Paediatric endotracheal tubes: cuff or no cuff?

Traditional teaching states that when an endotracheal tube is required for airway management of children under the age of about 8 years an uncuffed tube should be used. Cuffed endotracheal tubes were really only used in specific circumstances such as patients requiring ventilation with poorly compliant lungs.

Benefits of using cuffed tubes

Although not widespread, there is now a growing interest in using cuffed tubes in younger paediatric patients. There are a great number of potential benefits which include:

- Decreased gas leak
- **Decreased requirement to change and** upsize the tube (if leak present), therefore reducing the number of potentially traumatic re-intubations in an attempt to find the correctly sized or a 'snugly fitting' uncuffed tube, and also having economic benefits
- **Having the ability to ventilate using** higher inflation pressures (and positive end expiratory pressure) and so improved efficiency of ventilation
- **A decreased risk of aspiration**
- **Decreased atmospheric pollution**
- **Improved accuracy of end-tidal carbon** dioxide, tidal volume and lung compliance monitoring.

Disadvantages of using cuffed tubes

The problems with cuffed tubes were that there were concerns especially with the old low-volume high-pressure cuffs that they could be over-inflated and so would cause tracheal mucosal ischaemia and oedema (and therefore stridor), ulcerations and necrosis.

Concerns were also raised over the fact that it was necessary to use a tube 1–2 sizes smaller than the uncuffed equivalent and so this would have a smaller internal diameter. This would increase the resistance of flow through the tube and so increase the work in patients who are breathing spontaneously. While this would not cause too much of an increase in a big child with a larger tube, it would have a much bigger impact in a smaller child. For example for a 1-year-old to breathe through a size 3.0 endotracheal tube rather than a size 4.0 tube would cause roughly a threefold increase in airway resistance and thus the work of breathing, according to the Hagen–Poiseuille equation.

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Discussion

Dalal et al (2009) looked at the laryngeal dimensions of 128 paediatric patients, and confirmed that the larynx is indeed cylindrical (like adults) and not funnel shaped as previously thought (Eckenhoff, 1951). They found that the cricoid is 'ellipsoid rather than round' and suggested, along with the accompanying editorial, (Motoyama, 2009) that this may be an 'anatomical basis' for the use of cuffed tubes in children. It is argued that tight-fitting uncuffed tubes would put more pressure, therefore possible ischaemia, on the lateral walls of the cricoid ring and so could give rise to more swelling and therefore stridor.

There is now evidence that using cuffed tubes may actually decrease the incidence of post-intubation stridor. Having moved over to solely using cuffed tubes Murat (2001) described no cases of post-intubation stridor or croup in her tertiary centre in Paris over a 3-year period. This may be because the use of a smaller diameter tube puts less pressure on the tracheal and laryngeal mucosa compared with the correctly sized or 'snugly' fitting uncuffed tube.

With advances in equipment available there are more varieties of thin-walled endotracheal tubes with short high-volume, low pressure cuffs available. If pressures are kept to less than 15 cmH_2O then there is no increase in airway complications (Dullenkopf et al, 2005).

With regards to increased resistance caused by the reduction in tube size, ventilators in anaesthesia and intensive care are now much more sophisticated. There are improved flow dynamics which can include 'automatic tube compensation' (found in the Evita XL, Dräger Medical), which allows compensation in both inspiration and expiration for the smaller size of tube. There are even pressure-assisted or support modes on anaesthetic ventilators, which can be used in the spontaneously breathing patient, or they can be ventilated completely which is probably more common practice.

Conclusions

For many short surgical cases the choice between cuffed and uncuffed tubes will make little difference, but for longer cases or those that need paediatric intensive care unit postoperatively a cuffed tube would be beneficial. In the sick child requiring ventilation a cuffed tube should certainly be considered. Indeed the Paediatric Advanced Life Support guidance (American Heart Association, 2005) recommends the use of cuffed tubes as an acceptable alternative to uncuffed tubes. **BJHM**

American Heart Association (2005) Part 12. Pediatric Advanced Life Support. *Circulation* **112:** IV-167–IV-187

Dalal PG, Murray D, Messener AH, Feng A, McAllister J, Molter D (2009) Paediatric laryngeal dimensions: an age-based analysis. *Anaesth Analg* **108**: 1475–9

Dullenkopf A, Gerber AC, Weiss M (2005) Fit and seal characteristics of a new paediatric tracheal tube with high volume-low pressure polyurethane cuff. *Acta Anaesthesiol Scand* **49**: 232–7

Eckenhoff JE (1951) Some anatomic considerations of the infant larynx influencing endotracheal anesthesia. *Anaesthesiology* **12**: 401–10

Motoyama EK (2009) The shape of the pediatric larynx: cylindrical or funnel shaped? *Anaesth Analg* **108**: 1379–81

Murat I (2001) Cuffed tubes in children: a 3 year experience in a single institution. *Pediatr Anesth* **11**: 748–9

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