

# A COMPARATIVE STUDY OF HEMODYNAMIC RESPONSES TO LARYNGOSCOPY AND INTUBATION USING MCCOY AND MACINTOSH LARYNGOSCOPE BLADES WITH AND WITHOUT FENTANYL

## Anesthesiology

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### Abstract:

**Background:** Macintosh blade is the most popular blade with a gently curved tongue which extends to the tip. The McCoy blade laryngoscope has a hinge on the tip to avoid the lifting force in the vallecula reducing the amount of force exerted in the vallecula causing less hemodynamic changes. Fentanyl is a potent analgesic that suppress the nociceptive stimulation caused by the intubation procedure and minimal circulatory changes.

**Aim:** An attempt had been made to compare hemodynamic changes during laryngoscopy with Macintosh and McCoy blades with and without fentanyl in adult patients undergoing elective surgeries.

**Materials and Methods:** After Institutional Ethics Committee approval, and an informed and written consent 120 adults (18–60 years) of both sexes, ASA Grade I and II, undergoing elective surgery under general anesthesia requiring endotracheal intubation were enrolled in this study. Patients were randomly divided into 4 groups

**Group 1:** McCoy laryngoscope with fentanyl (McC +F)

**Group 2:** McCoy laryngoscope without fentanyl (McC +NF)

**Group 3:** Macintosh laryngoscope with fentanyl (MK+F)

**Group 4:** Macintosh laryngoscope without fentanyl (MK+NF)

After induction of anesthesia, laryngoscopy was performed and trachea was intubated. The change in systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP) and heart rate (HR) was observed for 7 min, post intubation, 1,2,3,4,5,6 and at 7 minutes.

**Results:** McCoy with fentanyl group showed statistically significant lower values of mean HR, SBP, DBP, and MAP after intubation when compared to other 3 groups. Conclusions: HR, SBP, DBP, and MAP all rises in all the group following laryngoscopy and intubation but changes were least with McCoy with fentanyl group and maximum with Macintosh without fentanyl group.

**Keywords:** McCoy laryngoscope blade, Macintosh Laryngoscope blade, fentanyl, hemodynamic responses, laryngoscopy

## Introduction

The induction of anaesthesia, laryngoscopy, endotracheal intubation is associated with a stress response along with an increase in catecholamine concentration.[1] and surgical stimulation also evoke transient cardiovascular response characterized by alterations in systemic blood pressure, heart rate and cardiac rhythm. During laryngoscopy and tracheal intubation, cardiovascular changes occur due to the forces exerted by the laryngoscope blade on the base of the tongue when lifting the epiglottis.[2] These sympathoadrenergic response following laryngoscopy and intubation peaks at 1 -2 min and returns to baseline within 5 -10 mins, leads to complications like left ventricular failure, myocardial ischemia and cerebral haemorrhage in patients with preexisting hypertension, coronary heart disease, cerebrovascular disease, intracranial pathology and hyperactive airways. This reflex circulatory responses needs to be suppressed by following methods.

Methods to suppress circulatory response	
1. Operator dependent	Senior / experienced
	Time taken during procedure
	Gadgets used during procedure
	First should be best attempt
2. Non pharmacological	1. Various laryngoscopic blades. a) McCoy laryngoscope b) Glidescope laryngoscope video system, c) Truview Premier
	2. Flexible fiberoptic aided intubation
	3. Intubating LMA
	4. Gum elastic Bougie aided ETI.
	5. Variety of endotracheal tubes.
3. Pharmacological measures	
A} Systemic agents	1. Opioid – Fentanyl, remifentanyl etc. 2. Vasodilators, 3. Adrenergic Blockers: 4. Alpha 2 Agonist:- Clonidine 5. Magnesium sulphate Calcium channel blockers
	B} Topical agents

## Aim of the study

This study was done to compare the hemodynamic response to laryngoscopy and intubation using McCoy and Macintosh laryngoscopic blade with or without fentanyl.

## Material and methods

It was a prospective randomized controlled study, conducted after getting approval by our institution ethical committee and obtaining written informed consent from the patient. 120 patients of ASA physical status I&II, belonging to age groups of 18–60 years of both sexes, undergoing elective surgical procedure under general anaesthesia with endotracheal intubation were included in the study.

## Exclusion criteria

- Patients with difficult airway (Mallampatti Class III and IV, thyromental distance <6 cm, inter-incisor distance <3 cm, and cervical instability)
- Require more than one attempt and external manipulation for intubation.
- Hypertension
- Obese (BMI>30)
- Laryngopharyngeal lesion
- Diabetes mellitus,
- Ischemic heart disease,
- Contraindication to drugs that are used.

All patients were randomly allocated into 4 groups each consisting of 30 patient. In Fentanyl group fentanyl 2µg /Kg and non fentanyl group equal volume of saline was given 6 minutes prior to laryngoscopy

**Group A:** intubated with McCoy laryngoscope with fentanyl (McC+F).

**Group B:** intubated with McCoy laryngoscope without fentanyl and received equal volume of saline (McC+NF).

**Group C:** intubated with Macintosh laryngoscope with fentanyl (Mk+F).

**Group D:** intubated with Macintosh laryngoscope without fentanyl and received equal volume of saline (Mk+NF).

Preanaesthetic checkup with detailed airway examination was performed in all patients. Tab alprazolam 0.5mg was given night before surgery. On the day of surgery once the patient was on the operation table ,pulse oximeter and electrocardiography leads and automated non-invasive blood pressure monitor were attached. Baseline parameter were recorded. Intravenous line was secured with 20 gauge cannula. inj ranitidine 150mg Inj. midazolam 2 mg and inj. glycopyrolate 0.2 mg were given 30 min prior to surgery. Patients with ≥ 20% rise in heart rate after glycopyrolate

were removed from the study, 6 mins prior to the start of induction injection fentanyl citrate 2 mcg/kg was given in designated groups (Group 1 and Group 3) and same volume of saline was given in the no fentanyl group (Group 2 and Group 4) by the anesthesiologists, all the events on the trend graph of the multiparamonitor were recorded. The patient was preoxygenated with 100% oxygen for 3 min. Then anaesthesia was induced with 2 mg/kg of propofol. After ventilation is confirmed with a face mask, injection succinylcholine 2 mg/kg was administered, and the patient was ventilated with 100% oxygen for 1 minute, Then laryngoscopy and intubation were carried out in classical sniffing position by a single, experienced anesthesiologist & Endotracheal cuff was inflated with minimal leak. Anaesthesia was maintained with controlled ventilation with Nitrous oxide 60% and oxygen 40%. No surgical simulation was permitted for 7 minutes after intubation HR, SBP, DBP, MAP were noted at different time points- baseline, after induction, immediately after intubation, and subsequently at 1, 2, 3, 4, 5, 6, 7 minutes interval after intubation.

**Statistical analysis:** Means and standard deviations were calculated for quantitative data. Data analysis was done with the help of SPSS version-14. Four groups were analysed for statistical significance by using Kruskal Wallis test, chi square test and t test according to the type of data. P value <0.05 was considered as statistically significant.

## Results

All groups were comparable in terms of demographic

data as well as baseline hemodynamic parameter (Table no.-1) There is no statistically significant difference in the prelaryngoscopy hemodynamic parameters.

There is high statistically significant difference in mean heart rate across 4 groups ( $p < 0.027$ ) at postintubation, 1, 2, 3, 4, and 5 minutes. Group A has 9.9%, Group B has 11.3%, Group C has 14.3%, Group D has 18.2% increase in heart rate from basal value. (Table no.-2)

There is high statistically significant difference in systolic blood pressure across 4 groups ( $p < 0.027$ ) at post intubation, 1, 2, 3, 4 minutes. Group A has 10.9%, Group B has 12.4%, Group C has 14.9% & Group D has 16.8% increase in systolic blood pressure from basal value. (Table no.3)

There is high statistically significant difference in diastolic blood pressure across 4 groups ( $p < 0.027$ ) at postintubation, 1, 2, 3, 4, 5, 6, 7 minutes. Group A has 8.0% Group B has 10.5%, Group C has 12.5%, Group D has 15.7% increases in diastolic BP from basal value. (Table no.4)

There is high statistically significant difference in MAP across 4 groups ( $p < 0.027$ ) at post-intubation, 1, 2, 3, 4, 5, 6, minutes. Group A has 11.5%, Group B has 12.9%, Group C has 16.0%, Group D has 21.4% increase in arterial pressure (MAP) from basal value. (Table no.-5)

Mean heart rate, blood pressures and mean arterial pressure changes are least with group A (McCoy laryngoscope with fentanyl) and maximum with group D (Macintosh laryngoscope without fentanyl).

**Table :- 1 Demographic variables**

	<b>Group A (N=30)</b>	<b>Group B (N=30)</b>	<b>Group C (N=30)</b>	<b>Group D (N=30)</b>	<b>P Value</b>
Age (years)	35.97±9.4	36.73±10.3	35.9±7.3	36.2±5.03	0.909 Non Significant
Sex (M:F)	16:14	12:18	16:14	19:11	0.346 Non Significant
Weight (kilograms)	54.1±3.8	55.0±3.2	54.3±4.8	53.2±3.4	0.256 Non Significant

**Table – 2: Changes in the heart rate at various time intervals**

Heart Rate	Group A		Group B		Group C		Group D		p – value
	Mean	S. D.							
Baseline	82.8	9	83.8	9.6	84.2	7.8	84.1	8.1	0.211 Not Significant
Pre laryngoscopy	84.2	9.7	86.4	10	87.6	6.4	88.4	7	0.123 Not Significant
Post Intubation	87.9	10.2	88.7	10.7	89.6	11	90.8	11.1	0.04 Significant
At 1 minute	91	6.8	93.3	6.9	96.2	4.9	99.4	6	0.0001 Significant
At 2 minutes	91.1	9.5	93.1	9.9	95.7	5.7	99.9	8.1	0.0001 Significant
At 3 minutes	89.9	9.6	92.1	10.2	92.9	5.4	96.8	7.1	0.01 Significant
At 4 minutes	88.5	9.5	89.3	10.8	90.2	6.7	95.6	7.0	0.012 Significant
At 5 minutes	86.8	7.6	87.7	9	89.1	6.8	90.6	6.1	0.0039 Significant
At 6 minutes	85.4	9.4	87.4	11.4	88.1	6.8	89.2	6.4	0.173 Not Significant
At 7 minutes	83.4	9.0	85.7	11.3	88.3	8.1	91.2	5.7	0.31 Not Significant

**Table – 3 : Changes in the Systolic BP at various time intervals**

Systolic BP	Group A		Group B		Group C		Group D		p – value
	Mean	S. D.							
Baseline	119.3	12.1	120.1	11.9	121.2	10.3	122.5	9.1	0.377 Not Significant
Pre laryngoscopy	117.8	7.8	118.3	9.1	119.2	6	121.3	7.3	0.127 Not Significant
Post Intubation	125.2	8.2	126.6	11	128	9.1	129.9	9.7	0.03 Significant
At 1 minute	132.3	7.6	135	8.9	139.1	9.4	143.1	6.1	0.0001 Significant
At 2 minutes	131.3	9.5	132.2	9.3	135.5	9.6	139.7	6.5	0.0001 Significant
At 3 minutes	130.7	7.3	131	10.1	134	9.4	136.9	8	0.015 Significant
At 4 minutes	129.2	8.5	130.1	9.3	131.6	8.7	133.7	8	0.101 Not Significant
At 5 minutes	126.9	6.8	129	6.9	130.8	5.6	131.4	5.4	0.3195 Not Significant
At 6 minutes	124.5	10.4	126.5	9.4	127.4	8.5	128.2	7.2	0.796 Not Significant
At 7 minutes	121.5	10.7	122.2	11.3	124.4	8.1	125.9	7.5	0.971 Not Significant

**Table – 4 : Changes in the Diastolic BP at various time intervals**

Diastolic BP	Group A		Group B		Group C		Group D		p – value
	Mean	S. D.							
Baseline	80.2	8.2	81	8.6	81.3	7.8	83.5	7.6	0.228 Not Significant
Pre laryngoscopy	80.1	8.1	81.8	7.5	82.9	8.2	83.1	10.1	0.076 Not Significant
Post Intubation	82.3	7.5	84.2	8.6	85.1	7.5	86.6	8.4	0.014 Significant
At 1 minute	86.6	8.1	89.5	9.6	91.5	6.9	96.6	7.8	0.0001 Significant
At 2 minutes	85.1	8.2	87.3	9.9	89.5	7.4	91.6	7.9	0.008 Significant
At 3 minutes	83.5	8.1	85.7	9.7	87.4	6.4	93.1	7.5	0.0001 Significant
At 4 minutes	82.7	7.8	84.5	9.4	85.2	6.6	89.1	9.8	0.006 Significant
At 5 minutes	81.7	8.5	83.6	9.2	84.3	7.5	87.4	9.7	0.008 Significant
At 6 minutes	80.3	8.3	82.6	9.7	86.3	9.3	90.7	6.4	0.01 Significant
At 7 minutes	80.4	7.6	84.5	8.5	85.4	8.4	88.3	7.6	0.029 Significant

**Table – 5 : Changes in the mean arterial pressure (MAP) at various time intervals**

MAP	Group A		Group B		Group C		Group D		p – value
	Mean	S. D.							
Baseline	91	8.4	92.5	10	93.2	7.3	95.2	8.9	0.382 Not Significant
Pre laryngoscopy	91.3	5.2	92	7.4	93.4	5.9	95.4	9.6	0.067 Not Significant
Post Intubation	94.7	8.6	95.6	9.8	97.1	6.3	100.3	9.5	0.024 Significant
At 1 minute	101.5	7.8	103.4	9.4	104.5	6.8	111.7	7.3	0.0001 Significant
At 2 minutes	100.6	8.6	102.1	9.8	103.2	6.6	107.6	7.4	0.007 Significant
At 3 minutes	99.2	7.9	100.8	9.9	101.5	8.7	108.1	7	0.001 Significant
At 4 minutes	98.3	8	99.2	9.7	99.9	7	104	9.2	0.039 Significant
At 5 minutes	96.7	7.4	97.1	9.4	98.3	6.5	102.1	7.8	0.003 Significant
At 6 minutes	95.6	8.6	96.9	9.9	97.3	5.5	99.8	8.2	0.089 Significant
At 7 minutes	93.9	8.7	94.5	10.6	95.4	5.6	97.2	8.6	0.16 Not Significant

## Discussion

In 1940, Reid and Brace [4] first described hemodynamic response to laryngoscopy and intubation. Laryngoscopy and Endotracheal intubation is associated with rise in blood pressure, heart rate and cardiac dysarrhythmias [5]. These above mentioned effects may be short lived but they may have adverse effects in high risk patients like, those with cardiovascular diseases, increased intracranial pressure or anomalies of cerebral vessels [6]. Recommendations for attenuating the reflex hypertension and tachycardia elicited by upper airway irritation are therefore manifold. Various anaesthetic techniques has been tried to obtund these deleterious hemodynamic responses like hypertension, tachycardia and arrhythmias in susceptible individuals. Use of McCoy blade instead of Macintosh blade for laryngoscopy is one such measure. The McCoy blade laryngoscope was introduced in 1993, it decreases the amount of force exerted during laryngoscopy and endotracheal intubation so the exaggerated reflex haemodynamic response is significantly reduced. Laryngoscopy with McCoy blade required only 53% of the force (10.1 N) in order to obtain a clear view of vocal cord as compared to Macintosh blade (18.9 N). The reason could be the hinged tip elevates the epiglottis rather than forward displacement of the attached structures by curved blade[7].

Fentanyl is a potent, synthetic narcotic analgesic with a rapid onset and short duration of action. It is extremely lipid soluble, has a low molecular weight and is a synthetic opioid agonist popularly used as intravenous analgesic supplement component of inhalation anaesthesia, balanced anaesthesia and neurolept analgesia and also as a sole anaesthetic. It is 75 to 125 times more potent than morphine as an analgesic [8]. Fentanyl act at opioid receptors and predominantly acts on  $\mu$  receptors [9]. After intravenous administration, onset of effect is 1-2 minutes, and the duration is 1 hour. Consequently it has been proved ideal for control of the short lived haemodynamic sequelae, associated with laryngoscopy and intubation. Fentanyl brings haemodynamic stability during perioperative period by its action on cardiovascular and autonomic regulatory areas. It decreases sympathetic tone and increases parasympathetic tone.

In present study, comparison of hemodynamic response between the two types of blades with or without fentanyl was done & observed that Mean heart rate, blood pressure and mean arterial pressure changes are least with group

A (McC + F) and maximum with group D (MK+NF). In our study the mean laryngoscopy and intubation time in all four groups were below 13 seconds and it has been found that short duration direct laryngoscopy time less than 15 seconds is useful in minimizing the magnitude and duration of the circulatory changes associated with tracheal intubation [10] and all intubation were done in first attempt without cricoid pressure.

McCoy E.P, Mirakhur.R.K, McCloskey B.V (1995) [11] compared the cardiovascular changes and catecholamine concentration in 20 patients before and after laryngoscopy with either McCoy and Macintosh laryngoscope blade. They concluded that plasma catecholamine didn't rise in McCoy group and the stress response is less marked in McCoy blade.

Forbes and Dally [12] observed that laryngoscopy and endotracheal intubation is immediately associated with an average increase in mean arterial pressure of 25 mmHg in all 22 normotensive patients. These responses were interpreted as due to reflex sympathetic adrenal stimulation

Nishiyama T, Higashizawa T, Bito H, Konishi A, Sakai T [13] who concluded that Plasma epinephrine after laryngoscopy in the McCoy group were lower than other two groups and stress response was least in McCoy group and maximum in Macintosh group.

Sachidananda et al. conducted a study and found that McCoy blade laryngoscope provides better attenuation of hemodynamic response as compared to intubation using the Macintosh laryngoscope and intubation can be performed without the aid of stylets [14].

Yushi et al., in his study concluded that 2  $\mu$ g/kg fentanyl suppresses the hemodynamic response to endotracheal intubation more than the response to laryngoscopy [15].

It was shown that supplementation of anesthetic induction with fentanyl 2  $\mu$ g/kg significantly attenuated the increase in heart rate, arterial pressure and rate pressure product after laryngoscopy and intubation, and fentanyl 6  $\mu$ g/kg completely abolished pressure responses [16].

Gupta and Tank [17] showed that fentanyl in bolus dose of 2  $\mu$ g/kg before induction of anesthesia are effective in attenuating the hemodynamic responses to laryngoscopy and endotracheal intubation like heart rate and rate pressure product.

Low doses of fentanyl were employed because a large dose was lead to muscular rigidity, bradycardia, nausea and vomiting. Large doses may also cause postoperative respiratory depression; especially in surgery with short duration of less than 1 hour [16,18]. McClain et al., reported apnoeic episodes in four out of seven patients who received 3.2-6.5 µg/kg fentanyl [19].

## Conclusion

Intubation with McCoy blade along with use of fentanyl 6 minutes before intubation provided a least rise in mean heart rate, mean systolic blood pressure, mean diastolic blood pressure and mean arterial blood pressure.

Intubation with Macintosh blade without fentanyl pretreatment produces maximum stress response when compared with another groups. Thus McCoy laryngoscope produces significantly less rise in haemodynamic parameters as compared to Macintosh laryngoscope during laryngoscopy and intubation. It can be utilized as an additional tool along with pharmacological interventions for obtunding this reflex response. And combination of McCoy with fentanyl produces best combination to reduce stress response so this nonpharmacological intervention of McCoy blade can be utilized as a tool along with pharmacological drug fentanyl, for obtunding hemodynamic responses to laryngoscopy and intubation.

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