



Original Research Article

A randomized comparative study of Airtraq[®], McCoy and Macintosh laryngoscopes for endotracheal intubation in patients with simulated difficult airway using a rigid cervical neck collar in elective surgeries under general anaesthesia

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ABSTRACT

Introduction and Aims: Laryngoscopy in patients with suspected neck injuries has one goal: sufficient laryngeal exposure with least cervical spine movement. This is achieved by either Manual In-line Stabilisation (MILS), a forehead tape or rigid cervical collars. Cervical collars reduce movements of spine and also mouth opening leading to difficult direct laryngoscopy. This is due to difficulty in aligning the oro-pharyngo-laryngeal axes. The laryngoscope giving best glottic view with least cervical spine movement in the shortest time would be most ideal. We intend to compare Airtraq, McCoy and Macintosh laryngoscopes in terms of intubation time and Cormack-Lehane glottic view in patients undergoing elective surgeries with simulated neck immobilization using rigid cervical collar.

Materials and Methods: Following approval from Institutional Ethical Committee, 90 consenting patients, aged 18-65 years were assigned into three groups by random sampling (Serially numbered Opaque Sealed Envelope), namely Group A (Airtraq), M (McCoy) or C (Macintosh). Intubation time, Intubation difficulty scale (IDS) and Modified Cormack-Lehane grading were noted.

Results: Mean intubation time was 27.2sec (± 6.47), 40.2sec (± 12.36) and 33.10sec (± 23.05) for Airtraq, McCoy and Macintosh respectively (p-value 0.007). IDS values were 0, 3 and 2 respectively (P < 0.0001). Cormack Lehane glottic view was 2 for Macintosh and McCoy and 1 for Airtraq, respectively (P < 0.0001).

Conclusion: Airtraq improves ease of intubation significantly when compared to McCoy and Macintosh blade with shorter intubation time and IDS Score, in patients with simulated difficult airway using neck immobilization.

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1. Introduction

Expertise in airway management is a lifeline for anaesthesiologist with patients presenting for anaesthesia. Maintaining a patent airway is essential for adequate oxygenation and ventilation, and failure to do so can be life threatening.¹

Respiratory events are the most common anaesthetic related injuries. Three main causes of respiratory related injuries are inadequate ventilation, esophageal intubation

and difficult tracheal intubation.²

It is a challenge to intubate patients in whom cervical spine movement is restricted. Here, use of direct laryngoscopy is restricted as it requires adequate neck extension for alignment of oro-pharyngo-laryngeal axes. Intubation must be performed using cervical spine immobilization to prevent exacerbation of spinal cord injury, by rigid collar forehead tape or manual-in-line stabilization (MILS).³

Reduced mouth opening with no neck extension is a disadvantage when using rigid cervical collars.⁴ It has been seen that the mouth opening reduces to almost half after

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application of a rigid cervical collar and the neck extension in all patients is reduced to less than 35 degrees thus simulating a difficult airway.⁵

Video-laryngoscopy and optic intubation are preferred in such airways. Difficult Airway Society has included video-laryngoscopes as a part of difficult airway cart.⁶

Macintosh is the most popular laryngoscope worldwide. Tongue of blade has a curve that extends to the tip.⁷ Macintosh blade requires alignment of oro-pharyngo-laryngeal axes and adequate neck extension which gives poor glottic view in cervical spine immobilization.^{8,9}

Airtraq® (Prodo Ltd., Vizcaya, Spain) is a disposable battery-operated laryngoscope with unique blade curvature (90 degrees) that allows good glottic view without requiring alignment of oro-pharyngo-laryngeal axes.¹⁰ Blade of Airtraq® consists of two side-by-side channels. (Figure 1)

One channel is a conduit through which endotracheal tube (ETT), bougie or suction catheter can be passed, and other channel contains a series of lenses and mirrors that transfers image from illuminated tip to a proximal viewfinder.¹¹



Fig. 1:

McCoy™ laryngoscope (Penlon), is a modification of standard curved laryngoscope blades. These blades have a hinged distal tip activated by a lever. Curved levering tip blade is used by placing the tip in the vallecula and activating it by pressing the lever.¹²

There is not much literature on the utility of Airtraq® in Indian population, with a simulated difficult airway. We intend to study the efficacy of Airtraq, Macintosh and McCoy laryngoscopes for endotracheal intubation undergoing elective surgeries under general anaesthesia with simulated difficult airway using a rigid cervical collar, this an investigational method of the research with primary

objective of to comparing intubation time and secondary objective of to comparing Cormack-Lehane grading and IDS.

2. Materials and Methods

Following approval from Institutional Ethical Committee, informed consent taken from 90 American Society of Anaesthesiologists Physical Status (ASA PS) Class I-II patients, aged 18-65years undergoing elective surgery selected by an observer not conducting laryngoscopy and were randomly allocated into three groups by Simple random sampling (SNOSE:Serially numbered Opaque Sealed Envelope), into Group A(Airtraq®), Group M(McCoy) or Group C (Macintosh). Patients with anticipated difficult airway, pregnant patients, patients with cervical spine disease and obese patients with Body Mass Index (BMI) >30kg/m² were excluded.

Group A: Intubation with Airtraq® preloaded with an endotracheal tube (ETT; 7.5mm internal diameter [ID] for women and 8.5 IDmm for men) and

Group M: McCoy laryngoscope with styletted ETT of appropriate size.

Group C: Macintosh Laryngoscope with styletted ETT of appropriate size.

There were no confounders or effect modifications in the study.

Patients were evaluated and Tab. Alprazolam 0.5mg and Tab.Ranitidine 150mg per oral given on previous day. On day of surgery Intravenous(IV) access with 18G cannula was secured. In operation theatre ECG, Non Invasive Blood Pressure(NIBP) and Pulse oximeter were attached, and baseline parameters recorded

All patients were premedicated with Inj.Ondansetron 0.15mg/kg and Inj.Fentanyl 1.5mcg/kg. Following preoxygenation patients induced with Inj.Propofol 2mg/kg. After confirmation of mask ventilation, Inj.Vecuronium 0.1mg/kg was given for neuromuscular blockade. Rigid Philadelphia Cervical Collar (Tracheostomy Philadelphia Collar; Philadelphia Cervical Collar Co., Thorofare, NJ, USA) of appropriate size was positioned around neck but not fixed. After adequate neuromuscular blockade, collar was fixed. Laryngoscopy was done by experienced anaesthesiologist. Intubation was done with appropriate size ETT. Closed circuit was connected to Dräger Fabius® Plus workstation and ventilation confirmed by capnography. Collar was removed after intubation.

Potential bias was reduced by using the same anaesthesiologist for all the intubations with all three laryngoscopes.

Time taken for intubation was considered as the primary end point and additional endpoints include, the number of intubation attempts and the number of optimization maneuvers required (use of a bougie, external laryngeal pressure, second assistant) to aid tracheal intubation, and the Cormack and Lehane grade at laryngoscopy. In event

of failed intubation rigid cervical collar was removed, and patient intubated with Macintosh laryngoscope.

2.1. Definitions

1. Experienced anaesthesiologist is defined as one, who has done at least 25 laryngoscopies with all three laryngoscopes
2. Time required for intubation, defined as time from insertion of blade between teeth to successful intubation and confirmation with capnography.¹³
3. Intubation difficulty score (IDS) described by Adnet et al as described¹⁴

Table 1: Intubation difficulty score (IDS)

Parameter	Score
Number of attempts >1	N1
Number of operators >1	N2
Number of alternate techniques	N3
Cormack grade – 1	N4
Lifting force required: Normal Increased	N5=0 N5=1
Laryngeal Pressure: Not applied Applied	N6=0 N6=1
Vocal cord mobility: Abduction Adduction	N7=0 N7=1
Total IDS = Sum of scores	N1-N7

Table 2:

IDS Score	Degree Of Difficulty
0	Easy
1-5	Slight difficulty
>5	Moderate to major difficulty
IDS=∞	Impossible intubation

Table 3: Rules for calculating IDS score

N1	Every additional attempt adds 1 point
N2	Every additional operator adds 1 point
N3	Each alternate technique adds 1 point
N4	Apply Cormack Lehane grading for first attempt. For successful intubation N4=0
N6	Sellicks manoeuvre adds no points

Table 4: Modified cormack lehane grading¹⁵

Grade 1	Most of the glottis is visible
Grade 2a	Posterior part of the cords visible
Grade 2b	Only arytenoids visible
Grade 3a	Epiglottis is visible and liftable
Grade 3b	Epiglottis adherent to pharynx; not liftable
Grade 4	No laryngeal structures are visible

1. Failed intubation attempt defined when trachea was not intubated with 3 attempts or required more than

120s³ Then collar was removed, and patient intubated with conventional laryngoscope.

2. Airway trauma includes blood seen on lips, teeth, oral mucosa or on device during intubation
3. Airway complications include bronchospasm, vocal cord paralysis, arytenoid injury, tracheal or esophageal perforation.

Sample size was decided using a difference of 10 sec in intubation time (with the formula below) and with power 0.8 and alpha 0.05. A value of 27 per group was obtained. Considering dropouts from study, a sample size of 30 per group was taken. Macintosh group was kept as a control group with 30 patients

$$N = 2[(\alpha + \beta) \sqrt{\sigma^2} / (\mu_1 - \mu_2)]^2$$

N = Sample size in each group

μ_1 = Mean intubation time in Group M

μ_2 = Mean intubation time in Group A

$\mu_1 - \mu_2$ = Difference investigator wishes to detect i.e., 10

σ^2 = Population variance (SD), conventionally taken as 20

α = Conventional multiplier for alpha = 0.05, i.e. 1.96

β = Conventional multiplier for power = 0.80, i.e. 0.84

Statistical analysis was performed using SPSS version 21. Continuous data are presented as mean±SD, ordinal data as median with interquartile range (IQR), and categorical data are presented as frequency and proportions. Categorical data were compared between three groups Chi-square test. Significance level for all analyses was $P < 0.05$.

3. Results

Total of 90 patients were enrolled. There were no exclusions after the enrollment. Demographic data are as follows. (Table 5)

Intubation time in Group A was 27.22sec (6.47) as compared to 40.2sec (12.36) in Group M and 33.1sec (23.05sec) in Group C (p-value 0.007). Airtraq was superior when compared to McCoy and Macintosh laryngoscopes because of presence of a channel. Macintosh group had faster intubation times than McCoy group (p-value 0.142) Bulkiness of McCoy blade probably increased intubation time (Figure 3)

Airtraq laryngoscope gave reduced IDS score of 0. In McCoy and Macintosh groups IDS scores were not different as both were 'Slightly Difficult'. (p value =0.98404).(Tables 6 and 7)

Cormack Lehane grading was significantly better with Airtraq scope with 27 patients having grade I view. In McCoy group only 10 patients had Grade I view whereas 19 patients had grade II view. Macintosh group 18 patients had grade II view and 4 patients had grade III view. Alignment of oro-pharyngo-laryngeal axes were poor with minimal neck extension while using Macintosh

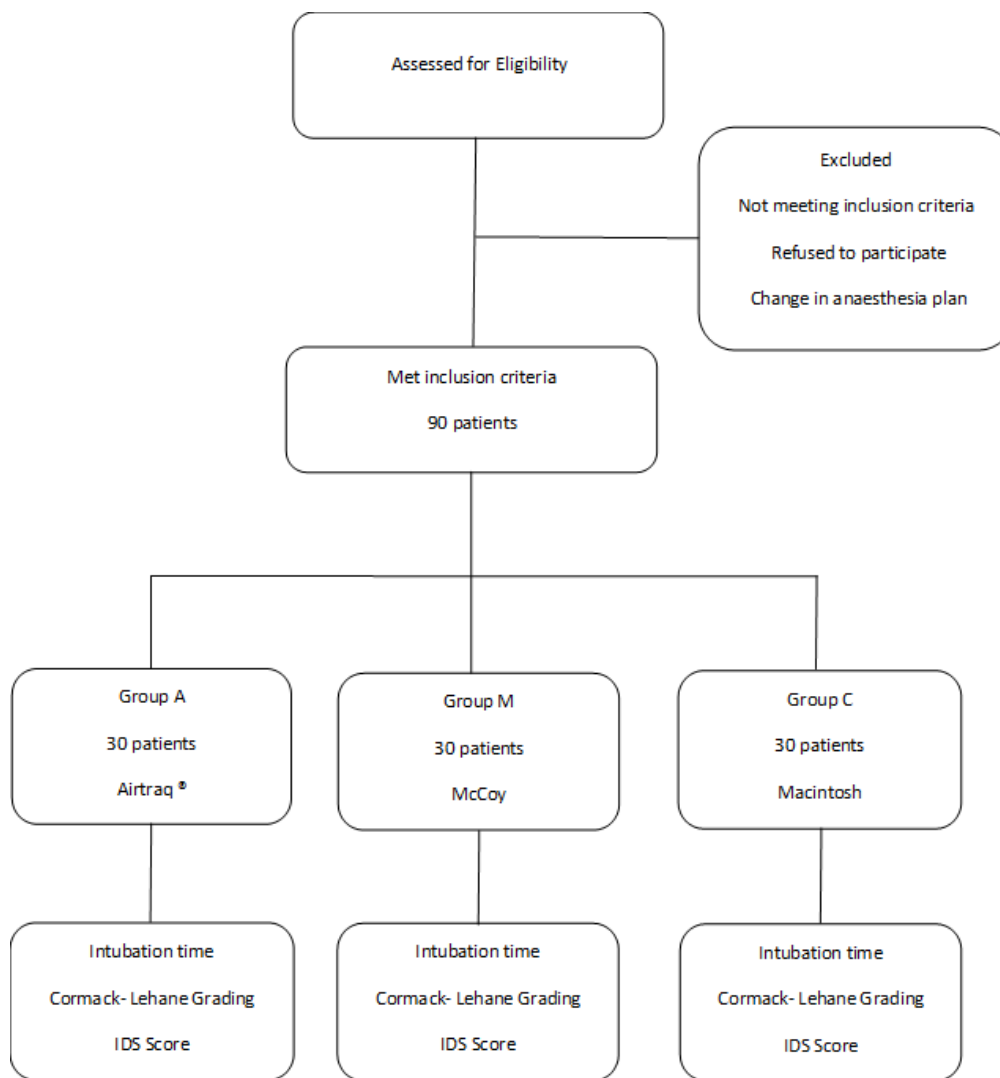


Fig. 2:

laryngoscope. Flexible tip of McCoy blade improves Cormack Lehane grading, (P =0.38) (Figure 4)

Parameters within IDS show significant improvement with Airtraq (p<0.0001). IDS scores were better in Macintosh when compared to McCoy (p value=0.97). (Table 7)

Laryngeal pressure required is more in McCoy and Macintosh laryngoscope. Lifting force used is minimal in Airtraq.¹¹

Airway trauma was found in all groups though it was less with Airtraq with 4 when compared to McCoy with 8 and 5 in Macintosh group. Airtraq® causing trauma was restricted to minimal oral bleeding when compared to McCoy.¹⁶

Flexible tip of McCoy may injure uvula or surrounding structures if it gets entrapped into hinge of the tip.

One patient in Macintosh group could not be intubated with collar who was eventually intubated as per protocol.

No other airway complications noted.

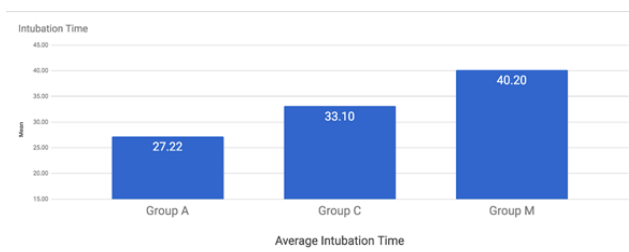


Fig. 3:

4. Discussion

Patients with cervical spine injury requiring intubation is not unusual in the hospital. Quadriplegia has occurred

Table 5:

Variable	Airtraq	McCoy	Macintosh
Age (mean years) (SD)	35.13 (11.36)	33.37 (11.19)	34.13(12.27)
Gender (%)			
Female	17(56.67)	17(56.67)	14(46.67)
Male	13(43.33)	13(43.33)	16(53.33)
Weight (mean kilogram) (SD)	60.53(8.78)	59.10(9.84)	61.57(10.10)
BMI \pm SD(kg per m2)	23.15(2.48)	22.7(2.92)	22.75(3.24)
Mouth Opening (MO) (in cm)(SD)	3.88(0.49)	4.05(0.56)	4.05(0.34)
Mallampati grade (%)			
1	13(43)	15(50)	11(36.67)
2	17(56)	15(50)	19(63.33)
Thyromental distance (in cm)(TMD)(SD)	6.54(0.46)	6.75(0.56)	6.74(0.37)

Table 6:

Variable	Airtraq	McCoy	Macintosh	P value
IDS Median (IQR)	0	3(2.75)	2(1)	<0.0001
Airway Trauma (% of group)	4(13.3%)	8(26.6%)	5(16.67%)	0.4933
Airway Complications (% of group)	0(0%)	0(0%)	0(0%)	-
Failed intubations (% of group)	0(0%)	0(0%)	1(3.3%)	-

Table 7:

Variable	Airtraq	McCoy	Macintosh	P value
Number of attempts > 1				
0	30(100%)	24(80%)	28(93.3%)	0.02372
1	0(0%)	6(20%)	1(0.33%)	
2	0(0%)	0(0%)	1(0.33%)	
Number of operators > 1				
0	30(100%)	28(93%)	29(97%)	0.4915
1	0(0%)	2(7%)	1(3%)	
Alternate Intubation Techniques				
0	27(90%)	23(77%)	24(80%)	0.299
1	3(10%)	7(23%)	5(17%)	
2	0(0%)	0(0%)	0(3%)	
Cormack- Lehane Grading				
1	27(90%)	10(33%)	8(27%)	<0.0001
2	3(10%)	19(63%)	18(60%)	
3	0(0%)	1(3%)	4(13%)	
Lifting force required				
0	30(100%)	7(23%)	3(10%)	<0.0001
1	0(0%)	23(77%)	27(90%)	
Laryngeal Pressure				
0	29(97%)	8(27%)	9(30%)	<0.0001
1	1(3%)	22(73%)	21(70%)	
Vocal Cord Mobility				
0	30(100%)	30(100%)	30(100%)	1
1	0(0%)	0(0%)	0(0%)	

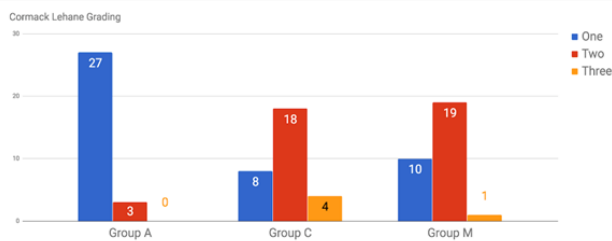


Fig. 4:

in association with airway management in cervical-spine injured patient whose neck was not immobilized.¹⁷ Hence these patients must be stabilized either by MILS or rigid collar.

MILS and rigid collars reduce segmental angular rotation and distraction, therefore protects from further injury.¹⁸

Rigid collar reduces mouth opening significantly and this leads to increased difficulty of laryngoscopy in this form of cervical spine immobilization. Rigid collar also lifts and tips the larynx anteriorly. Fibreoptic is gold standard in such situations. Non-availability in rural areas, long learning curve and lack of expertise are disadvantages.¹⁹

Airtraq, novel indirect-laryngoscope with prism system unlike no other laryngoscope, is a good cheap alternative.

Airtraq has been proven to be superior than other conventional laryngoscopes in normal airway^{20,21} as well as in difficult conditions in mannequins and in patients with simulated difficult airway.^{20–23}

Hosalli et al, found that IDS scores were significantly better with Airtraq when compared to McCoy and Macintosh laryngoscopes. But when comparing Macintosh and McCoy group, IDS score was better with McCoy, but statistically insignificant. Cormack Lehane view was better statistically with Airtraq consistent to our results.²⁴

Tolon MA et al compared Macintosh and Airtraq laryngoscopes in patients with cervical spine immobilisation (confirmed by using C-arm) and found higher intubation times and IDS scores with Macintosh compared to Airtraq.²⁵

Koh et al. reported higher success rate of intubation with Airtraq in patients with cervical immobilization with collar.²⁶

Arslan et al. evaluated effectiveness of the Airtraq and C TrachTM in lean patients with simulated cervical spine injury after application of rigid cervical collar.²⁷

Wetsch WA et al, compared various video - laryngoscopes with conventional Macintosh laryngoscope. It was found that intubation time was least with conventional Macintosh laryngoscope, closely followed by Airtraq. Video-laryngoscopes required significantly more time to secure airway.²⁸ Hence, Airtraq was concluded to be a better alternative to other video - laryngoscopes.

Although we faced no failure of intubation with Airtraq, it has been quoted in a few studies.^{3,20} Failure to intubate

using video laryngoscopes despite a good glottic view is known. Channelled video-laryngoscopes perform better in these cases and extension of channel to tip of scope further improves success rate. Channel doesn't extend to the tip in Airtraq and this can cause a difficulty.

Limitations were that anaesthesiologist was not blinded to devices used, Measurements used like glottic-view grading, lifting force applied are subjective. IDS score utility when used with indirect laryngoscopes is less clear.

Results may differ in hands of less experienced users as this study is conducted by anaesthesiologist experienced in using all three devices.

5. Conclusion

Airtraq laryngoscope reduces intubation time significantly when compared to McCoy and Macintosh laryngoscopes in patients with an immobilised neck using a rigid cervical collar. It also improves ease of intubation with better glottic view and is a cheaper alternative to various other video-laryngoscopes.

It can be an ideal laryngoscope in patients with cervical neck injuries requiring intubation.¹⁹

6. Source of funding

None.

7. Conflict of interest

None.

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