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The Parker Flex-Tip^<TM> tracheal tube makes endotracheal intubation with the Bullard laryngoscope easier and faster.

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Title The Parker Flex-Tip™ tracheal tube makes endotracheal intubation with the Bullard laryngoscope easier and faster.

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Summary

Background. The Bullard laryngoscope (BL) can be useful in management of the difficult airway. When the endotracheal tube (ETT) is advanced over the original BL stylet, the ETT sometimes makes contact with structures around the vocal cords, especially the right arytenoids. A similar problem also occurs with flexible fiberoptic intubation and it has been shown that use of the Parker Flex-Tip™ tube (PT) usually resolves the problem. In this study we tested our hypothesis that use of the PT might improve ETT passage with the BL.

Methods. Forty patients scheduled for elective anesthesia were randomly assigned into group ST (Standard tube) and Group PT. The time taken to achieve successful ETT placement after obtaining the best laryngeal view, the number of attempt at intubation and the incidences of successful intubation at first attempt and of re-direction of the BL during intubation were recorded. The unpaired Student's t-test and chi-square test were employed and $p<0.05$ was considered significant.

Results. Use of The PT reduced from 14±6 to 6±2 sec ($p<0.01$) the time required for successful ETT placement after the best laryngeal view was obtained. It also reduced from 10/19 to 1/19 ($p<0.01$) the incidence of requirement for re-direction of the BL during intubation. The incidence of successful intubation at the first attempt (18/19 vs. 15/19) was higher in the PT group but the difference was not statistically significant.

Conclusions. During intubation with the BL, use of the PT is associated with more rapid success and a lower incidence of re-direction of the BL during endotracheal intubation when compared to a standard ETT.

Key words: AIRWAY DEVICE, AIRWAY MANAGEMENT, BULLARD LARYNGOSCOPE

Introduction

The Bullard laryngoscope (BL) can be useful in management of the difficult airway. It often enables tracheal intubation under vision in patients in whom this had not been possible with the Macintosh laryngoscope[1]. In comparison with blind use of stylets and introducers with the Macintosh laryngoscope, the BL facilitates fast, less traumatic tracheal intubation[2] under vision as a consequence of the anatomical shape of the blade and transfer of the proximal end of the line of sight of the larynx from the maxillary teeth to the laryngopharynx so that displacement of the tongue is not necessary. Its rigidity allows rapid control of the position of the tip of the laryngoscope. Passage of the endotracheal tube (ETT) from the stylet is an integral part of the laryngoscope design and intubation technique. However, when the ETT is advanced with the original stylet (standard introducing stylet), it sometimes impinges on laryngeal structures around the vocal cords. Many techniques have been advocated to make intubation with the BL easier[3-11]. The Parker Flex-Tip™ tube (PT) has a tapered fountain pen shaped tip which is designed to glide past obstructions and pass easily through the glottis[Figure 1]. A recent study demonstrated that use of the PT results in a significantly lower incidence of repositioning and repeated attempts when oral flexible fiberoptic intubation is performed. This success is attributed to the minimal gap between the ETT tip and fiber insertion cord so that there is little chance for the ETT to impact on the vocal cords [12]. In this study we tested our hypothesis that the PT could improve the reliability of ETT passage with the BL.

Methods

The protocol was approved by the clinical research committee of our institution, and written informed consent was obtained from 40 unpremedicated ASA I or II, adult patients, scheduled for elective surgery, who required a general anesthetic with endotracheal intubation. Patients with known pathology or previous surgery to the mouth, pharynx, larynx, or cervical spine were excluded. Mallampati classification without phonation and thyromental distance were evaluated before surgery and recorded in all patients. Three anesthesiologists (AS, AT, NA), who are skilled in endotracheal intubation with the BL, performed all intubations in order to eliminate a learning process bias.

The two ETTs compared were a standard tube (ST) (7.5 mm ID, 10 mm OD, Fuji Systems, Tokyo) and a PT (7.5 mm ID, 10 mm OD, Parker Medical, Englewood, CO). Both tubes have high volume, low pressure cuffs. Patients were randomly assigned into two groups, the ST group and the PT group immediately prior to induction determined by sealed envelope technique.

The standard introducing stylet for the BL was used, and the ETT was backloaded over the lubricated stylet. The distal end of the stylet was passed through the Murphy eye of the standard tube as instructed in the manufacturer's manual. The stylet was passed through only the central lumen and not through the side holes of the PT.

The prepared stylet was then attached to the BL, and the BL and ETT were kept warmed until use.

Before intubation, the BL was connected to a video camera, monitor and hard disk drive (HDD) recorder in order to store a visual record.

Unpremedicated patients were placed in the supine, neutral neck position with a U-shaped pillow and then they breathed 100% oxygen for 3 minutes. Induction of anesthesia was performed with propofol (1.5-2.0 mg/kg) and fentanyl (1 μg/kg) intravenously. After loss of consciousness, confirmed by loss of eyelid reflex, positive pressure mask ventilation was initiated. Anesthesia was then maintained with sevoflurane (3-5%) with oxygen. Once adequate mask ventilation was established, vecuronium (0.1mg/kg) was administered. After complete paralysis developed, as determined by a peripheral nerve stimulator, the BL without blade extender was passed into the oropharynx and, after optimal visualization of the vocal cords located in the center of the field of view was achieved, the ETT was advanced from the stylet and tracheal intubation was completed.

The position of the ETT tip in relation to the laryngeal structures just before the ETT passed between the vocal cords was recorded on a diagram of the clock face similar to one described previously[13].

When the ETT tip touched or was impeded by laryngeal structures, or any abnormal resistance was felt by the operator, the tube was withdrawn to the initial position (for the ST group, the Murphy eye could not be passed through the stylet during withdrawal) and fine adjustment of the BL position was made to improve ETT direction towards the glottis.

When any of the following situations occurred, the BL was removed and mask ventilation employed: 1) Intubation had not been achieved after 3 adjustments of the BL position; 2) The ETT could not be positioned in the trachea within 60 seconds of the BL entering the oral cavity; 3) SpO2 dropped below 95% during the procedure. Under these situations, the ETT and stylet were again attached in the initial setup position and the procedure was counted as one tracheal intubation attempt. If intubation was not achieved within 3 attempts, the operator was allowed to choose a different intubation technique, and those cases are excluded from the analysis.

The video record of the procedure recorded in the HDD was analyzed after surgery. Both the time from the blade entering the oral cavity until the best laryngoscopic view was achieved (T1), and the time to complete the tube placement after achieving the best laryngeal view (T2) were obtained, and the total time for intubation (T3) was the sum of T1 and T2. The number of intubation attempts and adjustments made were counted. The incidence of the ETT tip touching or meeting resistance from the vocal cords or other laryngeal structures was counted.

After the operation, all patients were asked to phonate and to report if they had a sore throat or hoarseness.

Data are expressed as mean±SD unless otherwise noted. Unpaired Student's t-test and chi-square test were employed where appropriate to examine the difference between the groups. A value of $p<0.05$ was considered statistically significant.

Results

Two patients who required more than 3 attempt to complete intubation were excluded from the analysis. One was from the group ST and had poor visualization as a consequence of excessive saliva secretion, and the other, from the group PT, required the blade extender to achieve intubation with the BL.

No significant differences were found between the groups regarding age, sex, ASA class, height, weight, Mallampati class, and TMD (Table1).

Although the time to obtain the optimal laryngeal view (T1) was similar in both groups, the time to place the ETT after best visualization of glottis (T2) was significantly shorter in the PT group. The total time to position the ETT (T3) was less in the PT group, but the difference was not statistically significant. (Table2).

The higher success rate of ETT placement at the first attempt (without additional adjustment of the BL position) in the PT group was statistically significant. The lower incidence of the ETT touching the vocal cords or other laryngeal structures in the PT group was also statistically significant. Examination of ETT tip position just prior to intubation in the video showed that in the PT group there was no arytenoid contact, but that in 1 case the left vocal cord was touched (Figure 2). In one case in which the ETT tip passed between the vocal cords the BL was removed as a consequence of timeout (>60sec) criteria because further tube advancement was difficult since the ETT made contact with the right vocal cord and the operator felt abnormal resistance. A similar situation happened once in the ST group. In another 9 cases in the ST group the tube tip made contact with the right arytenoid. This is similar to the results from previous investigators who showed that in most cases, the ETT was directed to between 3 to 6 hours of a clock face[13].

However, in most cases, the ETT was passed into the trachea at first intubation attempt with fewer than 3 adjustments of the BL position and there were no significant differences between the groups(Table2).

The incidence of postoperative sore throat and hoarseness was lower in the PT group, but the difference was not statistically significant. Every symptom disappeared within 48h.

Discussion

Our results show that use of the PT improves the reliability of ETT placement in the trachea when the BL is used with the standard introducing stylet. The incidence of success at first intubation attempt was significantly higher, with less impingement of the tip around the vocal cord. Although it took a similar length to get to optimal laryngeal view (T1) in both groups, the tube passed more quickly (T2) in the PT group compare to the ST. The two ETTs compared have the same internal and external diameters, are made of same material (PVC), and have identical pre-formed curvatures. Therefore the differences in tip design must be responsible for the improved ETT passage. Similar results have been found with the LMA Fastrack™ Endotracheal Tube [3].

Problems as a consequence of the ETT tip striking the vocal cords or other laryngeal structures when the ETT is advanced from the BL into the trachea have been reported. Mounting the ETT on the stylet with the bevel facing right (reversed bevel) has been suggested as a method of preventing this problem [9]. However, it is often difficult to mount the ETT on the BL stylet in this manner. In addition, when the ETT has been mounted in reversed bevel position it starts to rotate to an undesirable direction as it is advanced off the stylet. Although rotation of the ETT on the stylet as it is advanced has also been suggested [8], fine adjustment of ETT rotation is difficult because of the shape of the stylet. The torque applied to the proximal end does not transmit well to the distal end of the ETT. Our results show that selection of the PT is an easier solution to this ETT advancement problem.

A recent study revealed that the right arytenoid frequently prevents passage of the standard ETT into the trachea during flexible fiberoptic intubation [14]. Use of the PT was associated with a higher incidence of initial successful passage of the ETT during flexible fiberoptic intubation [12]. Our results also show that the most frequent site of obstruction of passage of the standard ETT during intubation with the BL is at the right arytenoid and lies between 4 and 5 hours on the clock face.

Although the different tip designs did not result in statistically significant differences in the incidence of hoarseness and sore throat, a lower incidence was observed in the PT group. A larger study would be needed to determine whether this is actually the case. Multiple intubation attempts in the difficult airway can cause bleeding or edema and may further compromise the airway. Thus use of the PT with the BL to reduce the number of intubation attempts is recommended.

This study compared the PT with the manufacturer's recommended technique of ST passage. However, an unavoidable limitation of the study design concerns maintenance of the stylet position in relation to the Murphy's eye during intubation attempt. Once the tube was advanced from the stylet and failed to be placed, the stylet can not be returned through the Murphy's eye any more but contained within the tube during following adjustment. When the stylet is in this position, the tube tip will be located further to the right and result in a higher risk that it will impinge on the right arytenoids. Further changes of BL direction will then be required in order to pass the tube. Thus, altered set up of the stylet on the Bullard in our study may affect the result. We used the Murphy's eye aiming for easier intubation as proven in Kato et al's work[9] , although some authors suggest it should not be used. Passage of the stylet through the Murphy's eye remains a controversial issue. Further studies to compare the PT with other techniques of passing the ST with the BL, include the position of the stylet in relation to the Murphy's eye, are needed. Also, further research should be undertaken in patients with difficult airways since this study only investigated patients with normal airways.

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Table 1. Patient details.

	Standard tube (n=19)	Parker tube (n=19)
Age	52±21	52±14
Gender (M/F)	9/10	10/9
ASA grade (I/II)	11/8	10/9
Height (cm)	159±9	161±11
Weight (kg)	59±11	59±12
Mallampati class (I/II/III)	3/15/2	2/13/4
Thyromental distance (cm)	8.0±1.1	7.8±0.9

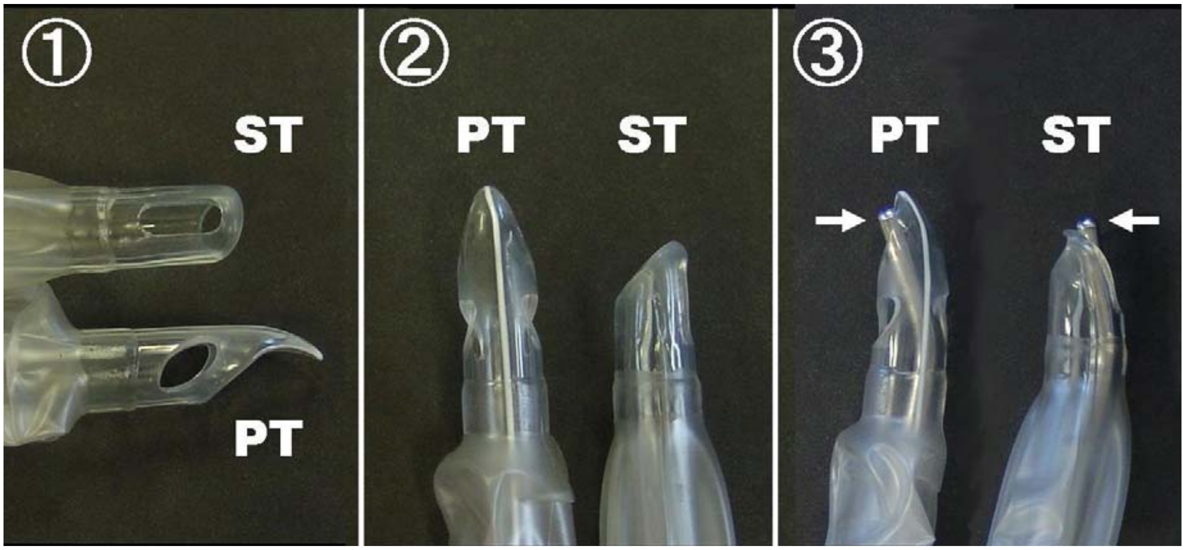
Data are presented in mean±SD or numbers of patients.

Table 2. Tracheal intubation results.

	Standard tube (n=19)	Parker tube (n=19)	P
Successful intubation at very first attempt (without adjustment of Bullard laryngoscope position)	9(47.4%)	18(94.7%)	0.001
Success at first tracheal intubation attempt (within 3 adjustment of Bullard laryngoscope position)	15(78.9%)	18(94.7%)	0.1
T1 (Time to obtain the best laryngeal view) (s)	24±12	25±14	0.88
T2 (Time to place the tube after best laryngeal view obtained) (s)	14±6	6±2	0.0006
T3 (Total time to complete the tube placement; T1+T2) (s)	39±15	32±16	0.28
Frequency of tracheal tube impingement	10(52.6%)	1(5.3%)	0.003
Number of intubation attempts	1.4±0.8	1.1±0.3	0.1
Postoperative sore throat	12/19	9/19	0.3
Postoperative hoarseness	12/19	6/19	0.1

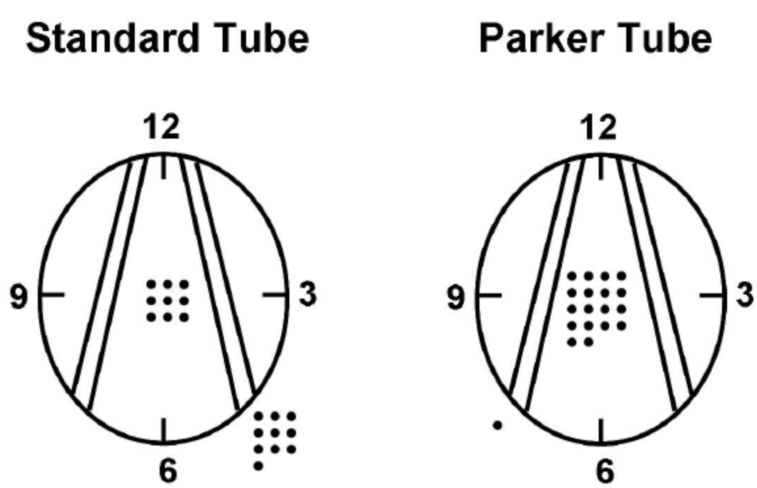
Data are presented in mean±SD or number(proportion)

Figure1



ST:Stabdard tube PT: Parker tube

Figure2



Distribution of the tube tip positions in relation to the vocal cords. The numbers refer to those on a clock face. Each dot indicates an individual case.