

The use of cuffed tracheal tubes in paediatric patients: a survey of practice of anaesthetists in Ireland

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Keypoints

Despite increasing evidence advocating for the routine use of high-volume low-pressure cuffed tracheal tubes for tracheal intubation of children, anaesthetists practicing in Ireland are more inclined to use non-cuffed tracheal tubes, in line with traditional teaching. However, anaesthetists with higher paediatric workloads are more likely to use a high-volume low-pressure cuffed tracheal tube.

Abstract

Background

Traditionally, non-cuffed tubes have been used for tracheal intubation of children under eleven years of age. The evidence is now strongly supportive of cuffed tubes in this population.

Objectives

We aimed to ascertain the patterns of tracheal tube usage in paediatric anaesthesia in Ireland.

Materials and methods

A self-structured questionnaire was distributed at anaesthesia conferences and departments in Ireland between March and August 2012 (n = 231).

Results

75% of the 231 respondents routinely used non-cuffed tracheal tubes in these children. Emergency procedures in unfasted children, obesity and planned laparoscopy influenced anaesthetists to use a cuffed rather than a non-cuffed tube (p <0.001). 66% of respondents were unsure if they would use a high-volume low-pressure

cuff. Compared to anaesthetists with proportionately lesser paediatric workloads, those with greater paediatric workloads were inclined to use a cuffed tracheal tube with a high-volume low-pressure cuff (p <0.01).

Conclusion

We concluded that despite plentiful data supporting the use of cuffed tracheal tubes in children their rate of use is low amongst anaesthetists in Ireland. There is considerable uncertainty regarding high-volume low-pressure cuffed tubes.

Keywords: Anesthesia, intra-tracheal intubation airway management, pediatric intensive care unit, survey, ireland

Background

In adults the narrowest part of the upper respiratory airway is at the level of the vocal cords whereas in children there is further narrowing distally to the level of the cricoid ring [1]. This anatomical characteristic is the foundation for the traditional teaching that only non-cuffed tracheal tubes (TT) should be used in children

under eleven years of age [ii]. Consequently, cuffed TT have tended only to be used with exception for tracheal intubation of children less than eleven years old [iii]. Organisations such as the American Heart Association (AHA), the International Liaison Committee on Resuscitation (ILCOR) and the European Resuscitation Council (ERC) state in their latest guidelines for paediatric resuscitation that the use of cuffed TT in children and infants is now an accepted alternative to non-cuffed TT [iv, v, vi]. A high-volume low-pressure cuffed TT specifically designed for children has been available since 2004 (MicroCuff®, Kimberly-Clark) and since then there has been an increasing body of evidence which supports high-volume low-pressure cuffed TT[vii]. There is a developing consensus in the literature that cuffed rather than non-cuffed TT should be used in children less than eleven years old.

Despite substantial data favouring their use we observed that there appeared to be surprisingly low utilisation rates of cuffed TT in paediatric anaesthesia. We decided to investigate the pattern of usage of cuffed TT by anaesthetists in Ireland. We aimed to establish what factors might influence an anaesthetist to use a cuffed TT in a child. We also aimed to ascertain if cuffed TT use in children was influenced by the proportion of an anaesthetist's workload comprised by paediatric patients. Finally we aimed to identify knowledge and usage surrounding high-volume low pressure cuffed tracheal tubes.

Materials and methods

This was a descriptive cross-sectional study. Following a review of the literature and a pilot study, an anonymous self-structured questionnaire was designed [Appendix A].

No standardised questionnaire was available in the literature. Questions were thus constructed based closely on variables identified in previous studies on this topic through a review of the literature. The age range for children was indicated as 0 - 8 years unless stated otherwise. A mixed qualitative/quantitative approach

was used. There were nine questions covering two general areas: profile of respondents and use of endotracheal tubes.

The questionnaire was distributed at three Irish anaesthesia conferences in 2012:

- The Western Anaesthesia Symposium – Galway; March 2nd – 3rd
- The Irish Paediatric Anaesthesia and Critical Care Society Annual Scientific Meeting - Antrim; April 21st – 22nd
- The Irish Congress of Anaesthesia – Dublin; May 25th – 26th

Anaesthetists attending the conferences were asked to complete a questionnaire when collecting registration documents.

In addition to these conferences anaesthesia departments of pre-determined hospitals were visited in 2012, these were:

- Cork City Teaching Hospitals (Cork University Hospital, Mercy University Hospital, South Infirmery and Victoria University Hospital and the Bon Secours Hospital)
- Children's University Hospital, Temple Street, Dublin 1
- Tallaght Hospital, Dublin 24.

A purposive sampling method was employed in selecting locations of survey distribution. It was hoped that this would achieve the aim of maintaining a balance across both geographical variation of practice within Ireland and proportion of workload involving paediatric patients.

In order to meet inclusion criteria, respondents had to be an anaesthetist of any grade practicing in Ireland at the time they were surveyed.

In order to avoid duplication of responses, all participants were reminded both verbally, and via a handwritten note on each questionnaire, not to complete a que-



stionnaire if they had done so at a previous conference or at their own hospital.

The data were collected and entered into the Statistical Package for Social Sciences (SPSS) Version 19 (Chicago, IL).

Descriptive statistics were used to analyse the characteristics of the study sample and to review overall responses to the questions. In testing associations for categorical variables, Pearson's chi-square tests for independence were performed.

A probability value of <0.05 was considered statistically significant.

Appendix A: study questionnaire



What the Cuff? The Use of Endotracheal Tubes in Paediatric Anaesthesia

Thank you for taking part in this short survey which is being conducted as part of a final medical year research project in UCC. All surveys are anonymous and confidential.

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A. General Information

Please tick the box that applies to you:

- Consultant Specialist Registrar Registrar Senior House Officer

1. What proportion of your clinical workload in anaesthesia/ICU involves children (0-16 yrs)?

- <25% 25-50% >50%

2. Where do you carry out most of your clinical work?

- Munster Connaught Co. Dublin Leinster outside Co. Dublin Ulster

B. Use of Endotracheal Tubes (ETT)

1. Are you aware of any complications relating to the use of a cuffed ETT in a child?

- Yes No

If yes, please state complications: _____

Please turn over – more questions overleaf

2. In non-obese children (0-8 years old) presenting for elective surgery, which is your preference for tracheal intubation?

- A. Cuffed Endotracheal Tube B. Un-Cuffed Endotracheal Tube

3. Would any of the following factors influence you to use a cuffed ETT (as opposed to an un-cuffed ETT) in a child less than 8 years old? Please tick Yes/No		Yes	No
A.	Age <i>If yes, explain</i> _____	<input type="radio"/>	<input type="radio"/>
B.	Obesity <i>If yes, explain</i> _____	<input type="radio"/>	<input type="radio"/>
C.	Site of surgical procedure: <i>If yes, explain</i> _____	<input type="radio"/>	<input type="radio"/>
D.	A surgical procedure > 3 hrs duration	<input type="radio"/>	<input type="radio"/>
E.	Non-fasted child in an emergency procedure	<input type="radio"/>	<input type="radio"/>
F.	Planned laparoscopy	<input type="radio"/>	<input type="radio"/>
G.	Decreased lung compliance	<input type="radio"/>	<input type="radio"/>
H.	Other, please state: _____		

4. If you were to use a cuffed ETT in a child (0-8 years old) would you use a high-volume low pressure cuffed ETT?

- Yes No Unsure

5. When using a cuffed ETT in theatre do you monitor intra-cuff pressure?

- Frequently Occasionally Never

6. When intubating the trachea of a child (0-8 years old) who is or who will be in ICU, do you have a preference for the orotracheal or nasotracheal route?

- Orotracheal Nasotracheal

Results

All anaesthetists asked to participate obliged. 235 surveys were collected of which 231 met inclusion criteria. Following personal communication with the College of Anaesthetists of Ireland, this figure (n = 231), was calculated to be just over a quarter of the total number of anaesthetists practicing on the island of Ireland (both consultants and trainees) [Table 1 and Figure 1].

Anaesthetists were asked to specify their preference of TT, cuffed or non-cuffed, for tracheal intubation of a non-obese child (0 - 8 years) in an elective surgical setting. 75% of respondents (n = 170) indicated a preference for non-cuffed TT in this setting.

Anaesthetists were asked that if they were to use a cuffed TT whether or not they would avail of a high-volume low-pressure cuffed TT. 23% (n = 52) of the sample group confirmed that they would select a high-volume low-pressure cuffed TT with 11% (n = 26) saying they would not. The majority of anaesthetists reported being 'unsure' (66%; n = 149).

Grade	Number (%)
Consultant	123 (53%)
NCHD	108 (47%)

*NCHD; Non Consultant House Doctor

Table 1. Grade of Anaesthetist surveyed

Anaesthetists were asked to indicate if any of a number of variables would influence them to use a cuffed TT over a non-cuffed TT [Table 2]. Anaesthetists were significantly influenced to use cuffed over non-cuffed TT by a number of factors including obesity, planned laparoscopy or an unfasted child for an emergency procedure ($p < 0.001$).

Variable	Yes (%)
Age	89 (40%)*
Obesity	119 (53%)*
Site of Surgical Procedure	91 (42%)*
Procedure >3 hrs duration	95 (43%)*
Non-fasted child in an emergency procedure	146 (65%)*
Planned Laparoscopy	113 (51%)*
↓Lung Compliance	120 (55%)*

Table 2. Results showing anaesthetists response when asked if they would be influenced by specified clinical variables to use a cuffed tracheal tube (TT) over a non-cuffed TT in children aged 0-8 years old. Responses were compared to previous answers regarding TT preference where 25% of respondents said they would use a cuffed TT over a non-cuffed TT for a non-obese, fasted child in a routine setting. Pearson's Chi Squared analysis is utilised. (* = $p < 0.001$)

The relationship between anaesthetist preference for cuffed or non-cuffed TT and their proportion of workload involving paediatric patients is shown in Figure 2. Anaesthetists with paediatric workload comprising less than 25% of their practice were significantly less likely to use cuffed TT ($p < 0.05$).

Those anaesthetists with the greatest paediatric workload (>50%), had a significant preference for a high-volume low-pressure cuffed TT ($p < 0.05$). 59% ($n = 13$) of this group reported that they would use a high-volume low-pressure cuffed TT, compared to 18% ($n = 31$) and 29% ($n = 8$) of the lesser paediatric workloads - <25% and 25-50% respectively (Figure 3).

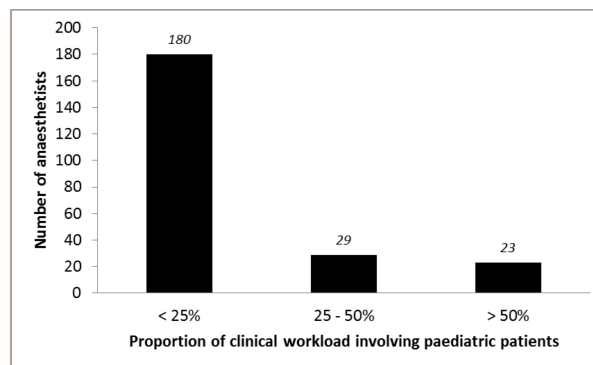


Figure 1. Estimation by respondents of the percentage proportion of their clinical workload which involves paediatric patients.

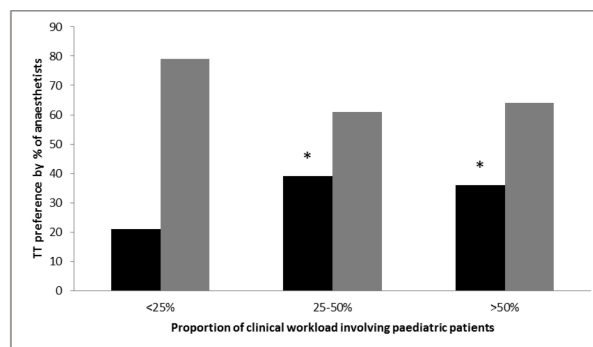


Figure 2. Results showing respondents grouped according to their proportion of clinical workload that involved paediatric patients and their proportional % preferences for either cuffed TT (black; ■) or non-cuffed TT (grey; ▒) in a specified routine

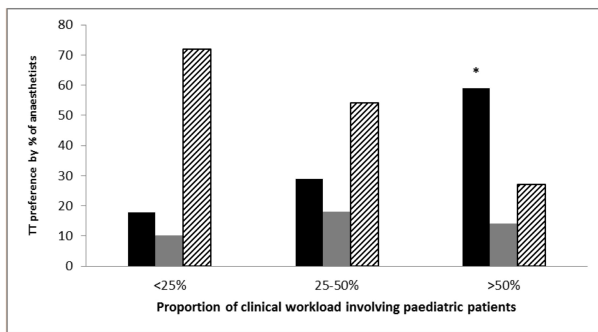


Figure 3. Anaesthetist response of Yes, (black; ■) No, (grey; ■) or being unsure, (striped; ▨) as to whether or not they would use a high volume – low pressure cuffed TT if using a cuffed TT for tracheal intubation of a paediatric patient. Respondents were grouped according to their proportion of clinical workload involving paediatric patients. Pearson’s Chi Squared Analysis and cross tabulations was used to compare each group. (* = $p < 0.05$)

Discussion

Different areas of anaesthesia have basic fundamentals that are among the first things residents learn. The importance of using non-cuffed TT in younger children has been one such foundational principle of practice. Convincing data and expert opinion supporting the use of cuffed TT in paediatric anaesthesia has accumulated very significantly in the past ten years. Despite this there is a relatively low rate of adoption of cuffed TT for use in younger children among anaesthetists practicing in Ireland. There is widespread preference for non-cuffed TT with 75% of our sample group preferentially selecting this over a cuffed TT. Why isn’t there a larger upswing in the use of the non-cuffed TT given the current state of the medical literature on the subject? Anaesthesia is a very hands-on medical specialty. Changes in practice may tend to be stimulated by personal experience. It may be that anaesthetists encounter problems with non-cuffed TT insufficiently frequently to motivate them to consider change. Appropriately designed cuffed TT will eliminate the main cause of tracheal injury which is over-sized non-cuffed TT^[viii,ix] but this type of injury is unlikely to be encountered significantly frequently even by those with large paediatric practices. Disadvantages of non-cuffed TT that are due to inadequate sealing leading to leakage of ventilatory gases with resultant unde-

pendable ventilation, variable capnography, pulmonary aspiration and increased fresh gas flow requirements^[x,xi] may also be either inadequately frequent or insufficiently troubling to trigger a change to cuffed TT. It is also possible that problems with non-cuffed TT may not be attributed to the lack of a cuff and therefore the solution of utilising a cuffed TT is not deduced.

Other factors that may cause an individual to change a component of their practice such type of TT are likely to include the weight of evidence or strength of opinion in the literature; promotion by companies of a particular TT and the culture of the department in which they practice. It would appear that in the majority of our sample that none of these factors have adequate weight either individually or combined to bring the practitioner to the mental tipping point that will result in a change in practice. Alternatively it may be that anaesthetists practicing in Ireland are either unaware of the evidence or are unconvinced of the benefits that may result from changing. The finding that the larger the proportion of an individuals’ practice that comprises children appears to increase the likelihood they will utilise the non-cuffed TT suggests that those most experienced in paediatric anaesthesia are recognising and embracing the advantages of the non-cuffed TT more readily than their less experienced colleagues. This also reinforces the soundness of the developing consensus in favour of changing to cuffed TT.

Knowledge and Usage of the High-Volume Low-Pressure Cuffed TT

A considerable degree of uncertainty was evident amongst the majority of anaesthetists pertaining to use of a high-volume low-pressure cuffed TT. 66% of respondents stated that they were “unsure” about its selection for a small child. Anaesthetists with proportionately greater paediatric workloads were significantly more aware of its availability with 59% of those with a paediatric workload of >50% confirming they would use a high-volume low-pressure cuffed TT when choosing a cuffed TT. It is unsurprising that anaesthetists who deal

more regularly with paediatric patients would be both more aware of and more inclined to use an instrument specifically designed for paediatric anaesthesia. It is striking that such a large proportion of those who didn't have large paediatric workloads were unsure about high-volume low-pressure cuffed TT. Given the evidence base it is possible that a well-designed educational program would convert many to its adoption.

Influence of variables on choosing a cuffed TT

Certain variables were found to have a significantly positive influence on selection of cuffed TT over non-cuffed TT. There was a striking increase in the proportion of anaesthetists selecting a cuffed TT if the patient was an unfasted child for emergency case procedure ($p < 0.001$). This may in part reflect the endorsement of cuffed TT in 2005 from the American Heart Association and the Paediatric Advanced Life Support (PALS) course, which states that a cuffed TT is at least as safe as and at times preferable to, a non-cuffed TT in certain emergency circumstances. Impaired lung compliance in a younger child is another variable where a significant proportion of the group would choose a cuffed TT in lieu of a non-cuffed TT ($p < 0.001$). Interestingly reduced lung compliance was cited as the most common reason for cuffed TT use in a UK survey in 2008. Use of a cuff creates an improved tracheal seal allowing respiratory parameters such as tidal volume and airway pressure to be more accurately monitored which is vital in impaired lung compliance. These results suggest that anaesthetists may be mindful of this and aware of the superior sealing properties of a cuffed TT. Obesity in a child less than eight years old was also significantly more likely to result in the selection of a cuffed TT. Several anaesthetists specifically cited 'increased aspiration risk' as the reason behind this. A Belgian study published in June of 2010 showed that use of a high-volume low-pressure cuffed TT resulted in 100% protection against silent aspiration in morbidly obese patients^[xii]. Whether the same effects are seen in obese paediatric patients is uncertain but patterns of practice amongst anaesthetists in

Ireland may suggest they are mindful of the potential anti-aspiration benefits of the non-cuffed TT. An increased aspiration risk secondary to high intra-abdominal pressures exists during laparoscopic procedures^[xiii]. A significant proportion of respondents indicated that a planned laparoscopic procedure would prompt them to use a cuffed TT ($p < 0.001$). The results of this study may suggest that anaesthetists are aware that paediatric patients intubated with a cuffed TT have a lowered risk of gastric content aspiration^[xiv]. The scenarios described which anaesthetists said would cause them to utilise a cuffed TT are quite common in paediatric anaesthesia. This suggests that the potential benefits of cuffed TT are recognised by many anaesthetists practicing in Ireland. It also suggests that the utilisation of the non-cuffed TT in younger children is viewed less as dogma but more as an approach to which risk/benefit analysis can be applied allowing the advantages of other clinical choices to be rationally weighted.

International Context

The overall prevalence of cuffed TT usage in our study (25%), exceeds that of both an International internet-based survey (6%) and a UK survey of specialist practice (13%) and is consistent with an apparent trend of increasing utilisation of cuffed TT in paediatric patients. Based on data in a recent published survey of members of the Association of Paediatric Anaesthetists of Great Britain and Ireland and the section of paediatric anaesthesia in the Netherlands (SKA), anaesthetists in Ireland with higher paediatric workloads appear to have comparable rates of use of cuffed TT with those in the APAGBI but lower rates than their Dutch counterparts^[15]. These findings lead to the impression that amongst those intubating children the non-cuffed TT is the majority choice amongst paediatric specialists while the non-cuffed TT dominates amongst non-specialists. The proportion of anaesthetists utilising a cuffed TT may be a gradually increasing. This may be due to recently trained specialists entering practice with newer practice techniques displacing retiring anaesthetists. It

may also be due to currently practicing anaesthetists changing their techniques.

Conclusion

It is encouraging to see that anaesthetists who more regularly deal with tracheal intubation of children have tailored their methods of practice in line with consistent, up-to-date evidence. In a world where enormous volumes of medical studies are produced every year, supervisory and academic bodies are well positioned to help ensure that anaesthetists are exposed to the most important evidence with which to inform their practices. We suggest that it may be beneficial to have as a part of the continuing professional development of anaesthetists a prescribed component comprising what regulatory bodies consider to be fundamental to clinical practice. This could be modified annually depending on new evidence and recommendations. Such a prescribed module would enable specialist supervisory bodies to ensure that doctors were fully versed on recent developments that were relevant to them. A universally accepted practice does not become a shibboleth overnight.

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Notes

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