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Method of endotracheal tube fixation and iatrogenic ear deformities

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Abstract There is no consensus regarding which type of endotracheal tube or method of fixation should be employed in neonates. We use oral endotracheal tubes held in place by a flange tied to a bonnet. In three very pre-term infants the ligatures holding the bonnet to the flange caused pressure necrosis to the ear while the infants suffered poor perfusion due to profound hypotension. Permanent ear deformities have resulted. **Conclusion:** extra vigilance and precautions are required to prevent iatrogenic problems in sick, very prematurely born infants.

Keywords Endotracheal tubes · Iatrogenic problems

Abbreviations ETT endotracheal tube · NICU neonatal intensive care unit

Introduction

There is no consensus regarding which type of endotracheal tube (ETT) or method of fixation should be employed in neonates. On the neonatal intensive care unit (NICU) at King's College Hospital oral shouldered ETTs are used and fixed by a flange which is tied, but could be sewn, to the ETT. The flange is kept in place by ligatures from a bonnet (Fig. 1). By necessity the ligatures must be kept tight thus, as part of nursing practice, the bonnet is regularly lifted to inspect the ears for developing areas of pressure necrosis. Nevertheless, we describe three infants in whom this method of fixation led to iatrogenic ear deformities.

Case reports

Case 1

A 27-week twin infant, birth weight 700 g, was delivered by emergency caesarean section. The second twin was a fresh stillbirth, the mother's high vaginal swab grew *Streptococcus agalactiae*. The infant was intubated at birth, received surfactant and was supported by high frequency oscillatory ventilation. On day 7, her respiratory status deteriorated when she developed *Enterobacter* septicaemia. This was associated with coagulopathy, low platelets and severe hypotension. The septicaemia proved difficult to treat and only responded to triple therapy with meropenem, teicoplanin and amikacin, which were continued for 3 weeks. She remained ventilator-dependent until day 40. During the period of severe hypotension and coagulopathy, a small necrotic area of the left pinna was noted. She has been left with a 1 cm deficit in that pinna.

Case 2

A 24-week gestation infant, birth weight 700 g, was intubated at birth and required ongoing ventilation and surfactant therapy for respiratory distress syndrome. He subsequently developed severe pulmonary interstitial emphysema and his respiratory status deteriorated, necessitating 100% oxygen with high ventilatory pressures. On day 11, he became profoundly hypotensive requiring treatment with dobutamine, dopamine and hydrocortisone. Inotropes were required until day 21. On day 18, he was noted to have suffered pressure necrosis on the right helical rim and has been left with a deficit on the right helical fold (Fig. 2). He was extubated on day 53 following a course of dexamethasone.

Case 3

A term infant, birth weight 2,920 g, required no resuscitation at birth, but on day 2 became poorly perfused, acidotic and had a distended abdomen. An abdominal radiograph confirmed the clinical diagnosis of necrotising enterocolitis. As there was no evidence of perforation, the infant was managed conservatively. Unfortunately, she developed increasing abdominal distension and respiratory failure and on day 6 underwent a right hemicolectomy. She then developed renal failure, abnormal clotting due to sepsis and hypotension requiring inotropic support. During this period, after 11 days of ventilation, a 0.5×2 cm discoloured area on her right ear was noticed. This later necrosed and the infant was left without part of her pinna (Fig. 3).

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Fig. 1 ETT fixation method illustrated on a doll



Fig. 3 Case 3: the deficit in the left pinna seen from behind



Fig. 2 Case 2: deficit on the right helical fold

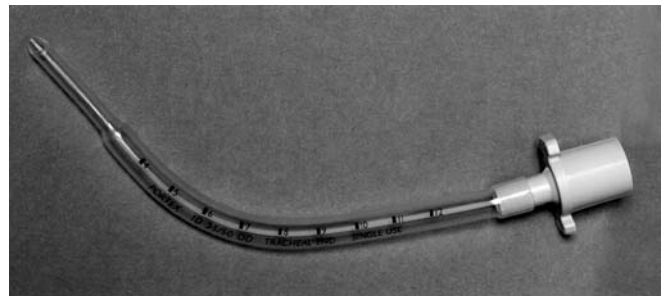


Fig. 4 Shouldered ETT

Discussion

We report three infants who developed ear deformities as a result of the method of fixation of the ETTs. In all three infants oral shouldered ETTs (Fig. 4) were used, as is the usual practice of our NICU. Nasal ETTs, once in place, can be fixed rigidly to the baby's face which might reduce the incidence of subglottic stenosis [4]. Nasal intubation, however, has been suggested to be a risk factor for bacteraemia [1] and can lead to ulceration and excoriation of the nostrils. At follow-up, notches in the alae of the nose and damage to the nasal septum have been described in infants who had undergone nasal intubation [2]. Oral tubes are generally thought easier to

insert, but can be harder to stabilise. Infants may suck and swallow on an oral ETT. At follow-up, high palatal arches, narrow pressure-induced grooves or clefts in the palate [5], and damage to the alveolar ridge leading to dentition problems have been described [2]. Shouldered compared to straight oral ETTs are easier to fix because of their greater relative width at the mouth. It had been claimed, however, that shouldered ETTs were more likely to cause subglottic stenosis [7]. Yet, in a retrospective review of the incidence of subglottic stenosis in the four metropolitan regions of London, no significant difference in the incidence of subglottic stenosis between NICUs which used straight or shouldered ETTs was noted (Rivers et al., unpublished data). Nevertheless, impaction of the shouldered part of the ETT onto the cricoid ring could lead to rapid pressure necrosis in the subglottic region [4,7]. Impaction of the ETT, however, can be avoided if the tip of the ETT is positioned at or above the level of the clavicles on the chest radiograph. Results of a recent study [6] suggest that use of a small diameter, straight ETT could significantly increase the work of breathing. Comparison of the airflow resistance of straight tubes of similar internal diameter to the

narrow section of the shouldered ETT demonstrated that the shouldered ETT had a lower resistance [6]. The resistance of the shouldered ETT was approximately 50% lower than that of a straight tube with an internal diameter corresponding to the narrowed part of the shouldered ETT.

A variety of methods have been used to fixate oral ETTs. These include suturing the ETT to a strip of Elastoplast stuck over the philtrum, an H-shaped piece of zinc oxide tape to stabilise the tube or plastic clips which grip the tube and stretch across the mouth to be tied to a hat [3]. Our method of fixation was a variation of the latter method. The ETT fixation method had been used on the NICU for approximately 20 years, as it was felt to provide a secure method of fixation. Until the three infants described, serious complications had not been previously experienced. All three infants were profoundly hypotensive and their poor peripheral perfusion must have contributed to the problem. It is not practical to frequently change the “fixating” bonnets in very sick infants. To avoid recurrence, therefore, we have modified our ETT fixation method by placing dental rolls just in front of the ears and beneath the

ligatures, to relieve any pressure on the ears. To date, this has proved a successful preventative strategy.

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