Comparison of hemodynamic response to tracheal intubation with Macintosh and McCoy laryngoscopes

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Abstract

Background: Use of McCoy blade laryngoscope avoids the lifting force in the vallecula and theoretically should lead to a lower hemodynamic response related to laryngoscopy and tracheal intubation. The available literature on the topic is conflicting. **Materials and Methods:** We studied the hemodynamic response to laryngoscopy and tracheal intubation in 60 ASA 1 AND 2 adult patients using either Macintosh or McCoy laryngoscopes. The change in systolic, diastolic, mean arterial pressure, and heart rate (HR) was observed for 10 min post intubation. Arrhythmias and ST changes were also observed. **Results:** The maximum change in HR was 18.7% in the Macintosh and 7.7% in the McCoy group, and in systolic arterial pressure was 22.9% in the Macintosh and 10.3% in the McCoy group. This difference between groups was significant ($P < 0.0001$). The change lasted for a lesser duration in the McCoy group. No arrhythmias or ST changes were observed in either group. **Conclusion:** Hemodynamic changes with use of McCoy laryngoscope were lesser in magnitude and of shorter duration.

Keywords: Hemodynamic response, laryngoscopy and intubation, Macintosh laryngoscope, McCoy laryngoscope

Introduction

The major stimuli to cardiovascular change during laryngoscopy and tracheal intubation are the forces exerted by the laryngoscope blade on the base of the tongue while lifting the epiglottis.[1] These hemodynamic changes can be detrimental in vulnerable patients, e.g., those with ischemic heart disease, cerebrovascular disease, etc., and need to be prevented. Anesthetic literature has focused more on the pharmacological methods for obtundation of the response, and literature related to non-pharmacological methods, specifically laryngoscopy blade design, is limited.[2,3] The McCoy blade laryngoscope was introduced in the nineties and has a hinge on the tip to avoid the lifting force in the vallecula.[4]

The objective of this study was to determine the effectiveness of McCoy laryngoscope in attenuating the pressor response secondary to laryngoscopy, compared to standard Macintosh laryngoscope in adult patients undergoing elective surgery.

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Materials and Methods

This randomized, controlled observational study was conducted between 3 October 2008 and 10 April 2009. After approval from the ethical review committee of the university and written informed consent from the patients were obtained, 60 American Society of Anesthesiologists (ASA) 1 and 2 patients of either gender between 18 and 60 years scheduled for elective procedures were randomly allocated to either Macintosh or McCoy laryngoscopy group. Patients with history of anticipated difficult intubation, diabetes, hypertension, chronic obstructive airway disease, ischemic heart disease, and/or cardiac arrhythmias, and those undergoing head and neck surgery were excluded. We also excluded patients with body mass index (BMI) more than 30.

Sample size was calculated using software package NCAA PASS 2000. Thirty patients in each group were required to reach 80% power and 5% level of alpha error to detect a 20% change in blood pressure (BP).

Patients were randomly allocated to two equal groups using the sealed opaque envelope technique. Laryngoscopy and intubation was performed by one of the primary investigators who were familiar and trained with intubation using the McCoy laryngoscope. Due to the nature of the study, true blinding was not possible; however, the person recording the BP measurements was unconnected to the study.

All patients received midazolam 7.5 mg orally approximately 1 h before surgery as premedication. Anesthetic technique was standardized. Patients were pre-oxygenated with three vital capacity breaths using 8 L/min of oxygen via the circle system. Fentanyl 2 mcg/kg was administered intravenously (IV) over 10 s, followed by thiopentone 5 mg/kg given over 30 s. Atracurium 0.5 mg/kg was administered over 10 s to facilitate tracheal intubation. The lungs were ventilated with oxygen (33%), nitrous oxide (66%), and 1% isoflurane. Laryngoscopy and intubation followed 2 min later. The aim was to keep the apneic period during intubation to less than 30 s. An assistant timed the period using a stop watch. A size 7.5 mm ID polyvinyl chloride tracheal tube was inserted in females and size 8.5 mm ID in males. Size 3 laryngoscope blade was used in all cases. No external pressure was applied.

Monitoring included measurement of noninvasive BP, heart rate (HR), oxygen saturation, end-tidal carbon dioxide, concentration of inhalational anesthetic agent, and ST segment analysis (Datex Cardio-cap). All values were recorded before induction, immediately before and after laryngoscopy and tracheal intubation, every minute for 5 min following tracheal intubation, and then 10 min after intubation by an independent observer. Any dysrhythmias or ST segment changes were also recorded during this period. CM_5 lead was used for electrocardiography monitoring.

Data were entered and analyzed using Statistical Package for Social Sciences (SPSS) version 17.0 (Chicago, IL, USA). Mean and standard deviation were calculated for age, weight, and hemodynamic variables at nine time intervals between groups. Repeated measure analysis of variance (ANOVA) was used to compare means for hemodynamic variables in intragroup comparison to baseline parameters. A *P* value of less than 5% was considered significant. Intergroup comparison was done by paired *t*-test. The statistician was not aware of group allocation.

Results

Demographic data and baseline variables are given in [Table 1]. No significant differences were detected for gender ratio, age, weight, baseline HR, systolic, diastolic, and mean BP.

HR rose significantly for 3 min following laryngoscopy in the Macintosh group and for 2 min in the McCoy group.

Table 1: Demographic and baseline data

Variable	Macintosh group	McCoy group	*P* value
Gender-frequency (%)			0.795
Male	14 (46.67)	13 (43.34)	
Female	16 (53.33)	17 (56.66)	
Age (years)	36.23±10.73	31.93±11.44	0.139
Weight (kg)	63.40±11.30	62.60±11.10	0.976
Laryngoscopy and intubation time (s)	16.6±4.0	22.8±4.1	0.000
Heart rate (beats/min)	79.27±6.94	77.7±5.72	0.354
Systolic blood pressure (mmHg)	111.3±6.65	110.4±7.71	0.630
Diastolic blood pressure (mmHg)	71.9±5.53	70.0±6.79	0.248
Mean arterial pressure (mmHg)	84.7±5.18	83.0±6.59	0.272
Pulse pressure (mmHg)	39.4±5.63	40.1±6.16	0.210

A significant drop was seen at 10 min following laryngoscopy in the Macintosh group only. On intergroup comparison, McCoy group showed statistically significant lower values immediately after and at 1, 2, 3, 4, and 5 min following laryngoscopy. 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 ($P = 0.0001$). These changes are shown in [Figure 1].

Both groups showed a significant rise in systolic BP [SAP], compared to baseline immediately after laryngoscopy and at 1 and 2 min following laryngoscopy in the Macintosh group. A significant drop was observed in the Macintosh group at 5 and 10 min after intubation compared to 3, 4, 5, and 10 min in the McCoy group. On intergroup comparison, significantly lower values were seen immediately after and at 1, 2, and 3 min following tracheal intubation in the McCoy group. The maximum change observed in SAP in the Macintosh group was 22.9% compared to 10.3% in the McCoy group ($P = 0.0001$) [Figure 2].

Both groups showed a significant rise in diastolic BP, compared to baseline immediately after laryngoscopy, but only Macintosh group showed a significant rise at 1 and 2 min following intubation. A significant drop was observed at 5 and 10 min in the Macintosh group and at 3, 4, 5, and 10 min in the McCoy group. On intergroup comparison, significantly lower values were seen immediately and at 1, 2, 3, and 4 min following tracheal intubation in the McCoy group. The maximum change observed in the diastolic arterial pressure [DAP] in the Macintosh group was 27% compared to 15% in the McCoy group ($P = 0.0001$) [Figure 3].

The changes in mean BP mimicked the changes in diastolic BP in individual groups. On intergroup comparison, significant changes were seen immediately and at 1 and 2 min after tracheal intubation. The maximum change observed in the Macintosh group was 25.6% compared to 13.6% in the McCoy group ($P = 0.0001$) [Figure 4].

No rhythm disturbances (premature atrial or ventricular complexes or change in pacemaker) or ST segment changes (elevation or depression) were seen in any of the groups during the study period.

A statistically significant difference was observed in the intubation time between the two groups. Time taken for laryngoscopy and intubation was 16.6 ± 4.0 s in the Macintosh group and 22.8 ± 4.1 s in the McCoy group ($P = 0.0001$)

Discussion

Several methods have been used to blunt the cardiovascular response associated with laryngoscopy and tracheal intubation, with more focus on pharmacological methods as compared to non-pharmacological methods. There is limited literature available regarding the influence of type of laryngoscope blade on the hemodynamic response to laryngoscopy and intubation. The McCoy laryngoscope was developed as an aid to difficult laryngoscopy. It requires less force for performing laryngoscopy[5] and, as a result, may alter the associated hemodynamic response. Our literature search on the subject located only a limited number of studies with controversial results. McCoy *et al.* compared HR and BP responses between Macintosh and McCoy laryngoscopes following laryngoscopy in 20 ASA 1 or 2 patients. Intubation was not performed, but catecholamine concentration was measured.[2] HR and BP showed significantly greater increase in the Macintosh group compared to the baseline values, but no significant difference was observed between the two blades. The study sample, however, was small (10 patients

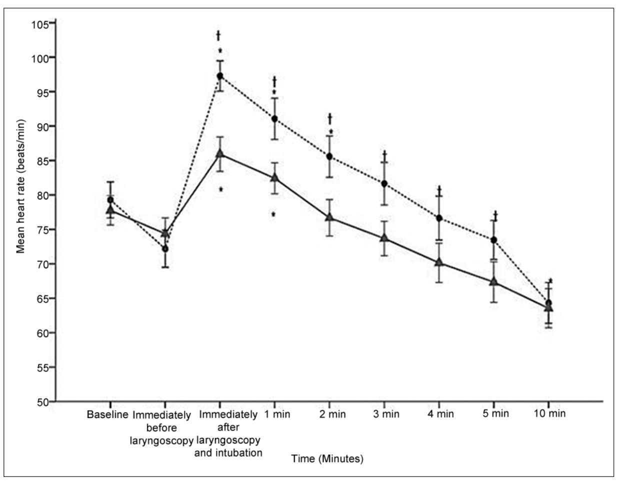

Figure 1: Comparison of mean heart rate between Macintosh blade (•...•) and McCoy blade (▲____▲). *Indicates significant difference from baseline; †indicates significant difference between groups

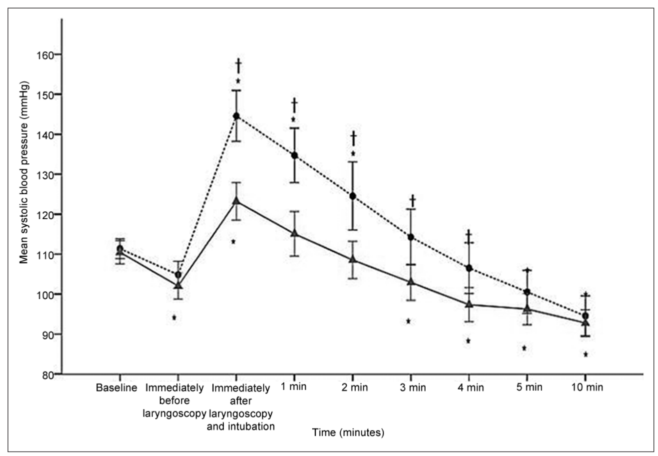

Figure 2: Comparison of mean systolic blood pressure between Macintosh blade (•....•) and McCoy blade (▲___▲) †indicates significant difference between groups

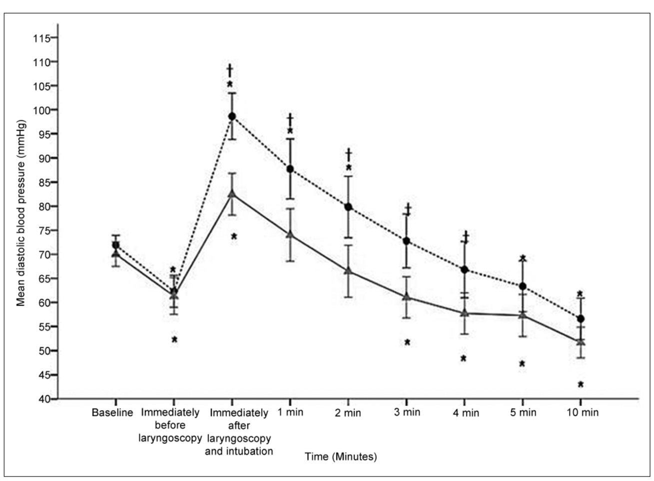

Figure 3: Comparison of mean diastolic blood pressure between Macintosh blade (•....•) and McCoy blade (▲___▲). *Indicates significant difference from baseline; † indicates significant difference between groups

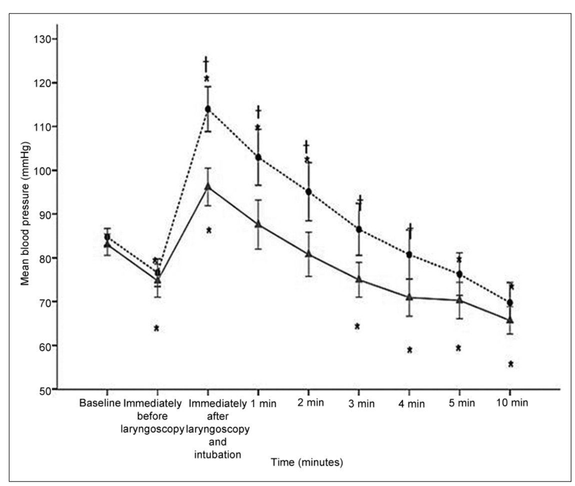

Figure 4: Comparison of mean blood pressure between Macintosh blade (•....•) and McCoy blade (▲___▲). *Indicates significant difference from baseline; † indicates significant difference between groups

in each group) and no justification was provided for the small sample size. Tewari *et al.* compared the two blades in 160 neurosurgical patients and showed that use of McCoy laryngoscope resulted in lesser change in HR and BP, compared to Macintosh blade when fentanyl was not used in obtundation of response. However, when fentanyl was given as an analgesic, no difference was observed between the groups.[3] On the other hand, some studies did not observe any difference in the hemodynamic response between the two blades.[6-8] Lesser response with McCoy laryngoscope can be of clinical benefit as lesser dose of drugs will be required to attenuate this response thereby decreasing the side effects associated with drugs like potent narcotics.

Our results support the studies with lesser response seen with the use of McCoy laryngoscope. In McCoy's study, no change in HR was observed, whereas in our study HR did rise significantly for 2 min following laryngoscopy and intubation. This could be explained by the fact that McCoy only studied response to laryngoscopy and not tracheal intubation. Tracheal intubation has been shown to affect HR more than laryngoscopy.[1] Use of video laryngoscope also causes lesser stimulation of hypopharynx, and investigators have studied the effect of video laryngoscopy on sympathetic response associated with intubation and have reported lesser hemodynamic response compared to Macintosh blade.[9,10]

One limitation of our study was the noninvasive measurement of BP, but it was not justified to use this technique in the relatively healthy ASA 1 and 2 patients. We also did not measure the muscle relaxation and the degree of relaxation at the time of tracheal intubation which may affect the response. Another critique will be the significantly longer intubation time with the McCoy group (22.8 ± 4.1 s vs. 16.6 ± 4.0 s). However, a study by Gill *et al.* showed that laryngoscopy duration less than 30 s did not have any effect on the hemodynamic response.[11] All our intubations were performed in less than 30 s.

Conclusion

The hemodynamic response to laryngoscopy and intubation with McCoy laryngoscope was significantly less than with Macintosh laryngoscope and within 15% of baseline values in ASA 1 and 2 patients. Based on these results, further studies should be performed in high-risk populations.

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