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Fibreoptic Orotracheal Intubation of Obese Patients Using Parker Flex-Tip vs. Standard Endotracheal Tube

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Abstract

Objective: Advancement of the endotracheal tube through a fibreoptic scope can sometimes prove to be challenging in obese patients. The Parker Flex-Tip endotracheal tube was developed with a curved and tapered distal tip to facilitate easier placement in the trachea. This study examined the use of the Parker Flex-Tip tube as compared to standard endotracheal tubes in patients with a body mass index of 30 or greater.

Methods: Sixty patients undergoing surgery requiring general anaesthesia were randomised into two groups. Using the fibreoptic scope, one group was intubated with the Parker Flex-Tip tube and the other group with a standard polyvinyl Portex tube. The time for intubation and the number of attempts required to place the endotracheal tube were measured and recorded.

Results: Using the Mann-Whitney U rank sum test, the median time needed for intubation with the two types of endotracheal tubes did not show a significant difference. The chi-square analyses were conducted for the number of attempts needed to place the endotracheal tubes, which also did not demonstrate any significant difference.

Conclusions: Parker Flex-Tip endotracheal tube was not superior to the standard endotracheal tubes for fibreoptic intubation in obese patients.

Keywords: Endotracheal tube, fibreoptic intubation, obesity, Parker Flex-Tip

Introduction

A significant challenge of orotracheal fibreoptic intubations is the advancement of the endotracheal tube (ETT) into the trachea in a timely manner (1). Laryngeal structures such as redundant tissue in the oropharynx, commonly found in patients with a high body mass index (BMI), may impede ETT (2, 3). Different positioning techniques and devices like the Ovassapian Airway have been tried for successful placement of the ETT.

Delayed placement of the ETT in patients with high BMI can be especially problematic as it may result in an increased incidence of hypoxaemia due to decreased functional residual capacity (4). The Parker Flex-Tip tube (PFT) was designed with a curved and tapered distal tip to slide past any protruding features in the airway, and result in an easier and faster intubation (5). The design of the tip also minimises the gap between the tube tip and introducer that prevents the tip from getting stuck on the redundant tissue (6).

In this study, we compared the ease of placement of the PFT tube to a standard polyvinyl Portex tube (SP) during asleep fibreoptic intubations in patients with a BMI of 30 or greater. The primary outcome measure was the time required for intubation. In addition, the number of attempts required for successful placement was recorded for data analysis.

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Methods

The Institutional Review Boards approved the study (H-31550); and the registration of the study was completed on the ClinicalTrials.gov registry (registration identifier: NCT01894178) prior to the first patient enrolment. This manuscript adheres to the applicable Equator guidelines. A written informed consent was obtained from all subjects enrolled in the study. Sixty patients were enrolled in this randomised, double-blinded study. Adults who were scheduled for surgery under general anaesthesia requiring orotracheal intubation were recruited based on the following inclusion criteria: 1) BMI of 30 or greater and 2) American Society of Anesthesiologists (ASA) Physical Status Classification of 1-3. Patients with a history of trauma or surgery in the oropharynx/larynx or cervical spine instability were excluded. A rapid sequence induction or an awake intubation also precluded study inclusion.

Patients were randomly assigned to either the SP or PFT groups using computer-generated codes sealed in envelopes. Once a patient consented and was enrolled in the study, the anaesthesia technician prepared the corresponding ETT for the fibreoptic intubation. Female patients received a size 7.0 mm and male patients a size 8.0 mm ETT. The ETT was loaded onto a fibreoptic scope, and an opaque plastic bag was placed over the ETT to ensure blinding of the anaesthesia personnel to the type of tube used as depicted in Figure 1. The bag was sealable at the top to secure it in place and open at both the bottom and the side to allow manipulation of the tube. Lubrication was applied both on the fibreoptic and on the endotracheal tube by the anaesthesia technician.

Figure 1. Example of concealed ETT
ETT: endotracheal tube

Upon arrival to the operating room, patients were placed on standard ASA monitors and pre-oxygenated with 100% oxygen by facemask. Positioning was optimised with a standardised foam ramp underneath the shoulders and head. Patients were then induced with fentanyl, lidocaine and propofol. Once mask ventilation was established, rocuronium was given for muscle relaxation. Following adequate muscle relaxation, an Ovassapian Airway was placed, and a trainee introduced the distal end of the fibreoptic scope into the trachea to position it at a depth of 1-2 cm above the carina. After confirmation of correct placement, the fibreoptic scope was handed to the attending anaesthesiologist, who then positioned the tip of the ETT just within the Ovassapian Airway. The trainee then provided a jaw thrust to facilitate the conditions for passing the ETT. Once the attending was ready to advance the ETT, a stopwatch was used to record the time it took to advance the tube from the Ovassapian Airway to the point of direct visualisation of the ETT in the trachea. If the initial attempt was unsuccessful, the attending then withdrew the ETT 5 cm and rotated it 90° counter-clockwise before making a second attempt. If the second attempt was also unsuccessful, the ETT was completely withdrawn back to the Ovassapian Airway and reinserted for any subsequent attempts. Such attempts were repeated until either 1) placement was successful, 2) 120 s had passed or 3) the patient's oxygen saturation fell below 90% during the procedure. In the latter instance, mask ventilation was to be initiated to restore the patient's oxygen saturation to baseline, and direct laryngoscopy or an alternate method of intubation was to be performed. The time taken to place the ETT, the number of attempts required and presence of mucosal bleeding were recorded after successful placement. Identification of the tube type and data analysis were conducted only after the last patient was enrolled in the study.

The primary outcome measure was time to intubation with the ETT following placement of the fibreoptic scope into the trachea. The secondary outcomes included the number of attempts at intubation and trauma to the airway during intubation. Sample size calculations were performed using G*Power v3.1.5. From the previous studies, we aimed to identify 35% reduction in the time for intubation (alpha error of 0.05 and power of 0.8) to keep the intubation time at around 10 s, which give us a sample size of 26 subjects in each group (5, 7, 8). To account for a dropout rate of 15%, 4 additional subjects were enrolled in each group, thus making the total sample size 60.

Statistical analysis

Demographic characters and the time to successful intubation between the two groups were compared using the Mann-Whitney U rank sum test. Comparison of proportion of individuals that needed more than one attempt to be successfully intubated between the two groups was performed using the chi-square

test. Multiple logistic regressions were used to assess the correlation between the dependent dichotomous variable (intubated in the first attempt vs. intubated in more than one attempt) with the independent variables - type of tube (PFT vs. SP), BMI and ASA physical status. Statistical analyses were performed using the SigmaPlot 11 software, and p value of <0.05 was considered to be statistically significant.

Results

Sixty patients were randomised to undergo intubation with PFT or SP ETT. One patient in the SP group was excluded from the study, as the fibreoptic scope could not be advanced into the trachea due to too much redundant tissue. Hence, our final analyses included 30 subjects in the PFT group and 29 in the SP group. The age, sex and ASA physical status were similar between the two groups (Table 1).

Furthermore, there was no difference in the BMIs between the two groups. The median time taken for the passage of the endotracheal tube was 6.3 s in the PFT group and 8.8 s in the SP group (p=0.2). As intubation in the first attempt is as important measure as the time to intubation, we assessed the proportion of individuals who were intubated with a single attempt in the two groups; chi-square analyses showed no significant difference (73% in PFT vs. 68% in SP; p=0.5). Similarly, logistic regression analyses did not show any significant correlation between the type of tube, BMI and physical status with intubations on first attempt.

Discussion

Our primary focus was to investigate a potential method of decreasing the total amount of time required for correct placement of an ETT in patients with a BMI greater than 30 when using a fibreoptic scope for intubation. A previous study demonstrated a significantly shorter median time and a higher success rate with the first attempt of advancing a PFT vs. a standard tube over a fibreoptic scope for patients with BMI less than 25 (5). We wanted to focus on patients with an increased BMI as obese patients have decreased functional residual capacity and are more prone to hypoxaemia with longer apnoeic periods.

Although it has been shown that patients with a higher BMI have increased redundant soft tissue in the oropharynx, the current evidence is conflicting on whether a higher BMI will increase the incidence of difficult intubations (9, 10). Often, the difficulty with fibreoptic intubations is not only the placement of the fibreoptic scope into the trachea, but also the successful advancement of the ETT over the scope. A study demonstrated that the right arytenoid or the interarytenoid soft tissues were often associated with inhibition of the advancement of the ETT (11). Increased soft tissue in the oropharynx can also further narrow the space between the epiglottis and posterior pharyngeal wall, which could impede the placement of the ETT (12). An ETT designed to slide over the fibreoptic scope without potentially getting stuck on redundant laryngeal tissue could be beneficial in obese patients. Previous studies demonstrated a higher success rate of advancing the ETT with the first attempt and significantly lower percentage of tube impingement when using the PFT tube compared to standard tubes (6, 13, 14).

The PFT tube was created with a curved flexible tip to overcome the problems of impingement of the tube over the soft tissue and reduce the overall time needed to intubate as depicted in Figure 2. The unique tip of the PFT tube is believed

Table 1. Demographics and intubation characteristics

	PFT	SP
Age, mean (SD), years	43.8 (12.8)	46.0 (14.1)
Total	30	29
Female, no. (%)	22 (73%)	21 (72%)
ASA physical status n (%)		
1	0 (0%)	1(3%)
2	21 (70%)	21 (70%)
3	9 (30%)	7 (27%)
BMI, median (IQR)	33.7 (32.3-37.6)	33.8 (32.2-39.5)
Time to intubation, median (IQR)	6.36 (5.0-10.4)	8.81 (5.3-14.2)
Intubated in the first attempt n (%)	22 (73)	18 (62)
Airway trauma	1	0

SD: standard deviation; IQR: interquartile range; BMI: body mass index; PFT: parker flex tip tube; SP: standard Portex tube

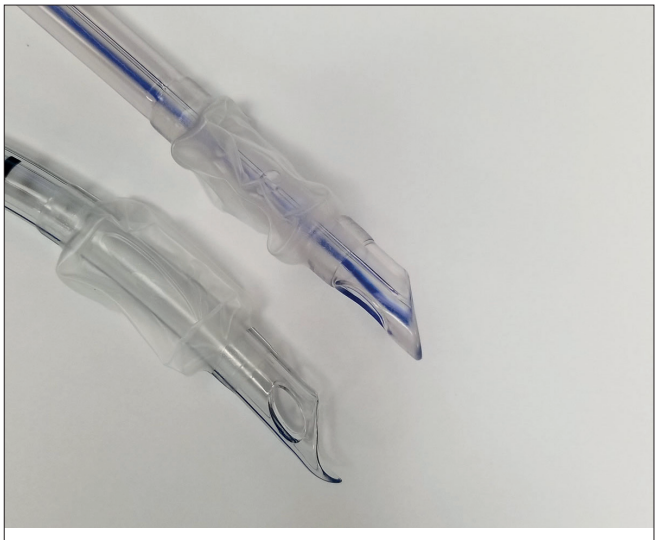

Figure 2. Comparison of PFT to SP endotracheal tube
PFT: Parker Flex-Tip tube; SP: standard Portex tube

Table 2. Studies comparing Parker Flex-Tip tube for fibreoptic intubation

Study	Type of tubes used	Sample size	Type of airway	BMI (average)	Type of intubation	Time for intubation	p
Jafari et al. (7)	PFT vs. WRT (ant) vs. WRT (post)	30/30/30	Normal airway	28	Orotracheal	8 (3.1)/ 11.7 (4.6)/6.9 (3.5)	<0.001
Lomax et al. (8)	PFT vs. pre-rotated RAE	55/55	Normal airway	25.8	Naso-tracheal	7.6 (7.7)/8.0 (8.4)	0.78
Prior et al. (15)	PFT vs. SP	20/20	ND	ND	Naso-tracheal	77.6/80.6*	0.839
Joo et al. (16)	PFT vs. SP	56/55	Difficult airway	29	Awake	ND	
Kristensen et al. (5)	PFT vs. SP	38/39	Normal airway	24	Orotracheal	7.5 (10) / 20 (22)	<0.0001

*Time included the fibreoptic time along with time to pass the endotracheal tube. PFT: Parker Flex-Tip tube; WRT: wire reinforced tube; Ant: anterior facing bevel; Post-bevel facing posteriorly); RAE: Mallinckrodt RAE tube; SP: standard Portex tube; ND: not described

to diminish the gap between the tip of a standard ETT and any introducers used during intubation, including the Eschmann catheter, flexible fibreoptic scopes and tube exchange catheters. Minimising the gap can reduce the incidence of the ETT getting caught on the soft tissue in the airway and facilitating the advancement of the ETT into the trachea (6). This could potentially reduce the resistance in placing the ETT and number of attempts needed, which in turn would decrease the overall time needed for correct placement.

However, in our study, we found no significant difference between the median time and number of attempts required to successfully place a PFT when compared to an SP tube using a fibreoptic scope for intubation on patients with a BMI greater than 30. We used number of attempts of the ETT required as a subjective indicator of the amount of resistance encountered, and that showed no difference either. There was also no significant difference in airway trauma between the two tube designs. An additional factor to consider is that the purchasing costs for a PFT are more than three times that of an SP tube.

We conducted a literature review to identify the studies comparing PFT tube for fibreoptic intubations. We identified five studies that used PFT tube for fibreoptic intubation listed in Table 2 (2, 7, 8, 15, 16). ETTs that were inserted with the bevel facing posteriorly were believed to have less impingement on the tissues and were found to have intubation characteristics similar to the PFT (7, 8). In patients with difficult airways requiring awake fibreoptic intubation, PFTs were not found to be superior to a standard tube; and the authors believe that it may have been because of preserved airway dynamics in awake patients (16).

There may be several reasons that supported the short intubation time in our obese patients: 1) all patients were positioned on a ramp to optimise positioning; 2) an Ovassapian Oral Airway was used to avoid tongue falling back into the pharynx and 3) jaw thrust was performed by an anaesthesia provider prior to the advancement of the ETT. These manoeuvres and techniques are routinely done for all asleep fibreoptic intubations, and they may have facilitated the tube placement by decreasing the resistance offered by the soft tissue (17).

Some of the limitations of the study are: 1) it is a single institution study; 2) the patients chosen to be enrolled were those who did not have a history or any indicators of a difficult airway. Further randomised controlled studies are required to establish if the PFT is better than SP tube in obese patients with suspected difficult airway.

Conclusion

Our study was conducted to estimate if the PFT tube facilitated ETT placement following fibreoptic intubation in obese patients when compared to the SP tube. We found that the special design of the PFT tube did not confer any benefit over the SP tube with respect to the intubation time or the number of attempts.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Baylor College of Medicines (H-31550).

Informed Consent: A written informed consent was obtained from all subjects enrolled in the study.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept – L.C.C.; Design – L.C.C.; Supervision – L.C.C., S.R.; Resources – L.C.C.; Materials – L.C.C., S.C.L., A.L.D., S.R.; Data Collection and/or Processing – L.C.C., S.R.; Analysis and/or Interpretation – L.C.C., S.C.L., A.L.D., S.R.; Literature Search – L.C.C., S.C.L., S.R.; Writing Manuscript – L.C.C., S.C.L., S.R.; Critical Review – L.C.C., S.C.L., A.L.D., S.R.; Other – L.C.C., S.C.L., A.L.D., S.R.

Conflict of Interest: The authors have no conflicts of interest to declare.

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