Airway management in morbidly obese adolescents: a comparison between Bonfils fiberscope and fiberoptic bronchoscope assisted with direct laryngoscopy

Mostafa M. Sabra

Background and aim Pediatric patients presenting to bariatric surgery is increasing in percentage in the last years and has become a fast growing epidemic problem. The aim of this study was to evaluate the usefulness of Bonfils fiberscope (BF-L) and fiberoptic bronchoscope (FO-L), assisted by direct laryngoscopy for intubation in morbidly obese adolescents with predicted easy intubation using the El-Ganzouri risk index score.

Patients and methods Thirty adolescent American Society of Anesthesiologist II–III patients, aged 12–19 years, scheduled for laparoscopic bariatric surgery were randomized into two equal groups for intubation, with assistance of regular Mackintosh laryngoscope in both groups, either group BF-L and group FO-L. The standard protocol for general anesthesia was used for both groups. The primary outcome measure was the visualization quality using the percentage of glottis opening score. The secondary outcome measures were: duration of intubation and number of intubation attempts.

Results Percentage of glottis opening scores were significantly better in group BF-L, when compared with group FO-L (93±6.44%/83±8%, respectively, P=0.002). The intubation success rate was 100% in both groups, and the mean intubation time was significantly longer (16±4.67 s) in group FO-L compared with 11±3.50 s in group BF-L (P=0.02). As regards the number of attempts, all patients were successfully intubated on the first attempt in group BF-L, while intubation was successful in 14 patients in group FO-L and one patient on the second attempt, which was statistically insignificant ($P<0.05$).

Conclusion Orotracheal intubation was performed more rapidly and easily with BF-L and FO-L, with superiority of BF-L than FO-L in patients with predicted easy intubation using the El-Ganzouri risk index score

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Department of Anesthesia and Intensive Care, Faculty of Medicine, Al-Azhar University, Cairo, Egypt

Correspondence to Mostafa M. Sabra, MD, PhD, Department of Anesthesia, Faculty of Medicine, Al-Azhar University, Cairo 112273, Egypt. Tel: 01006888814;
e-mail: moesabra7@gmail.com

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Introduction

Obesity in children is expanding at an increasing rate all throughout the world [1]. The estimate of obese children in Egypt was 15% in early 2010, in comparison with 6% in 1999s [2], and has become an issue of significant public health concern, and thus expanding the numbers of children presenting for bariatric surgery. Many surgical practices have developed to treat morbidly obese children (at or above the 95th percentile of BMI) [3]. Laparoscopic sleeve gastrectomy can be considered to be one of the best treatment options as it is a feasible, simple, and safe method for children [4].

Obesity alone is associated with only1.3% increase in risk of difficult/failed intubation, compared with 0.4% in normal-weight children [5], and adds more difficulties in mask ventilation (7.4 vs. 2.2%) [6], but positioning the obese child is of high importance, so failure to acquire correct head positioning may prompt a poorer view laryngoscopy.

Although fiberoptic intubation has a principal role in intubation in pediatric patients, many other promising reliable devices become an alternative in the practice of anesthesia as Bonfils fiberscope (BF-L).

BF-L has well-established advantages such as clear visualization of the intubation process, the capacity for portable light source and flexible use, and is especially suitable in children with their lower apnea tolerance [7].

This prospective, randomized, single-blinded, clinical, and controlled study compared the role and place of BF-L with fiberoptic bronchoscope (FO-L) for intubation of children with morbid obesity without compromising the visual quality or simplicity of intubation strategy.

Patients and methods

After approval of our ethics and scientific committee, an informed written consent was obtained from the child's parent or legal guardian on the day of the surgery. This prospective, randomized, controlled, and single-blinded study was conducted on 30 young cooperative children aged 12–19 years with a BMI more than 40 kg/m^2, or BMI=35–40 kg/m^2 in the presence of severe obesity-related complications. The children were scheduled for laparoscopic sleeve gastrectomy. All patients were of American Society of Anesthesiologist classes II–III. Exclusion criteria included: patient's refusal for consenting, patients with allergy to study drugs, bleeding disorder, patients with a history of hiatus hernia, a history of gastroesophageal reflux, or patients with neck surgery and/or scars.

Airway assessment using the El-Ganzouri risk index (EGRI) score [8], a score of less than 5 was suspected to be an easy intubation, if the score is more than or equal to 5 difficulty is suspected, and the patient was excluded.

Preprocedural assessment included history taking, physical examination, and laboratory investigations (complete blood picture, liver and kidney function tests, and coagulation profile).

All patients fasted for at least 6 h before the surgery and received EMLA cream (Rocipharm Kariskoga AB, AstraZeneca, Södertälje, Sweden) to an appropriate site for cannulation 1 h before induction. An intravenous line was secured with a 20-G cannula, and the patients were premedicated with intravenous midazolam 0.05 mg/kg and atropine 0.01 mg/kg (according to lean body weight), 30 min before operation.

On entry to the operating room (OR), a standard monitoring was applied (ECG, automated noninvasive blood pressure (BP) monitoring, peripheral nerve stimulator, and pulse oximetry). Baseline BP and heart rate (HR) were recorded, mean HR (HR1) and mean BP (BP1) were calculated (invasive BP was used in cases where NIBP was not appropriate). Lactated Ringer's solution was infused (5–6 ml/kg/h).

Randomization was done by utilizing a computer-produced randomization chart (www.randomization.com). Furthermore, the patients were randomly assigned into two groups of 15 patients each. Group FO-L: included patients who were intubated with FO-L assisted by direct laryngoscopy and group BF-L: included patients who were intubated with BF-L assisted by direct laryngoscopy.

Random group assigned was enclosed in a sealed envelope to guarantee concealment of assignment sequence. After transferring the patient to the operation theater, a sealed envelope was opened by the anesthesiologist, not engaged in the study.

Positioning of the patient: by utilizing the standard OR table to ramp the patient with head rest, and the patient is positioned on the bed with his back on the back segment. Raise the back segment 25° and at that point tilt the head segment back, until the external auditory meatus and the sternal notch are in the same horizontal plane. This position fundamentally improves maintenance of the passive pharyngeal airway, facilitates bag-mask ventilation, and improves the success of endotracheal intubation [9].

Anesthetic technique

Preoxygenation was applied for 4 min utilizing a facemask and 100% oxygen. When the expired oxygen concentration reached above 90% (Datex Ohmeda, S5, patient monitor; GE, Ventura, California, USA), anesthesia was induced by intravenous fentanyl (1 μg/kg) and propofol (2 mg/kg). Drug dosage was given according to lean body weight. Patient's ventilation using bag and mask was assessed by chest inflation and capnography before giving rocuronium (0.6 mg/kg) to facilitate tracheal intubation. Thirty seconds after drug administration, the patient was manually ventilated by a facemask with 100% oxygen and sevoflurane (2%). Tracheal intubation was performed 60 s after rocuronium injection, and train of four (TOF) count for intubation on the peripheral nerve stimulator.

Intubation technique

Preparation of the assigned device was prepared for utilization before entry of the patient to OR, and intubation in both groups was done by one expert and an experienced anesthetist.

In group fiberoptic bronchoscope

The fiberscopes (size 5.1 mm; Karl Storz, Tuttlingen, Germany) were prepared by using an antifogging solution, keeping the FO-L as sterile as possible. Endotracheal tubes were loaded onto the fiberscope with the Murphy eye up (bevel facing down); this orientation was maintained during passage of the endotracheal tube orally to facilitate successful placement into the trachea. An assistant at that point put a regular Mackintosh laryngoscope blade into the vallecula with left hand and tracheal intubation was performed utilizing the appropriate size of tracheal tubes.

In group Bonfils fiberscope

The BF (Bonfils; Karl Storz Endoscope) was prepared by using an antifogging solution; an endotracheal tube of appropriate size was then loaded onto the BF-L, so that the tip of it covered the tip of the scope somewhat; A fiberscope outer diameter of 3.5 mm was used. The investigator at that point put a regular Mackintosh laryngoscope blade, into the vallecula with left hand and introduced the BF-L with his right hand. The Bonfils intubation endoscope was introduced in the sagittal plane along the tongue. After visualization of the larynx, the endotracheal tube was passed through the vocal cords and into the trachea. The BF-L was carefully removed followed by the laryngoscope, while the tube was held in its position by the assisting anesthesia nurse. Confirm the endotracheal tube (ETT) position by capnography, auscultation of bilateral air entry, and observation of bilateral chest movement.

Outcome measures

The primary outcome measure was the visualization quality using the percentage of glottis opening score [10]. The duration of intubation (which is defined as the time from mask removal to confirmation of endotracheal tube placement by end-tidal carbon dioxide detection, this time it is measured by a stopwatch), and the number of attempts were the secondary outcome measures. The time of ventilation between attempts was calculated and subtracted.

BP and HR were recorded before intubation, 1 and 5 min after intubation; the mean HR and mean BP were calculated and compared.

After successful intubation, anesthesia was maintained with sevoflurane (1.5–2%) in an oxygen/air mixture (50/50) and fentanyl 0.5 μg/kg boluses, and rocuronium 0.1 mg/kg every 30 min according to peripheral nerve stimulation.

Any postoperative side effects such as throat pain, stridor, and hoarseness were recorded.

Statistical analysis

Sample size calculation concluded that 15 patients for each subgroup were sufficient to give α=0.05 with a confidence interval of 95% and actual power of 80% and β=0.2, for intubation time measurement. Data were coded and entered using the statistical package statistical package for the social sciences, version 21. Data were summarized using mean, SD, median, minimum, and maximum for quantitative variables and frequencies (number of cases) and relative frequencies (percentages) for categorical variables. Comparisons between groups were done using unpaired t test in normally distributed quantitative variables while nonparametrical Mann–Whitney test was used for non-normally distributed variables. For comparing categorical data, χ^2 test was performed. Exact test was used instead when the expected frequency is less than 5. P values of less than 0.05 were considered as statistically significant.

Results

Demographic data analysis

There were no statistically significant differences between the study groups as regards age, sex, height, weight, BMI, or American Society of Anesthesiologist status (Table 1).

All patients were assessed by the El-Ganzouri scoring system and there were no significant differences between the two studied groups (Table 2).

As regards percentage of glottis opening score

Two patients in group FO-L had 100% score, four had 50–100%, and nine had less than 50%. In group BF-L, 11 patients had 100% of glottis opening score, three had 50–100% score, and one had less than 50% score. The laryngeal view was significantly better in group FO-L compared with group BF-L (P<0.05) (Table 3).

Duration of intubation, number of attempts, and success rate: the intubation success rate was 100% in both groups. The intubation time was significantly longer (16±4.67 s) in group FO-L compared with (11±3.50 s) in group BF-L (P<0.05). As regards the number of attempts, all patients were successfully intubated on the first attempt in group BF-L, while intubation was successful on the first attempt in 14 patients in group FO-L, and one patient on the second attempt, which was statistically insignificant (Table 4).

There were no significant differences between both groups in HR and BP changes at baseline value, 1 and 5 min after intubation in hemodynamic changes including HR (Table 5) and BP (Table 6), respectively.

Table 1 Patients' demographic characteristics

Parameters	Group FO-L (N=15)	Group BF-L (N=15)	P value
Age (years)	15±2.5	14±3.4	0.545
Sex (male/female)	10/5	6/9	0.705
BMI (kg/m^2)	39.1± 8.5	40.2±7.8	0.343
ASA (II/III) (n)	11/4	10/5	0.61

Data were presented as mean±SD or n (%). ASA, American Society of Anesthesiologist; BF-L, Bonfils fiberscope; FO-L, fiberoptic bronchoscope.

Table 2 Predictors of difficult airway

		Group FO-L (*N*=15) [*n* (%)]	Group BF-L (*N*=15) [*n* (%)]	*P* value
Mouth opening (cm)				
>4	0	15 (100)	15 (100)	1.00
<4	1	0 (0)	0 (0)	
Thyromental distance (cm)				
>6.5	0	11 (73.3)	9 (60)	0.43
6–6.5	1	4 (26.7)	6 (40)	
<6	2	0 (0)	0 (0)	
Modified Mallampati score				
Class I	0	0 (0)	0 (0)	0.45
Class II	1	8 (53.3)	10 (66.6)	
Class III	2	7 (46.6)	5 (33.3)	
Class IV	2	0 (0)	0 (0)	
Neck movement				
>90	0	11 (73.3)	14 (93.3)	0.142
=90	1	4 (26.6)	1 (6.7)	
<90	2	0 (0)	0 (0)	
Ability to prognath				
Can prognath	0	15 (100)	15 (100)	1.00
Can approximate	1	0 (0)	0 (0)	
Can't prognath	2	0 (0)	0 (0)	
Body weight				
<90	0	0 (0)	0 (0)	1.00
90–110	1	8 (53.3)	8 (53.3)	
>110	2	7 (46.7)	7 (46.7)	
History of difficult intubation				
No	0	15 (100)	15 (100)	1.00
Questionable	1	0 (0)	0 (0)	
Definite	2	0 (0)	0 (0)	
Total score of EGRI (mean±SD)		3.466±0.516	3.266±0.457	0.271

BF-L, Bonfils fiberscopes; EGRI, El-Ganzouri risk index; FO-L, fiberoptic bronchoscope.

Table 3 Percentage of glottic opening score

Parameters	Group FO-L (*N*=15) [*n* (%)]	Group BF-L (*N*=15) [*n* (%)]	*P* value
<50%	9 (60)	1 (6.7)	0.002*
50–100%	4 (26.7)	3 (20)	
100%	2 (13.3)	11 (73.3)	

BF-L, Bonfils fiberscopes; FO-L, fiberoptic bronchoscope. *P value less than 0.05 between the two groups.

Table 4 Duration of intubation, number of attempts, in both groups

Parameters	Group FO-L (*N*=15)	Group BF-L (*N*=15)	*P* value
Duration of intubation (s)	16±4.67	11±3.50	0.02*
Number of attempts			
1 attempt	14 (66.7)	15 (100)	0.4
>1 attempt	1 (6.66)	0 (0)	

Data were presented as mean±SD or *n* (%). BF-L, Bonfils fiberscopes; FO-L, fiberoptic bronchoscope. **P* value less than 0.05 between the two groups.

As regards the incidence of complications, only one case in group B complained postoperative sore throat.

Discussion

In this study, the intubating conditions were studied and prospectively evaluated in 30 patients. The patients were divided into two groups (15 patients each) according to airway assessment using the EGRI score less than 5. Group FO-L: includes patients who were intubated with the FO-L with assistance of conventional Macintosh laryngoscope and group BF-L included patients who were intubated with the BF-L, with assistance of conventional Macintosh laryngoscope.

Table 5 Heart rate changes in both groups (beats/min)

Parameters	Group FO-L (*N*=15)	Group BF-L (*N*=15)	*P* value
Baseline	80.800±5	77.8±4.798	0.107
Before intubation	78.600±5	75.6±7.798	0.23
1 min after intubation	96.8±7.491	94±8.31	0.139
5 min after intubation	86.31±7.273	82.93±9.89	0.067

Data were presented as mean± SD. BF-L, Bonfils fiberscopes; FO-L, fiberoptic bronchoscope.

Table 6 Mean blood pressure changes in both groups (mmHg)

Parameters	Group FO-L (*N*=15)	Group BF-L (*N*=15)	*P* value
Baseline	98.46±2.89	99.3±1.98	0.348
Before intubation	95.57±6.89	96.6±7.98	0.348
1 min after intubation	106.4±10.43	107.2±13.97	0.441
5 min after intubation	100.7±13.47	101.3±12.89	0.570

Data were presented as mean±SD. BF-L, Bonfils fiberscopes; FO-L, fiberoptic bronchoscope.

The aim of the present study was to explore the laryngoscopic view and intubation achievement, utilizing the new BF-L with assistance of regular mackintosh laryngoscope.

The success rate of intubation in this study was 100%, so the results could demonstrate that FO-L and BF-L are suitable devices for the intubation of morbidly obese children. However, using the BF-L gives a superior visualization of the larynx accomplished and less time for endotracheal intubation was required than with the FO-L, suggesting that BF-L may be easier, and faster, to intubate morbidly obese adolescence.

The time was recorded by a video system, so the measuring was accurate as the video camera was connected, another advantage of connection to a video camera was easy manipulation in BF-L because only one hand is used, and the other is free.

Both BF-L and direct laryngoscope can be handled at the same time, by the same operator without the need for an assistant, as the BF-L can be used by one hand when a video camera was connected to it, and the direct laryngoscope with the other hand. On the other hand, an expert assistant is mandatory while using a FO-L.

This study used direct laryngoscope, to facilitate intubation, as it was proven to be more helpful than other methods such as tongue traction, manual jaw lift, or jaw thrust [11,12], because using this maneuver increases the space in the oral cavity, keeping in mind wrong manipulation may be a source of failed attempt.

After visualization of the vocal cords, while using BF-L, the scope was not advanced into the trachea, to avoid airway injury, while FO-L must pass the vocal cords, then intubation was done, and this may explain the shorter intubation time recorded during intubation in the BF-L group. The shorter duration of intubation is required during induction of anesthesia in such a group of population, as rapid-sequence induction technique may be considered during induction due to increased danger of acid aspiration [13].

In this study, the hemodynamic responses were observed following intubation; there was no statistically significant difference in HR, mean arterial pressure, and 1 and 5 min after intubation in both groups.

FO-L is considered as the highest innovation for tracheal intubation in patients with difficult intubation; however, it is an invasive technique and it carries some risks, as desaturation, and trauma of the airway [14].The Bonfils is a rigid intubating endoscope. The term 'intubation endoscope' is more proper in descriptions of Bonfils than intubation fiberscope, as the typical honeycomb arrangement of optical fibers is eliminated to accommodate significantly more image fibers (up to 35 000 pixels), prompting better image quality [15].

Compared with pediatric flexible fiberoptic fiberscopes, at least 2–3 cm of mouth opening is necessary to guarantee insertion of BF into the mouth with further advancement [16]. Also, Bonfils provides no suctioning channel; therefore, premedication with an antisialagogue must be ensured.

Kim *et al.* [17] reported similar results when comparing effectiveness of Bonfils and FO-L (with assistance of direct laryngoscope), and concluded that airways intubation can be performed faster with the Bonfils group.

In contrast, the results of the study done by Bein *et al.* [18] indicated that the pediatric BF-L is associated with only a fair success rate, during the evaluation of the pediatric BF-L for elective endotracheal intubation, in children with normal airways.

Conclusion

In conclusion, orotracheal intubation was performed more rapidly and easily with BF than FB in patients

with predicted easy intubation using the EGRI score. The Bonfils intubation endoscope is less complicated to use than a flexible fiberscope.

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Conflicts of interest
There are no conflicts of interest.

References

1 Zahra SS. A prospective longitudinal study to estimate the prevalence of obesity in Egyptian children with nocturnal enuresis and the association between body mass index and response to therapy. *Egypt J Med Hum Genet* 2017; **18**:211–218.

2 Hadhood SESA, Ali RAE, Mohamed MM, Mohammed ES. Prevalence and correlates of overweight and obesity among school children in Sohag, Egypt. *Open J Gastroenterol* 2017; **07**:75–88.

3 Flodmark CE, Lissau I, Moreno LA, Pietrobelli A, Widhalm K. New insights into the field of children and adolescents' obesity: the European perspective. *Int J Obes* 2004; **28**:1189–1196.

4 Mecoli M, Kandil A, Campion M, Samuels P. Pediatric obesity: anesthetic implications and perioperative considerations for weight loss surgery. *Curr Anesthesiol Rep* 2017; **7**:125–134.

5 Sgalambro F. Unexpected difficult intubation: many algorithms, many devices, many techniques, the best choice would be not having to choose. is it utopian? *Br J Anaesth* 2016; **117**:672–674.

6 El-Metainy S, Ghoneim T, Aridae E, Abdel Wahab M. Incidence of perioperative adverse events in obese children undergoing elective general surgery. *Br J Anaesth* 2011; **106**:359–363.

7 Kaufmann J, Laschat M, Engelhardt T, Hellmich M, Wappler F. Tracheal intubation with the Bonfils fiberscope in the difficult pediatric airway: a comparison with fiberoptic intubation. *Paediatr Anaesth* 2015; **25**:372–378.

8 El-Ganzouri AR, McCarthy RJ, Tuman K, Tanck EN, Ivankovich AD. Preoperative multivariate airway assessment: predictive value of a risk index. *Anesth Analg* 1996; **82**:1197–1204.

9 Collins SR. Direct and indirect laryngoscopy: equipment and techniques. *Respir Care* 2014; **59**:850–864.

10 Kaufmann J, Laschat M, Hellmich M, Wappler F. A randomized controlled comparison of the Bonfils fiberscope and the GlideScope Cobalt AVL video laryngoscope for visualization of the larynx and intubation of the trachea in infants and small children with normal airways. *Paediatr Anaesth* 2013; **23**:913–919.

11 Bein B, Yan M, Tonner PH, Scholz J, Steinfath M, Dörges V. Tracheal intubation using the Bonfils intubation fibrescope after failed direct laryngoscopy. *Anaesthesia* 2004; **59**:1207–1209.

12 Kim TK, Son JD, Seo H, Lee YS, Bae JPH. A randomized crossover study comparing cervical spine motion during intubation between two lightwand intubation techniques in patients with simulated cervical immobilization: laryngoscope-assisted versus conventional lightwand intubation. *Anesth Analg* 2017; **125**:485–490.

13 El Solh AA. Airway management in the obese patient. *Clin Chest Med* 2009; **30**:555–568.

14 Terkawi RS, Altirkawi KA, Terkawi AS, Mukhtar G, Al-Shamrani A. Flexible bronchoscopy in children: utility and complications. *Int J Pediatr Adolesc Med* 2016; **3**:18–27.

15 Piepho TNR. *The Bonfils intubation endoscope in clinical and emergency medicine*. Der Aanesthetist Endo-Press: Endo-Press; 2011.

16 He N, Xue FS, Xu YC, Liao X, Xu XZ. Awake orotracheal intubation under airway topical anesthesia using the Bonfils in patients with a predicted difficult airway. *Can J Anesth* 2008; **55**:881–882.

17 Kim SH, Woo SJ, Kim JH. A comparison of Bonfils intubation fiberscopy and fiberoptic bronchoscopy in difficult airways assisted with direct laryngoscopy. *Korean J Anesthesiol* 2010; **58**:249–255.

18 Bein B, Wortmann F, Meybohm P, Steinfath M, Scholz J, Dörges V. Evaluation of the pediatric bonfils fiberscope for elective endotracheal intubation. *Paediatr Anaesth* 2008; **18**:1040–1044.