

A Questionnaire-Based Assessment of the Use of Cuffed Endotracheal Tubes in Paediatric Anaesthesia amongst Indian Anaesthesiologists

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Abstract

Aim: The aim of the present study was to understand the current practices regarding the use of cuffed endotracheal tubes in paediatric anaesthesia amongst Indian anaesthesiologists.

Methods: The present study was conducted at department of Anesthesiology, SNMMCH, Dhanbad, Jharkhand, India for one year and we formulated a questionnaire intended to assess the use of cuffed endotracheal tubes in pediatric age-group by pediatric and general anaesthetics in India. The questionnaire was also designed to evaluate practices related to the use of cuffed endotracheal tube in pediatric age group, such as the medium used for inflation of the cuff and whether or not cuff pressure monitoring was done during surgery.

Results: In our study, 46% anaesthetists were in the age range of 40 – 60 years, 44% in the range of 25 to 39 years, 8% above 60 years, while the remaining minority in the age group of less than 25 years. In our study, 41% respondents were males, while 59% were females. Only 6% were pediatric anaesthesiologists and 32% has experience more than 20 years. More number of cuffed ETT has been used in the age group of 2 to 8 years children however more number of uncuffed ETT has been used up-to 2 years aged children. 2000 children with cuffed ETT and 550 children with uncuffed ETT belonged to 2-8 years. There were more females who underwent cuffed and uncuffed ETT as compared to males.

Conclusion: In our study, we concluded that more number of cuffed ETT has been seen to be used by the practitioners who are in the age group of 25 to 40 years. More number of cuffed ETT has been used by female practitioners for pediatric anaesthesia. Strong association has been observed with practitioners with less than 10 years post PG experience preferring cuffed ETT while those with post PG experience of > 20 years preferring uncuffed ETT. We also concluded that majority practitioners prefer uncuffed ETT in neonates and in children between 1 month to 2 years of age while most of them prefer cuffed ETT in children above 2 years of age.

Keywords: Pediatric, cuffed endotracheal tube, cuff pressure

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Introduction

Endotracheal intubation is a routinely performed technique in the conduct of anesthesia as well as for critical care management in children for protection of the airway, ease of positive pressure ventilation, pulmonary toileting, and maintenance of oxygenation. The use of uncuffed or cuffed endotracheal tubes in children have their own advantages and disadvantages. Uncuffed endotracheal tubes (UETTs) are traditionally used for intubation in all children under 8 years of age, irrespective of the indication and duration of intubation. [1,2] Cuffed endotracheal tubes (CETTs) in children undergoing surgery have not been very popular because of the fear that the cuff will cause airway mucosal injury, leading to sub-glottic stenosis. [3-5] Cuffed tubes are more expensive, and their benefit remains unproven. [6]

The recommendation for the use of uncuffed endotracheal tubes in patients younger than 8 years follows from the developing airway anatomy. An endotracheal tube large enough to seal the cricoid ring, yet small enough to allow an air leak at pressures between 20 and 30 cm H₂O, should allow adequate positive pressure ventilation without exerting excessive pressure on the tracheal mucosa that could result in tissue hypoperfusion and injury. The practice of using uncuffed endotracheal tubes has proven to be safe. Black et al [7] studied 2,953 pediatric patients admitted to the intensive care unit during a 4-year period. The children had been nasotracheally intubated with uncuffed endotracheal tubes. None of the patients in the study showed clinical symptoms of acquired subglottic stenosis. The PVC cuff on the tracheal tube requires the tube to be sized down by one-half size to accommodate the increase in the

external diameter created by the bulk of the cuff. Because small changes in diameter result in large increases in resistance, this downsizing results in an increased work of breathing during spontaneous ventilation. This requirement for downsizing is a concern, especially in the smaller sizes of tracheal tubes. Although current ventilation techniques can readily overcome this increased resistance, [8] the successful suctioning of secretions in the smaller tubes is challenging.

The shortcomings of uncuffed endotracheal tubes have been accepted and tolerated for 50 years. Given the longstanding guidelines regarding pediatric intubation, it seemed imprudent to use cuffed tubes except when lung compliance was so poor that the necessary inspiratory pressures required a greater sealing pressure. When a cuffed endotracheal tube is used in a pediatric patient, it is very important to monitor the cuff pressure so as to reduce the risk of post-operative airway complications arising from excessive pressure of the cuff on the tracheal mucosal capillaries and their necrosis and resulting edema.

The aim of the present study was to understand the current practices regarding the use of cuffed endotracheal tubes in paediatric anaesthesia amongst Indian anaesthesiologists.

Materials and Methods

The present study was conducted at department of Anesthesiology, SNMMCH, Dhanbad, Jharkhand, India for one year and we formulated a questionnaire intended to assess the use of cuffed endotracheal tubes in pediatric age-group by pediatric and general anaesthetists in India. The questionnaire was also designed

to evaluate practices related to the use of cuffed endotracheal tube in pediatric age group, such as the medium used for inflation of the cuff and whether or not cuff pressure monitoring was done during surgery.

The self-structured questionnaire had 20 questions, and they were widely shared amongst anaesthetists practicing in India through social media, such as Facebook groups, WhatsApp groups and direct messages, over a period of four months. A brief message regarding the nature of the survey and why we were conducting this particular survey accompanied the

questionnaire. Voluntary participation by anaesthetists by clicking the link and answering the questionnaire was considered as implied consent.

On clicking the link, the anaesthetists were directed to a Google form that contained the questionnaire. After a few demographic questions, the survey was in the form of some multiple choice questions and some short answer questions. The results thus obtained were directly tabulated in an excel sheet and given for statistical analysis.

Results

Table 1: Demographic details of anaesthetists

Age in years	N%
<25 years	2 (2)
25-40 years	44 (44)
41-60 years	46 (46)
>60 years	8 (8)
Gender	
Male	40 (40)
Female	60 (60)
Years of practice post PG	
<1	10 (10)
1-5	12 (12)
6-10	16 (16)
10-20	30 (30)
>20	32 (32)
Number of exclusive pediatric anaesthesiologists	
Yes	6 (6)
No	94 (94)

In our study, 46% anaesthetists were in the age range of 40 – 60 years, 44% in the range of 25 to 39 years, 8% above 60 years, while the remaining minority in the age group of less than 25 years. In our study, 41% respondents were males, while 59% were females. Only 6% were pediatric anaesthesiologists and 32% has experience more than 20 years.

Table 2: Strong association has been observed between age-group of children and type of ETT

Age-group of children	Type of ETT used			Association test	
	Cuffed	Uncuffed	Total	Chi-square	p-value
< 1 month	10	320	370	2080.20	<0.00001
1 month to 2yrs	150	980	1130		
2 to 8yrs	2000	550	3000		

More number of cuffed ETT has been used in the age group of 2 to 8 years children however more number of uncuffed ETT has been used up-to 2 years aged children.

Table 3: ETT type used by practitioners with respect to their age

Age-group of practitioners	Cuffed ETT				Uncuffed ETT				Association test	
	Neonates	1 month to 2yrs	2 to 8yrs	Total	Neonates	1 month to 2yrs	2 to 8yrs	Total	Chi-square	p-value
<25	0	0	5	5	0	0		0 (00)	190.10	=0.0000'
> 60	2	10	95	107	20	50	60	130		
25 - 40	4	110	1500	1614	190	430	120	740		
41 - 60	4	30	400	434	110	500	370	980		
Grand Total	10	150	2000	2160	320	980	550	1850		

2000 children with cuffed ETT and 550 children with uncuffed ETT belonged to 2-8 years.

Table 4: ETT type used by practitioners with respect to their gender

Gender of practitioners	Cuffed ETT				Uncuffed ETT				Association test	
	Neonates	1 month to 2yrs	2 to 8yrs	Total	Neonates	1 month to 2yrs	2 to 8yrs	Total	Chi-square	p-value
Female	1	120	1600	1721	210	650	210	1070	190.05	< 0.00001
Male	9	30	400	439	110	330	340	780		
Grand Total	10	150	2000	2160	320	980	550	1850		

There were more females who underwent cuffed and uncuffed ETT as compared to males.

Discussion

Since more than 50 years, the traditional teaching and practice has been to use uncuffed endotracheal tubes for the tracheal intubation in neonates, infants and children below 8 years of age. These guidelines were based on a study conducted in 1953, on cadaveric larynx. The reason for not using cuffed endotracheal tube in pediatric age group was the belief that the pediatric larynx is funnel shaped, with the narrowest part being the sub-glottic area. A cuff was believed to exert pressure on the mucosal capillaries leading to necrosis, subglottic edema, trauma and post-operative airway problems. However, with recent technology such as MRI studies and bronchoscopic studies in live patients, our understanding of the basic anatomy of pediatric airway has undergone modifications. The pediatric larynx is no

longer believed to be funnel shaped, rather it is now stated to be cylindrical, just like in adults. Because of these changes in our understanding of the anatomy, in recent times, cuffed endotracheal tubes are being increasingly used for pediatric intubations for surgeries. The literature also supports use of cuffed endotracheal tubes due to certain definite advantages such as reduced theater contamination with anesthetic gas, decreased ETT exchanges, increased capnographic accuracy, and decreased risk of microaspiration and respiratory adverse event [9,10] without increasing the risk of any airway morbidity. Since 2004, a high-volume, low-pressure CET specifically designed for children has been made available (MicroCuff®, Kimberly-Clark, unomedical SDN, Kedah, Malaysia), which has been found to effectively seal the trachea at very low pressures (<15 cmH₂O) and since then, there have been substantial data which support their use. [11,12]

In our study, 46% anaesthetists were in the age range of 40 – 60 years, 44% in the range of 25 to 39 years, 8% above 60 years, while the remaining minority in the age group of less than 25 years. In our study, 41% respondents were males, while 59% were females. Only 6% were pediatric anaesthesiologists and 32% has experience more than 20 years. In the study conducted by Motiani et al [11], titled Current practice and attitudes regarding the perioperative use of cuffed tracheal tubes for pediatric and neonatal tracheal intubation: A survey-based evaluation among Indian anesthesiologists, the total response rate was 55% (99/180) and after excluding the responses of postgraduates, 96 responses were evaluated. Recent advances in the knowledge of pediatric airway anatomy have countered the previous beliefs which favored uncuffed ETTs, and this has further laid impetus on the benefits of CETs in children. [13] They have been shown to be safe for use even in small neonates. [14]

There were more females who underwent cuffed and uncuffed ETT as compared to males. 2000 children with cuffed ETT and 550 children with uncuffed ETT belonged to 2-8 years. Khine et al [15] studied 488 full-term newborns and children through 8 years of age who required anesthesia. They found that the lungs of patients with cuffed tubes were adequately ventilated with 2 L/min fresh gas flow, whereas 11% of those with uncuffed tubes needed greater fresh gas flow. Eschertzhuber et al [16] studied the consumption and related costs of sevoflurane and medical gases in matched groups of pediatric patients, half of whom were intubated with cuffed endotracheal tubes and half with uncuffed tubes. They found that the lowest possible fresh gas flow was significantly lower in the cuffed group than the uncuffed group.

In 2004 Newth et al [17] reported their experience with 860 critically ill children requiring long-term intubation. The

investigators collected data for a 1-year period for 597 children in the first 5 years of life. Of these, 210 were intubated with cuffed endotracheal tubes. Uncuffed endotracheal tubes were chosen using the modified Cole formula, and cuffed tracheal tubes were chosen one-half size smaller to accommodate the increase in external dimension from the PVC cuff. They found no significant differences in the use of racemic epinephrine for postextubation subglottic edema, the rate of successful extubation, or the need for tracheotomy between patients with cuffed and with uncuffed tubes in any age group. [18]

Use of cuffed endotracheal tubes in pediatric age group has always been a matter of debate. Use of cuffed endotracheal tube is not as widespread as it should have been owing to fear regarding postoperative stridor, laryngeal oedema, coughing and airway irritation. However, cuffed tubes have been shown to be safe and the incidence of such postoperative complications between two groups is not significant.

Conclusion

In our study, we concluded that more number of cuffed ETT has been seen to be used by the practitioners who are in the age group of 25 to 40 years. More number of cuffed ETT has been used by female practitioners for pediatric anaesthesia. Strong association has been observed with practitioners with less than 10 years post PG experience preferring cuffed ETT while those with post PG experience of > 20 years preferring uncuffed ETT. We also concluded that majority practitioners prefer uncuffed ETT in neonates and in children between 1 month to 2 years of age while most of them prefer cuffed ETT in children above 2 years of age. We also concluded that even though use of cuffed endotracheal tubes in pediatric patients is on a rise, the percentage of anaesthesiologists who monitor intraoperative cuff pressure is very low, thus compromising the safety.

References

1. Motoyama EK. Endotracheal intubation. In: Motoyama EK, Davis PJ, editors. *Smith's Anesthesia for Infants and Children*. 5th ed. St Louis, MO: C.V. Mosby; 1990. p. 269-75.
2. Fisher DM. Anesthesia equipment for pediatrics. In: Gregory GA, editor. *Pediatric Anesthesia*, 3rd ed. New York: Churchill Livingstone; 1994. p. 197-25.
3. Uejima T. Cuffed endotracheal tubes in pediatric patients. *Anesth Analg* 1989; 68:423.
4. Holzk J. Laryngeal damage from tracheal intubation. *Pediatric Anesthesia*. 1997 Nov;7(6):435-7.
5. Weiss M, Dullenkopf A, Gysin C, Dillier CM, Gerber AC. Shortcomings of cuffed paediatric tracheal tubes. *British Journal of Anaesthesia*. 2004 Jan 1;92(1):78-88.
6. Weber T, Salvi N, Orliaguet G, Wolf A. Cuffed vs non-cuffed endotracheal tubes for pediatric anesthesia. *Pediatric Anesthesia*. 2009 Jul; 19:46-54.
7. Black AE, Hatch DJ, Nauth-Misir N. Complications of nasotracheal intubation in neonates, infants and children: a review of 4 years' experience in a children's hospital. *Br J Anaesth*. 1990;65(4):461-467.
8. Fine GF, Borland LM. The future of the cuffed endotracheal tube. *Paediatr Anaesth*. 2004;14(1):38-42.
9. Litman RS, Maxwell LG. Cuffed versus uncuffed endotracheal tubes in pediatric anesthesia: the debate should finally end. *The Journal of the American Society of Anesthesiologists*. 2013 Mar 1;118(3): 500-1.
10. von Ungern-Sternberg BS, Boda K, Chambers NA, Rebmann C, Johnson C, Sly PD, Habre W. Risk assessment for respiratory complications in paediatric anaesthesia: a prospective cohort study. *The Lancet*. 2010 Sep 4;376(9743):773-83.
11. Motiani P, Ahmad Z, Sharma PK, Gupta A, Jain MK, Sahu DK. Current practice and attitudes regarding the perioperative use of cuffed tracheal tubes for pediatric and neonatal tracheal intubation: A survey-based evaluation among Indian anesthesiologists. In *The Indian Anaesthetists Forum 2021 Jan 1* (Vol. 22, No. 1, p. 26). Medknow Publications.
12. Flynn PE, Black AE, Mitchell V. The use of cuffed tracheal tubes for paediatric tracheal intubation, a survey of specialist practice in the United Kingdom. *European journal of anaesthesiology*. 2008 Aug;25(8):685-8.
13. Tobias JD. Pediatric airway anatomy may not be what we thought: implications for clinical practice and the use of cuffed endotracheal tubes. *Pediatric Anesthesia*. 2015 Jan;25(1): 9-19.
14. Weiss M, Dullenkopf A, Fischer JE, Keller C, Gerber AC, European Paediatric Endotracheal Intubation Study Group. Prospective randomized controlled multi-centre trial of cuffed or uncuffed endotracheal tubes in small children. *British journal of anaesthesia*. 2009 Dec 1;103(6):867-73.
15. Khine HH, Corddry DH, Kettrick RG, Martin TM, McCloskey JJ, Rose JB, Theroux MC, Zagnoev M. Comparison of cuffed and uncuffed endotracheal tubes in young children during general anesthesia. *The Journal of the American Society of Anesthesiologists*. 1997 Mar 1;86(3):627-31.
16. Eschertzhuber S, Salgo B, Schmitz A, Roth W, Frotzler A, Keller CH, Gerber AC, Weiss M. Cuffed endotracheal tubes in children reduce sevoflurane and medical gas consumption and related costs. *Acta Anaesthesiologica Scandinavica*. 2010 Aug;54(7):855-8.
17. Newth CJL, Rachman B, Patel N, Hammer J. The use of cuffed versus

- uncuffed endotracheal tubes in pediatric intensive care. J Pediatr. 2004;144(3):333-337.
18. Salih A. A., Saeedi S. M., & Ghali K. H. Impact of Fibrosis Related to TGF- β 1 and TNF- α Growth Factors in Renal Failure Patients. Journal of Medical Research and Health Sciences, 2022; 5(7): 2105–2111.