Original Research Article

A prospective, randomized study comparing the ease of endotracheal intubation with flexitip McCoy versus Macintosh direct laryngoscope blade in patients undergoing cervical spine surgery with cervical spine immobilization

Dipankar Dutta[1], Shrikanta Oak[2], Tanumoy Maulick[3*]

[1]Department of Critical Care Medicine, Asian Institute of Medical Sciences, Faridabad.
[2]Associate Professor, Department of Anaesthesiology, Seth G.S. Medical College and KEM Hospital, Mumbai, INDIA.
[3]Fellow in Chronic Pain Medicine , Atlas Pain Care, Peelamedu, Coimbatore.
Email: tanumoymaulick@gmail.com

Abstract

Context: In this study we have compared McCoy laryngoscope versus Macintosh laryngoscope in patients posted electively for cervical spine surgery who required manual in-line axial stabilization to stabilize the cervical spine and prevent secondary neurologic injury. **Material and Methods:** After Institutional Ethical committee approval, this prospective randomized study was done on 120 patients of ASA physical status I and II in the age group of 18 to 65 years and allocated randomly into two groups using McCoy laryngoscope and Macintosh laryngoscope to compare the hemodynamic response, intubation difficulty scores and the complication rate. **Results:** We observed that in our study the Macintosh laryngoscope produced greater hemodynamic changes after intubation than the McCoy laryngoscope in terms of significantly greater heart rate and raised systolic and diastolic blood pressures after intubation. In terms of ease of intubation, the Intubation difficulty scores were significantly higher with the Macintosh than McCoy laryngoscope. **Conclusion:** McCoy is a better and effective tool than Macintosh in difficult intubation in patients undergoing cervical spine surgery with manual in-line axial stabilization.

Key Words: Macintosh, McCoy, Endotracheal Intubation, Cervical Spine Surgery, Cervical Spine Immobilization

***Address for Correspondence:**
Dr. Tanumoy Maulick, Fellow in Chronic Pain Medicine, Atlas Pain Care, Peelamedu, Coimbatore, 641028
Email: tanumoymaulick@gmail.com
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INTRODUCTION

Cervical spine surgeries range from minimally invasive to major procedures. Prevention of secondary neurologic injury is very important while securing airway for these patients. Endo-tracheal intubation via direct laryngoscopy with manual in-line stabilization (MILS) is considered standard of care for acute trauma patients with suspected cervical spine injury with a goal of applying sufficient forces to the head and neck to restrict the movement which might be caused during airway management or medical intervention. The McCoy laryngoscope (penlon) is designed to elevate the epiglottis with its hinged tip and requires less neck movement during laryngoscopy[1]. It is frequently used to facilitate tracheal intubation when the view of the glottic opening is restricted. MILS[2] makes the glottic view difficult which might be overcome by McCoy blade in comparison to Macintosh blade. However, as per best of our knowledge very few studies

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are published comparing Macintosh laryngoscope with McCoy laryngoscope in cervical injury patients[3]. Therefore we conducted a prospective, randomized study comparing flexitip McCoy versus Macintosh direct laryngoscope blade in patients undergoing cervical spine surgery and cervical spinal immobilization for ease of intubation, complications and effects on hemodynamic and other body systems.

AIMS AND OBJECTIVES

The study was conducted with the following Aims and Objectives.

1. To compare the ease of intubation with respect to
2. a) Duration of intubation.
   b)Number of attempts.
   c) Adjuvant requirement.
3. d) Cormack- Lehane grade.
2. To compare the intubation difficulty scores.
3. To compare the hemodynamic response.
4. To compare the complication rate.

MATERIALS AND METHODS

The study began after obtaining permission from Institutional Review board. Written informed consent forms were taken from patients or guardians of all cases.

Study population:

This prospective and randomized controlled trial involved the patients posted for cervical spine surgery under general anaesthesia requiring endotracheal intubation with cervical spine immobilization using MILS technique.

Inclusion Criteria

1. Patients with written consent form.
2. ASA physical status I and II.
3. Patient underwent cervical spine surgery with cervical spine immobilization.
4. Age between 18-65 years.

Exclusion Criteria

1. ASA physical status III and above.
2. Pathology of oropharynx, larynx or mass that was likely to alter the anatomy of airway, interincisor distance < 3.5 cm.
3. Intracranial SOLs, features of raised intracranial tension.

Randomization:

One hundred and twenty chits, 60 each labelled with M and C, were put into the box and after mixing, were picked by subjects and not replaced in the box. This simple method of randomization ensured equal allocations of cases to Macintosh (M) and McCoy (C) groups. The use of airway device and endotracheal intubation were performed by the anaesthesiologists who had at least 2 years of experience in anaesthesia and had performed minimum 20 intubation in clinical settings with both the devices. Two anaesthesiologists performed the laryngoscopy for the study and they performed cases in both the groups, which were allocated according to "chit in box" method.

Details of Study Procedures Involved:

All the patients were kept nil per oral for 8 hours prior to the surgery. In the operating room, pre-induction monitoring will be performed with a five-lead electrocardiogram, non-invasive blood pressure and pulse oximeter. Appropriate intravenous access was secured. Premedication with Fentanyl 2 µg/kg and Midazolam 0.03 mg/kg were given. The patients were preoxygenated with 10 L of oxygen for 5 min and general anaesthesia was induced with propofol in a dose sufficient to produce loss of response to verbal commands. Muscle relaxant rocuronium bromide 1.0 mg/kg was administered after checking adequacy of the mask ventilation. At the end of the 90 seconds of mask ventilation, the neck was immobilized using MILS applied by an experienced assistant holding the sides of the neck and the mastoid processes thus preventing flexion/extension or rotational movement of the head and neck. Intubation was done with an appropriate size cuffed ETT. After successful tracheal intubation, the lungs were mechanically ventilated and anaesthesia was maintained with isoflurane in a mixture of N2O and O2. No other medications were administered or procedures performed during the 10 minutes data collection period after tracheal intubation. Further management was up to the discretion of the anaesthesiologist providing care for the patient. The duration of the tracheal intubation was noted.

Table 1: Definition used in the study

Duration of the laryngoscopy	Time taken from insertion of the blade between the teeth until the anaesthetist had obtained the best possible view of the vocal cords
Duration of the intubation	Time taken from when the anaesthetist indicated the best view at laryngoscopy until the TT was placed through the vocal cords confirmed by the presence of CO2 in the exhaled breath.
Total time taken	Sum of laryngoscopy and intubation times over the entire procedure.

A maximum of two intubation attempts were permitted with the device tested. If the tracheal intubation was unsuccessful with the device tested, tracheal intubation performed with the alternate laryngoscope blade. The duration of the first tracheal intubation or of the second, in case the first was unsuccessful, was recorded. The number of intubation attempts, the rate of successful placement of the ETT in the trachea, the number of optimization manoeuvres required (use of a bougie, cricoid pressure, second assistant) to aid tracheal intubation, the Cormack and Lehane grade at laryngoscopy and hemodynamic response to laryngoscopy were noted.

The IDS was calculated. The IDS score, developed by Adnet and colleagues, was a quantitative scale incorporating multiple indices of intubation difficulty that more objectively quantified the complexity of tracheal intubations.

IDS Score:

N1- Number of intubation attempts>1

N2- Number of operators> 1

N3- Number of alternative intubation techniques used

N4- Glottic visualization (Cormack- Lehane minus 1)

N5- Lifting force required during laryngoscopy (0= normal; 1=increased)

N6- Necessity for external laryngeal pressure (0= not applied; 1=applied)

N7= Position of vocal cords at intubation (0= abduction/not visualized; 1= adduction).

Sample size:

Sample size was calculated using nMaster 1.0, comparison of Intubation Difficulty Scores between the two laryngoscopes blades were taken as primary endpoints. A sample size of 120 was taken for the study, allocated 60 each patient randomly to Macintosh intubation and McCoy intubation in the hand of anaesthetists experienced to both the equipments. The study was prospective randomized controlled study. The sample size had been decided based on the two proportion testing hypothesis as follows.

Hypothesis – Lahane - Equable		
Proportion in group I =	0.97.	
Proportion in group II =	0.81.	
Risk differences =	0.16.	
Power (%) =	80.	
α - Error (%) =	5.	
Side =	2.	
Required sample size for each =	59.	
α - (%) Power (%)	Sample size (n)	
1	70	73
	80	88
	90	112
5	70	47
	80	59
	90	78
10	70	35
	80	46
	90	63

Data analysis

The data obtained from study was analyzed by statistical programming software statistical package for the social sciences version 10. SPSS is a statistical tool was used to analyze and correlate social data. The statistical test such as Chi square test, student's t- test and Paired t –test, and non-parametric Z test were applied to obtained data. P<0.05 was considered statistically significant.

RESULTS AND ANALYSIS

Characteristics	Mc Coy (Mean ± SD)	Macintosh (Mean ± SD)	P value
Age (years)	41.25 ± 13.70	42.20 ± 16.67	0.7336 using unpaired t test

Table 1: Comparison of the demographic profiles of two groups

Body weight (Kg)	57.60 ± 9.45	57.97 ± 12.14	0.8539 using unpaired t test
Gender	Mc Coy (%)	Macintosh (%)	P value
Female	23 (38.33)	25 (41.67)	0.7336 using unpaired t test
Male	37 (61.67)	35 (58.33)	
ASA Grade	Mc Coy Number of Patients (%)	Macintosh Number of Patients (%)	P value
1	35 (58.33)	45 (75.00)	0.05 Square test
2	25 (41.67)	15 (25.00)	
Since p value is >0.05 there is no significant difference in ASA grade distribution of both study groups			

Both the groups were demographically comparable.

Table 2: Comparison of Mallampati grading in both the groups

Mallampatti Grade	Mc Coy Number of Patients (%)	Macintosh Number of Patients (%)	P value
1	21 (35.00)	21 (35.00)	
2	29 (48.33)	29 (48.33)	Chi Square test
3	10 (16.67)	9 (15.00)	
4	0 (0.00)	1 (1.67)	
Since p value is >0.05 there is no significant difference in Mallampati grade distribution of both study groups			

The Mallampati grade had no statistically significant difference between the Mc Coy and Macintosh groups.

Table 2: Comparison of the mean Thyromental distance of two groups

Characteristics	Mc Coy (Mean ± SD)	Macintosh (Mean ± SD)	P value
Thyromental Distance (cm)	6.14 ± 0.32	6.03 ± 0.59	0.2128 using unpaired t test
Since p value is >0.05 there is no significant difference in mean thyromental distance of both study groups			

The mean thyromental distance for the Mc Coy group and Macintosh group was found to be 6.14 ± 0.32 cms and 6.03 ± 0.59 cms respectively. The values were comparable to each other and no statistical difference was observed among the two groups.

Table 3: Comparison of the mean Interincisor Distance

Characteristics	Mc Coy (Mean ± SD)	Macintosh (Mean ± SD)	P value
Inter incisors distance (cm)	4.18 ± 0.30	4.10 ± 0.43	0.2230 using unpaired t test
Since p value is >0.05 there is no significant difference in mean Intra incisors distance of both study groups			

Inter-Incisors distance was found to be comparable in both the study groups. There was no statistically significant difference between Mc Coy and Macintosh groups.

Table 4: Changes in heart rate with McCoy and Macintosh

Time Points	Mc Coy (Mean ± SD)	Macintosh (Mean ± SD)	p value	P value
Baseline (pre-op)	78.33 ± 11.47	77.51 ± 12.33	0.7079	P = 0.0[illegible] preoperative,
Induction	77.75 ± 11.56	77.08 ± 8.92	0.7242	$^{\#}$P = 0.0[illegible] induction,
After Intubation (0 mins)	86.87 ± 12.93*,#	94.41 ± 16.38*,#	0.0059	$^{@}$P = 0.0[illegible] after induction, calculated using RMANOVA test
Postintubation at 2 min	82.08 ± 12.32*	90.45 ± 15.58*,#	0.0014	
Postintubation at 5 min	79.45 ± 11.42@	82.96 ± 9.99*,#,@	0.0752	
Postintubation at 10 min	76.77 ± 10.60@	79.08 ± 8.69@	0.1931	
using unpaired t test Since p value is <0.05 there is significant difference in mean heart rate of both study groups at 2 mins after intubation				

The baseline heart rate was comparable between Mc Coy group (78.33 ± 11.47) and Macintosh group. (77.51 ± 12.33). After induction, the heart rate decreased gradually in both groups. However after intubation it was found to be higher in both the groups but the rise was found to be more in Macintosh than McCoy at all time points more so significantly at 2 mins after intubation. Post-intubation at 10 mins however the heart rate was comparable between Mc Coy group and Macintosh group.

Table 5: Changes in SBP with McCoy and Macintosh laryngoscope

Time Points	Mc Coy (Mean ± SD)	Macintosh (Mean ± SD)	P value	P value
Baseline(pre-op)	123.45±13.16	123.00 ± 14.61	0.8596	P = 0.0[illegible]
Induction	121.08±11.93	117.75 ± 18.62*	0.2455	$^{\#}$P 0.01
After Intubation(0 mins)	128.38±9.74*	131.85 ± 16.39*,#	0.0432	versus induction as compared to baseline
Postintubation at 2 min	127.91±14.95*	128.43 ± 14.49#	0.8479	calculated using
Postintubation at 5 min	124.10±10.73	125.25 ± 11.26#	0.5681	RMANOVA test
Postintubation at 10 min	123.30±11.90	124.15 ± 11.24	0.6883	
using unpaired t testSince p value is <0.05 there is significant difference in mean SBP of both study groups just (at 0 mins) after intubation				

The baseline systolic blood pressures were comparable in both groups. After induction, the systolic blood pressure decreased in both the groups. However just after intubation the systolic blood pressures increased in both the groups with a significantly higher increase in the Macintosh group when compared to the McCoy group. At 2 mins, 5 mins and 10 mins the blood pressures in both the groups were comparable, at 10 mins post intubation, however, it was restored in both the groups.

Table 6: Changes in DBP with McCoy and Macintosh

Time Points	Mc Coy (Mean ± SD)	Macintosh (Mean ± SD)	p value	P value
Preoperative	75.88 ± 9.04	78.47 ± 10.89	0.1600	P = 0 .0[illegible]
Induction	68.95 ± 9.49*	71.12 ± 13.66*	0.3150	using RMANOVA test
After Intubation(0 mins)	77.23 ± 9.84	83.10 ± 12.16*		as compared to
			0.0044	baseline
Postintubation at 2 min	73.12 ± 9.55		0.0014	
		79.70 ± 12.28		
Postintubation at 5 min	71.70±8.64	75.85 ± 10.58	0.2230	
Postintubation at 10 min	68.77 ± 6.78	72.40 ± 10.99	0.3313	

p value calculated Using unpaired t test Since p value is <0.05 there is significant difference in mean DBP of both study groups just (at 0 mins) after intubation and 2 mins post intubation

Preoperatively the diastolic blood pressures were comparable in both the groups. At the time of induction, diastolic blood pressure decreased in both the groups with no significant difference. However just after intubation and after 2 mins, the increase in diastolic BP was significantly higher in the Macintosh group than the McCoy group. Postintubation at 5 mins and 10 mins however diastolic BP was stable and comparable in both the groups. Oxygen saturation (SpO2) throughout the procedure showed no significant difference between the two groups.

Table 7: Comparison of mean number of attempts of both groups

Characteristics	Mc Coy		Macintosh		p value
	(Mean ± SD)	Median	(Mean ± SD)	Median	
Attempts	1.20 ± 0.55	1	1.32 ± 0.72	1	[illegible] W h i tney test

Since p value is >0.05 there is no significant difference in number of attempts req u i r e d in both study groups

There was no statistically significant difference in the number of attempts made between the two groups, median of both the groups was 1 which was found to be insignificant statistically using Mann-Whitney test.

Table 8: Comparison of the number of operators of both groups

Characteristics	Mc Coy		Macintosh		p value
	(Mean ± SD)	Median	(Mean ± SD)	Median	
No of Operators	1.18 ± 0.39	1	1.28 ± 0.49	1	[illegible] W h i tney test

Since p value is >0.05 there is no significant difference in number of operators req u i r e d in both study groups

There was no difference in the number of operators required for both the groups . (median=1 for both the groups)

Table 9: Comparison of the alternative techniq u e s used in both groups

Alternative technique	Mc Coy Number of Patients (%)	Macintosh Number of Patients (%)	P value
Yes	1 (1.67)	4 (6.67)	0.3644 using Fisher's exact test
No	59 (98.33)	56 (93.33)	

Since p value is >0.05 there is no significant difference in number of alternative methods req u i r e d in both study groups

Only in 1 out of 60 patients in the McCoy group and 4 out of 60 patients in the Macintosh group, there was a need for use of alternative technique (ie a switchover) indicating that there was no statistically significant difference.

Table 10: Comparison of glottis exposure in both groups

Glottis Exposure	Mc Coy Number of Patients (%)	Macintosh Number of Patients (%)	P value
0	39 (65.00)	16 (26.67)	[illegible] S q u a
1	19 (31.67)	24 (40.00)	test
2	2 (3.33)	20 (33.33)	

Since p value is <0.05 there is significant difference in proportion of patients req u i r e d glottis exposure in both study groups

Both the techniques had considerable impact on glottis exposure. McCoy technique showed better glottis exposure (in 65% patients) as compared to the Macintosh group (in 26.67% patients) .It was rated as the Cormack-Lehanne grade seen minus 1, so with McCoy most of the glottis views were Cormack Lehanne 1.

Table 11: Comparison of the lifting force used in both groups

Lifting Force	Mc Coy Number of Patients (%)	Macintosh Number of Patients (%)	P value
0	53 (88.33)	31 (51.67)	Chi Square test
1	7 (11.67)	28 (46.66)	
2	0 (0.00)	1 (1.67)	
Since p value is <0.05 there is significant difference in proportion of patients required need for different lifting force in both study groups			

Normal lifting force (score 0) was required in 88.33% patients for Mc Coy group as compared to 51.67 % patients for Macintosh group. Similarly, increased lifting force was needed in the McCoy group in 11.67% of the patients whereas in the Macintosh group it was needed in 46.66 % of the patients. Overall results indicate that more number of patients in Macintosh group required need for increased lifting force as compared to the Mc Coy group.

Table 12: Comparison of the need of laryngeal pressure in both groups

Need for external Laryngeal Pressure	Mc Coy Number of Patients (%)	Macintosh Number of Patients (%)	P value
0	45 (75.00)	26 (43.33)	Chi Square test
1	5 (25.00)	34 (56.67)	
Since p value is <0.05 there is significant difference in proportion of patients required need for laryngeal pressure in both study groups			

Almost 75 % of patients needed no external laryngeal pressure in the Mc Coy group compared to 43.33% patients in the Macintosh group indicating that more number of patients in Macintosh group required need of laryngeal pressure.

Table 13: Comparison of the vocal cord mobility of both groups

Vocal Cord Mobility	Mc Coy Number of Patients (%)	Macintosh Number of Patients (%)	P value
0	59 (98.33)	58 (96.67)	1.000 using Fisher's exact test
1	1 (1.67)	2 (3.33)	
Since p value is >0.05 there is no significant difference in proportion of patients with vocal cord mobility in both study groups.			

98.33% patients in the Mc Coy group and 96.67% patients in the Macintosh group had an ideal vocal cord position indicating that there was no significant difference between the two groups.

Table 14: Comparison of IDS Score of the study groups

Characteristics	Mc Coy (Mean ± SD)	Median	Macintosh (Mean ± SD)	Median	p value
IDS Score	1.08 ± 1.31	1	2.83 ± 2.20	3	<0.0001 using Mann - Whitney test
Since p value is <0.05 there is significant difference in IDS score in both study groups					

The intubation difficulty scale (IDS) for Macintosh group was significantly higher (Median 3) compared to the Mc Coy group (Median 1) the p value being <0.0001. Even the mean of the groups was considerably higher with the Macintosh when compared with the McCoy groups.

Table 15: Comparison of duration of laryngoscopy of the study groups

Time Points	Mc Coy (Mean ± SD)	Macintosh (Mean ± SD)	P value
Duration (seconds)	18.65 ± 19.93	23.73 ± 27.52	0.2489 using unpaired t test
Since P value is >0.05, there is no significant difference in Duration of Laryngoscopy between both study groups			

The duration of laryngoscopy was also found to be comparable in both the groups. The mean value being 18.65 ± 19.93 sec for Mc Coy group and 23.73 ± 27.52 sec for Macintosh group indicating that there is no statistically significant difference in the two groups.

Table 16: Comparison of duration of intubation of the study groups

Time Points	Mc Coy (Mean ± SD)	Macintosh (Mean ± SD)	P value
Duration (seconds)	11.70 ± 8.39	14.63 ± 8.74	0.0632
p = 0 . 0 6 3 2 using unpaired t test			
Since p value is >0.05, there is no significant difference in Duration for intubation between both study groups			

Duration of intubation for Mc Coy group was 11.70 ± 8.39 sec and for Macintosh group was 14.63 ± 8.74 seconds which was comparable in both the groups. Similarly, there was no statistically significant difference observed.

Table 17: Comparison of total time of intubation of the study groups

Time Points	Mc Coy (Mean ± SD)	Macintosh (Mean ± SD)	P value
Duration (seconds)	30.25 ± 27.76	38.25 ± 31.18	0.1403
p = 0 . 1 4 0 3 using unpaired t test. Since p value is >0.05, there is no significant difference in Total time for intubation between both study groups			

Both the methods required similar time for intubation (30.25 ± 27.76 sec for Mc Coy group and 38.25 ± 31.18 sec for Macintosh group).

Table 18: Comparison of req u i r e m ent for additional manoeuvres of the study groups

Bougie	Mc Coy Number of Patients (%)	Macintosh Number of Patients (%)	P value
Required	9 (15.00)	26 (43.33)	0.0013 using Chi-S q u a r e test
Not required	51 (85.00)	34 (56.67)	
Since p value is <0.05 there is significant difference in proportion of patients req u i r e d need of an additional Method (Bougie) in both study groups			

More number of patients in the Macintosh group (43.33%) required additional method i.e Bougie as compared to the Mc Coy group (15%).

Table 19: Comparison of complications of the study groups

Complications	Mc Coy Number of Patients (%)	Macintosh Number of Patients (%)
Yes	7 (11.67)	11 (18.33)
No	53 (88.33)	49 (81.67)
p = 0 . 4 4 3 1 using Chi - S q u a r e test Since p value is >0.05 there is no significant difference in proportion of patients with complications in both study groups		

88.33% patients in the Mc Coy group and 81.67% patients in the Macintosh group reported to have no complications during and post the surgery. The results were comparable to each other and there was no statistically significant difference observed between the two groups.

DISCUSSION

Endotracheal intubation is recommended with utmost care in patients with cervical spine fracture to prevent secondary neurologic injury. The use of semi-rigid cervical collar or manual in-line stabilization of cervical spine to prevent neck movements may cause poor view on conventional laryngoscopy leading to difficulty in intubation. The standard practice by most anaesthesiologists is to use a laryngoscope with a Macintosh blade and a sufficiently large tube with stylet inserted. The McCoy 'levering laryngoscope' has a hinged blade tip, which can be controlled by a lever attached to the blade. This improves the view of the glottis, especially in patients posing problems, i.e. limited neck mobility. This was a prospective and randomized controlled trial. The study involved the patients ASA I and II posted for cervical spine surgery under general anaesthesia requiring endotracheal intubation with cervical spine immobilization using Manual in line axial stabilization technique. It was carried out in Neurosurgery operation theatre, Department of anaesthesia, Seth G.S Medical College and King Edward Memorial hospital, Mumbai. One hundred and twenty patients were employed sixty in each group. In this study, we confirmed the two study groups were comparable in relation to demographic factors such as age, gender distribution, body weight and ASA grading. Similarly, Mallampatti grading, thyromental distance and inter-incisor distance were also found to be statistically insignificant when comparing the Mc Coy group and Macintosh group. In this study, the baseline heart rate was comparable between McCoy group (78.33 ± 11.47) and Macintosh group. (77.51 ± 12.23) After induction, the heart rate decreased gradually in both groups. However just after intubation it was found to be higher in both the groups but the rise was found to be more in Macintosh(94.41 ± 16.38) than McCoy (86.87 ± 12.93) although it was statistically insignificant. At 2 mins after intubation,

however the difference was significant (90.45 ± 15.58 with Macintosh and 82.08 ± 12.32 with McCoy with a p value of 0.0014 using unpaired t- test). Post-intubation at 5mins, there was no significant difference (82.96 ± 9.99 in Macintosh and 79.45 ± 11.42 in McCoy). At 10 mins, however the heart rate was comparable in both the groups. Mccoy *et al* reported no change in either heart rate with the McCoy blade indicating that the use of this instrument did not cause significant stimulation of the oropharynx. This could be explained by the fact that McCoy only studied response to laryngoscopy and not tracheal intubation. (Mccoy *et al*., 1995)[77] Haidry *et al*[10] reported that HR rose significantly for 3 min following laryngoscopy in the Macintosh group and for 2 min in the McCoy group. A significant drop was seen at 10 min following laryngoscopy in the Macintosh group only. The maximum rise in the HR compared to baseline seen was 18.7% in the Macintosh group compared to 7.7% in the McCoy group. The baseline systolic blood pressures were comparable in Macintosh (123.00 ± 14.61 mm Hg) and McCoy (123.45 ± 13.16 mm Hg) groups. After induction, the systolic blood pressure decreased in both the groups. However just after intubation ie at 0 mins the systolic blood pressures increased in both the groups with a significantly higher increase in the Macintosh group(131.85 mm Hg ± 16.39 mm Hg) when compared to the McCoy group(128.38 ± 9.74 mm Hg) with a p value of 0.0432 using unpaired t-test. At 2 mins, there was a rise found but, with no significant difference(128.43 ± 14.[4] mm Hg in Macintosh group and 127.91 ± 14.95 mm Hg in the McCoy group). At 5 mins and 10 mins the blood pressures in both the groups were comparable with no significant difference, the P value of the means was found to be 0.5681 and 0.6883 respectively using unpaired t-test. Preoperatively the diastolic blood pressures were comparable in both the groups (78.47 ± 10.89 mm Hg in Macintosh and 75.88 ± 9.04 mm Hg in McCoy). At the time of induction, diastolic blood pressure decreased in both the groups with no significant difference. However just after intubation the increase was significantly more with Macintosh (83.10 ± 12.16 mm Hg) than McCoy group (77.23 ± 9.84 mm Hg) with a P value of 0.0044 using unpaired t-test. Similarly after 2 mins, the increase in diastolic BP was significantly higher in the Macintosh group(79.70 ± 12.28 mm Hg) than the McCoy group (73.13 ± 9.55 mm Hg) with a P value of 0.0014 using unpaired t-test. Postintubation at 5 mins and 10 mins however diastolic BP was stable and comparable in both the groups, the P value being 0.2230 and 0.3313 at the respective time points. Haidry *et al* observed elevated change in BP in the Macintosh group compared to the McCoy group. (Haidry *et al*., 2013)[10] Our results were in accordance with the above mentioned studies. However Arshad *et al* reported no significant difference in the systolic blood pressure but significant difference in the diastolic blood pressure after induction and laryngoscope between the groups in both predicted easy and difficult airway. It is believed that the major stimulus to cardiovascular changes during and after laryngoscopy is the force exerted by the laryngoscope blade on the base of the tongue or lifting the epiglottis, and may be independent of the type of laryngoscope used. Straight and curved blades have been compared with regard to pressor and heart rate and rhythm changes in response to laryngoscopy with conflicting results. The McCoy blade has previously been shown to require less force than a Macintosh blade for visualisation of the larynx. This would support the view that application of less force during laryngoscopy causes a smaller cardiovascular response as is the case with the McCoy blade

Intubation difficulty score:-

N1-Number of intubation attempts>1

N2-Number of operators>1

N3- Number of alternative intubation techniques used

N4- Glottic visualization (Cormack- Lehane minus 1)

N5- Lifting force required during laryngoscopy (0= normal; 1=increased)

N6- Necessity for external laryngeal pressure (0= not applied; 1=applied)

N7= Position of vocal cords at intubation (0= abduction/not visualized; 1= adduction). The mean number of attempts required was 1.20 for McCoy group and 1.32 for Macintosh group, median of both the groups being 1, indicating that there was no statistically significant difference between the two groups. There was no significant difference even for the number of operators required in both the groups, median being 1 for both the groups. Only in 1 out of 60 patients in the McCoy group and 4 out of 60 patients in the Macintosh group, there was a need for use of alternative techniques ie a switchover technique indicating that there was no statistically significant difference between the study groups. Both the techniques had considerable impact on glottis exposure. McCoy technique showed better glottis exposure (in 65% patients) as compared to the Macintosh group (in 26.67% patients). It was calculated as Cormack-Lehane grade seen minus 1, so the McCoy Flexitip improved the glottis visualization in most of the patients and 65% of the patients were found to have a Cormack-Lehane grade 1. Lifting force ie. grade 0 was normal in 88.33% patients for Mc Coy group as compared to 51.67 % patients for Macintosh group. An increased lifting force ie. grade 1 was required in 11.67% of the patients in McCoy group as opposed to 46.66 % of the patients in Macintosh group. Overall results indicate that more number of patients in Macintosh group required need for increased lifting force

as compared to the Mc Coy group. This was in accordance with the study conducted by Mc Coy *et al* observing that the use of the McCoy laryngoscope blade is associated with significantly less force required during laryngoscopy in order to obtain a clear view of the vocal cords when compared to the Macintosh blade. (Mc Coy *et al*., 1996)[6] Almost 75 % of patients needed no external laryngeal pressure in the Mc Coy group compared to 43.33% patients in the Macintosh group indicating that more number of patients in Macintosh group required need of laryngeal pressure. 98.33% patients in the Mc Coy group and 96.67% patients in the Macintosh group had an ideal cord position at intubation indicating that there was no significant difference between the two groups. The intubation difficulty scale (IDS) which was calculated from the above mentioned factors, was significantly higher (Median 3) for Macintosh group compared to the Mc Coy group (Median 1) the p value being <0.0001 using Mann-Whitney test suggesting McCoy laryngoscope facilitates intubation in these patients Kulkarni AP *et al* 2013[7] reported that Grade 1 view was obtained by Miller (83%), then McCoy (77%) and then the Macintosh blade (63%). This was not statistically significant and intubation was easier (Grade 1) with McCoy blades (93% each). The ease of intubation was similar with Macintosh blade, i.e., 90% of patients had Grade 1 intubation. With the Miller blade, Grade 1 ease at intubation was seen only in 57% patients Arino *et al*[8] found that laryngoscopic views obtained with Belscope (98/100 Grade I views) and Miller (96/100 Grade I views) blades were similar. The levering tip of the McCoy blade laryngoscopes significantly improved the laryngoscopic view (87/100 Grade I views) as compared to that without the use of the levering tip (69/100 Grade I views). The Macintosh blade fared the worst (72/100 grade views). Uchida *et al*.[4] found that when laryngoscopy was performed with neck in neutral position the grade of glottic view improved with use of McCoy blade from Grade 2 to 3 views obtained with Macintosh blade. The difference in glottic visualisation can also be explained by the mechanics of laryngoscopy with different types of blades. With the Macintosh blade, the curvature of the blade acts as a visual "hill;" interrupting the line of sight, called the "Crest of the Hill" effect. With the Macintosh blade, the oral axis makes an angle with the laryngeal axis, masking the glottis as it is covered by the epiglottis and this interferes with glottic view. When the McCoy blade is used, the epiglottis is lifted out of the way improving glottic exposure. Thus, the force required is reduced as the tongue only needs to be displaced laterally. The duration of laryngoscopy, ie the time taken from insertion of the blade between the teeth until the best possible view of the vocal cords was obtained, was also found to be comparable in both the groups. The mean value being 18.65 ± 19.93 sec for Mc Coy group and 23.73 ± 27.52 sec for Macintosh group indicating that there is no statistically significant difference in the two groups. Duration of intubation , ie the time taken from obtaining the best view at laryngoscopy until the endotracheal tube was placed through the vocal cords confirmed by the presence of CO2 in the exhaled breath, was comparable in both the groups , being 11.70 ± 8.39 seconds for the McCoy group and 14.63 ± 8.74 seconds for the Macintosh group. Both the methods required similar total time for intubation (30.25 ± 27.76 sec for Mc Coy group and 38.25 ± 31.18 sec for Macintosh group). Haidry *et al* reported significantly longer intubation time with the McCoy group. (Haidry *et al*., 2013)[4] Arshad *et al*[1] reported that time taken was less in McCoy group compared to the Macintosh group.

88.33% patients in the Mc Coy group and 81.67% patients in the Macintosh group reported to have no complications during and post the surgery. The results were comparable to each other and there was no statistically significant difference observed between the two groups. This study is unique in a way that only hemodynamic studies have been performed when comparing the Mc Coy and Macintosh type tracheal intubation for spinal cord injury. It throws more light on the ease of intubation, number of adjuvants required and rate of complications involved. On the whole parameters such as heart rate and systolic and diastolic BP were elevated in the Macintosh group. Additionally lifting force, laryngeal pressure, and IDS and glottis exposure also indicated that Mc Coy method was better than the Macintosh method. However there was no difference in the age, gender distribution, body weight, ASA grade, thyromental distance, inter- incisors distance, number of attempts, number of operators, number of alternative techniques required, duration of laryngoscopy, time for intubation, vocal cord mobility and complications. The main limitation of this study is that the potential of observer bias exists, as it is impossible to blind the anesthesiologist to the device being used. However, we incorporated the intubation difficulty score for the assessment of ease of intubation that incorporate multiple indices of intubation difficulty and objectively quantifies the complexity of tracheal intubations. Another limitation of our study is that we did not compare the relative efficiencies of these devices with other intubation modalities which are recommended in difficult airway scenarios, such as the intubating laryngeal mask airway, the Bullard laryngoscope, Airtraq, and glidescope. Further comparative studies are needed to determine the relative efficacies of these devices.

CONCLUSION

McCoy laryngoscope possesses more advantages over Macintosh laryngoscopes for tracheal intubation in patients with immobilized cervical spine.

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