Original Article

Comparative evaluation of Airtraq™ optical Laryngoscope and Miller's blade in paediatric patients undergoing elective surgery requiring tracheal intubation: A randomized, controlled trial

Address for correspondence:
Dr. Bikramjit Das,
Type-IV, I-7, Government Medical College Campus,
Haldwani - 263 139,
Uttarakhand, India.
E-mail: bikramjit.anesth@gmail.com

Bikramjit Das, Arijit Samanta[1], Subhro Mitra, Shahin Nikhat Jamil[2]

Department of Anaesthesiology, Government Medical College, Haldwani, Uttarakhand, [1]Department of Critical Care, Sir Ganga Ram Hospital, New Delhi, [2]Department of Anaesthesiology, Jawaharlal Nehru Medical College, Aligarh, Uttar Pradesh, India

Access this article online

Website: www.ijaweb.org

DOI: 10.4103/ija.IJA_541_15

Quick response code

ABSTRACT

Background and Aims: The Airtraq™ optical laryngoscope is the only marketed videolaryngoscope for paediatric patients besides the fibre-optic bronchoscope. We hypothesized that intubation would be easier with Airtraq™ compared to Miller blade. Hence, we compared Airtraq™ with the Miller laryngoscope as intubation devices in paediatric patients. **Methods:** This prospective, randomized study was conducted in a tertiary care teaching hospital. Sixty children belonging to American Society of Anesthesiologists' Grade I–II, aged 2–10 years, posted for routine surgery requiring tracheal intubation were randomly allocated to undergo intubation using a Miller (n = 30) or Airtraq™ (n = 30) laryngoscope. The primary outcome measure was time of intubation. We also measured ease of intubation, number of attempts, percentage of glottic opening score (POGO), haemodynamic changes and airway trauma. Student t test was used to analyse parametric data. **Results:** Intubation time was comparable between Miller's laryngoscope (15.13 ± 1.33s) compared to Airtraq™ (11.53 ± 0.49 s) (P = 0.29) The number of first and second attempts at intubation were 25 and 5 for the Miller laryngoscope and 29 and 1 for the Airtraq™. Median visual analogue score (VAS) for ease of intubation was 5 in Miller group compared to 3 in Airtraq™ group. The median POGO score was 75 in the Miller group and 100 in the Airtraq™ group (P = 0.01). Haemodynamic changes were maximum and most significant immediately and 1 min after intubation. Airway trauma occurred in three patients (9.09%) in Miller group and one patient (3.33%) in Airtraq™ group. **Conclusion:** The Airtraq™ reduced the difficulty of tracheal intubation and degree of haemodynamic stimulation compared to the Miller laryngoscope in paediatric patients.

Key words: Intubation, laryngoscopes, paediatrics, randomized controlled trial, surgery

INTRODUCTION

The Airtraq™ optical laryngoscope is a recently developed intubating device. The exaggerated curvature of the blade and an internal arrangement of optical components provide a clear view of the glottis, without need for alignment of the oral, pharyngeal and laryngeal axes.[1]

Recently, smaller versions of Airtraq™ have been introduced for tracheal intubation in paediatric patients. Three sizes are available: size 2, size 1 and size 0 which are green, purple and grey coloured respectively and accommodate endotracheal tube sizes 6.0–7.5, 4.0–5.5 and 2.5–3.5, respectively.[2]

How to cite this article: Das B, Samanta A, Mitra S, Jamil SN. Comparative evaluation of Airtraq™ optical Laryngoscope and Miller's blade in paediatric patients undergoing elective surgery requiring tracheal intubation: A randomized, controlled trial. Indian J Anaesth 2017;61:326-31.

In this study, we hypothesised that intubation with Airtraq™ would be easier than Miller blade in paediatric patients.

METHODS

After approval from the Institutional Ethical Committee, sixty children were studied. A randomized prospective study was planned to compare size 1 and size 2 Airtraq™ (Prodol Meditec S.A., Vizcaya, Spain) with Miller blade of same sizes. This study was conducted according to Good Clinical Practice standards and the Helsinki Declaration, and the protocol was registered at ClinicalTrial.gov (NCT02423317). Our study followed the CONSORT recommendations. The duration of the study was from June 2012 to June 2013.

The children included in the study were 2–10 years of age, American Society of Anesthesiologists' physical status I-II and posted for elective plastic and paediatric surgeries requiring tracheal intubation. The following were excluded from the study: (i) patients with upper respiratory tract symptoms, (ii) those at risk of gastroesophageal regurgitation and (iii) those with airway-related conditions such as trismus, limited mouth opening, trauma or mass. Sixty patients were equally randomized by block randomisation to one of the two groups (Airtraq™ and Miller) of 30 each for airway management using a computer-generated randomisation programme by an anaesthetist who was not involved in the operating room procedures. Operating room nurse in-charge assigned the participants to interventions. As it was a single-blind study, participants were blinded to the interventions. Three anaesthesiologists, involved in this study, were assigned to intubation using the two devices. The anaesthesiologists had performed at least 300 intubations using the Miller blade in pediatric patients and more than 50 intubations using the Airtraq™ in adult manikins and at least 40 intubations in pediatric patients before this study. The primary outcome measure was time for intubation. We also measured ease of intubation, number of attempts, POGO score, haemodynamic changes and airway trauma.

Written informed consent was taken from the parents before intervention, and a standardised protocol for anaesthesia was maintained for all cases. All the children were kept nil per mouth as per standard guidelines. They were premedicated with 0.3 mg/kg of midazolam syrup 1 h before induction of anaesthesia. Induction of anaesthesia included sevoflurane in oxygen, with monitors including SpO2, non-invasive blood pressure, electrocardiogram (ECG) and temperature. Intravenous cannula was secured after induction. Patients were premedicated with dexamethasone, midazolam, fentanyl and glycopyrrolate though intravenous route. Anaesthesia was maintained with 1%–2% sevoflurane and 60% nitrous oxide in oxygen.

After adequate muscle relaxation with injection rocuronium (0.6 mg/kg) and mask ventilation for 2 min, intubation attempts were taken using Airtraq™ or Miller on a random basis. Following successful intubation, breathing circuit was attached. Correct placement of tracheal tube was confirmed by capnography and bilateral chest auscultation. Anaesthesia was maintained on O_2, N_2O and sevoflurane. Surgery was allowed to commence after the collection of the last haemodynamic data at 5 min post-intubation interval. Haemodynamic data were collected at the following interval: pre-induction, after induction, immediately after intubation (T0), 1 min, 3 min and 5 min after intubation (T1, T3 andT5, respectively).

Neuromuscular blockade was maintained as and when required. At the end of the surgery, inhalational anaesthetic agents, sevoflurane and nitrous oxide, were discontinued, and the patient was put on 100%O_2. Residual neuromuscular blockade was reversed with injection neostigmine (40 μg/kg) and injection glycopyrrolate (10 μg/kg).

The parameters recorded were intubation time (defined as the time from placement of Airtraq™ or Miller laryngoscope into the mouth till appearance of the capnograph waveform), number of intubation attempts, ease of intubation, percentage of glottic opening (POGO) scoring, overall intubation success rate, number of oesophageal intubation, haemodynamic changes and airway trauma (blood detected on the devices).

A single insertion of the Airtraq™ or a single insertion of the Miller laryngoscope blade into the mouth with passing the endotracheal tube beyond the teeth was considered as an attempt. With either device, tracheal intubation was labelled as a failure if it could not be accomplished within three attempts of intubation. Patients were ventilated with bag and mask in between two attempts. Hemodynamic responses were measured in each attempt and were averaged for total number of attempts.

The intubating anaesthesiologist graded the ease of intubation for both techniques on a visual analogue scale from 1 to 10, 10 being most difficult or failed intubation and 1 being very easy intubation. Reasons for failed attempts when multiple attempts of intubation were required, or overall intubation was unsuccessful were also recorded.

We based our sample size estimation on time taken for intubation in previous studies.[3,4] In the study by Riad *et al*.,[3] mean time of intubation with the Airtraq™ group was 22.84 s with standard deviation 6.1. Based on that study, using $\alpha = 0.05$, power of the study 80% and assuming 25% difference between the means as significant, we estimated that 56 patients would be required. Therefore, we recruited 60 patients in our study. Non-continuous data were compared with Mann–Whitney U-tests. The incidence of intubation complications and the overall intubation success rate were tested by Fisher's exact test. Continuous data were compared using unpaired *t*-tests. Statistical analysis was performed using SPSS software version 20.0; (SPSS Inc. Chicago, IL, USA). $P < 0.05$ was considered statistically significant.

RESULTS

Demographic parameters were comparable in both groups [Table 1]. Overall intubation success rates were 100% for both devices. The number of first and second attempts at intubation were 25 and 5 for the Miller's laryngoscope and 29 and 1 for the Airtraq™ ($P = 0.19$), respectively. Time to intubation was faster with the Airtraq™ (11.53 ± 0.49 s) than with the Miller's laryngoscope (15.13 ± 1.33 s), but it was not significant [Table 2]. Median visual analogue score (VAS) score for ease of intubation was 5 in Miller group compared to 3 in Airtraq™ group ($P = 0.01$) [Table 2]. For patients assigned to the Miller laryngoscope group, the median POGO score was 75, and in the Airtraq™ group, the median POGO score was 100. Number of oesophageal intubations with Miller's blade were 4 and none with Airtraq™ ($P = 0.11$) [Table 2]. Haemodynamic changes in terms of pulse rate and mean arterial pressure (MAP) were maximum and most significant immediately and 1 min after intubation in Miller group. [Figures 1 and 2]. Airway trauma occurred in three (9.09%) patients in the Miller group and one patient (3.33%) in the Airtraq™ group [Table 2].

Table 1: Comparison of demographic parameters between the Airtraq™ and Miller groups

Parameters	Millers group (*n*=30)	Airtraq™ group (*n*=30)
Male:female	19:11	25:05
Age (years)	5.4 (1.78)	6.15 (2.64)
Weight (kg)	15.9 (2.53)	16.5 (3.87)
ASA grade (I/II)	19/11	22/8

Data are presented as number or mean (SD). SD – Standard deviation; ASA – American Society of Anesthesiologists

DISCUSSION

Miller blade is commonly used for paediatric airway management for routine as well as difficult laryngoscopic situations.[5] We, therefore, wished to compare the utility of Airtraq™ to Miller laryngoscope in this randomized controlled clinical trial.

We have demonstrated 100% overall success rate with both the Airtraq™ and the Miller laryngoscope in paediatric age group in this study. However, intubation was about 3.6 s faster with the Airtraq™ in comparison with Miller laryngoscope, though it was not significant. Sørensen and Holm-Knudsen.[6] also showed similar intubation time (15.8 s) with Airtraq™ in children.

The Airtraq™ was successful in all our patients, although the second attempt was required in one patient. The failed attempt with the Airtraq™ resulted from the introducer blade's tip advancing into the

Table 2: Comparison of AirtraqTM laryngoscope and Miller's blade in terms of overall success rate, time of intubation, number of attempts, ease of intubation, percentage of glottic opening score, oesophageal intubation and airway trauma

Parameters	Millers group (*n*=30)	Airtraq™ group (*n*=30)	*P*
Overall success rate [*n* (%)]	30 (100)	30 (100)	-
Time of intubation in seconds (Mean±SD)	15.13 (1.33)	11.53 (0.49)	0.29
Number of attempts			
1/2/3	25/5/0	29/1/0	0.19
Ease of intubation (VAS Median [IQR])	5 [3.75-6]	3 [2-3.25]	0.01*
POGO score Median [IQR]	75 [66-100]	100 [93-100])	0.04*
Oesophageal intubation[*n* (%)]	4 (13.33)	0	0.11
Airway trauma (*n*)	3	1	0.61

Data are presented as Mean±SD, *n* (%) or median [IQR]. *Statistically significant. POGO – Percentage of glottic opening; VAS – Visual analogue score; SD – Standard deviation; IQR – Inter-quartile range

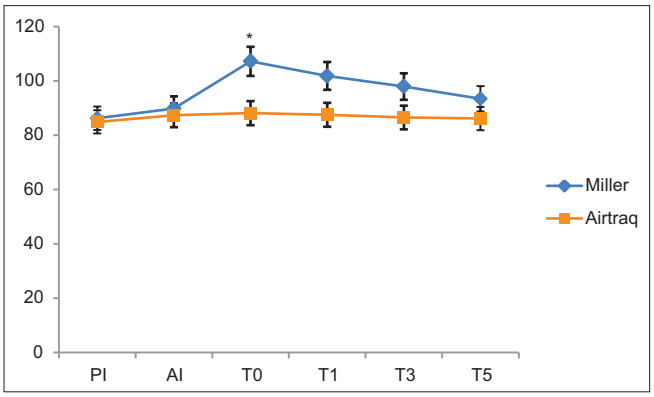


Figure 1: Comparison of heart rate (Y-axis, beats/min) between Miller and Airtraq™ group. Data are represented as mean and standard deviation. *$P < 0.05$ compared with the Miller's blade

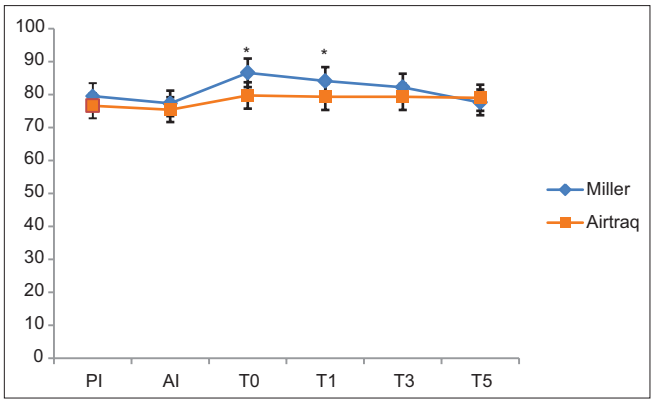


Figure 2: Comparison of mean arterial pressure (Y-axis, mmHg) between Miller and Airtraq™ group. Data are represented as mean and standard deviation. *$P < 0.05$ compared with the Miller's blade

vallecula rather than beneath the epiglottis. However, this was easily corrected by partially withdrawing the device, and with a subsequent scooping movement of the introducer blade, lifting the epiglottis and advancing the tracheal tube into the trachea. Only a few seconds were required for this manoeuvre, which explains why intubation time with the Airtraq™ was faster than with the Miller laryngoscope.

Although according to the user's guideline, during intubation the tip of the Airtraq™ should be kept at the vallecula.[7]

We had a median POGO score of 75 with Miller's blade compared to 100 with Airtraq™. White *et al*.[8] also showed similar POGO score in their study. They revealed median POGO score of 100 with Airtraq™, compared to 77 with conventional laryngoscopy. Ali *et al*.[9] also demonstrated significantly improved POGO score in children using Airtraq™.

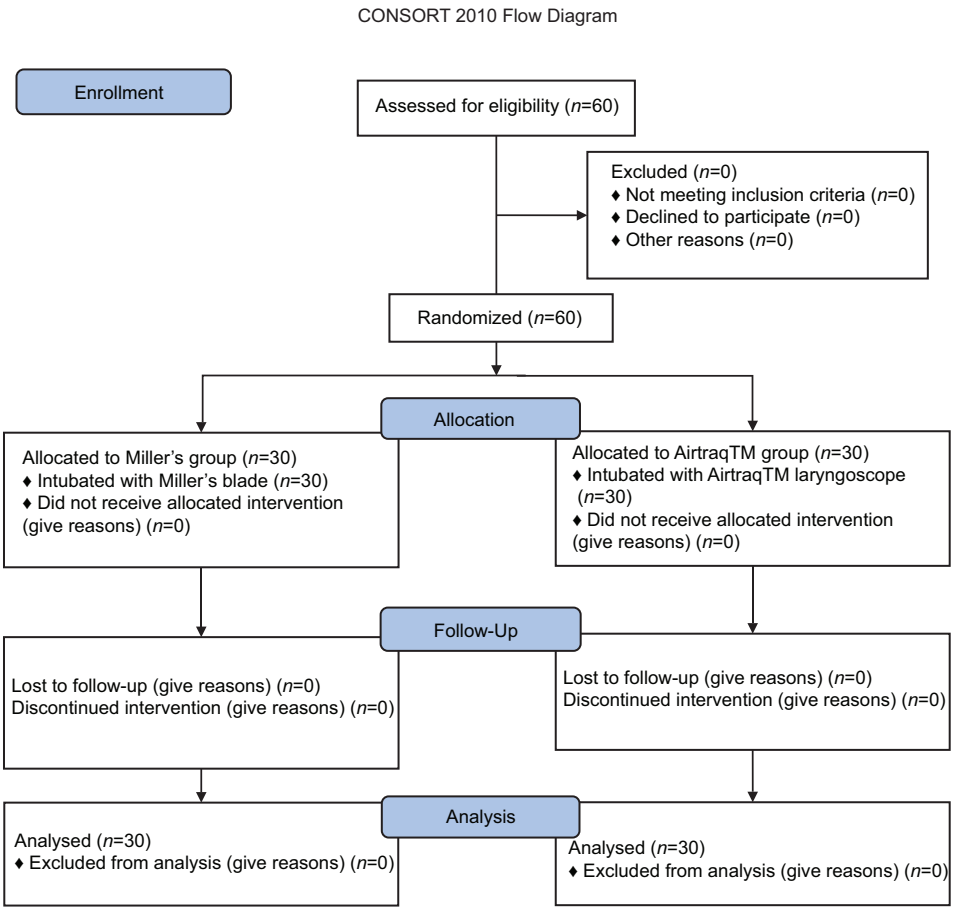
We experienced a significantly lower VAS score for ease of intubation in Airtraq™ group. There are minor manipulations needed with Airtraq™ to align the vocal cord with the pre-loaded tube. Furthermore, the glottis viewing was significantly improved with Airtraq™ in our study. These factors, together, probably explain the lower VAS score in the Airtraq™ group. Maharaj *et al*.[10] and Park *et al*.[11] also showed similar results regarding VAS score for ease of intubation in their studies.

There were no oesophageal intubations in patients assigned to the Airtraq™ group. It provided an early complete view of the larynx and allowed the operator to observe the advancement of the tube into the trachea from outside the larynx. This continuous view allowed detection of inaccurate tube advancement which was then corrected before oesophageal intubation. In contrast, oesophageal intubation occurred in 13.33% of patients assigned to the Miller laryngoscope (POGO scores were 70, 60, 60 and 30). This could be attributed to poor visibility of the glottis as well as poor manoeuvrability of the tube due to limited oropharyngeal space.

The Airtraq™ resulted in a lesser stimulation of heart rate and MAP which was statistically significant compared to the Miller group. This was most probably due to the fact that there was no need to make the patients in sniffing position to do the intubation and lesser force, and comparatively lesser time was needed to accomplish the procedure. Thus, lesser stimulation of the periglottic sympathetic plexus was occurred.[12-16] It is mostly beneficial in those situations where suppression of laryngoscopy response is required.

Although we were concerned that the view through the Airtraq™ might become obstructed by secretions or fogging, neither problem was observed. However, lip injuries with the Airtraq™ occurred when the introducer blade was initially introduced into the mouth and were related to the bulkiness of the introducer blade. In contrast, the Miller laryngoscope, which is less bulky (especially in the width of the blade), did not cause lip injury but 3 cases of deep structure injuries were noted due to the limited space for manipulation in the oropharynx.

One of the major limitations of our study was operator bias to assess the ease of intubation. We used VAS to assess the ease of intubation. Another problem we faced was cost-effectiveness. The cost of Airtraq™ as a



single use device is still quite high in the third world countries like India.

CONCLUSION

In this study, time of intubation with the Airtraq™ was not faster compared to the Miller laryngoscope in paediatric patients. Overall success rate was similar, although ease of intubation and glottis visualisation were better with the Airtraq™

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

REFERENCES

1. Maharaj CH, Higgins BD, Harte BH, Laffey JG. Evaluation of intubation using the Airtraq™ or Macintosh laryngoscope by anaesthetists in easy and simulated difficult laryngoscopy – A manikin study. Anaesthesia 2006;61:469-77.
2. Airtraq™ Guided Video Intubation. Airtraq™ SP. Available from: http://www.Airtraq™.com/index.php?option=com_contentandtask=viewandid=200andItemid=329. [Last accessed on 2014 Oct 10].
3. Riad W, Moussa A, Wong DT. Airtraq™ versus Macintosh laryngoscope in intubation performance in the paediatric population. Saudi J Anaesth 2012;6:332-5.
4. Riad W, Ansari T. Effect of cricoid pressure on the laryngoscopic view by Airtraq™ in elective caesarean section: A pilot study. Eur J Anaesthesiol 2009;26:981-2.
5. Varghese E, Kundu R. Does the Miller blade truly provide a better laryngoscopic view and intubating conditions than the Macintosh blade in small children? PaediatrAnaesth 2014;24:825-9.
6. Sørensen MK, Holm-Knudsen R. Endotracheal intubation with Airtraq™® versus storz®videolaryngoscope in children younger than two years – A randomized pilot-study. BMC Anesthesiol 2012;12:7.
7. Airtraq™ Guided Video Intubation. Tips and and Techniques. Available from: http://www.Airtraq™.com/index.php?option = com_contentandtask=viewandid=221andItemid=337. [Last accessed on 2014 Oct 10].
8. White MC, Marsh CJ, Beringer RM, Nolan JA, Choi AY, Medlock KE, *et al*. A randomized, controlled trial comparing the Airtraq™™ optical laryngoscope with conventional laryngoscopy in infants and children. Anaesthesia 2012;67:226-31.
9. Ali QE, Amir SH, Firdaus U, Siddiqui OA, Azhar AZ. A comparative study of the efficacy of PediatricAirtraq™® with conventional laryngoscope in children. Minerva Anestesiol 2013;79:1366-70.
10. Maharaj CH, O'Croinin D, Curley G, Harte BH, Laffey JG. A comparison of tracheal intubation using the Airtraq™® or the Miller laryngoscope in routine airway management: A randomized, controlled clinical trial. Anaesthesia 2006;61:1093-9.
11. Park EY, Kim JY, Lee JS. Tracheal intubation using the Airtraq™: A comparison with the lightwand. Anaesthesia 2010;65:729-32.

12. Schälte G, Scheid U, Rex S, Coburn M, Fiedler B, Rossaint R, *et al*. The use of the Airtraq™® optical laryngoscope for routine tracheal intubation in high-risk cardio-surgical patients. BMC Res Notes 2011;4:425.
13. Ndoko SK, Amathieu R, Tual L, Polliand C, Kamoun W, El Housseini L, *et al*. Tracheal intubation of morbidly obese patients: A randomized trial comparing performance of Macintosh and Airtraq™ laryngoscopes. Br J Anaesth 2008;100:263-8.
14. Gaszynski T, Gaszynski W. A comparison of the optical Airtraq™ and the standard Macintosh laryngoscope for endotracheal intubation in obese patients. AnestezjolIntensTer 2009;41:145-8.
15. Trimmel H, Kreutziger J, Fertsak G, Fitzka R, Dittrich M, VoelckelWG. Use of the Airtraq™ laryngoscope for emergency intubation in the prehospital setting: A randomized control trial. Crit Care Med 2011;39:489-93.
16. Shah A, Patwa A, Patwa A. Use of Airtraq™® optical laryngoscope for the intubation in Pierre Robin sequence in a teenage child. Indian J Anaesth 2016;60:295-7.