A COMPARATIVE STUDY OF HAEMODYNAMIC STRESS RESPONSE TO LARYNGOSCOPY- WITH THE McCOY, THE MACINTOSH AND THE MILLER LARYNGOSCOPE BLADES

G. Venkatesan[1], T. Renganathan[2]

[1]Assistant Professor, Department of Anaesthesiology, Government Stanley Hospital, Chennai.
[2]Assistant Professor, Department of Anaesthesiology, Government Stanley Hospital, Chennai.

ABSTRACT

BACKGROUND

Laryngoscopy by rigid direct laryngoscope for the purpose of intubation causes haemodynamic stress response (increase in heart rate and mean arterial pressure). The reduction of the stimulation of the oropharynx by the design of laryngoscope blade has reduced the magnitude of the haemodynamic stress response. In this study, the haemodynamic stress response (increased heart rate and increased mean arterial pressure) before, during and after laryngoscopy with McCoy, Macintosh and Miller laryngoscope blades are compared.

MATERIALS AND METHODS

Sixty patients in the age group of 20 to 50 years of both sexes posted for elective surgeries under general anaesthesia were divided into three groups of 20 each as McCoy, Miller and Macintosh group and the haemodynamic stress response to laryngoscopy before, during and after laryngoscopy were compared.
Statistical Analysis- The statistical data were analysed by using ANOVA and paired t-test and the p value of <0.05 was considered statistically significant.

RESULTS

The results of the study showed that the increase in the heart rate and mean arterial pressure were least with McCoy, most with Miller and in between with Macintosh.

CONCLUSION

The study concluded that the haemodynamic stress response to laryngoscopy is least with McCoy laryngoscope, most with Miller laryngoscope and is in between with Macintosh laryngoscope.

KEYWORDS

Laryngoscopy, Haemodynamic Stress Response, McCoy Laryngoscope, Macintosh Laryngoscope, Miller Laryngoscope.

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BACKGROUND

Rigid direct laryngoscopes are most commonly used to view the larynx and adjacent structures under direct vision for the purpose of endotracheal intubation.[1,2,3,4,5]

Apart from the direct trauma to the oropharynx and larynx, adverse physiological effects of cardiovascular system occur as sympathetic haemodynamic stress response to upper airway manipulation during laryngoscopy.[6,7,8,9,10] The sympathetic haemodynamic stress response of cardiovascular system occurs as increase in the heart rate and the mean arterial pressure.[11,12,13]

Although, this haemodynamic stress response to laryngoscopy is transient, generally of short duration and of little consequence in healthy individuals. It is hazardous to those with systemic hypertension, coronary heart diseases, cerebrovascular diseases and the complications like tachycardia, hypertension, myocardial ischaemia, left ventricular failure, cardiac dysrhythmias and cerebral haemorrhage can occur.[10,14,13,15]

Till date, the mainstay of attenuation of the haemodynamic stress response to laryngoscopy was the pharmacological methods like local anaesthetics, vasodilators, beta blocking agents, calcium channel blockers, opioids and volatile anaesthetic agents.[2,14,4,5,16]

The reduction of the stimulation of the oropharynx by the design of laryngoscope blade has also reduced the magnitude of the haemodynamic stress response.[14,17]

In this study, the haemodynamic stress response (increased heart rate and increased mean arterial pressure) before, during and after laryngoscopy with McCoy, Macintosh and Miller laryngoscope blades are compared.

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Corresponding Author:
Dr. G. Venkatesan,
No. 15/8, Pennar Apartment,
Kalakshetra Road, Thiruvanmiyur, Chennai-600041.
E-mail: gvanaes@gmail.com
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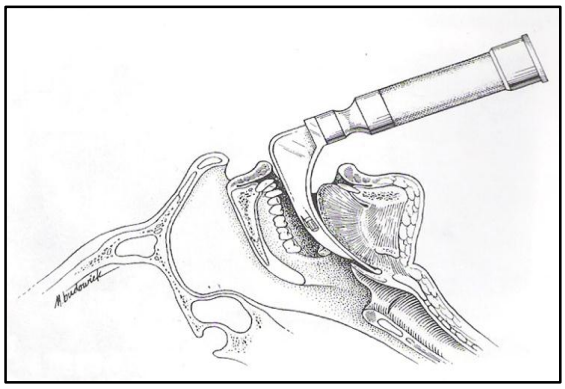

Figure 1. Macintosh Laryngoscope

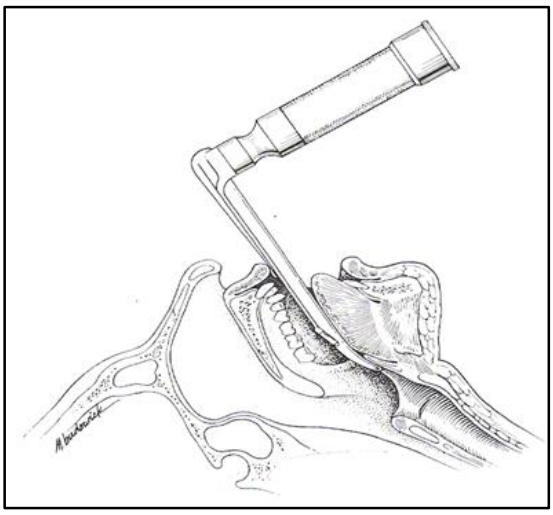

Figure 2. Miller Laryngoscope

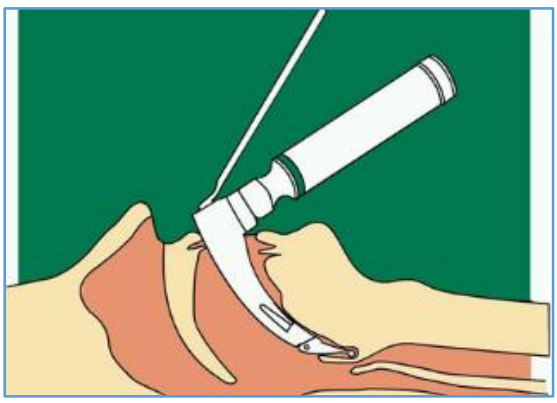

Figure 3. McCOY Laryngoscope - Normal Position

Figure 4. McCOY Laryngoscope - Lever Pressed and Tip Elevated

MATERIALS AND METHODS

This study was conducted to compare the haemodynamic stress response (increased heart rate and mean arterial pressure) to the laryngoscopy with the three laryngoscope blades- McCoy, Macintosh and Miller in patients posted for elective surgeries under general anaesthesia requiring endotracheal intubation.

This study comprised of sixty patients in the age group of 20-50 years, of both sexes, posted for elective surgeries under general anaesthesia requiring endotracheal intubation. In this study, sixty patients were randomly allocated into twenty patients each in the three groups.

All patients were premedicated with Inj. Glycopyrrolate 5 µg/kg IM forty-five minutes before surgery.

Patients were shifted to the operation theatre and connected to the standard multi-monitor, monitoring the ECG, SpO_2, noninvasive automated blood pressure and heart rate.

Intravenous access was obtained using 18G IV cannula.

Patients were preoxygenated with 100% O_2 for three minutes.

Induction was done with Inj. Fentanyl 2 µg/kg, Inj. Thiopentone sodium 5 mg/kg and Inj. Vecuronium 0.08 mg/kg IV. Patients were ventilated by facemask with 100% O_2.

After three minutes of vecuronium administration, the heart rate, systolic blood pressure, diastolic blood pressure and mean blood pressure was noted as baseline value (B).

Laryngoscopy was then performed (with either McCoy or Macintosh or Miller laryngoscope blade) enabling a clear view of the vocal cords for duration of less than 15 seconds.

With McCoy laryngoscope, the laryngoscope blade was gently introduced and the tip of the blade was placed in the vallecula. By just pressing the lever of the laryngoscope, the epiglottis is lifted indirectly exposing the larynx.

With Macintosh laryngoscope, the laryngoscope blade was gently introduced and the tip of the blade was placed in the vallecula. By lifting the laryngoscope upward and forward, the epiglottis is lifted indirectly exposing the larynx.

With Miller laryngoscope, the laryngoscope blade was gently introduced and the epiglottis was included under the tip of the blade. By lifting the laryngoscope upward and forward with the tip of the blade compressing the epiglottis on the base of the tongue, the epiglottis is lifted directly exposing the larynx.

The heart rate, systolic blood pressure, diastolic blood pressure and mean blood pressure measured at the end of insertion of laryngoscope (L). Then, the laryngoscope was then removed and the patients were ventilated for 5 minutes with $N_2O:O_2$ (66%:33%). Heart rate, systolic blood pressure, diastolic blood pressure and mean blood pressure were recorded at 1st minute (L+1), 3rd minute (L+3) and 5th minute (L+5) after laryngoscopy. Then, the patients were intubated and anaesthesia was continued.

The baseline (B), laryngoscopy (L), one minute after laryngoscopy (L+1), three minutes after laryngoscopy (L+3), five minutes after laryngoscopy (L+5) values of the heart rate and the mean arterial pressure were noted. In

each group, changes in the values of the heart rate and the mean arterial pressure were based on the difference between the baseline value (B) and the values obtained at L, L+1, L+3, L+5.

The B, L, L+1, L+3, L+5 values of the heart rate and mean blood pressure were compared among the three groups.

All results were expressed as mean ± SD.

Data were analysed by using ANOVA and paired t-test.

A p value of <0.05 was considered statistically significant.

OBSERVATION AND RESULTS

Number of Patients	Laryngoscope	Group
20	McCoy laryngoscope	Group I
20	Macintosh laryngoscope	Group II
20	Miller laryngoscope	Group III
60	**Total**	

Table 1. Allocation of Groups

The demographic profile as follows-

Group III	Group II	Group I	Age
7	7	6	20-30
6	6	7	31-40
6	6	7	41-50

Table 2. Age Distribution

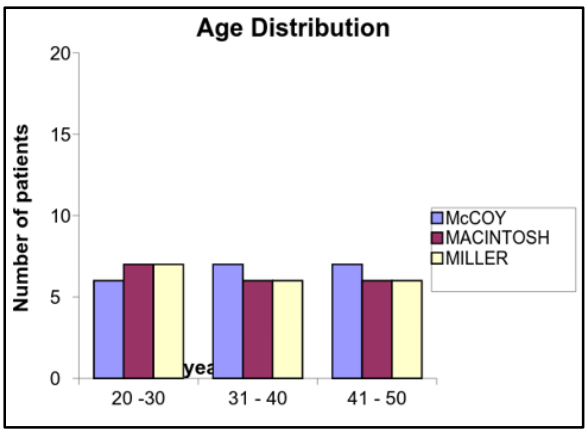

Figure 3. Age Distribution

Group III	Group II	Group I	Sex
14	13	12	Male
6	7	8	Female

Table 3. Sex Distribution

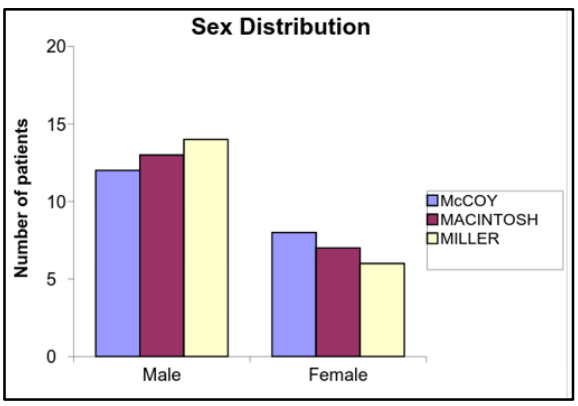

Figure 4. Sex Distribution

Group III	Group II	Group I	Weight (Kg)
5	6	5	40-50
9	8	10	51-60
6	6	5	61-70

Table 4. Weight Distribution

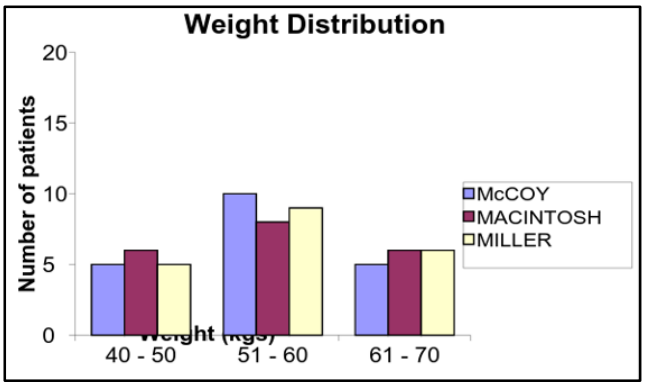

Figure 5. Weight Distribution

F	Group III	Group II	Group I	Weight
0.4209	55.25 ± 6.1308	54.85 ± 6.6698	54.5 ± 5.7140	Mean ± SD

Table 5. Weight Distribution

Group III	Group II	Group I	Height (cms)
11	14	12	150-160
9	6	8	161-170

Table 6. Height Distribution

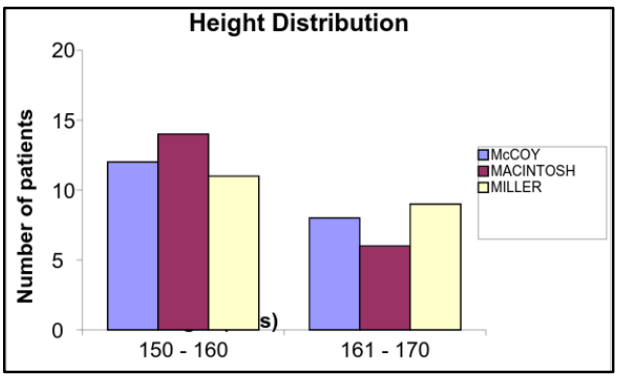

Figure 6. Height Distribution

The mean ± SD of the heart rate and the mean arterial pressure of the three groups are-

Group III	Group II	Group I	Heart Rate
77.9 ± 5.3094	76.1 ± 4.8363	78.3 ± 3.4510	Baseline
78.0 ± 5.3291	76.3 ± 4.9839	76.5 ± 5.2488	L
112.6 ± 4.4989	98.5 ± 5.5452	86.1 ± 5.8137	L+1
110.8 ± 4.4974	94.2 ± 4.7916	84.4 ± 5.6685	L+3
106.1 ± 3.7013	92.9 ± 4.5376	82.11 ± 5.3716	L+5

Table 7. Heart Rate of three Groups

Group III	Group II	Group I	Mean Arterial Pressure
92.05 ± 5.0544	91.5 ± 9.6695	92.8 ± 5.1536	Baseline
92.10 ± 2.8089	92.55 ± 3.3387	95.15 ± 4.9927	L
122.45 ± 12.4977	108.85 ± 3.6506	101.45 ± 4.8731	L+1
116.80 ± 4.6624	104.8 ± 3.7629	98.35 ± 4.7146	L+3
110.35 ± 4.1385	102.05 ± 3.7346	96.35 ± 4.1746	L+5

Table 8. Mean Arterial Pressure of three Groups

The L+1, L+3, L+5 values of the heart rate were compared among the three groups.

I and III			II and III			I and II			Heart Rate
p value	p	t	p value	p	t	p value	p	t	
<0.05	<0.0001	15.2529	<0.05	<0.0001	5.4084	<0.05	0.0084	2.6272	L+1
<0.05	0.0004	3.9574	<0.05	<0.0001	5.2094	<0.05	0.1965	0.8741	L+3
<0.05	<0.0001	7.4246	<0.05	0.0002	4.3902	<0.05	0.1965	0.874	L+5

Table 9. Comparison of Heart Rate Among Three Groups

There was statistically significant difference in the L+1, L+3, L+5 values of heart rate among the three groups. When the mean values of heart rate were compared among the three groups, the values were least with group I (McCoy), most with group III (Miller) and in-between with group II (Macintosh).

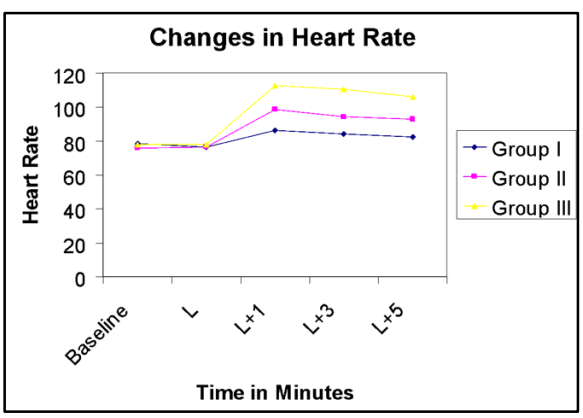

Figure 7. Changes in Heart Rate

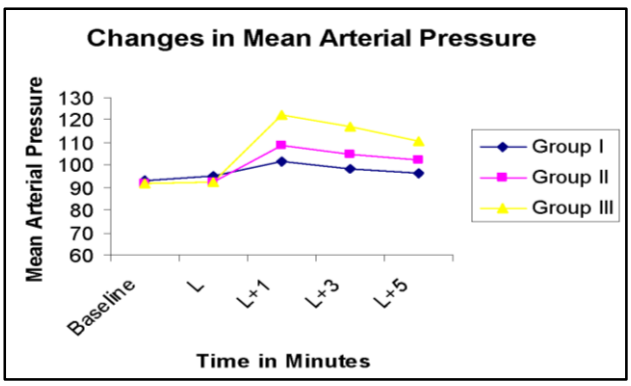

Figure 8. Changes in Mean Arterial Pressure

The L+1, L+3, L+5 values of the mean arterial pressure were compared among the three groups.

I and III			II and III			I and II			Mean Arterial Pressure
p value	p	t	p value	p	t	p value	p	t	
<0.05	<0.0001	6.1875	<0.05	<0.0001	5.4449	<0.05	0.0002	4.2117	L+1
<0.05	<0.0001	8.5020	<0.05	0.0003	4.1184	<0.05	0.0002	4.2826	L+3
<0.05	0.0002	4.2196	<0.05	<0.0001	5.1945	<0.05	0.0154	2.3362	L+5

Table 10. Comparison of Mean Arterial Pressure Among Three Groups

There was statistically significant difference in the L+1, L+3, L+5 values of mean arterial pressure among the three groups. When the mean values of mean arterial pressure were compared among the three groups, the values were least with group I (McCoy), most with group III (Miller) and in-between with group II (Macintosh).

DISCUSSION

Since the first description of the sympathetic haemodynamic stress response to the laryngoscopy and intubation,[6,7,9,10,13,15] there have been numerous studies concerning both the haemodynamic stress response and the various ways by which it can be attenuated.[4,5,16] It is found that the major stimulus to sympathetic haemodynamic stress response during laryngoscopy is the force exerted by the laryngoscope blade upon the structures of oropharynx (tongue, epiglottis). Reduction in the force applied on the structures of oropharynx has attenuated the magnitude of the haemodynamic stress response.[14]

With the McCoy laryngoscopy, the epiglottis is elevated indirectly by the hinged tip of the blade by just pressing the lever rather than upward and forward displacement of structure of the entire lower jaw.[3,18,19] Hence, the force exerted on the structure of oropharynx is limited to area of the vallecula and the adjacent base of the tongue in contact with distal movable part of blade (distal to the hinge of the blade). Hence, the magnitude of haemodynamic stress

response (increased heart rate and mean arterial pressure) elicited by McCoy.

Laryngoscopy is least when compared to that of Macintosh and Miller laryngoscopy.

With the Macintosh laryngoscopy,[3,4,5] the laryngoscope blade is lifted upward and forward with the force applied on the entire curvature of the spatula of the blade lifting the entire lower jaw. The area of oropharynx upon, which the force exerted is on the entire inner aspect of the lower jaw with the tip of the blade in the vallecula. This causes more haemodynamic stress response than that of McCoy laryngoscopy. But, as the epiglottis is not stimulated directly as seen with the use of Miller laryngoscope blade, the haemodynamic stress response is less than that of Miller laryngoscopy.

With the Miller laryngoscope blade,[20,3] the blade is introduced into the oropharynx and the tip of the blade is passed over the posterior surface of the epiglottis. The epiglottis is included under the tip of the blade and the blade is lifted upward and forward with the force applied on the entire inner aspect of lower jaw and compressing the epiglottis on the base of the tongue. The epiglottis is lifted directly to view the larynx. Hence, the haemodynamic stress response with the Miller laryngoscopy is more than that of McCoy and Macintosh laryngoscopy. The haemodynamic stress response (increased heart rate and mean arterial pressure) is least with McCoy laryngoscopy, most with Miller laryngoscopy and in-between with Macintosh laryngoscopy, when the haemodynamic stress response (increased heart rate and mean arterial pressure) is compared among these three laryngoscope blades.

CONCLUSION

The sympathetic haemodynamic stress response (increased heart rate and mean arterial pressure) to laryngoscopy is compared with McCoy, Macintosh and Miller laryngoscope blades. It is concluded that the haemodynamic stress response (increased heart rate and mean arterial pressure) to laryngoscopy is least with McCoy laryngoscope and most with Miller laryngoscope and in-between with Macintosh laryngoscope.

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