doi: 10.53446/actamednicomedia.1099336

Acta Medica Nicomedia

Cilt: 5 Sayı: 3 Ekim 2022 / Vol: 5 Issue: 3 October 2022
https://dergipark.org.tr/tr/pub/actamednicomedia

Research Article | Araştırma Makalesi

COMPARISON OF THE AIRTRAQ®, THE NASOTRACHEAL AIRTRAQ NT®, THE AIRTRAQ COMBINED WITH FIBREOPTIC BRONCHOSCOPE FOR OROTRACHEAL INTUBATION: A PROSPECTIVE RANDOMISED CLINICAL TRIAL

AIRTRAQ, NAZOTRAKEAL AIRTRAQ, AIRTRAQ İLE FİBEROPTİK BRONKOSKOP KOMBİNASYONUNUN OROTRAKEAL ENTÜBASYONDA KARŞILAŞTIRILMASI: PROSPEKTİF, RANDOMİZE KLİNİK ÇALIŞMA

Zehra Ipek Arslan[1*], Funda Seyhan[1]

[1]Kocaeli University Medical Faculty, Anesthesiology and Reanimation, Kocaeli, Türkiye.

ABSTRACT

Objective: The standard Airtraq is an effective channeled video laryngoscope for difficult airways. Fiberoptic intubation is the gold standard for patients with expected difficult airways. Intubation with Airtraq could be improved with the aid of a fiberoptic bronchoscope. Airtraq NT was produced to be used in nasotracheal intubation.

Methods: After Research Ethics Committee approval and written informed patient consent was obtained from all patients, 120 patients ASA I-II undergoing elective surgery requiring orotracheal endotracheal intubation were enrolled in this prospective randomised clinical study. Patients were divided into; standard Airtraq (group A), nasotracheal Airtraq NT combined with a stylet inserted endotracheal tube (group N) and Standard Airtraq combined with a fiberoptic bronchoscope (group A+F). Optimization and tube insertion maneuvers, Cormack-Lehane grades, insertion times, intubation and total intubation times, hemodynamic changes and postoperative minor complications were recorded.

Results: Demographic variables and airway characteristics of patients were similar. The Airtraq inserted slower than the nasotracheal Airtraq NT ($p<0.001$). Tracheal intubation times were shorter in the Airtraq when compared to the nasotracheal Airtraq NT and the fiberoptic combination of the Airtraq ($p<0.001$). Groups were comparable regarding the need for maneuvers, hemodynamic changes and postoperative minor complications.

Conclusion: Even the Standard Airtraq combined with a fiberoptic bronchoscope produced longer intubation times than the use of only the standard Airtraq, this prolongation is clinically negligible. The nasotracheal Airtraq NT could be used for orotracheal intubation. The fiberoptic combination with Airtraq could be an option in selected difficult airway cases.

Keywords: Adult, difficult, fiberoptic, intubation, tracheal, video laryngoscope

ÖZ

Amaç: Bu çalışmanın amacı, standart Airtraq, Nazotrakeal Airtraq ile stile yerleştirilmiş tüp kombinasyonu ve standart Airtraq ile fiberoptik kombinasyonunun normal havayolu olan hastalardaki orotrakeal entübasyon sürelerini karşılaştırmaktır.

Yöntem: Araştırma Etik Komite ve tüm hastalardan aydınlatılmış onam alındıktan sonra, orotrakeal entübasyon gerektiren elektif cerrahiye girecek ASA I-II 120 hasta bu prospektif randomize klinik çalışmaya dahil edildi. Hastalar; standart Airtraq (Grup A), Nazotrakeal Airtraq ve stile yerleştirilmiş tüp kombinasyonu (Grup N), standart Airtraq ile fiberoptik kombinasyonu (Grup A+F) olarak üç gruba ayrıldı. Optimizasyon ve tüp ilerletme manevraları; cihazın yeniden yerleştirmesi, cihazın geri çekilmesi, krikoid bası, tüpün 90° saat tersine rotasyonu manevrası, Cormack-Lehane evreleri, yerleştirme süreleri, entübasyon ve toplam entübasyon süreleri, hemodinamik değişiklikler ve postoperatif minor komplikasyonlar kaydedildi.

Bulgular: Hastaların demografik verileri ve havayolu karakteristikleri benzerdi. Airtraq, nazotrakeal Airtraq ten bir saniye daha uzun sürede yerleştirildi ($p<0,001$). Toplam entübasyon süreleri Airtraq'de Airtraq ile fiberoptik kombinasyonundan daha kısaydı ($p<0,001$). Manevra gereksinimi, hemodinamik parametreler ve postoperatif minor komplikasyonlar açısından gruplar benzerdi.

Sonuç: Normal havayoluna sahip erişkin hastalarda fiberoptik bronkoskop ile kombine edilmiş standart Airtraq, tek başına kullanımından daha uzun entübasyon süresi sağlasa da bu süre, klinik açıdan önemsizdir. Nazotrakeal Airtraq, orotrakeal entübasyonda kullanılabilir. Airtraq'in fiberoptik ile kombinasyonu seçilmiş zor entüübasyon vakalarda seçenek olabilir.

Anahtar Kelimeler: Erişkin, zor, fiberoptik, entübasyon, trakeal, videolaringokop

***Corresponding author/İletişim kurulacak yazar:** Zehra Ipek Arslan; Kocaeli University Medical Faculty, Anesthesiology and Reanimation, Umuttepe, 41001 İzmit, Kocaeli, Türkiye.
Phone/Telefon: +90 (262) 303 79 46 **e-mail/e-posta:** zehraipek48@gmail.com
Submitted/Başvuru: 06.04.2022 • **Accepted/Kabul:** 15.09.2022 • **Published Online/Online Yayın:** 15.10.2022

Introduction

The Airtraq laryngoscope (Prodol Meditec, Vizcaya, Spain) is a single-use, channeled, anatomically shaped optical laryngoscope. A high-resolution touch screen that can turn 180° degrees and can be attached to all Airtraq types (Figure 1). The Airtraq has a smartphone application to reduce the video monitor cost as well. Unfortunately, the standard Airtraq could fail in patients with limited mouth opening, in device insertion and advancement of the tube.[1] There is a need for effective maneuvers or aids to improve both the view and to direct the tracheal tube.

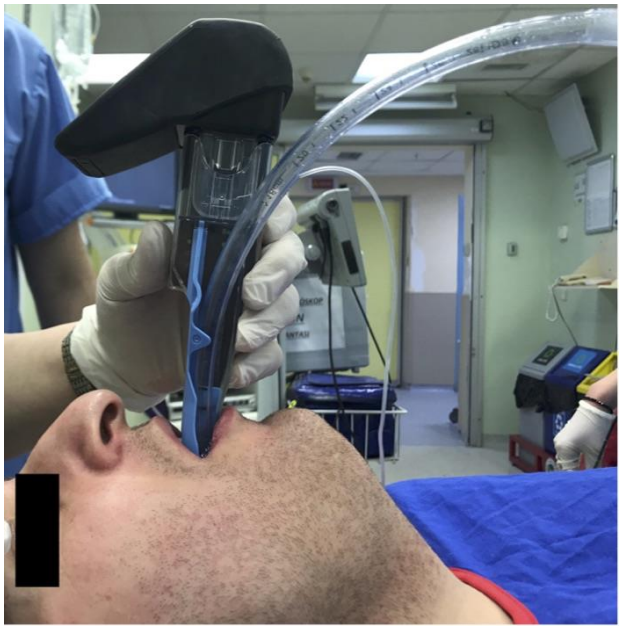

Figure 1. Orotracheal intubation with the standard Airtraq

In a letter to the editor, the author used the nasotracheal Airtraq (without channel) with a stylet inserted tracheal tube combination in 42 patients for orotracheal intubation because the standard Airtraq was not available in their hospital at that time.[2] The nasotracheal Airtraq did not have a channel in its original version. Thus, it could be used as a hyperangulated videolaryngoscope in which the operator would manage the videolaryngoscope and the tube separately (Figure 2).
Fiberoptic bronchoscopy requires both ongoing education and non-technical skill retention. Finding an easy way to perform fiberoptic bronchoscopy is essential for anesthesiologists. NAP4 recently demonstrated that anesthesiologists did not want to perform fiberoptic intubation in real difficult airways resulted in death.[3] A recently published study used the combination of the standard Airtraq and fiberoptic on an easy and difficult airway manikin.[4] A new prospective study, that followed an algorithm in the UK in 16,695 patients, demonstrated that tracheal intubation conditions with the standard Airtraq could be facilitated with the combination of a flexible stylet or a fiberoptic bronchoscope in difficult airway patients with a difficult direct laryngoscopy.[5]

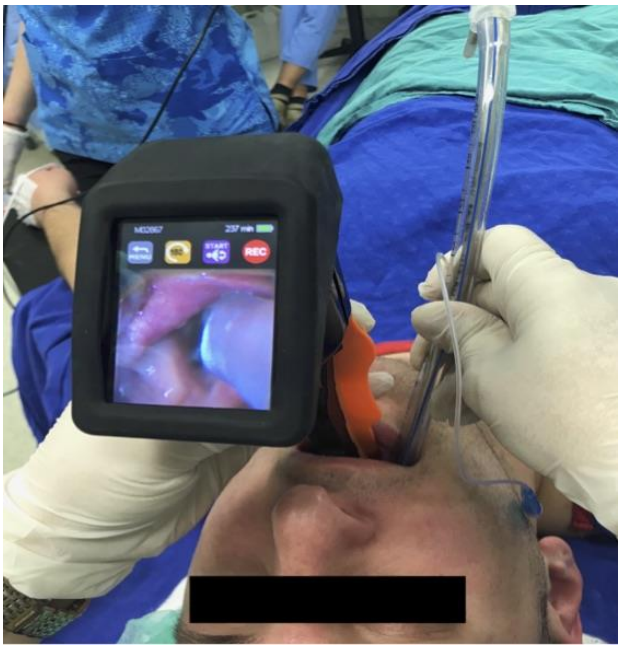

Figure 2. Orotracheal intubation with the naotracheal Airtraq NT combined with a stylet inserted endotracheal tube in Group N

We hypothesized that the fiberoptic combination would prolong the duration of tracheal intubation with the standard Airtraq in a statistically significant but clinically negligible duration time.
The primary aim was to compare the intubation times of the standard Airtraq, nasotracheal Airtraq NT and the combination of Airtraq and the fiberoptic bronchoscope in normal airway patients. Secondary aims were to compare the insertion times, the need for maneuvers to facilitate intubation with the devices, hemodynamic changes and postoperative minor complications. If necessary, these findings could be generalised to any trouble moment in normal airways, difficult airways or in pediatric patients as well.
According to our knowledge, our study is the first randomised study in patients with normal airways that compared the standard Airtraq, the Airtraq NT combined with a stylet inserted tracheal tube and the standard Airtraq combined with a fiberoptic bronchoscope regarding the measurement of intubation times.

Methods

The study was approved by the Ethics Committee (KIA 2018/446 number – 2/10/2018) and patient consent was obtained (NCT03709524). This trial was conducted in accordance with the principles of the Helsinki Declaration in between 15 October 2018 – 20 February 2019.
120 patients with an American Society of Anesthesiologists (ASA) physical status 1-2, 18-70 years of age, undergoing elective surgery requiring tracheal intubation were included. Patients with pregnancy, BMI>35, predictors of difficult intubation, unfasted were excluded from this study.
Patients were pre-medicated with midazolam 0.03 $mg.kg^{-1}$ intravenous (IV). Standard anesthesia monitoring

(electrocardiogram, noninvasive blood pressure, heart rate, pulse oximetry and end-tidal carbon dioxide) was applied. Demographic (age, gender, weight, height, body mass index, ASA) and airway variables (thyromental distance, sternomental distance, inter incisor distance, neck circumference, Mallampati, head extension, mandibular protrusions, teeth morphology and presence of snoring were recorded. All patients were pre-oxygenated using a facemask with 100% O_2 for 3 minutes. Patients were divided into three groups by using a sealed envelope technique; the standard Airtraq group (blue, size 3: for endotracheal tube 7.0-8.5) (Group A)(Figure 1), the Airtraq NT group (without tube guidance channel) combined with a stylet inserted tracheal tube (Group N) (there is only one size, orange which is the same size with the standard Airtraq size 3) (Figure 2) and the standard Airtraq size 3 combined with a fibreoptic bronchoscope group (Group A+F) (Figure 3). General anesthesia was induced with propofol 3 $mg.kg^{-1}$and fentanyl 1 $\mu gr.kg^{-1}$ IV. Ease of facemask ventilations were recorded as; easy, airway, two-handed + jaw-thrust, oxygen flush and impossible. 0.6 $mg.kg^{-1}$ rocuronium IV was administered for muscle relaxation and tracheal intubation was then performed. A 7.5 mm lubricated polyvinylchloride tracheal tube was used for women and an 8.0 mm was used for men in all groups.

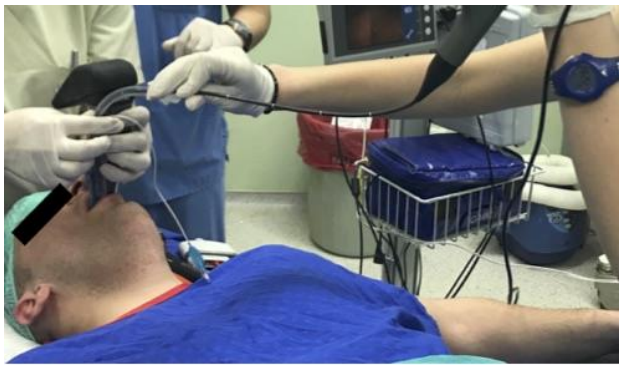

Figure 3. Orotracheal intubation with the standard Airtraq and fiberoptic combination

In Group A, a camera was attached to the standard Airtraq and a lubricated tracheal tube was inserted in the channel of the standard Airtraq before starting the intubation process. Insertion time, was defined as the time elapsing from the handling of the device until optimal vocal cord visualisation occurred. Reinsertion of the device (turning the standard Airtraq right or left in-place), removal of the device (backward) and handling force maneuvers were applied if necessary. Tracheal intubation time was defined as the time elapsing from the handling of the device until the visualisation of the tube entering through the vocal cords. If resistance was felt during tube adjustment, then 90°anti-clockwise rotation, cricoid pressure, head flexion and cuff inflation maneuvers were applied if needed. Total tracheal intubation time was the time elapsing from the time the handling of the device started until confirmation of tracheal intubation from the capnograph.

In Group N, a camera was attached to the nasotracheal Airtraq (orange) and a stylet (Mallinkrodt Inc., Blanchardtown, Dublin, Ireland) inserted into a polyvinyl chloride tracheal tube formed into a hockey stick shape was prepared before starting the tracheal intubation process. As soon as the tracheal tube tip passed the glottis, the stylet was withdrawn, and the tracheal tube was advanced into the trachea.

In Group A+F, one operator optimised the view of the standard Airtraq from the head of the patient. The second provider inserted the fiberoptic bronchoscope into the vocal cords by standing face-to-face with the patient from the right or left side of the patient. Then the first provider advanced the tracheal tube just after the fiberoptic bronchoscope entered through the vocal cords. The C-MAC fibreoptic bronchoscope 650 mm in length, an outside diameter of 4.1 mm was used and attached to a C-MAC 7-inch monitor with a 1280 x 800-pixel camera (Karl Storz SE & Co.KG, Tuttlingen, Germany) (Figure 3).

The Cormack-Lehane grades of the patients were recorded. Baseline preoperative systolic blood pressure, diastolic blood pressure, mean arterial pressure, heart rate and pulse oximetry values were recorded (preoperatively), after anesthesia induction, after insertion of the device, just after intubation and at 1-minute intervals three times. If the patient could not be intubated after three attempts or in 2 minutes they were then intubated according to the DAS unexpected difficult airway algorithm.[6]

All intubations were performed by consultant Anesthesiologists with at least 20 successful orotracheal intubations with all devices.

Oxygen saturation of (SpO_2) < 90 was recorded as hypoxemia. Esophageal intubation, teeth, tongue, lip or mucosal damage (bloodstaining on the device), sore throat, hoarseness, dysphagia, bronchospasm, hypoxia, nausea and vomiting were recorded.

Sample size was calculated according to our preliminary study in 15 patients (5 people per group). Tracheal intubation times of Group A, Group N and Group A+F was as follows 9.00 [8.00-18.50], 10.00 [8.00-24.50], 20 [11.5-30.5]. Based on this data, and for detecting a minimal 100% increase in the tracheal intubation time, and for iα= 0.05 and β= 0.2 sample size was as 35 patients for each group. 40 patients were enrolled for possible exclusions.

The analysis was made using the Statistical Package of Social Sciences (SPSS) for Windows 16.0 (SPSS Inc., Chicago, IL, USA). For normally distributed data we used ANOVA, Kruskal Wallis and Monte Carlo test were used. $p<0.05$ was considered as statistically significant.

Results

One hundred twenty patients were enrolled in this prospective randomized study. One patient that was in Group A+F was lost due-to follow-up, and 119 patients were included in the analysis. The demographic and

airway variables of patients were similar (Table 1). All patients had normal head flexion and extensions.

Mask ventilation and Cormack-Lehane grades were comparable between the groups (Table 2). The reinsertion maneuver and the removal of the device (backwards) were helpful in optimising the view in the midline of the screen in all groups. Handling force and head flexion maneuver was not needed in any patient during the optimisation of the view. In addition, a 90° anti-clockwise rotation or cricoid pressure maneuvers were helpful in all groups (Table 2). The cuff inflation maneuver was required for 1 patient in Group N. The groups were similar regarding postoperative sore throat and dysphagia (Table 2). Hoarseness occurred in 2 patients in Group N.

The Airtraq NT was inserted faster than the standard Airtraq ($p<0.001$). Tracheal intubation time and total tracheal intubation time was shorter in Group A and Group N when compared to Group A+F ($p<0.001$) (Table 3). All patients were intubated on the first attempt in all groups.

Table 1. Demographic and airway variables of patients; values are given as number, or as mean ± Standard Deviation, or as median [25-75 percentiles]

	Group A (N=40)	Group N (N=40)	Group A+F (N=39)	p
Age; years	45.13±13.42	40.6±14.03	38.82±15.13	0.130
Height; cm	166.00 [158.25-174.00]	164.00 [160.00-172.50]	168.00 [162.00-178.00]	0.142
Weight; kg	69.05±16.07	71.08±14.89	74.62±14.97	0.268
Body mass index; $kg.m^{-2}$	24.79±5.91	25.95±5.12	25.73±4.01	0.556
Thyromental distance; cm	8.00 [7.00-9.00]	8.00 [7.00–8.75]	8.00 [7.00-9.00]	0.378
Sternomental distance; cm	15.00 [13.00–17.00]	15.00 [13.00–16.75]	16.00 [14.00-17.00]	0.086
Neck circumference; cm	37.00 [34.25–43.00]	37.50 [34.25–40.75]	36.50 [35.00-42.00]	0.902
Interincisor distance; cm	4.50 [4.00–4.87]	4.25 [3.63–4.50]	4.50 [4.00-5.00]	0.239
ASA; 1/2	23/17	30/10	30/9	0.115
Gender; F/M	24/16	26/14	19/20	0.325
Mallampati; 1/2	26/14	26/14	25/14	0.995
Mandibular Protrusion; A/B	39/1	40/0	38/1	0.597
Teeth morphology; Full/lack/absent	34/4/2	38/1/1	33/2/4	0.357
Snoring; Present/Absent	12/28	13/27	8/31	0.456

Table 2. Airway management variables of patients; values are given as numbers

	Group A (N=40)	Group N (N=40)	Group A+F (N=39)	p
Mask ventilation; Easy/airway/two handed + jaw thrust	26/11/3	28/11/1	25/7/7	0.171
Cormack-Lehane; 1/2	25/15	33/7	28/11	0.135
Cricoid pressure; Present/Absent	3/37	4/36	3/36	0.905
Draw-back maneuver; Present/Absent	6/34	6/34	11/28	0.231
Re-insertion maneuver; Present/Absent	29/11	33/7	27/12	0.366
90° anticlockwise rotation maneuver; Present/Absent	1/39	1/39	5/34	0.080
Postoperative sore throat; Present/Absent	6/34	7/33	4/35	0.647
Postoperative dysphagia; Present/Absent	9/31	8/32	3/36	0.171

Table 3. Duration of insertion, intubation and total intubation times of patients: values are given as median [25-75 percentiles]

	Group A (N=40)	Group N (N=40)	Group A+F (N=39)	p
Insertion time; s	5 [4 - 6.75]	3 [3 - 4]	5 [3 - 6]	<0.001[&]
Intubation time; s	10 [8 - 12]	11 [8.25-13]	27[19 - 35]	<0.001[&]
Total intubation time; s	20 [19.25 - 25]	21 [20 - 24]	40 [31 - 50]	<0.001[&]

&; $p<0.001$

The groups were similar regarding hemodynamic changes such as mean arterial pressure and heart rate values (Table 4 and 5). No esophageal intubations were detected. Lip damage occurred in 1 patient and bloodstaining occurred in 2 patients in Group N. No teeth damage or desaturation occurred in any of the groups.

Table 4. Mean arterial pressure (MAP) parameters between the groups at baseline, after anesthesia induction, just after the device insertion, just after intubation and at 1-minute intervals, three times. Values were given as mean± SD or median [25-75 percentiles]

	Group A (N=40)	Group N (N=40)	Group A+F (N=39)	p
Baseline MAP (mmHg)	101.50 [87.00-117.75]	100.00 [65.00-133.00]	99.00 [89.00-107.00]	0.515
After anesthesia induction	88.48 ±14.04	85.70±22.36	82.15±14.66	0.276
After the device insertion	95.00 [74.75-104.75]	90.00 [74.50-108.50]	92.00 [75.00-103.00]	0.805
Just after the intubation	86.56 ± 18.08	87.26 ±15.46	84.28 ± 18.40	0.731
1 min after intubation	78.38 ±18.41	75.37 ± 13.25	78.28 ± 13.67	0.621
2 min after intubation	78.28± 14.31	74.42 ± 12.14	74.85 ± 15.54	0.415
3 min after intubation	80.73±15.26	77.24 ± 13.45	74.74 ±11.31	0.468

Table 5. Heart rate values between the groups at baseline, after anesthesia induction, just after the device insertion, just after intubation and at 1-minute intervals, three times. Values were given as mean± SD or median [25-75 percentiles]

	Group A (N=40)	Group N (N=40)	Group A+F (N=39)	p
Baseline HR (beats/min)	80.73 ± 15.26	86.90 ± 16.40	81.26± 12.40	0.123
After anesthesia induction	80.00 [67.25-94.00]	75.00 [70.25-90.00]	80.00 [70.00-88.00]	0.765
After the device insertion	97.50 [77.25-111.75]	93.50 [79.75-99.75]	94.00 [80.00-107.00]	0.565
Just after intubation	87.70 ± 16.49	85.55 ± 15.03	90.44 ± 17.69	0.419
1 min after intubation	85.18 ± 16.82	83.55 ± 15.11	85.26 ± 15.81	0.870
2 min after intubation	81.00 [70.00-94.75]	77.00 [71.75-91.50]	85.00 [74.00-90.00]	0.669
3 min after intubation	81.50 [70.00-95.00]	75.50 [70.00-88.50]	82.00 [69.75-87.25]	0.732

Discussion

This prospective randomised interventional study showed that the standard Airtraq combined with a fiberoptic bronchoscope required a longer tracheal intubation time compared to the standard Airtraq alone and the nasotracheal Airtraq combined with a stylet in normal patients. However, this prolongation was clinically negligible. Backwards and re-insertion maneuvers could be used to optimize the view of the Airtraq, 90º anticlockwise rotation or cricoid pressure maneuvers could be used to improve direction of the tube into the trachea.

There is a study that used a fiberoptic facilitated tracheal intubation with the standard Airtraq.[1] This study suggested that severe micrognathia and limited head and neck movement were the possible problems for the failure of the standard Airtraq.[1]

There were some instances in which the Airtraq failed because the operator did not position the glottis in the middle of the viewfinder. A recently published prospective study recommended the use of a stylet or a fiberoptic bronchoscope in combination with the standard Airtraq in the operating theatre in patients with difficult direct laryngoscopic views for whom the standard Airtraq alone had failed even in experienced hands.[5]

Authors reported failed intubation with both direct laryngoscopy and the standard Airtraq alone with experienced users and they were rescued with a fiberoptic bronchoscope in combination with the standard Airtraq outside of the operating room.[7] A trial reported that the tracheal intubation duration with fiberoptic combined with the standard Airtraq lasted longer than the standard Airtraq alone in the manikin with a simulated normal airway. However, they found a shorter intubation time in a manikin with simulated tongue edema.[3] Consistent with previous studies, the combination of the standard Airtraq and fibreoptic bronchoscope required two operators in our trial; one for optimizing the view with the standard Airtraq and inserting the tracheal tube after the fiberoptic bronchoscope had passed through the vocal cords and the second for fiberoptic tracheal intubation.[4,7,10,24] Two providers needed to combine Airtraq with fiberoptic, one for inserting the Airtraq successfully and optimising the view and the second for manipulating the fiberoptic bronchoscope at that time.[4,7,10,11]

Fiberoptic combined with the standard Airtraq did not require much skill and all processes could be monitored.[8,9] A patient with a huge cervical tumor that distorted the airway was intubated with the standard Airtraq and fiberoptic combination.[10] There is no record about the fiberoptic bronchoscope that was used in this case. We used a fiberoptic cable that could be attached to a C-MAC video monitor and did not need an extra light source or white-balance. It had a high-resolution LED monitor that everyone in the room could watch.[12] There were also successful tracheal intubations in pediatric patients that had been performed with the standard Airtraq and fiberoptic combination.[13] In accordance with their study, we also inserted the tube into the Airtraq channel and kept it just at the distal end of the channel (bottom) to obtain an adequate space and view for the

fiberscope. A child with Pierre-Robin sequence was intubated with an Airtraq-assisted fiberoptic bronchoscope.[13] There is a published case of a difficult airway, intubated with the combination of the standard Airtraq and a flexible stylet that has the ability of upward movements of 30° up to 60°.[14]

There is a case report of successful use of the combination of the standard Airtraq with the insertion of a gum elastic bougie into an Endoflex tracheal tube that had an adjustable tip.[15] This needs a second operator as with the fiberoptic combination. Fiberoptic provided a view, however the bougie did not. The group of authors recommended inserting a flexible stylet into the tracheal tube to overcome the tracheal tube that had fallen posteriorly during tracheal intubation with the standard Airtraq.[16]

All these methods could be used and kept in mind as a step-by-step plan in real difficult airways in concordance with the Vortex approach.[17]

The Airtraq insertion took longer than the nasotracheal Airtraq NT in this study. Not having a tracheal tube guidance channel made the Airtraq NT thinner than the standard Airtraq. Not having a tube guidance channel allows for the management of the tube and the optic laryngoscope separately. Insertion of the standard Airtraq was a challenge and it prolonged the tracheal intubation time in morbidly obese patients and those with a limited mouth opening.[4,18] The combination of the Airtraq NT with a fiberoptic during a nasal fiberoptic intubation of a patient who was wearing a molded thoroco cervical collar with a mouth opening of 15 mm and bleeding from the nasal mucosa could ease and allow for monitoring of the whole tracheal intubation process.[19]

A recently study was published that simulated 480 patients with limited mouth opening and limited neck movement with a cervical collar compared the nasotracheal Airtraq NT, King-vision and A.P Advance MAC.[20] The first attempt success rate was better with the Airtraq NT (82%). A problem with tube direction through the vocal cords was reported as the reason for failure. All intuabations were performed by airway experts and who were trained with all types of videolaryngsocopes in this study. They concluded that the unchanneled version of Airtraq was as effective as its standard channelled version. As such, the tracheal intubation performance of a videolaryngoscope depends on the shape of the blade not the guidance channel.[20]

Difficult Airway Society 2015 difficult airway guidelines recommended using the angulated-type video laryngoscopes with a stylet inserted tracheal tube to increase intubation success rates.[6] Some authors also inserted a stylet into the polyvinyl chloride tracheal tube, and they shaped it like a 'hockey stick' while attempting tracheal intubation with the Airtraq NT. They intubated all normal airway patients successfully within a total range of 10-23 seconds.[2] The tracheal intubation time description and the experience of the operators in this study were similar to ours, and the results were as well.[2]

A report of cranio-maxillo facial reconstructive surgery of congenital malformations in 12 pediatric and adult patients (age 1 year to 29 years) demonstrated that tracheal intubation could be performed with the Airtraq NT using it with a stylet inserted reinforced tracheal tube.[20] In contrast to our study, they shaped the stylet to a 90° angle and they introduced the stylet inserted tracheal tube from the right corner of the mouth.[21] This trial did not report the maneuvers needed, the exact insertion time or the tracheal intubation time for the Airtraq NT during orotracheal intubation.

The standard Airtraq must be repositioned with the help of three maneuvers to center the glottis.[22] We used maneuvers such as; the reinsertion maneuver which is the turning of the Airtraq right or left in-place, a removal of the device similar to the backward maneuver used to optimise the view to center the glottis view on the monitor. In addition, we used the 90° anti-clockwise rotation, cricoid pressure and cuff inflation maneuvers to facilitate the direction of the tracheal tube into the trachea.[22,23]

We used a polyvinyl chloride tracheal tube because it was shown that the success rate of intubation with the standard Airtraq was significantly higher with the polyvinyl chloride tubes when compared to straight reinforced tubes.[24]

The limitations of our study were that; our patients had normal airways not difficult airways, our operators were experienced, the operator was not blind to the device being used, and that our power calculation was for the tracheal intubation time not for the maneuvres, not for hemodynamic changes or postoperative minor complications. Further investigations are needed on this subject for the morbidly obese, for real difficult intubations or for those with different tracheal tube designs and so on.

In conclusion, even the standard Airtraq combined with a fibreoptic bronchoscope resulted longer intubation times this prolongation is clinically negligible. The fiberoptic combination with the standard Airtraq could be an option in selected difficult airway cases. Airtraq NT could be used as a hyper-angulated video laryngoscope for orotracheal intubation if needed. Backwards and re-insertion maneuvres could be used to optimise the view of the Airtraq, 90º anticlockwise rotation or cricoid pressure maneuvres could be used to improve the tube direction into the trachea.

Acknowledgement

This trial was presented as a poster at the World Anesthesia Management Meeting (WAMM) 13-16 November 2019, Amsterdam, Holland

Compliance with Ethical Standards

The study was approved by the Ethics Committee (KIA 2018/446 number – 2/10/2018) and patient consent was obtained (NCT03709524).

Conflict of Interest
The authors have no conflict or competing interests regarding the devices being used in this trial.

Author Contribution
Author contribution is equal.

Financial Disclosure
No funding source present.

References

1. Niforopoulou P, Pantazopoulos I, Demestiha T, Koudouna E, Xanthos T. Video-laryngoscopes in the adult airway management: a topical review of the literature. *Acta Anaesthesiol Scand.* 2010;54:1050-1061. doi:10.1111/j.1399-6576.2010.02285.x
2. Xue FS, Liao X, Yuan YJ, Wang Q, Liu JH. The nasotracheal Airtraq laryngoscope also may be useful for orotracheal intubation in anesthetized patients. *J Clin Anesth.* 2011;23(8):667-669. doi:10.1016/j.jclinane.2010.12.027
3. Cook TM, Woodall N, Frerk C, on behalf of the Forth National Audit Project. Major complication of the airway management in the UK: results of the Forth National Audit Project of the Royal College of Anaesthetists and the Difficult Airway Society Part 1: *Anaesthesia. Br J Anaesth.* 2011;106:617-31. doi:10.1093/bja/aer058
4. Nishikawa K, Hukuoka E, Kawagishi T, Shimodate Y, Yamakage M. Efficacy of the Airtraq laryngoscope with a fiberoptic bronchoscope compared with that of Airtraq alone for tracheal intubation: a manikin study. *J Anesth.* 2011;25(1):93-7. doi:10.1007/s00540-010-1038-7
5. Cook F, Lobo D, Martin M, et al. Prospective validation of a new airway management algorithm and predictive features of intubation difficulty. Br J Anaesth. 2019;122(2):254-254. doi:10.1016/j.bja.2018.09.021
6. Ferk C, Mitchell VS, McNarry AF, al. Difficult Airway Society intubation guidelines working group. Difficult Airway Society 2015 guidelines for management of unanticipated difficult intubation in adults. *Br J Anaesth.* 2015;115(6):827-48. doi:10.1093/bja/aev371
7. Matioc AA. Use of the Airtraq with a fiberoptic bronchoscope in a difficult intubation outside the operating room. *Can J Anaesth.* 2008;55(8):561-2. doi:10.1007/BF03016679
8. Asai T, Shingu K. Difficulty in advancing a tracheal tube over a fiberoptic bronchoscope: incidence, causes and solutions. *Br J Anaesth.* 2004;92(6):870-81. doi:10.1093/bja/aeh136
9. Johnson DM, From AM, Smith RB, From RP, Maktabi MA. Endoscopic study of mechanisms of failure of endotracheal tube advancement into the trachea during awake fiberoptic orotracheal intubation. *Anesthesiology.* 2005;102(5):910-4. doi:10.1097/00000542-200505000-00008
10. Yuan YJ, Xue FS, Liao X, Liu JH, Wang Q. Facilitating combined use of an Airtraq optical laryngoscope and a fiberoptic bronchoscope in patients with a difficult airway. *Can J Anaesth.* 2011;58(6):584-5. doi:10.1007/s12630-011-9484-8
11. Xue FS, He N, Liu JH, Zhang YM. Use of a fiberoptic bronchoscope to facilitate tracheal intubation after failed intubation using the Airtraq laryngoscope. *Acta Anesthesiol Scand.* 2010;54:256-7. doi:10.1111/j.1399-6576.2009.02100.x
12. Gomez-Rios MA, Serradilla LN. Combined use of an Airtraq optical laryngoscope, Airtraq video camera, Airtraq wireless monitor and a fiberoptic bronchoscope after failed tracheal intubation. *Can J Anaesth.* 2011;58(4):411-2. doi:10.1007/s12630-011-9460-3
13. Zhang S, Yi M. Airtraq laryngoscope-assisted fiberoptic intubation in a child with Pierre-Robin sequence: a case report. Int J Clin Exp Med 2015; 8(4): 6372-3. eCollection 2015.
14. Gaszynski T. A combination of Airtraq and Truflex for intubation in morbidly obese patient. *J Clin Anesth.* 2018;44:32-33. doi:10.1016/j.jclinane.2017.10.012
15. Xue FS, Liu JH, Yuan YJ, Liao X. Comments on comparison of the combined Airtraq laryngoscope and fiberoptic bronchoscope with the Airtraq alone for tracheal intubation. *J Anesth.* 2011;25(3):465-6.
16. Xue FS, Liu HP, Xiong J, Liao X. A useful suggestion to facilitate tracheal intubation using the Airtraq laryngoscope in the infants with difficult airways. *Paediatr Anaesth.* 2010;20(7):678-9. doi:10.1007/s00540-011-1140-5
17. Chrimes N, Fritz P. The Vortex Approach: Management of the Unanticipated Difficult Airway. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://rollcagemedic.com/resources/Archived_newsletters/the-vortex-approach-management-of-the-unanticipated-difficult-airway.pdf
18. Dhonneur G, Ndoko SK, Amathieu R, Attias A, Housseini EL, Polland C, et al. A comparison of two techniques for inserting the Airtraq laryngoscope in morbidly obese. *Anaesthesia.* 2007;62(8):774-7. doi:10.1111/j.1365-2044.2007.05128.x
19. Schoettker P, Bathory I, Broome M. Use of the nasotracheal Airtraq to assist difficult nasal fiberoptic intubation. *Can J Anaesth.* 2008;55(12):884. doi:10.1007/BF03034066
20. Kleine-Brueggeney M, Buttenberg M, Greif R, Nabecker S, Theiler L. Evaluation of three unchannelled videolaryngoscopes and the Macintosh laryngoscope in patients with a simulated difficult airway: a randomized, controlled trial. *Anaesthesia.* 2017;72(3):370-378. doi:10.1111/anae.13714
21. Ferrari F, Marchetti G, Picardo SG. The use of nasotracheal Airtraq laryngoscope with reinforced endotracheal tube: our experience. *Paediatr Anaesth*. 2014;24(8): 890-1. doi:10.1111/pan.12459
22. Dhonneur G, Abdi W, Amathieu R, Ndoko S, Tual L. Optimising tracheal intubation success rate using the Airtraq laryngoscope. *Anaesthesia.* 2009;64(3):315-9. doi:10.1111/j.1365-2044.2008.05757.x
23. 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(11):981-2. doi:10.1097/EJA.0b013e32832e9a32
24. Dimitriou VK, Zogogiannis ID, Douma AK, et al. Comparison of standard polyvinyl chloride tracheal tubes and straight reinforced tracheal tubes for tracheal intubation through different sizes of the Airtraq laryngoscope in anesthetized and paralyzed patients: a randomized prospective study. *Anesthesiology.* 2009;111(6):1265-70. doi:10.1097/ALN.0b013e3181c0ad5b