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Similitude and Disparity between Airtraq and McCoy Laryngoscope in Simulated Cervical Spine Injury during Tracheal Intubation: A Prospective Randomized Study

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Abstract

Background: The study aimed at comparing the efficacy of Airtraq with McCoy laryngoscope on ease of intubation with cervical immobilization in patients undergoing elective surgery. *Methods:* Sixty consenting American Society of Anaesthesiologist's physical status I-II patients (ASAPS-I, II), aged 18-50 years, scheduled for various surgeries requiring tracheal intubation were randomly assigned into two groups of thirty each to undergo intubation with Airtraq or McCoy laryngoscope with neck immobilisation using cervical collar. The ease of intubation based on Intubation Difficulty Scale (IDS) score, Cormack-Lehane grade of glottic view and impact on haemodynamic parameters were recorded. Statistical analysis was performed with independent student t test and chi square test. *Statistical analysis:* Chi Square test and t-test. *Results:* All patients in two groups had a comparable demographic profile and were successfully intubated. The Airtraq laryngoscope significantly reduced the IDS (mean = 0.663) as compared with both McCoy (mean = 2.2) (p = 0.001) and improved the Cormack-Lehaneglottic view (80% grade 1 view and no patients with grade 3 or 4 view). There were less haemodynamic variations during laryngoscopy with the Airtraq compared to the McCoy laryngoscope group. *Conclusion:* In patients undergoing endotracheal intubation with cervical immobilisation, Airtraq laryngoscope was superior to the McCoy with greater ease of intubation and lower impact on haemodynamic variables.

Keywords: Airtraq; McCoy; Laryngoscope; Tracheal Intubation; Simulated Cervical Spine Injury.

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Introduction

Direct laryngoscopy is commonly used to facilitate tracheal intubation under vision. Successful direct laryngoscopy depends on aligning the axis of oral cavity, pharynx and larynx. which is achieved by 'sniffing position' where there is flexion at lower cervical spine and extension at atlanto-occipital joint. Laryngoscope range from simple rigid scopes with a light bulb to complex fibre optic video devices [1].

In a patient with cervical spine injury, these movements are restricted. Also extension of head and flexion on neck can't be allowed because it can cause further injury. That means the patient has to be intubated in neutral position. We have to intubate patients with neck injury without causing any movements at cervical spine. For stabilizing the patients neck in neutral position, we can use either rigid cervical collar or Manual in line stabilisation (MILS)[2].Among these techniques, MILS is said to cause less cervical movement whereas hard cervical

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collar act as a fulcrum and tends to cause more injury to the patient. It also obstructs vocal cord visualisation and reduces the mouth opening. According to Gerling et al. neither MILS nor hard cervical collar has previously emerged as superior [2]. It is due to the difficulties in performing controlled trials in cervical spine injury patients due to low incidence. Axial tractions is no longer recommended in cervical injury patients because it might accelerate injury by hyper distraction at fracture site [2].

Direct laryngoscopy in patients with cervical spine injury is associated with cervical spine instability. The use of rigid collar may result in an increase of Grade III and grade IV laryngoscopic view in conventional laryngoscopy. These issues have promoted the development of newer approaches to securing the airway in patients at risk of cervical spine injury. Laryngoscopy is known to have profound cardiovascular effects which manifest as tachycardia and hypertension [3]. The McCoy blade invented in the early 1990s is a modification of the Macintosh blade (with tip hinged). It decreases the amount of force exerted during laryngoscopy and endotracheal intubation. McCoy bladed laryngoscope has a lever, which flexes the tip while pushing it towards the handle [4]. It helps to lift the epiglottis. Thus, the exaggerated haemodynamic responses become clinically insignificant [5].

Airtraq optical laryngoscope is a new intubation device that has been developed for the management of the normal and difficult airway. As a result of exaggerated curvature of blade and an internal arrangement of optical components, a high quality view of glottis and surrounding structures is provided without sniffing position. It produces less cervical movement when compared to other direct laryngoscopes [6]. It keeps the neck in a neutral position. It has got optical lens internally and a mechanism to prevent fogging. It has got a series of prisms, lenses and mirrors in its optic channel. It's guiding channel act as a conduit for endo-tracheal tube. Airtraq has an eye piece at a proximal end and an LED (light emitting diode) light source at the tip to direct the image. It has got a tube channel and batteries in situ [7]. Advantages of Airtraq are that, the device is disposable and self-contained. It also limits fogging due to the heating at lens. But insertion of ETT (Endotracheal tube) is very difficult unless it is well lubricated. Focusing on the eye piece itself can be difficult. It is designed to fit the oro-pharyngeal anatomy and it doesn't require the alignment of an oro pharyngeal and tracheal axis. It resulted in less stimulation of the heart rate following the tracheal intubation. According to Arslan et al it causes less airway mucosal damage, But the ETT might go posterior as it leaves the guide and further manipulation might be needed for intubation [8].

Unanticipated difficult intubation can be challenging to anaesthesiologists. Numerous investigators have attempted to predict difficult intubation by using a simple bedside physical examination. In 1985 Mallampati introduced a currently well-known screening test that classifies visibility of the oropharyngeal structure.

The distance from the thyroid notch to the mentum (thyromental distance), the distance from the upper border of the manubrium sterni to the mentum(sternomental distance) and a simple summation of risk factors (Wilson risk sum score) are widely recognized as tools for predicting difficult intubation.

Nevertheless, the diagnostic accuracy of these screening tests has varied from trial to trial, probably because of differences in the incidence of difficult intubation, inadequate statistical power, different test thresholds, or differences in patient characteristics.

The McCoy blade invented in the early 1990's is a modification of Macintosh blade (with tip hinged) [4]. The McCoy laryngoscope is otherwise called the Penlon [8].

Based on the above fact, the following study with an aim of comparison of tracheal intubation using Airtraq and McCoy laryngoscope in simulated cervical spine injury has been undertaken.

Materials and Methodology

Source of Data

This prospective randomized study was conducted on 60 patients undergoing elective surgery requiring general anaesthesia with oral endotracheal intubation in Justice K.S. Hegde Hospital, Derlakatte, Mangalore. The study was conducted from November 2015 to August 2017.

Inclusion Criteria

1. Patients undergoing elective surgeries requiring general anaesthesia with oral endotracheal intubation.
2. Aged 18 years and 50 years
3. ASA PS I – II.

Exclusion Criteria

1. Patients with anticipated difficult airway including
a. Mallampati class III & IV
b. Thyromental distance <6 cm
c. Sternomental distance <12 cm
d. Neck circumference >42 cm (males)>40 cm (females)
e. Obese (body mass index >30 kg/m^2)
2. Pregnant patient
3. Presence of any factor which can produce gastro-esophageal reflux disease (GERD) or delayed gastric emptying
4. Patient with cervical spine injury and pathology
5. Patients with known allergy to drugs used in the study
6. Patients with airway distortion and trauma
7. Patient refusal

Data Collection

Sample Size

Sample size was calculated using PASS (power analysis sample size) software version 11.0

At 95% confidence interval and 81% power of the study corresponding

$Z\alpha$=0.05 and $Z\beta$=0.19153

According to a study done by Padmaja Durga et al.

The IDS (median IQR) score of 4 in McCoy group

The IDS (median IQR) score of 0 in Airtraq group

Sample size calculation done using the formula:

$N = 4sp^2/d^2$

Where,

N = Number

SP = Pooled estimate of standard deviation

d = Difference between the mean

The sample size calculated was 60 patients, with 30 in each group (McCoy and Airtraq laryngoscope group)

Selection Method

Randomization was done. Patients were divided into two groups by computer generated table.

Where, Group A Laryngoscopy and tracheal intubation performed using McCoy blade Group B Laryngoscopy and tracheal intubation was performed by using Airtraq.

Methods

After obtaining approval by the ethical committee (Ref. per order INST.EC/ EC/099/ 2015-16, dated 16.11.2015) and obtaining written informed consent. A day prior to surgery, pre anaesthetic evaluation of the patient was done and necessary investigation were sent and reviewed. Airway assessment was done including mouth opening, modified Mallampati class, thyromental distance, neck movement, and any obvious neck pathology

Those satisfying the study criteria were enrolled for the study. Patient were randomly allocated into two group with help of computer generated table

Group A: Laryngoscopy and tracheal intubation performed using McCoy blade with appropriate size endotracheal tube

Group B: Laryngoscopy and tracheal intubation performed using Airtraqwith appropriate size endotracheal tube

Patients were kept fasting as per standard NPO guidelines. Patients were pre medicated with tablet diazepam 5 mg for those weighing below 50 kg or 10 mg for those weighing above 50 kg and tablet ranitidine 150 mg on pre-operative night and at 7 AM on the day of surgery. After shifting the patient to the operation theatre, ECG, pulse oximeter and non-invasive blood pressure (NIBP) monitors were attached IV access was secured

Patient mouth opening was measured before applying cervical collar belonging to either group

A rigid cervical collar of appropriate-sized was placed around neck according to manufacturer's instruction. Patient mouth opening was measured after the application of cervical collar. Injection fentanyl 2µg/kg iv was given for analgesia. Patient was pre oxygenated for 3 minutes. Anaesthesia was induced with injection propofol 2 mg/kg iv. Muscle relaxation was achieved by injection vecuronium 0.1 mg/kg iv. After ventilating for five minutes with oxygen and isoflurane, airway was secured according to the group allocation

Group A: patient was put in neutral position in presence of cervical collar, head ring and intubated using McCoy blade

To use McCoy, blade should be introduced at angle of mouth sweeping the tongue to one side.

Laryngoscope is advanced till tip of the blade is positioned in vallecula and the McCoy laryngoscope

is lifted straight up to visualize glottis. Hinge tip allows elevation of epiglottis.

Once the view of glottis is optimized, tracheal tube is passed through the vocal cords and held in place and device removed

Group B: Patient was put in neutral position in presence of cervical collar, head ring and intubated using Aitraq.

To use Airtraq, blade will be introduced in midline over the center of tongue, tip of the blade is positioned in vallecula and the Airtraqlaryngoscope is lifted straight up to visualize glottis. Once the view of glottis is optimized, tracheal tube is passed through the vocal cords and held in place and device removed Placement of tube was confirmed by 5-point auscultation and $EtCO_2$Tube was fixed at the angle of mouth

Thereafter mechanical ventilation was continued throughout the procedure and anaesthesia maintained using isoflurane in a mixture of 33% oxygen and 66% nitrous oxide.

No other procedure was performed or medication was administered during the first 5 minutes of data collection period after tracheal intubation.

The following parameters were monitored and recorded: The intubation difficulty scale (IDS) score is the sum of the following seven variables (Table 1).

Laryngoscopic view was graded as per Cormack and Lehane grade. Intubation time (beginning of insertion of laryngoscope blade to removal of blade completely) was noted for both techniques. Hemodynamic parameter was recorded at pre induction, pre intubation and post intubation at 1, 3 and 5 minutes. Measurements include heartrate, systolic blood pressure, diastolic blood pressure, Mean arterial pressure, SpO_2.

Criteria for Abandoning the Procedure

- Failure to intubate (> 3 attempts or >120 sec)
- Episode of desaturation (SpO_2< 90%)
- Airway trauma (blood seen on lip, teeth, oral mucosa or the device)
- If the above criteria are present, then procedure was abandoned and cervical collar was removed and normal intubation was done.

Statistical Analysis

- Data were tabulated using Microsoft Excel 2010 software (Microsoft office 2010 v 14.0) and analysed with SPSS version 20.0 (SPSS Inc. Chicago. IL, USA)
- Comparison of categorical variables of gender, difficulty in insertion were analysed using Chi Square test
- Comparison of continuous variables like heart rate, blood pressure, intubation time, number of intubation attempts were analysed using sample t – test
- Data of intubation difficult scale and Cormack – Lehane grade were analysed usingChi Square test

Table 1: Intubation difficulty scale (IDS) score

Variables	Score
Number(n) of intubation attempts	n-1
Number(n) of operators	n-1
Number(n) of alternative intubation techniques used	N
Glottic exposure- Cormack and Lehane grade of laryngoscopy 1/2/3/4	1/2/3/4
Lifting force required for laryngoscopy	0=normal
	1=increased
Necessity of external laryngeal pressure	0=not applied
	1=applied
Position of vocal cords at intubation	0=abduction/not visualized
	1=adduction

Results

There were no significant differences in baseline patient characteristics and airway parameters between the two groups (Table 2).

Comparison of the age between the two groups shows that age is higher in Airtraq group with a t value of 0.434 and is statistically non-significant with a p value of 0.666. Most of the patients age in both the groups ranged between 31-50yrs. The minimum age was 18yrs and maximum age was 50yrs (Table 3).

There were 16 males and 14 females in Airtraq group and 15 males and 15 females in McCoy group. The differences in the sex distribution between the two groups were statistically insignificant (p=1.00) (NS) (Table 4).

The mean Intubation Difficulty Scale (IDS) score in Airtraq group is 0.663 as compared to McCoy group with mean IDS score of 2.2 which is statistically highly significant with p value 0. 001. This demonstrates the utility of Airtraq laryngoscope with lower IDS score and better ease of intubation.

Intubation time was also measured between the Airtraq and McCoy group using independent student - t test. For which the p value appeared highly significant (<0.001). It appeared that McCoy (28.07sec) required less intubation time compared to Airtraq (37.8sec). All complication during intubation and post-operative complication occurred were due to McCoy which have occurred due to increased manipulation compared to the Airtraq (Table 5).

Table 2: Patient Characteristics

Characteristic	Group		p value
	Airtraq	McCoy	
Age (mean ± SD)	38.63 ± 8.876	37.6 ± 9.55	0.666(N)
Sex (M/F)	16/14	15/15	1.00(NS)
Weight (kg)	59.43 ± 8.904	61.23 ± 7.58	0.403(NS)
ASA (I/II)	15/15	18/12	0.604(NS)
TMD (mean ± SD)	6.8 ± 0.272	6.7 ± 0.44	0.301(NS)
SMD (mean ± SD)	12.53 ± 0.507	12.6 ± 0.49	0.61(NS)
Neck circumference	32.87 ± 1.592	32.93 ± 1.25	0.858(NS)
BMI (mean ± SD)	23.8383 ± 3.093	24.367 ± 2.69	0.483(NS)

S-Significant, NS-Not Significant

Table 3: Age Distribution

	Group			
	Airtraq McCoy		Airtraq McCoy	
	No. of patient	%	No. of patient	%
Age				
20 and below	2	6.67	2	6.67
21-30	2	6.67	5	16.66
31-40	13	43.3	9	30
41-50	13	43.3	14	46.66
Total	30	100	30	100
Mean	38.63	-	37.6	
SD	8.87	-	9.55	
t-value	0.434			
p-value	0.666			

Table 4: Gender Distribution

	Group			
	Airtraq		McCoy	
	No. of Patient	%	No. of Patient	%
Sex				
M	16	53.3	15	50
F	14	46.7	15	50
Total	30	100	30	100

Table 5: Intubation difficulty scale (ids) score for the two Groups

	Group	
	Airtraq	**McCoy**
Number of patients in whom intubation required more than one attempt	4	8
Number of patients in whom intubation required more than one operator	0	0
Number of patients in whom alternative intubation technique were used (bougie, stylet, different size blade, endotracheal tube)	3	6
Cormack and Lehane grade 1,2,3,4	24/6/0/0	10/14/6/0
Number of patients in whom increased lifting force required	0	11
Number of patients in whom laryngeal pressure was applied	3	17
Position of vocal cords at intubation	0	0

Air way trauma, desaturation, laryngospasm, hiccup, sore throat and nausea/vomiting were seen more in McCoy group than in Airtraq group as a part of complications.

Discussion

Securing the airway is a vital step in administrating general anaesthesia. 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.

The current study was aimed at comparing the two laryngoscopes one the conventional McCoy direct laryngoscope and the Airtraq video laryngoscope and to note the efficacy of these in terms of ease of intubation, glottic view obtained, the effect of laryngoscopy on the hemodynamic parameters, complication during intubation and postoperative complication occurring due to the process.

In this prospective, randomized study conducted at K. S. Hegde Medical Academy, Mangalore, 60 ASA grade I and II patients undergoing various elective surgeries under general anaesthesia were enrolled and divided randomly into two groups of 30 each, standard anaesthetic protocols were applied to both groups and intubation with appropriate size endotracheal tube was done using either McCoy laryngoscope or Airtraq laryngoscope.

There was no significant difference in the demographic profile and airway characteristics of patients in the two groups.

Our study demonstrates the utility of novel optical Airtraq laryngoscope over the conventional McCoy laryngoscope for endotracheal intubation in patients simulating cervical spine injury (difficult airway). Airtraq laryngoscope provided better ease of intubation with lesser mean IDS score of 0.663 as compared to 2.2 with McCoy laryngoscope which was statistically significant ($p = 0.001$).

Intubation difficulty scale as described by Adnet et al. [9] was used to assess the ease of intubation in our study as it is based on seven parameters like number of attempts, operators, alternative intubation techniques, glottic view obtained, requirement of external laryngeal pressure, force required for laryngoscopy and position of vocal cords at intubation, which completely defines the quality of intubation than based on a single parameter.

The data of the study is comparable to the study conducted by Hossalli et al. [10] comparing Airtraq, McCoy and Macintosh laryngoscope in patients with cervical spine mobilization. Ninety ASA grade I and II patients were intubated with either Airtraq McCoy and Macintosh laryngoscope, the mean IDS score was -0.43 in Airtraq group as compared to - 1.63 in McCoy and -2.23 in Macintosh group which was statistically significant.

Optical Airtraq laryngoscope provide a better intubation condition with goodglottic view, ease of intubation, less optimization manoeuvres and no marked hemodynamic responses to laryngoscopy as compared to conventional McCoy laryngoscope. Our study has also shown that, McCoy (28.07sec) required less intubation time compared to Airtraq (37.8sec).

There are some limitations in our study. Firstly, it was not possible to blind the anaesthetist to the device being used, thus a potential for bias exists. Secondly, certain measurements used in this study like laryngoscopicglottic view grading, are subjective in nature. Thirdly, the results may differ in the hands of less experienced users as this study is conducted by anaesthetist experienced in using both the devices.

Conclusion

The optical Airtraq laryngoscope provides a better intubation condition with:

1. Lower Intubation Difficulty Scale (IDS) score, better glottic view and no marked hemodynamic alterations to laryngoscopy as compared to McCoy laryngoscope.
2. McCoy laryngoscope was easy to introduce and Intubation is quickercompared to the Airtraq laryngoscopes.
3. McCoy required less intubation time compared to Airtraq.
4. complications were seen more with McCoy group than Airtraq group.
5. Optical Airtraq laryngoscope showed no marked hemodynamic responses to laryngoscopy as compared to conventional McCoy laryngoscope.

Airtraq is a better alternative to McCoy in patients with difficult intubations due to cervical spine injury, but adequate training is required before performing attempts on the patient.

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