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ORIGINAL ARTICLE

The Parker Flex-Tip™ tube for nasotracheal intubation: the influence on nasal mucosal trauma

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Summary

We tested our hypothesis that use of the Parker Flex-Tip™ tracheal tube could reduce the incidence of nasal mucosal trauma during nasotracheal intubation when compared with a conventional tip tracheal tube. One hundred and two patients, who were scheduled for elective oral surgery in which nasotracheal intubation was indicated to optimise the surgical approach, were recruited into this study. Either a Flex-Tip tracheal tube or a conventional tip tracheal tube was chosen randomly for each nasotracheal intubation. The incidence of epistaxis using the Flex-Tip tracheal tube (6 (11.8%)) was significantly lower than that with the conventional tip tracheal tube (18 (35.3%); $p = 0.009$). Nasal pain due to intubation, rated on a 100-mm visual analogue scale, was less intense with the Flex-Tip tracheal tube (median, (10th–90th percentile) 19 (12–28) mm compared with the conventional tip tracheal tube (30 (22–35) mm; $p < 0.001$). The Flex-Tip tracheal tube thus appeared to reduce the incidence of nasal mucosal trauma during nasotracheal intubation and the incidence of post-intubation nasal pain, compared with the conventional tip tracheal tube.

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Nasotracheal intubation is an established airway management technique in patients undergoing oral and maxillofacial surgery. The most frequent complication of nasotracheal intubation is nasal mucosal trauma, although various other complications resulting from nasal passage of the tracheal tube have been reported [1, 2].

It has been previously demonstrated that the shape of the tracheal tube tip is an important contributing factor to nasal mucosal trauma during nasotracheal intubation [3–6]. The Parker Flex-Tip™ tracheal tube (Parker Medical, Highlands Ranch, CO, USA) has a special tip, that is designed to glide past obstructions and pass easily through the glottis (Fig. 1) [7–9]. However the Parker Flex-tip tracheal tube has never been studied in terms of nasal mucosal trauma. In this study, we tested our hypothesis that the Parker Flex-Tip tracheal tube could reduce the incidence of nasal mucosal trauma during nasotracheal tube as compared to the conventional tip tracheal tube.

Methods

Following local research ethics committee approval and written informed consent, a total of 102 patients were recruited into the study. All patients were ASA physical status 1 or 2 , > 16 years of age and were scheduled for elective oral surgery. Inclusion criteria were patients who required nasotracheal intubation in order to optimise the surgical approach. Patients were excluded from the study if they had a documented history of difficult intubation, or if physical examination suggested a potentially difficult airway or need for awake intubation. Additional exclusion criteria were history of nasal surgery, nasal trauma, previous nasal intubation, recurrent epistaxis, and bleeding diathesis or history of taking anticoagulant drugs. Patients were not studied if there was an apparent unilateral decrease in nostril patency, which was determined by asking each patient to breathe through each nostril separately.

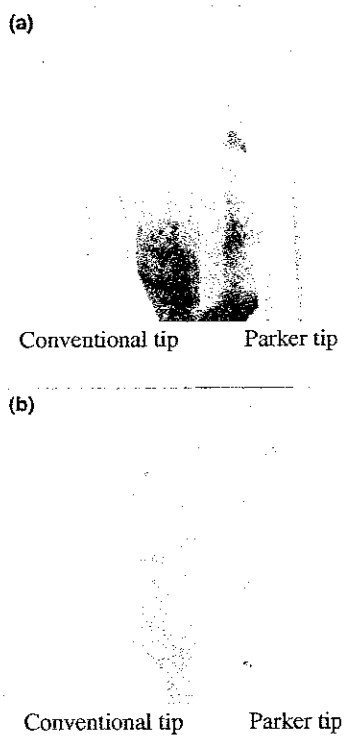

Figure 1 Tip difference between conventional-tip and Parker-tip tracheal tubes. (a) Top view, (b) Lateral view.

The anaesthetic technique was standardised for all subjects. Premedication was not prescribed. Anaesthesia was induced using propofol 1–2 $mg.kg^{-1}$ and fentanyl 1–2 $\mu g.kg^{-1}$. Nasotracheal intubation was facilitated using 0.6 $mg.kg^{-1}$ rocuronium for neuromuscular blockade. Anaesthesia was maintained with 1.5–2.5% sevoflurane in 33% oxygen and an infusion of 0.2–0.3 $\mu g.kg^{-1}.min^{-1}$ of remifentanil.

Both of the tracheal tubes used in this study, the Parker Flex-Tip tracheal tube and the conventional tracheal tube (Rusch endotracheal tube; Teleflex Medical, Durham, NC, USA) had an internal diameter of 7.0 mm, an external diameter of 9.3 mm, and high-volume, low-pressure cuffs. For each patient, the tracheal tube for nasotracheal intubation was chosen randomly (by means of computer-generated random numbers). Three anaesthetists with < 3 years' experience, who were unaware of the exact study design and aim, were recruited to conduct the tracheal intubations in the study. These three anaesthetists performed all the intubations, each being assigned the same number of intubations with each tracheal tube. Before tracheal intubation, any excess air in the cuff of the tracheal tube being used was completely aspirated, and the tracheal tube was lubricated with water-soluble jelly immediately before insertion. No other techniques for facilitating nasotracheal intubation, including warming the tracheal tube, were employed. The tracheal tube was advanced blindly into the nasal cavity and passed into the pharynx. If resistance was felt, the following manipulations were applied in sequence: (i) reinsertion, whereby the tracheal tube was withdrawn slightly, and reinsertion was attempted; (ii) tube rotation, whereby the tracheal tube was rotated counter clockwise, and the proximal end also gently tilted in a cephalad direction.

Once the tip of the tracheal tube had passed into the pharynx, the intubating independent anaesthetists, who were unaware of the study design and aim noted the severity of epistaxis using a laryngoscope. They classified the severity of epistaxis as being either: (i) blood absent; (ii) blood-staining of the cuff alone (mild epistaxis); or (iii) pooling of blood on the posterior pharyngeal wall (severe epistaxis) [10]. Tracheal intubation was then completed using direct laryngoscopy.

Thirty minutes before cessation of anaesthesia, each patient received 1–2 $\mu g.kg^{-1}$ fentanyl intravenously for postoperative analgesia. Neuromuscular blockade was reversed using neostigmine 0.04 $mg.kg^{-1}$ and atropine 0.02 $mg.kg^{-1}$ and the trachea was extubated when the patient was awake. Fifteen minutes after extubation, patients were asked to rate their nasal pain on a 100-mm visual analogue scale (VAS; from 0 cm, 'no pain' to 100 mm, 'too much pain') by independent anaesthetists who were unaware of which tracheal tube had been used for nasotracheal intubation.

On the basis of a pilot study, a sample size calculation was performed to detect a 25% difference in the incidence of epistaxis with a type I error of 0.05 and a power of 0.8 for a two-tailed 2 × 2 chi-squared test. Age, height and weight were analysed using the unpaired *t*-test. Gender, ASA physical status, number of patients who required manipulation of the tracheal tube, and the incidence of absent, mild, and severe epistaxis were analysed using the chi-squared test ± Yate's correction or Fisher's exact test, as appropriate. The severity of nasal pain was analysed using the Mann–Whitney *U*-test. All tests of significance were two-sided and values of $p < 0.05$ were considered significant.

Results

Patient, intubation and operation characteristics are shown in Table 1. There were no significant differences between the two groups. The incidence of epistaxis with use of the Parker Flex-Tip tube was significantly lower than that observed using the conventional tracheal tube (35.3%; $p = 0.009$). The incidence and severity of epistaxis are shown in Table 2. Although there was no

Table 1 Patient, intubation, and operation characteristics. Values are number (proportion) or mean (SD).

	Conventional-tip (n = 51)	Parker-tip (n = 51)
Patient characteristics		
Age; years	37.3 (16.5)	35.1 (15.1)
Weight; kg	55.9 (12.0)	59.7 (14.5)
Height; cm	163.0 (9.8)	165.8 (8.4)
Sex; M:F	27:24	29:22
ASA grade; 1:2	25:26	26:25
Intubation characteristics		
Nostril intubated; right:left	26:25	24:27
Reinsertion	10 (19.6%)	12 (23.5%)
Tube rotation	6 (11.8%)	4 (7.8%)
Operation characteristics		
Operation time; min	119.4 (46.9)	112.5 (44.8)
Doses of fentanyl; μg	180 (50)	170 (60)

Table 2 Incidence of absent, mild, and severe epistaxis, following tracheal intubation with the conventional or Parker-tip tracheal tube. Values are number (proportion).

	Conventional-tip (n = 51)	Parker tip-(n = 51)	p value
Absent	33 (64.7%)	45 (88.2%)	0.009
Mild	9 (17.6%)	5 (9.8%)	0.577
Severe	9 (17.6%)	1 (1.9%)	0.016

statistically significant differences in the incidence of mild epistaxis between the Parker Flex-Tip tube and conventional tracheal tube, the incidence of severe epistaxis was significantly lower with the Parker Flex-Tip tube compared with the conventional tracheal tube. With regard to nasal pain, as rated on the 100-mm VAS, pain scores were lower with the Parker Flex-tip tube than with the conventional tracheal tube (Fig. 2).

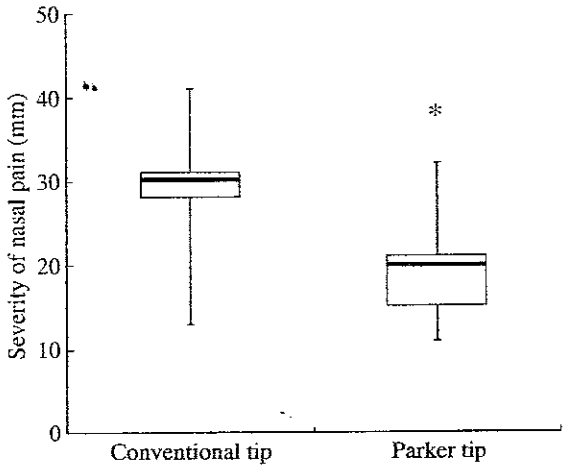

Figure 2 Severity of nasal pain on a 100-mm visual analogue scale, following tracheal intubation with the conventional or Parker-tip tracheal tube. The bold horizontal bars, the boxes, and the whiskers represent the median, IQR and ranges, respectively. *p > 0.001.

Discussion

We found that during nasotracheal intubation, NTI, epistaxis was significantly milder and less frequent with the Parker Flex-tip tube as compared to the conventional tracheal tube. Furthermore, following extubation, the patients rated intubation with the Parker Flex-Tip tube as being less painful than intubation with the conventional tracheal tube. These results suggest that use of the Parker Flex-Tip tube reduced both the incidence and the severity of nasal mucosal trauma during nasotracheal intubation compared with the conventional tracheal tube. Blood in the airway resulting from nasal mucosal trauma during nasotracheal intubation may obscure the view of the larynx, and increase the potential for aspiration of blood [11]. This may result in significant adverse effects and convert an easy intubation into a difficult one. The milder and less frequent epistaxis with the Parker Flex-Tip tube reduces the risk of such complications.

The two tracheal tube compared in this study had the same internal and external diameters, and were made of the same material (polyvinyl chloride; PVC). Therefore, the reduction in incidence of nasal mucosal trauma with the Parker Flex-Tip tube may be attributed to the differences in tip design. Nasotracheal intubation using conventional tracheal tubes is commonly associated with injury to the tissues of the nasal passage, such as the mucosal lining of the turbinates [6, 12]. The rounded, flexible tapered distal tip of the Parker Flex-Tip tube may explain why the incidence and severity of nasal trauma with this tracheal tube during nasotracheal intubation was substantially less than with the conventional tracheal tube. It appears that the distal end of the Parker Flex-Tip tube enhances smoother, less traumatic passage of the tube through the airway.

Suggestions to reduce the incidence of nasal mucosal trauma are numerous: tracheal tube guidance; using a gastric tube or a suction catheter [13, 14]; or softening the tracheal tube by heating in warm water [15] have been reported. Mechanical dilation [16] and application of adrenaline [17] have also been used to prepare the nasopharyngeal passages and minimise epistaxis during nasotracheal intubation. Use of the Parker Flex-Tip tube for nasotracheal intubation may have advantages over these methods since no other special equipment or preparation is required, except for routine lubrication of the Parker Flex-Tip tube before tracheal intubation.

There are several limitations in our study. Firstly, all nasotracheal intubations were performed by inexperienced users. Secondly, all nasotracheal intubations were performed in healthy, anaesthetised patients. Furthermore, all nasotracheal intubations were performed using tracheal tubes made of PVC. Therefore, our results may not be applicable to experienced users, to other patient populations or to tracheal tubes made of other materials. Our study also was not blinded. Blinding was not possible, as it was difficult to hide the tracheal tube tip from the anaesthetists who assessed the severity of epistaxis, and also from the anaesthetists who attempted tracheal intubation. However, we believe that the lack of blinding would not have significantly skewed our results, as the classification of the severity of epistaxis used in our study was robust and clearly defined. We conclude that the Parker Flex-Tip tube not only helps to minimise the incidence of nasal mucosal trauma during Nasotracheal intubation, but also may increase patient safety and comfort.

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