemodynamic response to tracheal intubation with Macintosh and Mccoy laryngoscopes. Journal of Evolution of Medical and Dental Sciences-JEMDS. 2015;4(50):8676-84.
11. Gotiwale K, Lele S, Setiya S. Stress response to laryngoscopy and ease of intubation: Comparison between macintosh and (levering) McCoys type laryngoscope. Int J Res Med Sci. 2016;4:3141-5.