Original Article

A comparative study of tracheal intubation characteristics using Macintosh and Airtraq laryngoscope

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ABSTRACT

Background: *Direct laryngoscopy for endotracheal intubation with the Macintosh blade is most commonly used for establishing a patent airway. Airtraq™ Optical Laryngoscope, does not require the alignment of the 3 airway axes for glottic visualization.*

Objective: *We aim to compare these two laryngoscopes in view of laryngoscopic grading, ease of tracheal intubation and hemodynamic changes associated with laryngoscopy and intubation.*

Materials and Methods: *50 ASA I and II patients were randomly divided into Macintosh (M) group and Airtraq (A) group. Cormack Lehane grading, ease of intubation, laryngeal intubation time in secs and incidence of sore throat was noted. HR & BP was recorded at 0, 1, 3, 5 & 10 minutes following intubation. Unpaired 't' test compared inter-group data, while paired 't' test compared within group cardiovascular data. ($p<0.05$ statistically significant)*

Results: *The demographic data of both groups were comparable. Cormack-Lehane grading was better in group A than in group M [grade I group A(84%) and group M(60%)]. The mean time for laryngeal intubation (Mean ± SD) for group A (8.3 ± 4.6 secs) and group M (20.46 ± 6.6 secs) ($t = 7.6$, $p< 0.01$). Ease of intubation was better in group A than group M. The rise in blood pressure and heart rate was significantly less in Group A as compared to Group M.*

Conclusion: *Airtraq laryngoscope was superior to Macintosh laryngoscope as it provided better laryngoscopic views, shorter laryngoscopy and intubation time, easier intubation and the rise in heart rate and systolic blood pressure was significantly less.*

Keywords: *Tracheal intubation, anaesthesia, Macintosh laryngoscope, Airtraq laryngoscope*

Introduction

The major responsibility of the anaesthesiologist towards the patient is the provision of patent airway and thereby providing an intact functional respiration. No anaesthesia is safe unless diligent efforts are devoted in maintaining a patent airway. Among the various means of establishing an intact airway endotracheal intubation is most common and thus it comprises as an important part of general anaesthesia. Intubation is not a risk free procedure, however not all patients receiving general anaesthesia require it. In general, intubation is indicated for insurance of a patent airway, prevention of aspiration, suction access to the airway for periodic removal of retained secretions, connection to mechanical ventilators and for those undergoing surgical procedures involving body cavities.

Laryngoscopes are used to visualize the larynx and adjacent structures most commonly for the purpose of inserting endotracheal tube into the tracheobronchial tree. They range from simple rigid laryngoscope to complex fiberoptic apparatus. Conventional direct laryngoscopy for endotracheal intubation with the Macintosh blade (a form of simple rigid laryngoscope) is considered as the gold standard as well as the fastest method for

endotracheal intubation. [1] However, tracheal intubation using a laryngoscope inevitably involves distortion of anatomy in order to bring the glottis in view. Beside direct laryngoscopy and intubation induces arterial hypertension, tachycardia and increased catecholamine concentration secondary to proprioceptor stimulation of the supraglottic structures. [2, 3, 4]

If a device can improve the view of laryngoscopy it will be a valuable aid to larygoscopy and intubation. Thus various types of laryngoscopes are in use in clinical practice in order to make laryngoscopy and intubation easier.

Airtraq^{Tm} Optical Laryngoscope [King Systems Corporation, Noblesville, IN 46060] is a newly introduced intubation aid. It can be used for routine endotracheal intubation as well as in patients with difficult airways. [5, 6] The curvature of the blade and the well designed optical components help in visualization of the glottis without the need for aligning the 3 airway axes namely the oral, pharyngeal and tracheal. Yet another advantage of this new device is that it does not obstruct the endoscopic view of the vocal cord during the act of laryngoscopy. [7] With these factors in mind in this present study we aimed to compare the conventional Macintosh laryngoscopes with the Airtraq Optical laryngoscope in view of laryngoscopic grading (Cormack and Lehan grading), intubation time, ease of tracheal intubation, peri-laryngoscopy intubation changes in heart rate and blood pressure and incidence of sore throat.

Material and Methods

The study was undertaken at J.N Medical College and Hospital, Aligarh during 2009 to 2010. Following approval by the institutional ethics committee, 50 ASA I & II non-obese patients of either sex aged 20-50 years undergoing general anesthesia for elective surgery were included. Patients with predicted difficult laryngoscopy and intubation and those posted for surgeries of head and neck were excluded. After informed consent, patients were randomly divided into 2 groups by a computer generated randomization table. Patients of Control Group [n = 25] were intubated using Macintosh (M) laryngoscope, while patients of Study Group [n = 25] were intubated using Airtraq (A) laryngoscope. Blinding of the attending laryngoscopist was not possible as the two laryngoscopes were conspicuously different.

Anesthetic technique comprised of a uniform premedication with Inj. midazolam 0.025 mg/kg, ondansetron 4.0 mg, and tramadol 2.0 mg/kg. All drugs were administered intravenously 15 min prior to induction of anesthesia. On arrival to the operative room all patients were connected to 5 lead ECG, non invasive blood pressure (NIBP) and pulse oximeter. Immediate preinduction heart rate (HR) and blood pressure (BP) value was recorded and considered as control value. Thereafter, HR & BP was recorded at 1, 3, 5 & 10 minutes after intubation such that 0 being base line, 1 as 1 min after intubation, 2 as 3 min after intubation, 3 as 5 min after intubation and 4 being 10 min after intubation. The above description of recording time was adhered for tabulating the observation on heart rate and systolic blood pressure.

Anesthesia was induced with 2 mg/kg of propofol. After adequate muscle relaxation with Succinylcholine 1.5 mg/kg, all laryngoscopies and intubations were carried out by an anesthetist with over one year experience with Macintosh laryngoscope and more than 25 intubations with Airtraq laryngoscope. Cormack and Lehan grading where Grade I – Vocal cords

are fully visible, Grade II –Vocal cords are partly visible, Grade III –Only epiglottis is seen and Grade IV –Epiglottis cannot be seen, was done by the attending laryngoscopist. Laryngoscopy time was calculated from introduction to the removal of laryngoscope blade from the mouth. The time was measured in seconds by an assistant using a stop watch.

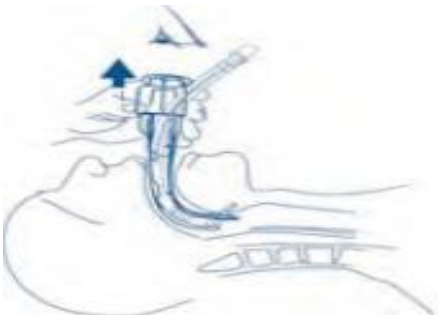
The ease of intubation was graded as Grade I: No manipulation of the larynx was required, Grade II: External manipulation was necessary to intubate, Grade III: Intubation possible only with a stylet and Grade IV: Failed intubation. Laryngeal Mask Airway (LMA) of appropriate size was kept ready as a rescue device for failed intubation.

Following successful intubation, breathing circuit was attached and an infusion of propofol [6 mg/kg/h] commenced while the patient received 60% N2O in Oxygen. Surgery was allowed to commence only after the collection of the last haemodynamic data at 10 minutes post-intubation interval.

Postoperatively, sore throat was assessed by an independent observer blinded to the nature of laryngoscopy [M & A]. Presence of an unpleasant sensation in the throat [which was not previously present] just prior to discharge from the recovery room and 24 hours later was recorded as evidence of sore throat.

The blue coloured regular Airtraq laryngoscope through which Endotracheal tube [ETT] of size 7.0 to 8.5 mm ID can be introduced in patients with a minimal mouth opening of 18mm was used for this study. Before inserting the Airtraq Laryngoscope, a well lubricated ETT of appropriate size was preloaded onto the dedicated side channel. The light sorce was switched on, which heated the distal lens to prevent fogging. The Airtraq blade was introduced in the midline, over the centre of the tongue and looked through the eyepiece as insertion was continued, to identify airway structures (Fig A) .The blade was introduced till its tip lied in the vallecula and thereafter gentle lifting and maneuvering of the Airtraq Laryngoscope helped (Fig B) to center the vocal cords into view. The ETT was passed via the vocal cord (Fig C) and then separated from the Airtraq Laryngoscope by pulling the Airtraq laterally while holding the ETT in position (Fig D). The Airtraq device was then removed. During the course of its use, the epiglottis may need to be lifted by elevating the blade into the vallecula.

Fig. A Airtraq blade introduced in the midline, over the centre of the tongue and looked through the eyepiece as insertion was continued



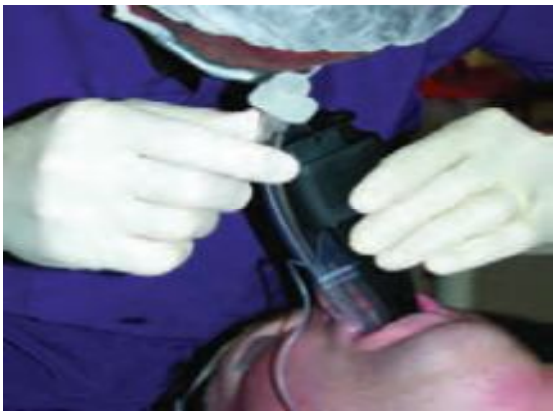


Fig. B Airtraq blade was introduced till its tip lied in the vallecula and maneuvering of the Airtraq Laryngoscope to center the vocal cords into view

Fig. D The ETT separated from the Airtraq Laryngoscope by pulling the Airtraq laterally while holding the ETT in position

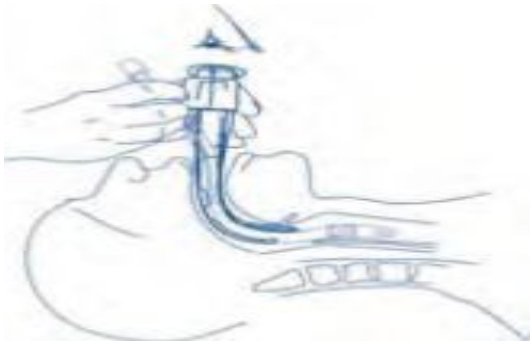


Fig. C The ETT was passed via the vocal cord

Statistical Analysis was done by Unpaired't' test which compared the inter-group data, while paired 't' test was used to analyze the significance of within group cardiovascular data. 'Z' test for proportions was used to analyze statistical significance of the sore throat incidence. $p<0.05$ was considered as significant in this study.

Results

50 patients, were randomly allocated by computer generation randomization table into two groups with 15 male and 10 female (25 patients) patients in each group. Demographic data as age, sex, weight and ASA physical status of all patients were recorded as shown in table I. The demographic data of both the groups were comparable with each other. The recording of laryngoscopic grading (Cormack Lehan

grading), ease of intubation, laryngeal intubation time in secs and incidence of sore throat was done. HR & BP was recorded at 0, 1, 3, 5 & 10 minutes following intubation.

Table I: Demographic data as age, sex, weight and ASA physical status of all patients

Parameter	Group A (n=25)	Group M (n=25)	P value
Sex (Male/Female)	15(60%): 10 (40%)	15(60%): 10 (40%)	(p>0.05)
Age in years (Mean±SD)	34.32± 8.33	35.4 ± 7.82	(p>0.05).
Weight in Kg (Mean±SD)	53.9 ± 8.0	51.9 ± 7.6	(p>0.05).
ASA Physical Status (I/II)	18/7	16/9	(p>0.05).

Table II: Cormack-Lehane grading on laryngoscopy in both groups

Cormack-Lehane	Group A		Group M	
	N	%	N	%
Grade I	21	84	15	60
GradeII	4	16	5	20
Grade III	0	0	5	20
Grade IV	0	0	0	0
Total	25	100	25	100

N – number of patients

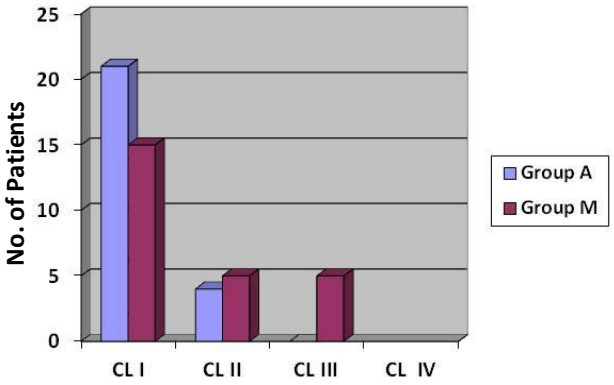


Fig 1: Cormack-Lehane grading on laryngoscopy in both groups

In table II and figure 1 distribution of patients according to Cormack-Lehane grading in both the groups has been shown. In group A 84% of patients were with C/L grade I, 16% of patients were with C/L grade II and no patients with grade III or grade IV. In group M 60% patients had C/L grade I, 20% of patients had C/L grade II and grade III each and no patients had grade IV. Hence Cormack Lehane grading was better in Group A than Group M.

Table III and figure 2 shows distribution of patients according to time of laryngeal intubation in both the groups. Most of the patients in Group A were intubated in between 1 -10 secs as compared to Group M in which most of the patients were intubated in between 11 –20 secs. The mean time for laryngeal intubation (Mean ± SD) for group A was 8.3 ± 4.6 secs and for Group M was 20.46 ± 6.6 secs. The mean time for laryngeal intubation was less in Group A as compared to Group M ($t = 7.6$, $p < 0.01$). The difference was statistically significant.

Table III: Distribution of time of laryngeal intubation of both groups

Time of LI in secs	Group A		Group M	
	N	%	N	%
1 – 10	18	72	0	0
11 – 20	7	28	15	60
21 – 30	0	0	7	28
>30	0	0	3	12
Total	25	100	25	100
Mean time for intubation ± SD	8.3 ± 4.6		20.46 ± 6.6	

N – number of patients

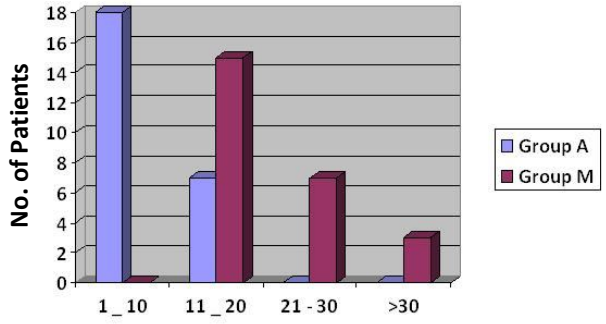


Fig 2: Distribution of time of laryngeal intubation of both groups

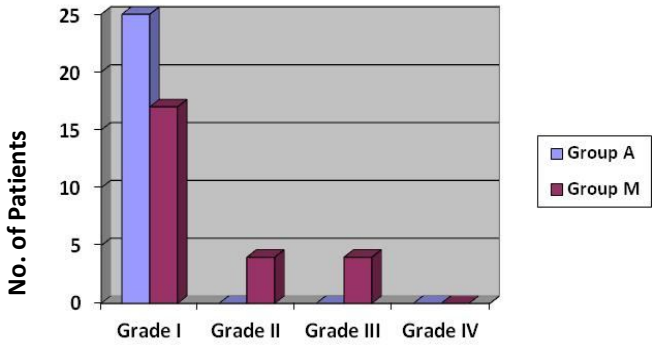


Fig 3: Distribution of ease of tracheal intubation

In Group A 100% patients were intubated without any external aid while in Group M 68% patients were intubated without any external aid, 16% of patients required external manipulation of larynx for intubation and 16% of patients were intubated by using a stylet. There was no case of failed intubation in both the groups. Hence the ease of tracheal intubation was better in Group A than Group M. (Table IV and figure 3)

In Table V and figure 4 Changes in systolic blood pressure at various intervals in both the groups has been shown. The rise in blood pressure is significantly less in Group A as compared to Group M in 1, 3, 5, 10 mins respectively following endotracheal intubation. The difference at all intervals is statistically significant. ($p<0.05$)

Table IV: Distribution of ease of tracheal intubation

Ease of tracheal intubation	Group A		Group M	
	N	%	N	%
Grade I	25	100	17	68
Grade II	0	0	4	16
Grade III	0	0	4	16
Grade IV	0	0	0	0
Total	25	100	25	100

N – number of patients

Table V: Changes in systolic blood pressure at various intervals in both groups

Group	BP at 0	BP at 1	BP at 3	BP at 5	BP at 10
Group A	120.96±8.68 NS	128.32±9.01 p =<0.001	118.96±7.68 p <0.001	114.16±7.48 p<0.01	110.16±5.82 p<0.01
Group M	120.0±10.66 NS	149.12± 12.61 p =<0.001	144.48 ± 11.29 p <0.001	139.76 ±12.72 p<0.01	118.08 ± 7.75 p<0.01

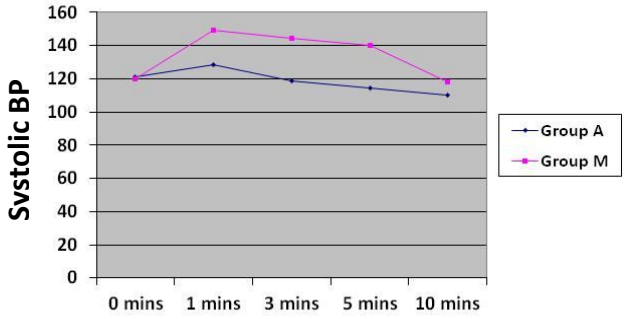


Fig 4: Changes in systolic blood pressure at various intervals in both groups

Table VI and figure 5 shows distribution of patients according to changes in Heart rate at various intervals in both the groups. The rise in heart rate was less in Group A as compared to Group M in 1, 3, 5, 10 minutes respectively following endotracheal intubation. The difference at all intervals is statistically significant.

Table VI: Changes in heart rate at various intervals in both groups

Group	HR at 0	HR at 1	HR at 3	HR at 5	HR at10
Group A	80.16 ±9.31 NS	85.52±9.60 p<0.001	82.16±9.56 p<0.001	75.28±7.57 p<0.001	72.4±7.21 p<0.05
Group M	77.28±9.36 NS	102.32±9.57 p<0.001	98.16±9.45 p<0.001	95.24±9.90 p<0.001	76.8±7.0 p<0.05

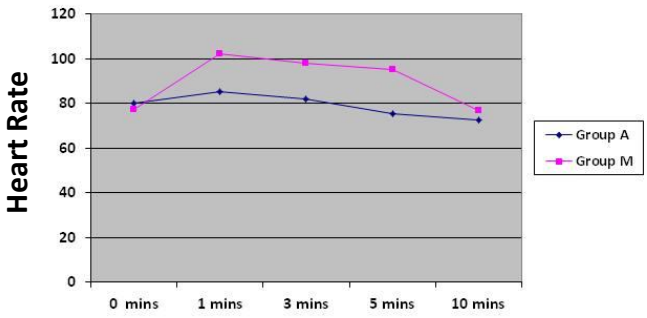


Fig 5: Distribution of heart rate in both groups

Discussion

In due course of development of anaesthesia so many new techniques of endotracheal intubation and supraglottic devices have been developed from time to time but the gold standard has always been laryngoscopy and endotracheal intubation.[8] Anaesthesiologists are thus working for development of improved version of laryngoscopes. Lot of work has been done till date for study of laryngoscopic view, ease of intubation, haemodynamic changes and complications associated with it.

In present study we compared the Macintosh Laryngoscope with Airtraq Laryngoscope to record the laryngoscopy and intubation time [M & A], to record peri-laryngoscopy & intubation changes in heart rate and blood pressure, grading ease of tracheal intubation and to record the incidence of postoperative sore throat.

Cormack Lehane grading was assessed at the time of laryngoscopy. Group A had 84% of patients with C/L grade I and Group M had 60% patients with C/L grade I. Again 16% of patients in Group A had C/L grade II compared to 20% in Group M. No patients in Group A had a Grade of III or IV but 20% of patients in Group M had grade III and no patients with Grade IV respectively. Hence C/L grade was better in Group A than Group M. This finding is supported by the study performance of the Airtraq laryngoscope after failed conventional tracheal intubation by Malin E and his colleagues in Aug 2009.[9] Laryngoscopy and intubation time was calculated from introduction to removal of laryngoscope blade from mouth and was taken in secs. Time taken for laryngeal intubation was less in Group A as compared to Group M. Most of the patients in Group A were intubated in between 1 -10 secs as compared to Group M in which most of the patients were intubated in between 11-20 secs. The mean time for laryngeal intubation was less in Group A as compared to Group M and the difference is statistically significant. This finding is supported by studies; Evaluation of the Airtraq and Macintosh laryngoscopes in patients at increased risk for difficult tracheal intubation by Maharaj CH and his colleagues in Feb 2008; [5] Tracheal intubation of morbidly obese patients: a randomized trial comparing performance of Macintosh and Airtraq laryngoscopes by Ndoko SK et al in Feb 2008 [10] and in Airtraq optical laryngoscope: tracheal intubation by novice laryngoscopists by Hirabayashi Yand Seo N in Feb 2009. [5,10,11]

Ease of tracheal intubation was graded as I, II, III and IV. In Group A 100% patients were intubated without any external aid while in Group M 68% patients were intubated without any external aid. Hence the ease of tracheal intubation was better in Group A than Group M. This findings are supported by the studies; Comparison of the Airtraq and Truview laryngoscopes to the Macintosh laryngoscope for use by Advanced Paramedics in easy and simulated difficult intubation in manikins by Nasim S and his colleagues, done in Feb 2009; [12] Tracheal intubation by inexperienced medical

residents using the Airtraq and Macintosh laryngoscopes--a manikin study by Maharaj CH et al, done in Nov 2007[13] and The Airtraq as a rescue airway device following failed direct laryngoscopy: a case series by Maharaj CH and his colleagues in Jun 2007. [12,13,14]

In the present study it was found that there was rise in heart rate and blood pressure in both the groups following laryngoscopy and intubation but the rise in heart rate was less in Group A as compared to Group M in 1, 3, 5, 10 mins respectively following endotracheal intubation. The rise in blood pressure was also less in Group A as compared to Group M in 1, 3, 5, 10 mins respectively following endotracheal intubation. The difference at all intervals was statistically significant. Heart rate and blood pressure returned to preoperative value much earlier in Group A as compared to Group M.

This finding is supported by the study A comparison of tracheal intubation using the Airtraq or the Macintosh laryngoscope in routine airway management.by Maharaj CH et al in Nov 2006[15] and Endotracheal intubation in patients with cervical spine immobilization: a comparison of macintosh and airtraq laryngoscopes by Maharaj CH his colleagues in Jul 2007. [15,16]

There were no patient in either group who complained of sore throat and there was no significant difference even after 24 hrs of discharge of the patient from the recovery room.

Based on above findings we conclude that Airtraq Laryngoscope is superior to Macintosh Laryngoscope as the Cormack-Lehanne views were better, mean duration of laryngoscopy and intubation time was much shorter, ease of intubation was much better and the maximum rise in heart rate and systolic blood pressure following laryngeal intubation with Airtraq Laryngoscope was significantly less.

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