

Original article

Comparison of ease of intubation with Airtraq optical laryngoscope versus Macintosh laryngoscope in pediatric patients undergoing elective surgeries

Narayan V. Kamath^{1*}, Neelam Dogra², Rama Chatterjee², Pakhi Sharma¹

¹Department of Anaesthesiology, Father Muller Medical College, Rajiv Gandhi University of Health Sciences, Karnataka, India

²Department of Anaesthesiology, SMS Medical College, Rajasthan University of Health Sciences, Jaipur, Rajasthan, India

*Corresponding author: pnvk92@yahoo.in

Abstract

Background: The AirTraq optical laryngoscope has been extensively evaluated in adults; it improves the ease of intubation and is associated with less movement of the cervical spine. Studies on pediatric patients are necessary due to the differences in airway in comparison with adults. This study aimed to compare the ease of intubation with AirTraq and Macintosh laryngoscopes in pediatric patients as primary objective and hemodynamic changes and airway trauma as secondary objectives.

Methods: 60 children of American Society of Anaesthesiologists (ASA) class I-II, aged 1-7 years of either sex posted for routine surgery requiring tracheal intubation were randomly divided into 2 groups; Group-A AirTraq (n = 30) and Group-B Macintosh (n = 30). Intubation time, number of attempts, percentage of glottic opening (POGO) score, Visual Analogue Scale (VAS) were recorded. Hemodynamic variables noted at baseline, immediately after intubation (T0), 1, 3, and 5 min after intubation (T1, T2, T3). Airway trauma (if any) during intubation was also noted.

Results: The use of AirTraq in comparison with Macintosh laryngoscope was associated with shorter intubation time [(15.83±3.949s) and (19.83±5.066s), P=0.001], better POGO score (p<0.001), better VAS (P=0.001), less increase in heart rate 5 min after intubation (P=0.042) and less increase in MAP at 1,3 and 5 min post-intubation. Airway trauma occurred in 2 patients in Group-B and 0 patients in Group-A.

Conclusion: AirTraq decreases intubation time, provides better POGO score and ease of intubation, less hemodynamic changes during intubation when compared with Macintosh laryngoscope.

Keywords: anesthesia; intubation; pediatric; videolaryngoscope

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Introduction

Tracheal intubation is a core anaesthetic skill and failed or prolonged attempts at intubation are major causes of morbidity (1). Video laryngoscopes and optical laryngoscopes have been developed and used in adults during the last decade, and some of these are now available for small children.

The AirTraQ optical laryngoscope has been extensively evaluated in adults and, in particular, it improves the ease of intubation and is associated with less movement of the cervical spine (2). Updated ASA algorithm recommends consideration for video laryngoscopy as the initial choice (3).

Studies on pediatric patients are necessary due to the differences in the airway of pediatric subjects compared with adult subjects. These differences are due to the large head, short jaw, large size of tongue relative to mouth, higher larynx (C2- C3), anterior angulation of the vocal cords, and narrow, omega shaped epiglottis which projects above the glottic opening in pediatric subjects (4).

Even in expert hands, direct laryngoscopy is not ideal for visualization of the larynx in children with anatomic anomalies such as Pierre Robin syndrome (Robin sequence). Poor visualization of the larynx may result in a failed intubation and may contribute to a failed airway (5).

The Airtraq has a short learning curve even for medical personnel inexperienced with laryn-

goscopy. Use of the Airtraq does not require displacement of the tongue and forceful elevation of the epiglottis resulting in less application of force compared with the conventional direct laryngoscopy (4). It is a battery operated laryngoscope that allows high-quality viewing of the vocal cords without requiring a straight line of sight from outside the patient to the vocal cords (4).

The blade comprises of two side-by-side channels. One channel acts as a conduit through which the tracheal tube is passed whilst the other contains a light source and a series of lenses, prisms and mirrors, that reflect the image from the tip of the blade to the viewfinder at the proximal end of the scope. The image can be viewed through the viewfinder or displayed on a wireless monitor (1). Airtraq's anatomical shape enables easy intubation, especially with CL Grade III & IV views, with no hyperextension of the neck. Optics and guiding channel "point" the user to the center of the viewing window. The user only has to center the vocal cords in the middle of the image and the endotracheal tube follows.

Two sizes of this pediatric version are available, size 0 - infant (tracheal tube size 2.5–3.5 mm ID) and size 1- child (tracheal tube size 4.0–5.5 mm ID) which are grey and purple coloured respectively (6).

Over the years, Miller's laryngoscope blade has been preferred over Macintosh blade

during conventional direct laryngoscopy in children. But some recent studies suggest that Miller blade does not necessarily provide a better view of the larynx and that the Macintosh blade is equally effective (7).

Studies are now being conducted comparing AirTraq with direct laryngoscopy. In this study, we aim at comparing the intubation time of AirTraq with Macintosh laryngoscopes in pediatric patients, number of intubation attempts, percentage of glottis opening (POGO) score, cardiovascular changes during intubation and cases associated with airway trauma.

Methodology

Study design and setting: A Prospective randomized controlled trial (RCT) department of Anaesthesiology, JK Lone Hospital (tertiary paediatric hospital), SMS Medical College, Jaipur, India for a duration of one year.

Population: children posted for routine surgery requiring tracheal intubation.

Sample size: Sample size was calculated to be 30 subjects for each of two groups at 95% confidence interval and 80% power, expecting minimum detectable difference duration of intubation in both groups to be $28.76 \pm 20.6s$ (as per reference article). This sample size was also adequate to cover all other study variables.

Sampling: Allocation concealment was done using serially labelled, opaque, sealed envelopes (SNOSE technique) that the investigator opened once the patient reached preoperative

area. Group A AirTraq (n = 30) and Group B Macintosh (n = 30).

Eligibility criteria -

1. **Inclusion criteria:** (i) ASA class I-II (ii) Age between 1-7 years (neonates excluded since neonatal airway management for elective surgery is associated with a higher risk of complications compared with the older paediatric population)
2. **Exclusion criteria:** (i) History of difficult intubation (ii) Children with airway-related conditions such as trismus, limited mouth opening, trauma or mass (these might increase the time taken for intubation, number of intubation attempts, and chances of airway trauma) (iii) Risk of gastric aspiration. (iv) Children with upper respiratory tract infection (since they are more prone to intraoperative spasm during manipulation).

Intervention and measurements:

With due permission from the Institutional Ethics Committee, the study was initiated. Written, free and informed consent was obtained from parents. After checking fasting status and pre-anesthetic checkup, calculated volume of intravenous fluid was started through already secured iv line as per hospital protocol. Inj. Midazolam 0.05 mg/kg i.v was given following which hemodynamic data (SBP, DBP, MAP, HR) and SpO₂ were noted.

Pre-anesthetic medication (Inj. Glycopyrrolate 0.005 mg/kg i.v + Inj. Fentanyl 1 µg/kg i.v) was administered.

After adequate preoxygenation with 100% O₂, anaesthesia was induced with Inj. Thiopentone Sodium 5 mg/kg intravenously slowly and intubation was facilitated with Inj. Atracurium 0.5 mg/kg iv and then Hemodynamic data (SBP, DBP, MAP, HR) and SpO₂ after induction were noted. Group A and Group B underwent endotracheal intubation with AirTraq optical laryngoscope and MacIntosh laryngoscope respectively. Time taken for intubation, number of intubation attempts, POGO score, airway trauma (if any) during intubation, hemodynamic data (SBP, DBP, MAP, HR) immediately after intubation (T0) were also noted. Visual analogue Scale (VAS) for intubation was also noted (0-extremely easy, 10- extremely difficult).⁴ Time taken for intubation was defined as time from the introduction of laryngoscope blade into the child's mouth till the appearance of waveform on the capnograph. A 100% POGO score is a full view of the glottis from the anterior commissure to the interarytenoid notch. A POGO score of 0 means that even the interarytenoid notch is not seen.

Anaesthesia was maintained with 40% O₂+60% N₂O and injection atracurium 0.1 mg/kg and sevoflurane 1-2 MAC. Hemodynamic data (SBP, DBP, MAP, HR) were recorded at 1, 3, 5 min after intubation (T1, T2, T3). At the end of surgery reversal of residual neuromuscular blockade was done with injection neostigmine (0.05mg/kg) and injection glycopyrrolate (0.01mg/kg) and after extubation, child was shifted to the PACU.

Statistics: Sample size was calculated to be 30 subjects for each of the groups at 95% Confidence Interval and 80% power with duration of intubation being the primary outcome. This sample size is also adequate to cover all other study variables. Data was entered into MS Excel spreadsheet and analyzed using SPSS version 21.0 (SPSS Inc., Chicago, IL, USA). The alpha error was set at 0.05. Continuous data are represented as mean and standard deviation and compared using unpaired t-tests. Non-continuous data which includes POGO Score, VAS for intubation and hemodynamic parameters are compared using Mann-Whitney U-tests. Categorical data are tested by Chi-square test. P < 0.05 was considered statistically significant.

Table 1. Socio-demographic data

Demographic variables	AIRTRAQ	MACINTOSH	p -Value
Age (in months) - mean (SD)	29.6 (28.13)	39.97 (30.09)	0.173
Weight (in kg) - mean (SD)	10.17 (5.916)	11.85 (5.928)	0.277
Male to female ratio	25:5	23:7	0.747
ASA grade (I/II)	20/10	21/9	1.000

Results

A total of 60 patients were included in this study. Demographic data between 2 groups presented in Table 1 were not statistically significant ($p < 0.05$).

Time taken for intubation was significantly less when compared to Macintosh group (19.83 ($p = 0.001$) in Airtraq group (15.83 \pm 3.949 s) \pm 5.066 s) as depicted in Figure 1.

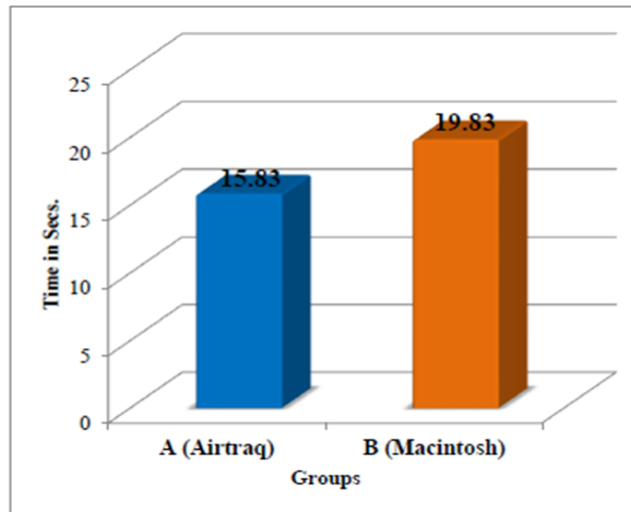


Figure 1. Time taken for intubation.

Mean duration of intubation of each group represented in columns and error bars showing SD. POGO score was used to evaluate visualization of glottis. There were significantly better

scores in patients of Airtraq group [100 (90-100)] in comparison to Macintosh [72.5 (30-90)] as seen in Figure 2.

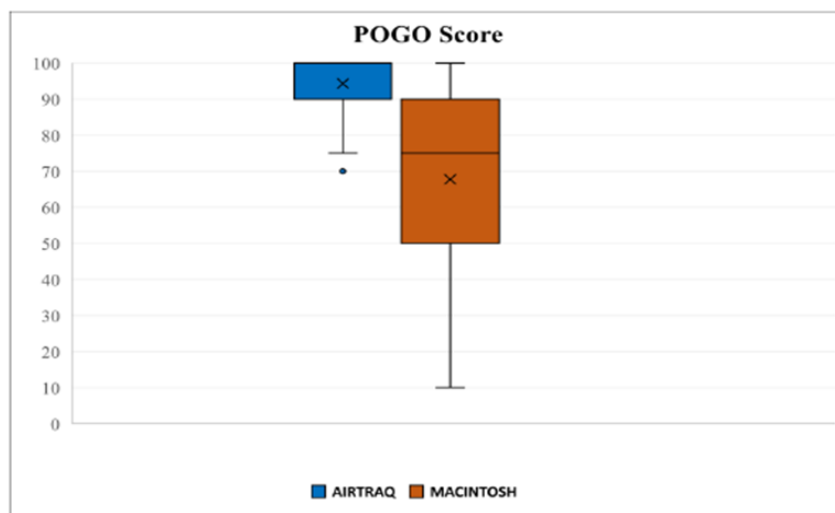


Figure 2. POGO score represented in Box and Whisker plot.

The numbers marked on the graph (100 and 75) represent the medians of Airtaq and Macintosh groups respectively. The box represents the inter-quartile range and the ends of the whiskers represent the extreme values.

Airraq group had a median VAS score of intubation of 1.0 which was significantly lesser

than in Macintosh (3.5) with a p-value of 0.001. 3 patients each in Airraq and Macintosh group were intubated successfully in the second attempt. Soft tissue trauma during intubation was noted in 2 patients of Macintosh group. Oesophageal intubation occurred in 1 patient from Macintosh group (Table 2).

Table 2. Intubation parameters

Intubation parameters	AIRTRAQ	MACINTOSH	p-Value
Time taken for Intubation (in seconds) - Mean (SD)	15.83 (3.949)	19.83 (5.066)	0.001
VAS -Median (IQR)	1.00 (1.00-2.00)	03.50 (1.75-6.0)	0.001
POGO Score -Median (IQR)	100 (90-100)	72.5 (30-90)	<0.001
Number of attempts (1/2/3)	(27/3/0)	(27/3/0)	1.000
Oesophageal Intubation	0	1(3.3%)	1.000
Trauma	0	2(6.7%)	0.472

Post intubation increase in heart rate was similar in both groups. However, heart rate recorded at 5 min after intubation was significantly

lower in Airraq group as compared to Macintosh group (p=0.042) (Figure 3).

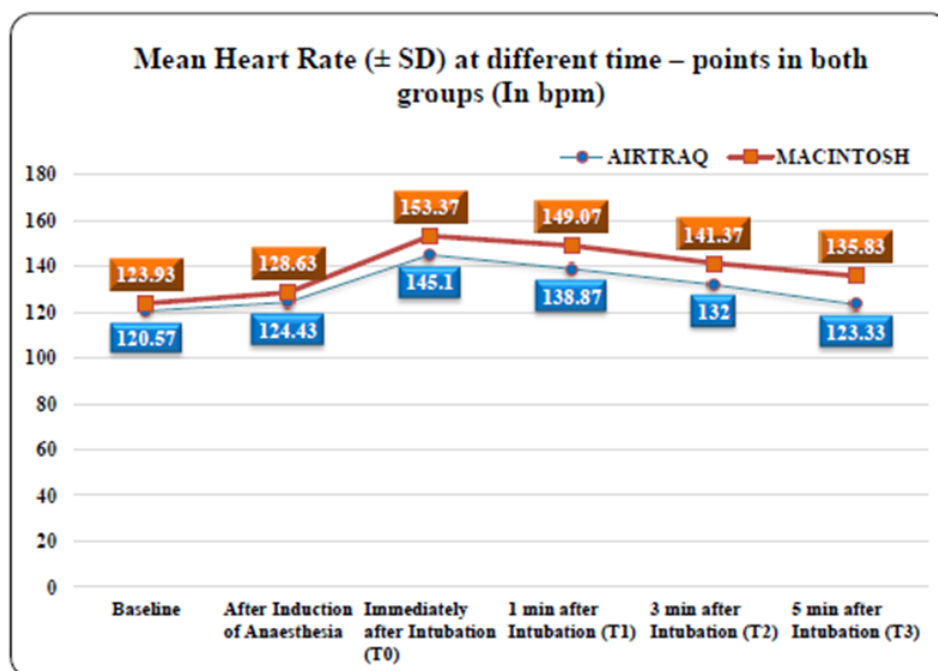


Figure 3. Trends of Mean Heart Rates at different time – points in both groups

SBP, DBP, MAP recorded at 1, 3 and 5 min post intubation showed significant difference

between Airtraq and Macintosh groups with less increase in Airtraq group. (Figure 4).

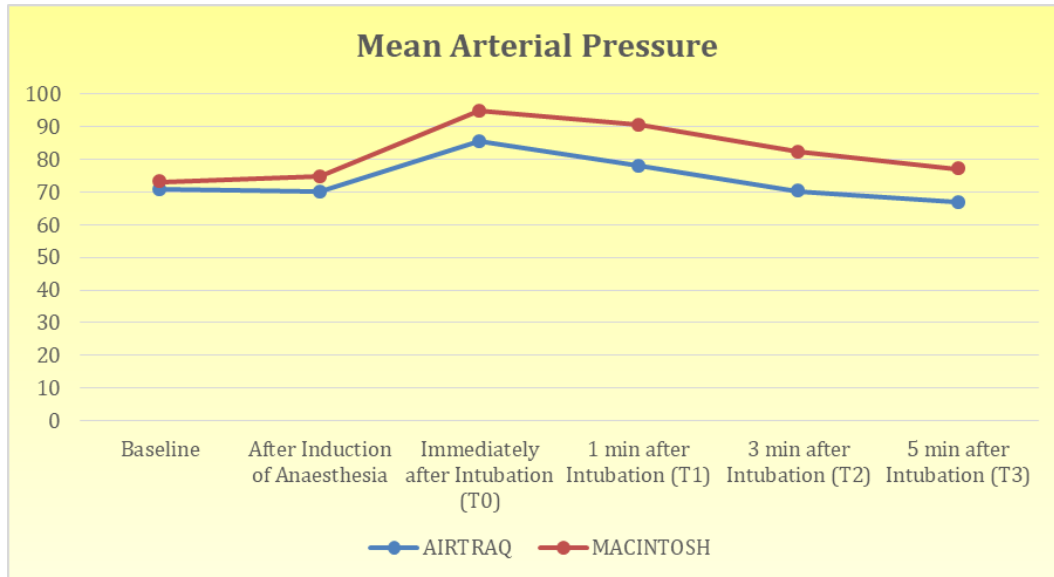


Figure 4. Mean arterial pressure

Discussion

Children enrolled in our study belonging to both groups were successfully intubated either in first or second attempt. No episodes of desaturation ($SpO_2 < 90\%$) or bradycardia ($HR < 60/min$) occurred while performing intubation using either of the laryngoscopes or during the entire peri-operative period. Second attempt with Airtraq optical laryngoscope was needed in 3 patients, 2 of who required a tube one size larger and the third case requiring slight withdrawal of the device to negotiate the ET tube into the trachea. Similar problems with ET tube introduction into the trachea were encountered prior to the study with the use of Airtraq in manikins and patients, and was successfully overcome by not introducing the tip till the vallecula and adequate lubrication of the channel where ETT is preloaded. Das B et al. also ob-

served 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 (6). This manoeuvre requires only a few seconds and hence intubation was faster with Airtraq. 30 successful attempts with Airtraq were presumed to be sufficient for adequate skill attainment.

Intubation with Airtraq optical laryngoscope was associated with better visualisation of glottis with a median POGO score of 100 as compared to scores of 72.5 with Macintosh. White et al. also demonstrated comparable results with POGO scores of 100 and 77 for Airtraq and Miller group respectively. The imaging channel gives a wide-angled view that allows a view of surrounding structures

and the tip of the tracheal tube, as it exits the distal end of the Airtraq and passes into the trachea. Indirect optical laryngoscopes can improve the viewing angle of the larynx from 15 to 80° compared with conventional laryngoscopes, and increasing the viewing angle increases the field of view (1). Lower POGO scores with prolonged intubation time were observed particularly with lower size Macintosh blade. Passi et al. concluded that the design of the MAC blade interferes with a full laryngeal view, but this can be ameliorated if the blade is inserted into the vallecula rather than on the glottic surface of the epiglottis. The 'English' MAC blade with its greater distal curve would likely interfere even more with the line of vision in a young child compared with the 'standard' MAC (8). Furthermore, our study also revealed similar POGO scores while intubating with Macintosh blade. Varghese et al. showed the Miller blade does not necessarily provide a better view of the larynx in small children and that the Macintosh blade is equally effective (7).

Our study also showed better VAS score in Airtraq group [1.00 (1.00-2.00)]. This was significantly less than in patients who got intubated with Macintosh [3.50 (1.75-6.00)]. This was largely because of better laryngoscopic view and less to almost nil manipulations required while using Airtraq. Maharaj et al reported similar VAS scores of 2.0 in Macintosh group and 1.2 in Airtraq group (9). A study conducted by Park et al showed the VAS scores for ease

of mask ventilation and the ease of use were lower in the Airtraq group than in the lightwand group (10). Better glottis appearance during laryngoscopy also meant lesser chances for oesophageal intubation; while 1 case in Macintosh (POGO scores of 10) underwent esophageal intubation, none were reported in Airtraq group. However, the difference among groups was not statistically significant ($p=0.6$). Larger study groups would be necessary to show a substantial difference, if any. Das B et al cited that a continuous view allowed detection of inaccurate tube advancement which was then corrected before oesophageal intubation (6).

Although increase in heart rate in children belonging to Airtraq group, there was no significant difference among the study groups post-intubation except at 5 min post-intubation. Riad et al also reported similar results with significant increase in the heart rate 5 min after intubation was in Macintosh group ($P=0.002$). A study conducted by Maharaj et al showed that Airtraq resulted in less stimulation of heart rate following tracheal intubation in comparison with the Macintosh laryngoscope (9). We observed lower readings of MAP, SBP and DBP post intubation in Airtraq group and significant differences were noted at 1, 3, 5 minutes' post intubation. Results of Das et al (4) were similar with respect to change in MAP. Maharaj et al (9) also reported significant lesser changes in MAP at 1 min following intubation.

Limitations: Our study was conducted in children of ASA class I-II with no other comorbidities and included children with mostly normal airway examination and hence use of Airtraq in difficult intubation situations could not be assessed, which was one of the major limitations of our study. Single blinding of the study, subjective grading using VAS score could amount to bias, however inter-observer bias was excluded. Lastly, a bigger sample size would benefit the results further.

Conclusion

Airtraq offers a new approach for the management of the normal airway. It provides significant reduction in intubation time, provides better POGO score, VAS and better hemodynamics when compared to Macintosh blade. Though future research is encouraged with larger sample size..

Declarations

Author contribution

Narayan V. Kamath- data curation, software, conceptualization

Neelam Dogra- supervision, validation

Rama Chatterjee- methodology, project administration

Pakhi Sharma- review and editing, formal analysis

Conflicts of interest: none

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Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work, no AI tool/service was used.

References

1. White MC, Marsh CJ, Beringer RM, Nolan JA, Choi AY, Medlock KE, Mason DG. A randomised, controlled trial comparing the Airtraq™ optical laryngoscope with conventional laryngoscopy in infants and children. *Anaesthesia*. 2012 Mar 1;67(3):226-31.
2. Sørensen MK, Holm-Knudsen R. Endotracheal intubation with airtraq® versus storz® video laryngoscope in children younger than two years-a randomized pilot-study. *BMC anesthesiol*. 2012 Dec;12(1):1-5.
3. Apfelbaum JL, Hagberg CA, Caplan RA, et al. Practice guidelines for management of the difficult airway: an updated report by the American Society of Anesthesiologists Task Force on Management of the Difficult Airway. *Anesthesiology*. 2013 Feb 1;118(2):251-70.
4. Riad W, Moussa A, Wong DT. Airtraq™ versus Macintosh laryngoscope in intubation performance in the pediatric population. *Saudi J Anaesth*. 2012 Oct1;6(4):332-5.

5. Vlatten A, Fielding A, Bernard A, Litz S, MacManus B, Soder C. Comparison of the airtraq laryngoscope to the direct laryngoscopy in the pediatric airway. *J. Pediatr. Intensive Care.* 2012 Jan 1;1(02):071-6.
6. 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 Apr;61(4):326-31.
7. Varghese E, Kundu R. Does the Miller blade truly provide a better laryngoscopic view and intubating conditions than the Macintosh blade in small children? *Pediatr. Anaesth.* 2014 Aug;24(8):825-9.
8. Passi Y, Sathyamoorthy M, Lerman J, Heard C, Marino M. Comparison of the laryngoscopy views with the size 1 Miller and Macintosh laryngoscope blades lifting the epiglottis or the base of the tongue in infants and children < 2 yr of age. *Br. J. Anaesth.* 2014 Nov 1;113(5):869-74.
9. Maharaj CH, O'croinin D, Curley G, Harte BH, Laffey JG. A comparison of tracheal intubation using the Airtraq® or the Macintosh laryngoscope in routine airway management: a randomised, controlled clinical trial. *Anaesthesia.* 2006 Nov;61(11):1093-9.
10. Park EY, Kim JY, Lee JS. Tracheal intubation using the Airtraq®: a comparison with the lightwand. *Anaesthesia.* 2010 Jul;65(7):729-32.