Original Research Article

Indian Journal of Anesthesia and Analgesia
July – August 2020;7(4)
DOI: http://dx.doi.org/10.21088/ijaa.2349.8471.7420.23

A Comparative Study of Laryngoscopic View and Intubation Response using Macintosh, McCoy and AirTraq Laryngoscopes in Adults Undergoing Elective Surgeries

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How to cite this article:

Nikhila Rajendra, Dinesh Krishnamurthy, Ravi Madhusudhana et al. A Comparative Study of Laryngoscopic View and Intubation Response using Macintosh, McCoy and AirTraq Laryngoscopes in Adults Undergoing Elective Surgeries. Indian J Anesth Analg. 2020;7(4):1011–1018.

Abstract

Context: Laryngoscopes are most commonly used for endotracheal intubation. It plays an important role in securing airway in emergency conditions and in administration of general anesthesia. They range from simple rigid scopes with a light bulb to complex fiber optic video devices.

Objectives: The purpose of the study was tocompare laryngoscopy and intubating conditions in three groups of patients using Macintosh, McCoy and Airtraq laryngoscope:Visualisation of pharyngeal structures and larynx as per Modified Cormack and Lehane grading; Hemodynamics; Adverse effects, if any.

Settings and Design: Randomised prospective comparative study.

Methods and Material: after obtaining ethical committee approval, 90 adult patients of either sex, aged between 18 to 60 years, of physical status ASA Grade I and Grade II undergoing elective surgeries under general anesthesia after obtaining written informed consent were included. Divided into 3 groups of 30 each and randomly allocated. Group I -Patients intubated with Macintosh laryngoscope (n-30); Group II - Patients intubated with Airtraq optical laryngoscope (n-30); Group III -Patients intubated with McCoy laryngoscope (n-30).

The laryngoscopy view obtained was compared according to Cormack and Lehane grading. The change in systolic, diastolic, mean arterial pressure, pulse rate and SpO_2 will be recorded at pre-induction, pre-intubation and post intubation at 1, 3 and 5 minutes.

Statistical analysis used: The demographic data was analysed using descriptive statistics and expressed as mean ± standard deviation. Categorical data was analyzed by chi square test. P value of 0.05 or less was considered statistically significant.

Results: Airtraq laryngoscope improved the Cormack and Lehane glottic view compared with the McCoy and Macintosh laryngoscopes. The maximum change in HR was 24% in the Macintosh, 2.27% in the Airtraq and 11.9% in the McCoy group, and increase mean arterial pressure was 20.63% in the Macintosh, 4.37% in the Airtraq and 7.37% in the McCoy group. This difference between the three groups was significant ($P < 0.0001$).

Conclusions: From the present study, it is concluded that Airtraq optical laryngoscope provides a better glottic exposure and triggers minimal hemodynamic response to laryngoscopy and intubation when compared to Macintosh and McCoy.

Keywords: Airtraq laryngoscope; Intubation response; Laryngoscopy; Macintosh laryngoscope; McCoy laryngoscope.

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Introduction

In General Anesthesia, Laryngoscopy and endotracheal intubation plays a crucial role. Facilitation of tracheal intubation under vision is done using Direct laryngoscopy.[1] "Sniffing position" where there is flexion at the lower cervical spine and extension at the atlanto-occipital joint is achieved, by aligning the axes of the oral cavity, pharynx and larynx.

Laryngoscopes are used for purpose of inserting an endotracheal tube into the endobronchial tree. They range from simple rigid scopes with a light bulb to complex fibre optic video devices.[2]

Macintosh laryngoscope is a type of rigid direct laryngoscope which is most commonly used in day to day practice.

The McCoy blade is a modification of the Macintosh blade (with a hinged tip) which blade decreases the amount of forces exerted during laryngoscopy and endotracheal intubation. Thus, the exaggerated reflex hemodynamic response becomes clinically insignificant.[3]

The Airtraq optical laryngoscope is a type of rigid indirect laryngoscope. It contains a lateral channel used for passage of endotracheal tube, which has a built in antifog system and a low temperature light.[4] Without the alignment of oral, pharyngeal and laryngeal axis, Airtraq allows the visualization of vocal cords.[5]

The process of laryngoscopy is known to have profound cardiovascular effects and stimulation of supraglottic region by laryngoscopic blade with tracheal tube placement is the major cause of the sympathoadrenal response and cuff inflation, causing little additional stimulation.[6,7] Following laryngoscopy the pressor response leads to complications like myocardial ischemia, cardiac failure, intracranial hemorrhage and increase in intracranial pressure.[8,9]

Objectives

Comparative assessment laryngoscopy and intubating conditions in three groups of patients using Macintosh, McCoy and Airtraq laryngoscope: Visualisation of pharyngeal structures and larynx as per Modified Cormack and Lehane grading in all three groups; Hemodynamics in all three groups; Adverse effects in all the three groups, if any.

Materials and Methods

Ninety (90) patients in the age group of 18-60 years undergoing elective surgery under General Anesthesia were included. The duration of study was December 2013 to May 2015.

Ethical clearance was obtained from Institutional Ethics, patients posted for various elective surgeries requiring general Anesthesia were recruited in our study after taking written informed consent. All the patients were explained regarding the study and objectives.

Ninety (90) patients scheduled for different elective surgeries under General Anesthesia were randomly allocated to one of the three groups of 30 patients each group.

Group I: Patients intubated with Macintosh laryngoscope (n-30)

Group II: Patients intubated with Airtraq optical laryngoscope (n-30)

Group III: Patients intubated with McCoy laryngoscope (n-30)

Inclusion criteria: ASA grade I and II; Age group 18-60 years; Mallampati class I or II.

Exclusion criteria: Patients with uncontrolled hypertension and cardiac disease.; Patients allergic to any of the general Anesthetics; Obese patients; Patients with inter incisor distance less than 3 cm; Patients recognised as difficult laryngoscopy and intubation during pre Anesthetic checkup.

All patients were examined a day prior to surgery. A systemic examination was done to rule out any conditions mentioned in the exclusion criteria. The hemodynamic variables, heart rate, systolic blood pressure, diastolic blood pressure and mean arterial pressure are recorded preoperatively and airway assessment was done. All the routine investigations were done.

All patients were kept Nil Per Oral (NPO) for 8 hr prior to the surgery. Pre-medication includes Tab. Ranitidine 150 mg and Tab. Alprazolam 0.5 mg at night previous today before surgery. Patients were repeated with Tab. Ranitidine at 6:00 am on the day of surgery.

In this study, English Macintosh size 3 blade, Airtraq optical laryngoscope size 3 and McCoy laryngoscope size 3 were used. Psychological assurance given to the patient in operation theatre and intravenous line was started.

The following monitors were connected before induction: Pulse oximeter; Non invasive blood pressure monitor; ECG monitor; $EtCO_2$.

Patients were premedicated with glycopyrrolate 0.2 mg, fentanyl 2 ug/kg and Injection Xylocard 1.5 mg/kg body weight. Then patient was

preoxygenated with mask for 3 minutes with 100% oxygen and preinduction heart rate, noninvasive blood pressure, SpO_2 and ECG monitoring were recorded.

General Anesthesia was standardized by using Injection propofol 2 mg/kg for induction and Inj. Suxamethonium 2 mg/kg for muscle relaxation before intubation. The heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure, oxygen saturation (SpO_2) and ECG was noted just prior to laryngoscopy.

Patients in group A and group C were put into "sniffing position" and intubated with Macintosh and McCoy laryngoscope respectively. Patients in group B were put in neutral position and intubated with Airtraq laryngoscope.

The laryngoscopy view obtained was compared according to Modified Cormack and Lehane grading as follows.

Grade 1: Most of the glottis is visible

Grade 2: Only posterior extremity of glottis visible

2a-partial view of the vocal cords

2b-only the arytenoids and the epiglottis seen

Grade 3: No part of glottis visible only epiglottis visible

3a–epiglottis can be lifted from the posterior pharyngeal wall

3b–epiglottis cannot be lifted.

Grade 4: Not even epiglottis visible

The endotracheal tube was connected to Bain's circuit. Position of the tube was confirmed by $EtCO_2$ and auscultation. The endotracheal tube was secured and controlled ventilation was instituted. General Anesthesia was maintained with 66% N_2O, 33% O_2 and isoflurane 0.4%. Intravenous vecuronium bromide, 0.1 mg/kg loading dose and 0.02 mg/kg as maintenance dose was used as neuromuscular blocking agent.

Study parameters were assessed. Noninvasive blood pressure, pulse rate and SpO_2 was recorded at preinduction, preintubation and post intubation at 1, 3 and 5 minutes. Any arrhythmias and complications during intubation like local injuries, bleeding, regurgitation, laryngospasm and fall in SpO_2 was noted.

Neuromuscular blockade was reversed with Inj. neostigmine 0.05 $mgkg^{-1}$ and Inj. Glycopyrrolate 0.01 $mgkg^{-1}$ both IV after ensuring adequate recovery from neuromuscular blockade. Oral cavity and throat were suctioned thoroughly prior to extubation.

Statistical analysis

The demographic data was analysed using descriptive statistics and expressed as mean ± standard deviation. Categorical data was analyzed by chi square test. P value of 0.05 or less was considered statistically significant.

Result

Ninety (90) patients in ASA grade I and II of either sex aged between 18 years to 65 years with Mallampatti Class I and II posted for elective surgery under general Anesthesia were selected for the study. The study was conducted to evaluate the efficacy of laryngoscopy on Cormack Lehane grade and hemodynamic response to endotracheal intubation between Airtraq optical laryngoscope, McCoy laryngoscope and Macintosh laryngoscope.

In our study, the mean age of the patients was 39.37±13.43 years in Group I, 35.67±12.1 3 years in Group II and 40.10±13.98 years in Group III. The difference in age groups between the two groups were statistically insignificant (p= 0.383).

There were 11 males and 19 females in Group I, 9 males and 21 females in Group II and 10 males and 20 females in Group III. The differences in the sex distribution between the two groups were statistically insignificant (p=0.861).

The mean weight of patients in Group I was 58.40±6.97 kg, Group II was 60.93±6.69kg and Group III was 59.03±8.98. The differences in mean weight between the three groups were statistically insignificant (p = 0.411).

The mean height of patients in Group I was 157.43±7.71 cm, Group II was 158.77±7.04 cm and Group III was 159.13±7.24 cm. The differences in mean height between the two groups were statistically insignificant (p = 0.642).

The mean BMI of patients in Group I was 23.68±3.26 kg/m^2, Group II was 24.21±2.29 kg/m^2 and Group III 23.28 ± 3.04 kg/m^2. The differences in mean BMI between the two groups were statistically insignificant (p = 0.463).

The differences in the Cormack and Lehane grading between the group I and II and between the group II and III were statistically significant (p = 0.001).

Table 1: Cormack and Lehane grading by groups

CLG	Group I		Group II		Group III	
	No	%	No	%	No	%
I	20	66.7	30	100.0	21	70.0
II	10	33.3	0	0.0	9	30.0
Total	30	100.0	30	100.0	30	100.0

P=0.002

Group I-Group II: P=0.001**

Group I-Group III: P=0.781

Group II-Group III: P=0.001**

Table 2: Mean heart rate (bpm) prior to intubation and after intubation

Heart Rate (bpm)	Group I	Group II	Group III	Overall P value	Pair-Wise Significance		
					Group I-Group II	Group I-Group III	Group II-Group III
Baseline	82.07±7.62	84.07±10.64	87.10±7.79	0.089+	0.654	0.074	0.379
0 min	81.53±7.53	85.33±10.79	85.03±7.83	0.186	0.225	0.281	0.991
1 min	105.53±6.93	87.60±10.57	96.93±7.95	<0.001**	<0.001**	0.001**	<0.001**
3 min	97.93±6.49	89.67±9.58	90.53±8.00	<0.001**	<0.001**	0.002**	0.910
5 min	92.43±8.65	92.67±10.30	87.70±7.78	0.059+	0.994	0.108	0.087+

The increase in mean heart rate after intubation was more with Macintosh laryngoscope compared to Airtraq optical laryngoscope and McCoy laryngoscope.

Table 3: Mean systolic blood pressure (mmHg) prior to intubation and after intubation

SBP (mm Hg)	Group I	Group II	Group III	Overall P value	Pair-Wise Significance		
					Group I-Group II	Group I-Group III	Group II-Group III
Baseline	120.60±10.53	123.27±9.77	122.23±9.38	0.577	0.552	0.799	0.914
0 min	122.23±10.53	121.67±10.02	120.37±9.44	0.761	0.974	0.751	0.870
1 min	148.70±10.03	128.03±10.24	130.50±8.77	<0.001**	<0.001**	<0.001**	0.589
3 min	136.73±9.47	125.37±10.14	124.40±9.63	<0.001**	<0.001**	<0.001**	0.922
5 min	110.27±20.82	115.60±9.24	117.87±10.72	0.121	0.334	0.112	0.818

The increase in systolic blood pressure after intubation was more with Macintosh laryngoscope compared to Airtraq optical laryngoscope and McCoy laryngoscope.

Table 4: Mean diastolic blood pressure (mmHg) prior to intubation and after intubation

DBP (mm Hg)	Group I	Group II	Group III	Overall P value	Pair-Wise Significance		
					Group I-Group II	Group I-Group III	Group II-Group III
Baseline	71.90±15.03	79.00±8.15	77.20±6.43	0.029*	0.029	0.132	0.787
0 min	76.17±7.09	77.27±8.39	76.03±6.39	0.775	0.831	0.997	0.792
1 min	93.43±6.04	80.40±8.58	86.63±6.14	<0.001**	<0.001**	0.001**	0.003**
3 min	87.73±6.65	79.40±8.54	81.17±6.46	<0.001**	<0.001**	0.002**	0.617
5 min	73.30±7.34	75.17±8.09	73.87±6.24	0.596	0.582	0.951	0.768

The increase in diastolic blood pressure after intubation was more with Macintosh laryngoscope compared to Airtraq optical laryngoscope and McCoy laryngoscope.

Table 5: Mean arterial pressure (mmHg) prior to intubation and after intubation

MAP (mm Hg)	Group I	Group II	Group III	Overall P value	Pair-Wise Significance		
					Group I-Group II	Group I-Group III	Group II-Group III
Baseline	90.13±7.23	93.77±8.31	92.13±5.53	0.147	0.124	0.523	0.648
0 min	90.97±7.19	91.77±8.41	90.80±5.56	0.855	0.902	0.996	0.860
1 min	111.60±6.32	95.97±8.60	98.17±19.17	<0.001**	<0.001**	<0.001**	0.780
3 min	103.90±6.41	94.77±8.61	95.53±5.37	<0.001**	<0.001**	<0.001**	0.904
5 min	86.77±6.65	88.73±8.03	88.53±5.77	0.479	0.512	0.582	0.993

The increase in arterial pressure after intubation was more with Macintosh laryngoscope compared to Airtraq optical laryngoscope and McCoy laryngoscope.

Discussion

Securing the airway is a vital step in administrating General Anesthesia. Airway is secured through endotracheal intubation. Direct laryngoscopy is used to facilitate tracheal intubation under vision. Successful direct laryngoscopy depends on achieving a line of sight from the maxillary teeth to the larynx. To aid the process of intubation, laryngoscopes ranging from simple rigid laryngoscope to complex fiber optic video devices have been developed and studied.

Tracheal intubation is a crucial skill in Anesthetic practice. It needs direct laryngoscopy to view the vocal cords for insertion of the tube. Both laryngoscopy and passage of a tracheal tube are noxious stimuli that can incite adverse events in the respiratory, cardiovascular and other physiologic systems.[1] Direct laryngoscopy and intubation are noxious stimuli that can provoke adverse responses in the cardiovascular system like tachycardia and hypertension. The hemodynamic changes was first described by Reid and Brace. The magnitude of the response is greater with increasing force and duration of laryngoscopy. Transitory hypertension and tachycardia are probably of no consequences in healthy individuals. Both may be hazardous to those with hypertension, myocardial insufficiency and cerebrovascular disease.

Thus the laryngoscopes should facilitate good laryngoscopic view of the vocal cords to ease the process of intubation while triggering minimal stress response. The Macintosh blade is one of the most popular blades. The tongue has a gentle curve that extends to the tip. In cross section, the tongue, web, and flange form a reverse Z. Numerous modifications have been suggested.

The McCoy laryngoscope is a modified Mackintosh laryngoscope, which has a hinged tip controlled by a lever on the handle. It is designed to elevate the epiglottis with its hinged tip. This unique design has two advantages compared with the Macintosh laryngoscope. First, using the McCoy laryngoscope results in less force being applied during laryngoscopy and the stress response to laryngoscopy is reduced. Secondly, difficult laryngeal visualization may be improved by lifting the epiglottis. Especially in patients with the neck fixed in the neutral position, this laryngoscope can improve the laryngeal view.

The Airtraq is a new intubation device that has been developed to facilitate tracheal intubation inpatients with normal or difficult airways As a result of the exaggerated curvature of the blade and an internal arrangement of optical components, a view of the glottis is provided without alignment of the oral, pharyngeal and tracheal axes.

The blade of the Airtraq consists of two side by side channels. One channel acts as a conduit through which an endotracheal tube (ETT) can be passed, while the other channel contains a series of lenses, prisms and mirrors that transfers the image from the illuminated tip to a proximal view finder, giving a high quality wide-angle view of the glottis.

In our study, the efficacy of laryngoscopy on Cormack Lehane grade and hemodynamic response to endotracheal intubation between English Macintosh laryngoscope, McCoy laryngoscope and Airtraq optical laryngoscope were studied.

A total of Ninety (90) patients between the age group of 18-60 years were included in the study. The study population was randomly divided into three groups with 30 patients in each group.

The mean age in Group I (Macintosh) was 39.37 ±13.43 years, Group II (Airtraq) was 35.67±12.13 years and Group III (McCoy). The differences in the mean age between the three groups were statistically insignificant.

There were 11 males and 19 females in Group I, 9 males and 21 females in Group II and 10 males and 20 females in Group III. The differences in the sex distribution between the two groups were statistically insignificant (p=0.861).

The mean weight of patients in Group I was 58.40±6.97kg, Group II was 60.93±6.69kg and Group III was 59.03±8.98kg. The differences in mean weight between the three groups were statistically insignificant(p = 0.411).

The mean height of patients in Group I was 157.43±7.71 cm, Group II was 158.77±7.04 cm and Group III was 159.13±7.24 cm. The differences in mean height between the two groups were statistically insignificant (p = 0.642).

The mean BMI of patients in Group I was 23.68±3.26 kg/m^2, Group II was 24.21 2.29 kg/m^2 and Group III 23.28±3.04 kg/m^2. The differences in mean BMI between the two groups were statistically insignificant (p = 0.463).

Thus patients in all three the groups were comparable with respect to age, sex, weight, height and BMI.

Laryngoscopic view

The laryngoscopic view was compared according to Modified Cormack and Lehane grading. The Cormack and Lehane grading system, although originally designed to compare glottic views at direct laryngoscopy, provided a useful comparison of the direct and indirect laryngoscopic views achieved in this study.

So in the present study the visualization of larynx according to Cormack and Lehane grading was better with Airtraq optical laryngoscope compared with Macintosh laryngoscope and McCoy laryngoscope which was statistically highly significant.

Maharaj et al. compared the Airtraq with the Macintosh laryngoscope in patients deemed at low risk for difficult intubation in a randomized, controlled clinical trial and found that Airtraq laryngoscope provided a better laryngoscopic view when compared to Macintosh laryngoscope.[10]

Lopez-Negrete et al. compared the AirTraq and Macintosh views and assessed whether predictor of intubation difficulty are useful when the AirTraq laryngoscope is used and found that Airtraq laryngoscope provided a better laryngeal view when compared to Macintosh laryngoscope.[11]

Ranieri D et al. compared intubation conditions produced by the Macintosh and Airtraq laryngoscopes when used in obese patients in the ramped position and concluded that the Airtraq laryngoscope provided an improved vocal cord view as assessed by the Cormack and Lehane score when compared with the Macintosh laryngoscope.[12]

These results are similar and comparable to the present study.

Hemodynamic response to laryngoscopy and intubation

Hemodynamic response to laryngoscopy and intubation include tachycardia, hypertension and dysrhythmias. In healthy patients these responses are generally well tolerated but in patients with limited coronary or myocardial reserve these changes can be detrimental.

Airtraq laryngoscope resulted in less alteration in heart rate following laryngoscopy when compared to Macintosh and McCoy laryngoscope.

The increase in systolic blood pressure after intubation between the three groups was statistically highly significant. The increase in systolic blood pressure was more with Macintosh laryngoscope when compared to McCoy and Airtraq laryngoscope.

The increase in diastolic blood pressure after intubation between the three groups was statistically highly significant. The increase in diastolic blood pressure after intubation was more with Macintosh laryngoscope compared to McCoy and Airtraq laryngoscope.

The increase in mean arterial pressure after intubation between the three groups was statistically highly significant. The increase in mean arterial pressure after intubation was more with Macintosh laryngoscope compared to McCoy and Airtraq laryngoscope.

Maharaj et al. compared the Airtraq with the Macintosh laryngoscope in patients deemed at low risk for difficult intubation in a randomized, controlled clinical trial and demonstrated that Airtraq resulted in less alterations in heart rate.[10]

Maharaj et al. compared the ease of intubation using the Airtraq with the Macintosh laryngoscope, in patients at increased risk for difficult tracheal intubation, in a randomized controlled clinical trial and found that Airtraq reduced the degree of hemodynamic stimulation when compared to the Macintosh laryngoscope.

McCoy et al. compared Macintosh and McCoy laryngoscope and concluded that the stress response to laryngoscopy was less marked with the use of the McCoy blade and is it probably due to a reduction in the force necessary to obtain a clear view of the larynx.[13]

Padmaja Durga et al. compared tracheal intubation using Airtraq and McCoy laryngoscope

in presence of a rigid cervical collar simulating cervical immobilisation for traumatic cervical spine injury cases and concluded that Airtraq improved the ease of intubation significantly when compared to McCoy blade.[14]

Gabbott compared the ease of intubation using the Macintosh laryngoscope and McCoy laryngoscopes in people with rigid cervical collar and concluded that McCoy laryngoscope significantly improves the view at laryngoscopy in the patient whose neck is immobilized in a rigid cervical collar.[15]

Mehtab A Haidry et al. compared the hemodynamic responses to tracheal intubation with Macintosh and McCoy laryngoscopes and concluded that hemodynamic changes was lesser in magnitude and of shorter duration with McCoy laryngoscope.[16]

These results are similar to our study. The process of laryngoscopy is known to have profound cardiovascular effects. This includes pressor response and tachycardia along with an increase in catecholamine concentration, mainly nor-epinephrine. The major cause of the sympathoadrenal response is believed to rise from stimulation of supraglottic region by laryngoscopic blade with tracheal tube placement and cuff inflation contributing little additional stimulation. The magnitude of response is greater with increasing force and duration of laryngoscopy.

In the present study, Airtraq optical laryngoscope resulted in lesser alterations in the heart rate, systolic blood pressure, diastolic blood pressure and mean arterial pressure when compared to Macintosh laryngoscope. This can be attributed to the fact that Airtraq provides a view of the glottis without the need to align the oral, pharyngeal and tracheal axes, and therefore requires less force to be applied during laryngoscopy.

Strength and Limitation

Strength of our study is all the health care providers with proper training can use Airtraq during both elective and emergency intubation. Airtraq has better laryngoscopic view with minimal hemodynamic response during laryngoscopes and intubation.

Limitation of our study is that Airtraq is costly and also all health care providers need adequate training in usage of the scope for laryngoscopy and intubation. When not used properly it may lead to difficult intubation.

Conclusion

From the present study, it is concluded that

1. Airtraq optical laryngoscope provides a better glottis exposure when compared to Macintosh and McCoy laryngoscopes.
2. Airtraq optical laryngoscope triggers minimal hemodynamic response to laryngoscopy and intubation when compared to Macintosh and McCoy laryngoscope and this can be attributed to the reduction in lifting force necessary to obtain a clear view of the glottis.

Key Messages

Students are trained with classical Macintosh blade and Miller blade in the initial period, once they understand the technique and when the novice becomes a master in routine case management; other gadgets are introduced for their appreciation in accessing difficult airway. When trained properly these gadgets can ease the access of instrumenting and intubation the difficult airway.

Prior publication: Nil

Support: Nil

Conflicts of interest: Nil

Permissions: Nil

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