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Research Article

A comparative study of endotracheal intubation as per intubation difficulty score, using Airtraq and McCoy laryngoscopes with manual-in-line axial stabilization of cervical spine in adult patients

Nilesh Sarvaiya, Deepali Pankaj Thakur*, Bharati Anil Tendolkar

Department of Anaesthesiology, Lokmanya Tilak Municipal Medical College and General Hospital, Mumbai, Maharashtra, India

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***Correspondence:**
Dr. Deepali Pankaj Thakur,
E-mail: deepshna@rediffmail.com

ABSTRACT

Background: The different types of laryngoscopes have been invented to improve the laryngoscopic view of the glottis in normal and difficult airway which helps anaesthesiologists to safeguard the airway during anaesthesia. Patients with cervical spine injury have deleterious compression forces on the spinal cord and that should be avoided by taking protective measures which include application of rigid collar, a forehead tape and manual-in-line axial stabilisation (MILAS). The objective of the study was to evaluate the ease of intubation with Airtraq and McCoy laryngoscope as per intubation difficulty score (IDS) with manual-in-line axial stabilization of cervical spine.
Methods: In this prospective observational study, 100 adults of ASA I-II, aged 18 to 60 years, with Mallampati classification I and II, undergoing elective surgery under general anaesthesia with oral endotracheal intubation were included. Fifty patients were intubated using Airtraq (Group A). Another fifty patients were intubated using McCoy laryngoscope (Group B). During intubation with both devices, neck was immobilized using MILAS. Ease of intubation as per IDS, insertion of device as per Likert scale, duration of laryngoscopy and intubation, number of attempts, haemodynamic changes and complications were compared for both devices.
Results: Demographic characteristics were comparable in both groups. There is no significant difference observed in the heart rate, systolic and diastolic blood pressure during device insertion, intubation and up to 10 minutes after intubation in Airtraq and McCoy group. There is statistically significant difference in number of intubation attempts, duration of laryngoscopy and intubation in both groups. As per Likert scale, ease of insertion of device was statistically insignificant between two groups. McCoy group had statistically significant higher intubation difficulty scores (2.9±0.68) compared to Airtraq group (0.56±0.54) (p=0.000). All patients in Airtraq group showed Cormack and Lehane grade 1, while 30% patients in McCoy group had Cormack and Lehane grade more than 1.
Conclusions: The Airtraq facilitates the ease of intubation by providing a better view of the larynx as compared to McCoy laryngoscope in patients with manual-in-line axial stabilization of cervical spine.

Keywords: Airtraq, McCoy laryngoscope, MILAS, IDS

INTRODUCTION

The primary responsibility of the anaesthesiologists as a clinician is to safeguard the airway during anaesthesia. The different types of laryngoscopes have been invented to improve the laryngoscopic view of the glottis in normal as well as difficult airway. In patients with cervical spine injury, deleterious compression forces on the spinal cord should be avoided by taking protective measures which include application of rigid collar, a forehead tape and manual-in-line axial stabilisation (MILAS). Application of cervical collars may reduce

cervical spine movements, but it hinders tracheal intubation with the standard laryngoscopes.

The Airtraq is a type of channelled video-laryngoscope that has been developed to facilitate tracheal intubation in patients with normal or difficult airways. It has an exaggerated curvature of the blade and an internal arrangement of optical components which facilitates view of the glottis with minimal need for airway optimization maneuvers.

There are published reports that Airtraq is superior to laryngoscopy in patients with normal airways and difficult airway scenarios simulated in manikins.[1-3] It improved the intubation difficulty score and ease of intubation in patients with normal airways. The Airtraq also appears to cause less cervical spine movements during tracheal intubation when compared with the McCoy laryngoscope.[4]

We conducted this prospective, observational study to evaluate the usefulness of Airtraq and McCoy laryngoscopes by experienced anaesthesiologist's in normal adult patients undergoing general anaesthesia with neck immobilization using manual-in-line axial stabilization (MILAS) of cervical spine. The primary objective was to study ease of intubation as per Intubation Difficulty Score. Secondary objectives were insertion of device as per Likert scale, duration of laryngoscopy and intubation, number of attempts, changes in haemodynamic parameters, and complications if any.

METHODS

The study was conducted over the period of one year from June 2013 to May 2014. It was designed as a prospective, comparative, observational trial. After the approval of institutional ethics committee, informed consent was obtained from 100 ASA I and II patients, aged between 18 and 60 years, belonging to either gender with Mallampati classification I and II, undergoing elective surgery requiring general anaesthesia with oral endotracheal intubation and patients willing to participate in the study to give consent. Patients with ASA III and IV, anticipated difficult airway (Mallampati grade III, IV, thyromental distance (TMD) <6 cm, interinciser gap <4cms) and patients with risk of pulmonary aspiration of gastric contents were excluded from the study.

The sample size for our study was calculated from the previous study done by Durga et al in 2012.[4] At 90% power and 95% CL, sample size was found to be 27 per group to get the statistical significance during study period. The data were collected for 50 patients per group. Fifty adult patients, who were undergoing elective surgery under general anaesthesia with intubation using Airtraq, were included in Group A.

Another fifty adult patients who were undergoing elective surgery under general anaesthesia with intubation using McCoy laryngoscope were included in Group B. All patients received a standardized general anaesthesia with controlled ventilation technique. Standard monitoring, including electrocardiography, non-invasive blood pressure, oxygen saturation measured by pulse oximetry and end-tidal carbon dioxide ($EtCO_2$) level measurement by capnometry were used in all patients. All patients were premedicated with inj. fentanyl (2µg/kg) and inj. midazolam (0.03mg/kg) intravenously.

After induction of anaesthesia with propofol (2-3 mg/kg), ventilation was checked and injection vecuronium (0.1 mg/kg) was administered. Patient was ventilated manually with sevoflurane (2 volume %) and oxygen for 3 minutes. After the onset of neuromuscular blockade, the neck was immobilized using manual-in-line axial stabilization applied by an experienced individual holding the sides of the neck and the mastoid processes, thus preventing flexion or extension or rotational movement of the head and neck during intubation.

All the intubations were performed by a consultant anaesthesiologist having an experience of intubating at least 30 patients with each device. For patients in group A, laryngoscopy was done using Airtraq with pre-mounted endotracheal tube.

For female patients small adult size 2 (green) Airtraq was used with pre-mounted number 7 portex cuffed endotracheal tube. For male patients regular adult size 3 (blue) Airtraq with pre-mounted number 8portex cuffed endotracheal tube was used. After visualisation of vocal cords, endotracheal tube was advanced through cords under vision.

For patients in group B, laryngoscopy was done using McCoy laryngoscope. Patients were intubated with appropriate size endotracheal tube under direct laryngoscopic vision. After intubation in both groups, tracheal cuff was inflated and anaesthesia breathing circuit was connected to start positive pressure ventilation.

Time for appearance of first square waveform of $EtCO_2$ was noted. Haemodynamic parameters were observed during laryngoscopy, intubation and after intubation for first ten minutes. During this period, patient was maintained on oxygen, nitrous oxide (40:60) and one minimum alveolar concentration (MAC) of sevoflurane with balanced anaesthesia technique and no surgical stimulus in the form of incision were given.

Comparison of ease of intubation as per Intubation Difficulty Score (IDS), insertion of device as per Likert scale, duration for laryngoscopy and intubation, number of attempts, haemodynamic changes and complications were recorded.[5,6] IDS contains seven parameters which

quantitatively determine intubation complexity. The seven variables are as follows:[5]

N_1 - The number of supplementary attempts, an attempt defined as one advancement of the tube in the direction of the glottis during direct laryngoscopy or one advancement of the tube in the case of a blind intubation trial.

N_2 - The number of supplementary operators; additional persons directly attempting (i.e. Not assisting) intubation.

N_3 - The number of alternative techniques used. For example, changing from an oral intubation to blind nasotracheal intubation or from curved blade to straight blade increases N_3 by 1 point.

N_4 - The glottic exposure as per Cormack-Lehane grade; grade I (N_4= 0) complete visualization of glottis, grade II (N_4 = 1) visualization of posterior portion of glottis, grade III (N_4 = 2) visualization of only epiglottis, grade IV (N_4= 3) no visualisation of epiglottis. Glottic exposure is evaluated during first attempt by the first operator. In case of successful blind nasotracheal intubation, N_4 = 0.

N_5 – The lifting force applied during laryngoscopy; N_5 = 0 if little effort is needed, N_5 = 1 if subjectively increased lifting force is needed.

N_6 – The necessity of applying external laryngeal pressure for optimizing the glottic exposure; N_6 = 0 if no external pressure is applied. N_6 = 1 if external laryngeal pressure is necessary. Application of SellickManoeuvre does not alter the score.

N_7 – Position of vocal cords; N_7 = 0 if vocal cords are in abduction. N_7 = 1 if vocal cords are in adduction. If the vocal cords are not visualized, N_7 = 0 by default.

The value of the individual components may be documented to offer details of the difficulties encountered, then a composite score is summed to provide an overall assessment of difficulty.

Table 1: Modified intubation difficulty score.

	Mc Coy laryngoscope	Airtraq
N1	No. of intubation attempts >1	No. of intubation attempts >1
N2	The number of operators >1	The number of operators >1
N3	No. of alternative intubation techniques used Hinge used-1; Bougie used-2; Others (Magil forceps, etc.)-3	No. of alternative intubation techniques used Bougie used-1; Others (Magil forceps, etc.)-2
N4	Glottic exposure (Cormack and Lehane: grade −1,N_4 =0)	Glottic exposure (Cormack and Lehane: grade −1,N_4=0)
N5	Lifting force required during laryngoscopy Normal-0; Increased-1	Lifting force required during laryngoscopy Normal-0; Increased or change in position of Airtraq required -1
N6	Necessity for external laryngeal pressure No-0; Yes-1	Necessity for external laryngeal pressure No-0; Yes-1
N7	Position of the vocal cords at intubation Abduction/not visualised-0 Adduction-1	Position of the vocal cords at intubation Abduction/not visualised-0 Adduction-1

We used modified intubation difficulty score (IDS) described by Adnet and colleagues to suit McCoy and Airtraq aided intubation (Table 1). As per IDS, ease of intubation was graded as: score 0- easy, 0-5 - slight difficulty, >5-moderate to major difficulty.

The comparison of difficulty of insertion of laryngoscopes was done as per Likert scale (-2 very difficult, -1 slight difficult, 0 not difficult, +1 easy, +2 very easy).[6] Total intubation time was taken as summation of duration of laryngoscopy and intubation. It was calculated from the time, the facemask was taken off patient's face to appearance of first square waveform on capnograph.

Complications like trauma, sore throat, hoarseness of voice etc. were noted immediately after intubation and 24 hours postoperatively. In case of failure to intubate any of the patient in two attempts, it was managed by the in charge anaesthesiologist as per difficult intubation protocol.

Statistical analysis

Results were analyzed with the help of SPSS Software version 15. Quantitative data are represented as mean and standard deviation.

Further comparison between the study groups was done with the help of unpaired t test or Mann-Whitney test. Qualitative data are represented as frequency and percentage tables and further analyzed using Chi-Square test. P value less than 0.05 was considered as significant.

RESULTS

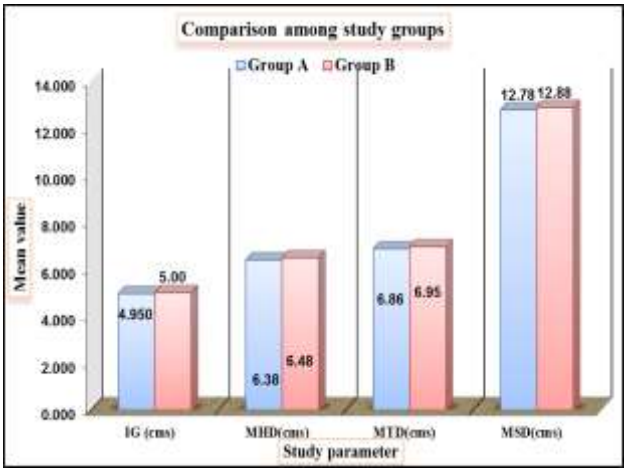
Demographic characteristics and airway assessment parameters were comparable in both groups (Table 2, Figure 1). There was no significant difference observed in the heart rate, systolic and diastolic blood pressure during device insertion, intubation and up to 10 minutes after intubation in Airtraq and McCoy group.

The comparison of difficulty of insertion of laryngoscopes is presented in Table 3. As per Likert scale (-2 to +2), in Airtraq group, insertion of device was very difficult in only 4% patients, while in McCoy group 12% patients had very difficult laryngoscope insertion. While no difficulty seen in 46% and 42% patients in Airtraq and McCoy group respectively.

Table 2: Demographic data.

Parameters	Group A (n=50)	Group B (n=50)	P value
Age in years (Mean ±SD)	37.98± 10.26	37.14±9.82	0.676
Ht (cm) (Mean±SD)	163.52±8.57	163.42±8.51	0.934
Wt. (kgs) (Mean ±SD)	64.26±7.49	64.04±7.30	0.915
Sex (%)			
Male	26 (52%)	28 (56%)	0.688
Female	24 (48%)	22 (44%)	
ASA (%)			
I	34 (68%)	33(66%)	1.000
II	16 (32%)	17 (34%)	
MPC (%)			
I	30 (68%)	35 (70%)	1.000
II	20 (32%)	15 (30%)	

ASA- American Society of Anesthesiologists; MPC- Mallampati classification; SD- Standard Deviation; P value not significant if p >0.05.



IG – Interincisor gap; MTD – Mentothyroid distance; MHD – Mentohyoid distance; MSD – Mentosternal distance.

Figure 1: Comparison of airway assessment between the groups.

Comparison of modified intubation difficulty score in both groups presented in Table 4 which revealed that the values were significantly different in N1, N3, N4, N5 and N6.

Table 3: Comparison of difficulty of insertion (Likert scale) of laryngoscopes among study groups.

Parameters	Group A (%)	Group B (%)	P value
-2 (very difficult)	4	12	0.164
-1 (slight difficult)	36	38	
0 (not difficult)	46	42	
+1 (easy)	12	6	
+2 (very easy)	2	2	

From these findings, it is very clear that McCoy group had statistically very highly significant higher intubation difficulty score compared to Airtraq group.

Table 5 shows that comparison of duration of laryngoscopy and duration of intubation between the two study groups were significantly different. In Airtraq group, only one patient had lip injury and one patient had tongue trauma. In McCoy group 1 patient had lip injury and one had teeth trauma.

Table 4: Comparison of modified intubation difficulty score (IDS) among study groups.

Parameters	Group A			Group B			P value
IDS	Mean	SD	Patients (%)	Mean	SD	Patients (%)	
N1	0.14	0.35	14	0.44	0.50	42	0.001
N2	0.02	0.14	2	0.04	0.20	4	0.560
N3	0.00	0.00	0	0.84	0.37	84	0.000
N4	0.00	0.00	0	0.30	0.46	30	0.000
N5	0.40	0.49	40	0.86	0.35	86	0.000
N6	0.00	0.00	0	0.42	0.50	40	0.000
N7	0.00	0.00	0	0.00	0.00	0	1.000
Total	0.56	0.54		2.90	0.68		0.000

N1- Number of Attempts >1; N2 - Number of Operators >1N3- Number of Alternative Techniques i.e. repositioning of the patient, change of materials; N4 - Cormack Grade- 1; N5 - Lifting Force Required, Normal (N5-0), Increased (N5-1); N6 - Laryngeal Pressure; Not applied (N6-0), Applied (N6-1); N7 - Vocal Cord position; Abduction (N7-0), Adduction (N7-1).
Group A – Airtraq group; Group B – McCoy group.

Table 5: Comparison of duration of laryngoscopy and duration of intubation between study groups.

Parameters	Group A	Group B	P value
Duration of Laryngoscopy (sec)	23.54±3.12	26.64±2.97	0.000
Duration of intubation (sec)	33.44±3.45	37.10±2.97	0.000

Group A – Airtraq group; Group B – McCoy group.P values were calculated as per Unpaired T- Test for duration of laryngoscopy and intubation.

Table 6: Comparison of complications (%) between the study groups.

Parameters	Group A	Group B	P value
Lip injury	1 (2%)	1 (2%)	0.572
Teeth trauma	0 (0%)	1 (2%)	
Tongue trauma	1 (2%)	0 (0%)	
Nil	48 (96%)	48 (96%)	

Group A – Airtraq group; Group B – McCoy group.

DISCUSSION

It is the primary responsibility of an anaesthesiologist to manage the airway under anaesthesia. There are well known disastrous outcomes with failed or difficult tracheal intubation following the induction of general anaesthesia. Successful airway management in cases of cervical spine injury is a great anaesthetic challenge. It requires careful patient positioning, various difficult intubation gadgets, experienced anaesthesiologist and trained assistant for cervical spine immobilisation.

Spinal cord injury has been reported in association with the airway management of patients with cervical spine instability in whom cervical spine immobilisation was not performed. Cervical spine immobilisation reduces the quality of glottis exposure.[7] Manual inline axial stabilization (MILAS) prevents head extension and neck flexion, which are necessary for optimal alignment of the three airway axes and exposure of the vocal cords using direct laryngoscopy techniques. Increased incidence of grade 3 and 4 laryngoscopic views (up to 64%) with conventional laryngoscopy with the use of a rigid collar, tape and sandbags is due to the combination of decreased interincisor distance and cervical spine immobility.[8] Consequently, manoeuvres to stabilise the neck in patients at risk of cervical spine injury may result in failure to secure the airway, which may result in substantial morbidity and even mortality in these patients. These issues have promoted the development of various difficult intubation gadgets for securing the airway in patients at risk of cervical spine injury.

The Airtraq is a type of channelled video-laryngoscope that has been developed to facilitate tracheal intubation in patients with normal or difficult airways. It has an exaggerated curvature of the blade and an internal arrangement of optical components which facilitates view of the glottis with minimal need for airway optimization manoeuvres. It has considerable advantages in the setting of cervical spine immobilisation when direct laryngoscopy is difficult or not recommended.[1-3]

Recently the Airtraq has been reported to limit cervical spine movement, without an increase in the intubation time. The Airtraq also improved the intubation difficulty score and ease of intubation in patients with normal airways and also appears to cause less cervical spine movements during tracheal intubation when compared with the McCoy laryngoscope.[4,9] There are published reports that Airtraq intubating device is superior to laryngoscopy in patients with normal airways and difficult airway scenarios simulated in manikins.[1-4] Airtraq has also been shown to produce less haemodynamic stimulation,a potentially important advantage in certain clinical situations.[10]

Turkstra et alreported 66% lesser movement at occiput–C1, C2–C5 and C5–thoracic segments with Airtraq than that during Macintosh laryngoscopy.[9] Maharaj CH et al studies have demonstrated that the Airtraq reduces the difficulty of tracheal intubation in patients undergoing cervical spine immobilisation with MILS when compared with the Macintosh laryngoscope.[11]

Koh et al. reported higher success rate of intubation with Airtraq in patients with cervical immobilisation with collar.[12] Arslan et al. evaluated the effectiveness of the Airtraq in patients with simulated cervical spine injury after application of a rigid cervical collar.[13]

Considering these multiple benefits of Airtraq laryngoscope, in present study we evaluated the relative efficacies of this intubation technique when used by experienced anaesthesiologist in the clinical setting of cervical spine immobilisation with MILAS in normal adult patients undergoing general anaesthesia and compared it with the commonly used McCoy laryngoscope. In this study both the groups were comparable in terms of demographic parameters like age, height, weight, sex, ASA grade, Mallampatti classification and other airway parameters like mentothyroid, mentohyoid, mentosternal distances, interinciser gap. All these parameters have shown P value >0.05, hence statistically not significant.

Other parameters compared were difficulty of insertion of laryngoscope, duration of laryngoscopy and intubation difficulty score (IDS). Difficulty of insertion of laryngoscope is a parameter, we have recorded as per Likert's scale i.e.-2 which was very difficult to insert Airtraq or McCoy laryngoscope to +2 which was very easy to insert.

In the present study, when considering the duration of the laryngoscopy that is time from removal of face mask to visualisation of vocal cord and duration of intubation that is removal of face mask to appearance of first wave form on $EtCO_2$ monitor were significantly shorter with the Airtraq group when compared to the McCoy group (P value was 0.000). The similar findings were observed by Marwa et al duration of the intubation procedure was significantly longer in Macintosh group than Airtraq group (34.3±12.27 s in Airtraq group versus 48.75 ± 21.57 s in Macintosh group).[14]

Intubation difficulty score was found to be significantly less in Airtraq group compared to the McCoy group. In the present study while comparing the number of intubation attempts, there was statistically significant difference between the two devices. In Airtraq group 14% patients was required more than 1 attempt, while in McCoy group 42% patients were required more than 1 attempt (P= 0.001). In agreement with the study, Durga et al. have reported nearly the same results; there was statistically significant difference between the Airtraq group and the McCoy group as regards the number of intubation attempts.[4]

In the present study 2% patients were required to change the operator in Airtraq group whereas 4% in McCoy group. P value was >0.05 with no significant difference. No patient required any alternative technique in Airtraq group whereas 84% patients in McCoy group required some alternative technique in the form of position change, hinge movement of the McCoy blade or bougie (p=0.000).

As regards optimization manoeuvres required, both devices needed some optimization manoeuvres during insertion and placement of the endotracheal tube. Airtraq had a statistically significant less optimization manoeuvres than McCoy and offered easier intubating conditions. Durga et al 2012 and Marwa et al showed similar findings in their study.[4,14]

All patients in Airtraq group showed Cormack and Lehane grade 1, while 30% patients in McCoy group had Cormack and Lehane grade more than 1. These results were also statistically very highly significant (P =0.000). Lifting force required in 40% of patients in Airtraq group while in 86% of patients in McCoy group (P =0.000). There was no requirement of external laryngeal pressure in Airtraq group while in McCoy group 40% patients required the same (P =0.000).

In our study, Airtraq group had required lesser intubation attempts, lesser change of operator, no change of position, lesser grade of Cormack Lehane, lesser degree of lifting force and no external laryngeal pressure as compared with McCoy group.

Similar finding were noted by Durga et al that intubation attempt, alternative techniques for intubation, lifting force, external laryngeal pressure required was more in patients of McCoy group compared to that of Airtraq group.[4]

As for the rate of successful placement of the ETT, all patients were successfully intubated by both the Airtraq and the McCoy laryngoscope. This is attributed to the easiness of use of the Airtraq and its quick learning curve. Maharaj et al also had nearly the same results as regards

the overall success rate of intubation in patients with cervical spine immobilization, with 100% of the patients intubated in the Airtraq group and 95% in the Macintosh group.[11]

Turkstra et al, compared Airtraq and Macintosh use in intubating patients with cervical spine immobilization using MIAS. Radio logically they found that C-spine motion was 53%, 95%, and 60% less during laryngoscopy with Airtraq compared to the Macintosh at the occiput-C1, C2–C5, and C5-thoracic motion segments, respectively (all P <0.01).[9]

Similar to the present study they concluded, use of the Airtraq Laryngoscope may be useful to limit movement without an increase in the duration of intubation.[9] Our study demonstrated that the Airtraq reduced the IDS, improved the Cormack and Lehane grade and reduced the number of optimisation manoeuvres compared with the McCoy laryngoscopy.

In our study both groups did not show statistically significant changes in pulse rate, systolic and diastolic blood pressure during the intubation. Marwa et al did a comparative study between the use of Macintosh Laryngoscope and Airtraq in cervical spine immobilisation by MILS which showed in Airtraq group both heart rate and mean arterial blood pressure did not show statistically significant changes during the intubation procedure while in Macintosh group, there was statistically significant increase in heart rate and mean arterial blood pressure at all periods following intubation when compared to the preinduction values.[14] Airtraq resulted in significantly less stimulation of heart rate and blood pressure after tracheal intubation in comparison with the Macintosh.

This finding could be attributed to the fact that the Airtraq provides a view of the glottis without a need to align the oral, pharyngeal and tracheal axes, and therefore requires less force to be applied during laryngoscopy, while when using the Macintosh during application of MIAS, which did not allow alignment of the three airway axes, more lifting force and more manipulations were exerted to get a glottic view.

However, in present study we have not observed any statistical significant change in haemodynamic parameters of both groups which could be attributed to our balanced anaesthesia technique.

As regards to the complications related to this study, there were no major complication noted, except lip bruising(2%), tongue bruising (2%) and teeth trauma, they were statistically also not significant. Durga et al 2012 demonstrated significantly less airway trauma with Airtraq compared to McCoy laryngoscope.[4]

Thus to summarise, this study demonstrated that the Airtraq reduced the duration of laryngoscopy and intubation, had lower IDS, it improved the Cormack and Lehane grade and also reduced the number of optimization manoeuvres compared with the McCoy laryngoscope.

Considering the complications there was no significant difference between the two groups. Overall Airtraq offers an easy, safe and effective tool to manage the difficult airway in patients with cervical spine injury with manual inline axial stabilization.

CONCLUSION

The Airtraq fascilitates the ease of intubation by providing a better view of the larynx as compared to McCoy laryngoscope in patients with manual-in-line axial stabilization of cervical spine.

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