Comparison of the Airtraq to the Bonfils Fibroscope for Endotracheal Intubation in a Simulated Difficult Airway

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Abstract

Background: Difficult intubation, represent a challenge to anesthetist especially that many cases are encountered after induction of anesthesia. The Airtraq and the Bonfils fibrosopes are new devices designed to facilitate intubation under normal and difficult circumstances. In the present study, the efficacy and the intubation success rate of the Airtraq to the Bonfils fibroscope were evaluated in patients wearing a rigid cervical collar to simulate difficult airway.

Methods: Sixty patients ASA I and II requiring intubation as part of anesthesia were enrolled in the study. Patients were randomly assigned according to the device used during intubation to the Airtraq group (n=30) or the Bonfils group (n=30). After administration of IV anesthetics and before intubation, the neck was stabilized with rigid neck collar. Overall intubation success rate, time required for intubation, the number of attempts required for successful intubation, visual analogue scale (VAS, 0-10) for easiness of use of both devices and airway complications related to intubation were recorded. Postoperative sore throat and hoarsness were also evaluated using numerical scale (0-10).

Results: The overall success of intubation was 93.3% for the Airtraq and 90% for the Bonfils, p>0.05. Time to successful intubation was significantly shorter for the Airtraq 40 ± 8 seconds compared to the Bonfils group 48 ± 10 seconds, p<0.05. The number of required intubation attempts, were comparable between the two groups. One attempt was required in 20 patients (66.6%) versus 19 patients (63.3%) and two attempts were required in 7 patients (23.3%) versus 6 patients (20%) while three attempts were required in 1 patient (3.3%) versus 2 patients (6.6%) in Airtraq group and Bonfils group respectively, p>0.05. The incidence of intubation complication was comparable between the groups. Visual analogue scale for easiness of use of both devices and numerical scale for postoperative sore throat and hoarsness were comparable between the two groups.

Conclusion: Both the Airtraq and the Bonfils fibroscope offer high success rate in patients with predicted difficult airway.

Key Words: Airtraq – Bonfils difficult airway.

Introduction

THE difficult airway is a challenge to anesthetists. In the anesthesia literature its frequency ranges from 0.4% to 8.5% of elective intubations [1-2].

The American society of Anesthesiologists task force on management of the difficult airway, defines it as the clinical situation in which a conventionally trained anesthesiologist experiences difficulty with face mask ventilation of the upper airway, difficulty with tracheal intubation or both [3].

The absence of any single factor that reliably predicts the existence of a difficult airway means that many difficult intubations are not recognized until after induction of anesthesia [4].

The rigid Bonfils intubation fibroscope (Karl Storz GmbHand aco. KG, Tuttlingen, Germany) is a semi-rigid optical stylet with an outer diameter of 0.5 mm, a fixed anterior tip curvature of 40º and a 1.2-mm working channel. The Bonfils fibroscope has been shown to be effective for difficult airway management, allows visualization of the glottic aperture and the trachea and thus endotracheal tube placement under vision [5] (Fig. 1).

The Airtraq (Prodol Ltd., Vizcaya, Spain) is a new single use laryngoscope designed to facilitate tracheal intubation in patients with both normal and difficult upper airway anatomy. A view of the glottis is provided without alignment of the oral, pharyngeal and tracheal axes [6]. In this laryngoscope a combination of lenses and prisms rather than fibers transmit an illuminated image to a proximal view finder. The device houses a channel acting as a conduit for placement of a tracheal tube [6] (Fig. 2).
In the literature search, there was no data concerning comparison of the Airtraq to the Bonfils fibroscope during difficult airway.

The purpose of this study is to compare the Airtraq to the Bonfils fibroscope when used by experienced anesthetists in patients with a difficult airway simulated by means of a rigid cervical immobilization collar.

**Patients and Methods**

This study was conducted at Cairo University Hospitals, and both devices studied were provided by the main distributors in Egypt.

After obtaining approval from the ethics and research committee, an informed written consent was obtained from 60 patients ASA I and II aged 20 and older with predicted normal airway undergoing routine surgical procedures except in the area of the head and neck. Exclusion criteria were patients with known difficult airway, those with predicted difficult airway (Mallampatti >2, thyromental distance <6cm, interincisor distance <4cm and those with neck extension <30º. Patients with history of snoring, obstructive sleep apnea and those who are edentulous and beard were all excluded from the study.

The patients were randomized into two equal groups with sealed envelope to either undergo intubation through the Airtraq or the Bonfils fibroscope in a single blinded prospective study. In the operating room, routine monitors were applied (ECG, Pulse oximeter, non-invasive blood pressure, ETCO2 later after intubation). General anaesthesia was induced in all patients with intravenous propofol 2-3 mg/kg, fentanyl 1 g/kg and atracurium 0.5 mg/kg. All patients were ventilated with 2% sevoflurane until full muscle relaxation was confirmed by a nerve stimulator, a difficult airway was then created with cervical immobilization collar. The appropriate collar size was selected based on the manufacturer's instructions with the finger sizing method. The collar effectively downsized the mouth opening and limited the neck extension. All anesthetists performing intubation were trained in the use of the Airtraq and the Bonfils fibroscope.

For patients designed for Airtraq intubation, the blade of Airtraq was inserted into the mouth in the midline, over the center of the tongue and once the view of the glottis was optimized, the tracheal tube was passed through the vocal cords and the cuff inflated. The tube was then held in place while the Airtraq was removed.

For patients designed to the Bonfils fibroscope intubation, the Bonfils was inserted from the right side of the patient's mouth by guiding it along the last molar. After insertion of the device, a jaw thrust was performed with the left hand to increase the retropharyngeal space and advancement of the fibroscope was performed with the right hand. The Bonfils was advanced up to the glottic aperture then the tracheal tube was advanced under direct vision into the trachea.

In each group, tracheal intubation was considered a failure if it could not be accomplished in 120 seconds or after 3 attempts and any forward movement of either devices was considered an
intubation attempt or if SPO2 decreased below 92%. If intubation failed, the collar was immediately removed and the trachea was intubated under direct vision with the Machintosh laryngoscope #3. The primary endpoints were success rate of tracheal intubation using each device. Secondary endpoints of the study were duration of tracheal intubation and subjective assessment of handling of both devices using a visual analogue scale (0 being very easy and 10 being impossible).

The duration of tracheal intubation was calculated as the time from insertion of the Airtraq blade between the teeth, in Airtraq group, or insertion of Bonfils from the right side of the patient mouth, in Bonfils group, until the ETT was correctly positioned by direct visualization.

Postoperative sore throat and hoarsness were assessed as patient interviewed 18 hours after the intubation using a numeric scale from 0 to 10 (zero being no sore throat and hoarsness and 10 the worst sore throat and hoarsness).

Statistical analysis:
Assuming the overall intubation success in the Bonfils group would be above 82% from the study of Byhahn et al. [7] in which difficult intubation was simulated by neck collar. We assumed that 15% difference in overall intubation success rate between the groups would be clinically important. Therefore 30 patients in each group would be necessary to detect such a difference ($\alpha=0.05$, $\beta=0.2$).

Data were presented as mean (SD) or number (%) as appropriate. Comparison between the two groups was performed using unpaired student’s $t$-test. Categorical variables were compared using test of proportion. A $p$-value less than 0.05 was considered statistically significant.

Results
A total of 60 patients were enrolled into the study, none had any predictor of difficult intubation. The demographic data and the airway assessment data of patients assigned to either the Airtraq or the bonfils were similar (Table 1).

Endotracheal tube placement was successful in 20 patients (66.6%) in the Airtraq group and in 19 patients (63%) in the Bonfils group on first attempt. Two attempts were required in 7 patients (23.3%) of the Airtraq and 6 patients (20%) of the Bonfils and three attempts were required in 1 patient (3.3%) of the Airtraq and 2 patients (6.6%) in the Bonfils. Failure to intubate was present in 2 patients (6.6%) of the Airtraq and 3 patients (9.9%) of the Bonfils. The overall success of intubation was 93.3% for the Airtraq and 90% for the Bonfils. All patients in whom intubation failed with the immobilization collar had successful intubation with size 3 macintosh after collar removal.

Time to successful intubation was significantly shorter for the Airtraq group 40±8 seconds compared to the Bonfils group 48±10 seconds, $p<0.05$ (Table 2).

Intubation complications were comparable in both groups and listed in Table (2). Hypoxia (SpO2 <95%) or dental injury was not recorded during intubation in any patient of both groups.

On a visual analogue scale (0 to 10), the easiness of use of both devices was comparable between the two groups (Table 2).

Sore throat and hoarsness reported after anesthesia scored on a numeric scale from (0 to 10) were comparable between the two devices (Table 2).

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<tr>
<th>Table (1): Demographic characteristics of patients involved in the study [mean (SD) or numbers].</th>
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<td><strong>Airtraq (n=30)</strong></td>
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<td>Age (years)</td>
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<td>Sex (M/F)</td>
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<th>Table (2): Intra- and postoperative data of both groups [Number (%) or mean (SD)].</th>
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<td><strong>Airtraq (n=30)</strong></td>
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<td>Intubation time (seconds)</td>
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<td>Incidence of intubation related complications: [n (%)]:</td>
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<td>Mucosal trauma</td>
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<td>Lip injury</td>
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<td>Oesophageal intubation</td>
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<td>Easiness of device usage [VAS (0-10 cm)]</td>
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<td>Postoperative complication: [numerical scale (0-10)]:</td>
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<td>Sore throat</td>
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<td>Hoarseness</td>
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VAS= Visual analogue scale.

* $\alpha<0.05$ compared to the other group.
Discussion

The present study has confirmed the efficacy of the Airtraq and the Bonfils fibroscope in intubation of patients with simulated difficult airway. In patients with known or anticipated difficult tracheal intubation, intubation with a fiberoptic laryngoscope with or without video monitoring can be considered a standard of care [8]. Fiberscope--assisted intubation is likely to decrease complications, but requires considerable training and skill to perform and leads to the use of large sized tracheal tube [8].

Many alternative adjuncts to routine intubation have evolved over the recent years. A variety of new devices and techniques utilizing rigid fiberoptic technology, or prisms are available to assist intubation under direct vision. These may be useful when flexible fiberoptic equipment or skills are not available [9].

The use of a rigid collar 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 laryngoscopic techniques. In addition to limitation of mouth opening and decreased interincisor distance, all the previously mentioned factors may result in an increased incidence of grade 3 and 4 laryngoscopic views in up to 64% of patients with conventional laryngoscopy [10]. Therefore the rigid collar was used in the present study to simulate difficult airway.

The Airtraq has been previously assessed in manikins when used by anesthetist [6], relatively in experienced medical personnel [11] and novice users [12] and demonstrated potential advantage in both easy and simulated difficult laryngoscopy scenarios. These previous studies also proved that Airtraq was comparable to the Machintosh in normal airway and had advantages over it in the difficult airway scenario.

Byhahn et al. [6] also demonstrated a higher success rate of endotracheal intubation with the Bonfils fibroscope, compared to the standard size 3 Machintosh blade, in patients with simulated difficult airway.

The current study demonstrated that 93.3% and 90% of patients with predicted difficult airway in the Airtraq and the Bonfils groups respectively could successfully be intubated. However more patients in the Airtraq group could be intubated on first and second attempts compared to the Bonfils group. These findings were in contrast to that found by Bein et al. [5] who reported 100% success rate in endotracheal intubation with the Bonfils fibroscope and to that of Nasim et al. [13] who also reported 100% success rate with the Airtraq in the simulated difficult airway scenario. The difference between the success rate of intubation in the present study and that reported in the previously mentioned two studies may be explained by the difference in the skills of handling of the two devices. On the other hand, failure to intubate with Bonfils may be attributed to the absence of suction channel, therefore large amounts of mucous secretion or blood in the airway may prevent successful use [13]. The inability to direct the rigid device underneath the epiglottis due to the fixed curvature of the tip of the device may be another cause of failure to intubate with Bonfils.

As regards the intubation time in the current study, the Bonfils group showed significantly longer duration of intubation (48±10 seconds) compared to the Airtraq group (40±8 seconds) in patients with simulated difficult airway. The intubation time recorded in Airtraq group in the present study was not in line with what was reported by Maharaj et al. [6] and Nasim et al. [13]. They reported shorter intubation time using the Airtraq in manikin with predicted difficult airway. The differences in the results between the present study and the previous two studies may be explained by the usage of manikins in the previous studies. Caution must be taken when comparing data from human and manikin and it is unclear how representative models are of live patients.

Concerning the Bonfils, the time to successful intubation reported in the current study in the simulated difficult airway patients was comparable to that reported in the study done by Bein et al. [5] who compared the Bonfils to the intubating laryngeal mask. On the other hand it disagreed with the results of Byhahn et al. [7] who reported a longer intubation time than that reported in the present study and could be postulated to the differences in skills in handling the Bonfils.

In the current study the complications of intubation were comparable between the two groups of patients. However lip injury occurred only with the Airtraq group and mucosal injury was reported in more patients of the Bonfils group (4 patients) versus (2 patients) in Airtraq group. The back and forth movement of the Bonfils device in the mouth seemed to be the cause of increased injuries, longer intubation times and multiple intubation attempts.
In the current study, the use of both devices studied was easy, however the Airtraq was easier to use as scored on a visual analogue scale. The incidence of sore throat and hoarseness were comparable in both groups with the use of both devices.

The Bonfils intubation fiberscope has several advantages. It is not as expensive and extensive and the preparation time is shorter than flexible fiberscope. An important advantage of the Airtraq is that it is single use device reducing the chance of prion transfer. These concerns arise from the difficulties in ensuring that all proteinaceous material has been removed from reusable laryngoscope blades during cleaning and sterilization [14,15].

An important limitation regarding this study is the potential bias that might exist since it was impossible to blind the anesthetist to the device being used.

In conclusion both the Airtraq and the Bonfils fiberscope represent a successful alternative to the conventional Macintosh laryngoscope in patients with predicted difficult airway. In addition the fact that the Airtraq is a single use device makes it a very suitable alternative to prevent the transmission of infection in case it exists.

References


