Egyptian Journal of Anaesthesia (2011) **27**, 157–161

Egyptian Society of Anesthesiologists

Egyptian Journal of Anaesthesia

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Research Article

Is fiberoptic bronchoscope a good intubating choice in anesthetized patients with anticipated difficult intubation?

Mohamed M. Tawfeek [a,*], **Abeer Mohamed Abdelbaky** [b]

[a] *Anaesthesia Department, Zagazig University Hospital, Egypt*
[b] *Orthopedic Department, Zagazig University Hospital, Egypt*

Received 7 April 2011; revised 31 May 2011; accepted 3 June 2011
Available online 2 August 2011

KEYWORDS

Fiberoptic;
Bronchoscope;
Direct;
Laryngoscope;
Anesthetized

Abstract *Background:* Fiberoptic bronchoscope may be a good intubating tool in anesthetized patients with predicted difficult intubation. We conducted this prospective randomized study to compare intubation using FOB and direct laryngoscopy (DL) after induction of general anesthesia.
Methods: One hundred adult patients (50 patients in DL group, and 50 patients in the FOB group) with at least one difficult intubation criteria were enrolled in the study. Both FOB and DL were attempted after induction of anesthesia and verification of mask ventilation. Incidence of failed intubation (more than two attempts), successful intubation, and total induction times were recorded. Adverse events during intubation process were documented. Postoperatively, patients fulfilled a questionnaire to assess sequale of intubation.
Results: The overall success rate for tracheal intubation was higher in the FOB (100% Vs 86%; $p < 0.05$). Successful primary and secondary intubation attempts were higher in the FOB group (94% Vs 64%; $p < 0.05$ and 100% Vs 61%; $p < 0.05$, respectively). All patients who failed laryngoscopic intubation were successfully intubated using the fiberoscope. Induction and successful intubation times were longer in the laryngoscopy group (128 + 93.7 s Vs 79.9 + 27.2 s $p < 0.05$ and 67.5 + 88.6 s Vs 19.2 + 27 s $p < 0.05$, respectively). Adverse effects including tissue trauma

* Corresponding author. Address: Zagazig University Hospital, Borg Ali Zky Saad Zaglool Street, Zagazig, Egypt. Tel.: +20 166638793; fax: +20 552301497.
E-mail addresses: dr_tawfeek72@yahoo.com (M.M. Tawfeek), nakera35@hotmail.com (A.M. Abdelbaky).

Peer review under responsibility of Egyptian Society of Anesthesiologists.
doi:10.1016/j.egja.2011.06.001

and dental injury were greater in the DL group. Postoperative patient's dissatisfaction, sore throat, and hoarseness were statistically higher in the DL group.
Conclusion: We concluded that, FOB is an effective and safe intubating tool in anesthetized patients with anticipated difficult intubation.

1. Introduction

Difficult airway has been reported to be a significant cause of anesthesia related morbidity and mortality [1]. Every anesthetist should have his own preformulated strategy for management of difficult airway according to his skills, preference, patient condition, anticipated surgery, and available airway tools [2]. FOB is an airway tool of choice for awake intubation but can be also done in anesthetized patients [3]. In Rose review, FOB was the most commonly utilized alternative to the direct laryngoscope either, electively, or in the case of unanticipated difficult intubation [4].

Our primary hypothesis was that, selected patients with predicted difficult intubation could be successfully and safely intubated using the FOB after induction of general anesthesia. The secondary hypothesis was that, patients could be intubated using a fiberoscope after failed laryngoscopic intubation attempts. Consequently, we can avoid repeated laryngoscopic trails that may compromise airway management [5]. Therefore, we conducted this prospective randomized study to compare tracheal intubation using FOB, and conventional DL after induction of general anesthesia in patients with predicted difficult intubation.

2. Methods

After approval from Zagazig university ethical committee, 100 American Society of Anesthesiologists (ASA) physical status I, II or III adult patients with predicted difficult intubation undergoing scheduled surgery under general anesthesia with tracheal intubation were prospectively enrolled in the study. Written informed consent was obtained from all patients. Six patients of whom criteria were eligible to participate refused to give the consent, so they were not included in the study.

Predictors for difficult intubation that was in accordance with the French Society of Anesthesiologists [6], and included at least one of the following parameters; thyromental distance < 65 mm performed in the setting position with the head in full extension [7], mouth opening 25–35 mm, limited cervical spine extension, and Mallampati class III or IV. Mallampati classification modified by Samsoon and Young [8] was performed during phonation in the setting position with head in full extension, and tongue protrusion [5]. Morbid obesity (body mass index > 35), and other predictors of difficult ventilation were excluded from the study. Patients with unstable cervical spine, at risk for aspiration, pathological abnormalities of the airway, mouth opening < 25 mm, or any contraindications to nasal intubation were also excluded. 0.5 mg intravenous atropine and topical nasal decongestant were administered and preoxygenation commenced 5 min before induction. Just before induction, patients were randomly allocated into one of the two groups; in the first group, patients were scheduled for laryngoscopic intubation "DL Group", and in the second group, patients were scheduled for fiberoptic intubation "FOB Group". Randomization was done using a sealed envelope technique.

Patients were monitored continuously with pulse oximetery, capnometry, and five leads electrocardiogram. Blood pressure was measured noninvasively at 1 min interval from induction to 5 min after intubation. General anesthesia was induced intravenously using 1–2 mg/kg propofol, 1–2 mcg/kg fentanyl, and 1 mg/kg succinylcholine. Thereafter, mask ventilation was verified.

In the DL group, primary intubation attempts were done using size 3 or 4 Macintosh blade with patients in the sniffing position. Bougies, or stylets were used if needed in the secondary intubation attempts. In the FOB group, all trials were performed nasally using a standard battery-powered 4.2 mm Pentax FOB (FI – 13BS/RBS). Both laryngoscopic and fiberoptic intubations were performed by staff anesthesiologists experienced in both maneuvers and specifically well experienced in awake nasal fiberoptic intubation (more than 80 cases).

In the DL group, 7.0- and 8.0-mm-internal diameter (ID) Polyvenyl chloride (PVC) endotracheal tubes (ETTs) were used for both women and men, respectively, while 6.5–7 and 7–7.5 mm ID PVC ETTs were used for both women and men, respectively in the FOB group. For both groups, correct positioning of ETT was confirmed by bilateral auscultation of both lung fields and detection of exhaled carbon dioxide.

During intubation process, mask ventilation was attempted if hypoxemia (oxygen saturation $< 90\%$ on pulse oximetry) occurred. LMAs were inserted for patients who cannot be ventilated, and then excluded from the study.

In the DL group, a well trained assistant was assigned for facilitation of laryngeal exposure by external laryngeal manipulation. In the FOB group, the role of the assistant was opening the oropharyngeal space either by jaw thrust or rigid laryngoscopy and advancing the ETT over the FOB. In both groups, the assistant was concerned with observing apneic time, patient monitoring, and data collection using a data collection form. The following data were collected; Patient characteristics, causes of difficult intubation, incidence of successful intubation (If two attempts did not result in a successful intubation, it was considered as failure, and then, intubation was attempted using FOB in the DL group or ILMA in the FOB group). Successful intubation time (time from insertion of the device to detection of exhaled carbon dioxide), and induction time (time from the administration of propofol to detection of exhaled carbon dioxide) were recorded. Hemodynamic parameters and oxygen saturation were also recorded during intubation process. Adverse events encountered during tracheal intubation in the form of soft tissue trauma, bleeding, or dental injury were documented by the intubator. On the first postoperative day; patients fulfilled a questionnaire to assess intubation sequale as patient dissatisfaction, sore throat, and

Table 1 Comparison of the fiberoptic bronchoscope (FOB) with direct laryngoscope (DL) in tracheal intubation.

Group	DLN = 50	FOBN = 50
Patient characteristics		
Male sex	28 (56)	30 (60)
Age (years)	49.2 ± 14.8	48.5 ± 14.5
Weight (kg)	77.9 ± 12.5	79.1 ± 10.9
Height (cm)	172 ± 10.3	170.9 ± 9.8
Causes of difficult intubation		
Mallampati classification		
III	22 (44)	24(48)
IV	14 (28)	12(24)
Thyromental distance (65 mm)	11 (22)	13(26)
Mouth opening (25–35 mm)	3 (6)	4 (8)
Limited neck extension	4 (8)	5 (10)

Data are mean ± SD, or number (%). No significant difference between groups. Because of rounding, adding percentages may not provide a sum of 100%.

Table 3 Number of adverse effects encountered during fiberoptic (FOB) and rigid laryngoscope (RL) tracheal intubation techniques.

Group	DL (n = 50)	FOB (n = 50)
Hypoxemia (SPO_2 < 90%)	5 (10)	3(6)
Dental injury and/or tissue trauma	7 (14)	0 (0)*
Overall adverse effects	12 (24)	3 (6)*

Data expressed number (%).
SPO_2 = Oxygen saturation measured by pulse oximetry.
* $p < 0.05$.

Table 4 Comparison of postoperative patient questionnaire.

Group	DL (n = 50)	FOB (n = 50)
Patient dissatisfaction (VAS 0–10, 10 worst)	3.6 ± 2.5	0.68 ± 0.71*
Sore throat (VAS 0–10, 10 worst)	4.5 ± 2.95	1.46 ± 1.48*
Hoarseness (VAS 0–10, 10 worst)	5.2 ± 3.0	2.0 ± 1.6*

Data expressed as mean ± SD.
* $p < 0.05$. VAS = Visual Analog Scale.

hoarseness on 10 points using a visual analog scale (VAS), 0 being maximum patient satisfaction, no sore throat, and no hoarseness, while 10 being the maximum patient dissatisfaction, worst sore throat, and worst hoarseness the patient can imagine.

Data are presented as mean + SD or percentage. Comparison of two means was performed using the Student Test. Comparison of percentages was performed using the Fisher exact method. p value < 0.05 was considered significant.

3. Results

One hundred adult patients were included in this study (50 patients in each group). There were no significant differences in the patient characteristics and causes of predicted difficult intubation between the two groups Table 1.

The overall success rate for tracheal intubation was significantly higher in the FOB group. (100% in the FOB group versus 86% in the RL group). Primary intubation attempts were successful in 32 patients (64%) in DL group, compared to 47 patients (94%) in the FOB group. Secondary intubation attempts were successful in 11 patients (61%) in the DL group, while, all patients were successfully intubated in the FOB group (100%). For both groups, mask ventilation was effective during hypoxemic episodes, and no patient required LMA insertion. All patients who failed secondary laryngoscopic intubation attempts were successfully intubated using FOB. Induction and successful intubation times were significantly longer in the laryngoscopy group, induction time in the laryngoscopy group was (**128** + **93.7** s) compared with (**79.9** + **27.2** s) in the FOB group, while, successful intubation time was (**67.5** + **88.6** s) in the laryngoscopy group compared with (**19.2** + **27** s) in the FOB group. Maximum heart rate, maximal systolic and diastolic blood pressure, and minimum oxygen desaturation during induction and tracheal intubation were similar in both groups Table 2.

The incidence of overall adverse effects including soft tissue trauma and dental injury were significantly greater in the DL group. However, there was no difference in the incidence of hypoxemia in both groups Table 3.

Table 2 Comparison of tracheal intubation.

Group	DL (n = 50)	FOB (n = 50)
Overall success rate (%)	43/50 (86%)	50/50 (100%)*
Successful primary attempts (%)	32/50 (64%)	47/50 (94%)*
Successful secondary attempts (%)	11/18 (61%)	3/3 (100%)
Patients required LMA insertion (%)	0 (0%)	0 (0%)
Total induction time (s)	128 ± 93.7	79.9 ± 27.2*
Intubation time (s)	67.5 ± 88.6	19.2 ± 27*
Patients monitoring during intubation		
Maximal heart rate (beats/min)	92 ± 13.75	93.5 ± 12.7
Maximal systolic blood pressure (mmHg)	134.9 ± 15.1	134.44 ± 15.3
Maximal diastolic blood pressure (mmHg)	84.2 ± 7.3	86.2 ± 8.8
Minimum oxygen de-saturation (%)	92. 8 ± 2.9	93.1 ± 3.7

Data expressed as mean ± SD, or number (%).
* $p < 0.05$.

Postoperative patient's dissatisfaction, sore throat, and hoarseness were statistically higher in the laryngoscopy group Table 4.

4. Discussion

Different devices of airway management for patients with difficult airway have been recommended in no specific sequence by the ASA difficult airway algorithm [9], selection of an ideal airway device for these patients remains controversial [10]. However, FOB has been shown to be the preferred device in predicted difficult airway management [11]. ASA difficult airway algorithm recommended FOB in two situations, either in awake intubation in patients with predicted difficult ventilation or after induction of anesthesia as an alternative approach to intubation after failed conventional laryngoscopic trials [9].

Although, FOB has been reported to be more difficult, and time consumer in anesthetized patients [5], in this study, time limitation imposed by an apneic patient was overcome by the highly qualified operators and well trained assistants. Moreover, opening the oropharyngeal space with jaw thrust, or lifting the tongue with rigid laryngoscopy solved the problem caused by poor laryngeal view due to lost tone of the tongue and pharyngeal muscles under anesthesia. Lastly, proper antisialagogue premedication prevented anesthesia related increased airway secretions [4].

In this study, patients with predicted difficult ventilation were excluded as awake intubation has been emerged as the technique of choice for these patients [12]. Predictors of difficult ventilation includes upper airway obstruction due to any cause, difficult mask fit due to bearded, retrognathic edentulous or morbidly obese patients, and presence of cranio-facial anomalies [13]. Many studies and case reports confirmed the safety and effectiveness of awake FOB intubation [14–17]. Failed intubation was considered after two laryngoscopic intubation attempts as more than two attempts were known to be associated with increased airway trauma, bleeding and edema that might limit further mask ventilation [10]. The operators were well trained in awake fiberoptic intubation, and preferred the nasal route for FOB insertion.

Failure to advance a nasal PVC ETT over FOB due to hanging up of the tube tip on the epiglottis remains a challenge for anesthetists interested in bronchoscopic intubation, many operators overcomed this problem by designing new innovative tubes or tube tips [18–23]. Only PVC ETTs were available in our hospital, but fortunately, the operators in this study were experienced in handling this ordinary tube during awake nasal fiberoptic intubation and faced no problem with tube advancement through the vocal cord by rotating the tube 90° counterclockwise while advancing [24].

We recorded a lower success rate for intubation in the laryngoscopy group. The high incidence of secondary laryngoscopic attempts in the laryngoscopy group was associated with longer induction and successful intubation times, more airway trauma, and subsequently more postoperative patient dissatisfaction.

Among the limitations in this study, the FOB is considered as an expensive device and requires a special skill, and high care for cleaning and maintenance.

In conclusion, in adult patients with an anticipated difficult intubation, we obtained a high success rate and less adverse effects of FOB intubation after induction of general anesthesia. Moreover, in case of failed laryngoscopic intubation, fiberoptic intubations were always successful. For optimization of maneuver, the authors recommended a battery powered fiberoscope in hand, proper antisialagogue, and lastly a topical nasal decongestant and well lubricated ETT if nasal route is chosen.

Lastly, further researches are required to compare FOB with other alternatives of conventional intubation as video assisted laryngoscopes after induction of general anesthesia in patients with predicted difficult intubation.

Conflicts of interest

These authors has no conflicts of interest

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