A Systematic Review on the Current Attitudes and Clinical Practices on the Use of Cuffed and Uncuffed Endotracheal Tubes in Pediatric Anesthesia

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ABSTRACT

Background. For several decades now, the use of uncuffed endotracheal tube (ETT) is the gold standard in providing airway and ventilatory support to children under anesthesia. However, there has been a change in focus from the application of uncuffed ETT to cuffed ETT among children, and this matter has been debated for years. In fact, several studies have shown that even across and within countries, the attitudes and practices of anesthesiologists on the use of types of endotracheal tubes differed.

Objective. To describe the current attitudes and practices of anesthesiologists regarding the use of uncuffed or cuffed ETT for children.

Methods. A systematic review of observational studies on the current attitudes and practices of pediatric anesthesiologists regarding the use of cuffed and uncuffed ETT was conducted from May to November 2020. Cochrane reviews, Medline, Pubmed, and EMBASE were searched and yielded five relevant studies.

Results. The use of cuffed ETT ranged between 11%-61% in the included studies and all reported that there were no consensus or standard on whether cuffed or uncuffed ETT was better. Reported factors for cuffed ETT use included: 1) Personal choice, 2) Department protocol, 3) Availability of resources, and 4) Specific conditions such as obesity, planned or emergency procedure, and reduced lung compliance. In terms of ETT size, reported criteria were: 1) Use of a formula, 2) Use of abacus/calculator, and 3) In relation to the fifth finger's width.

Conclusions. The current systematic review demonstrated that there is wide variation in current attitudes and practices of anesthesiologists regarding the use of uncuffed or cuffed endotracheal tubes in children. Likewise, factors affecting choice of ETT and criteria for selection varied in the published literature. The results of this systematic review highlight the need for a standard guideline to help clinicians choose if cuffed or uncuffed ETT is better in certain scenarios and to help them decide in selecting the most appropriate ETT size.

Keywords: endotracheal tubes, anesthesiology, pediatric

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INTRODUCTION

For several decades now, the use of uncuffed endotracheal tube (ETT) is the gold standard in providing airway and ventilatory support to children under anesthesia. This recommendation supported the idea that having a cuffed ETT was not only unnecessary but could also be a risk factor for airway morbidity. It was based on descriptions of anatomical variations between the child and adult larynx. However, there has been a shift of interest from the use of uncuffed ETT to cuffed ETT among pediatric patients and this topic has been a subject of debate for years now. In fact, several studies have shown that even across and within countries, the attitudes

and practices of anesthesiologists on the use of types of endotracheal tubes differed.[1-4]

Risks and benefits of both uncuffed and cuffed breathing tubes have been enumerated and discussed by different studies. Less mucosal pressure and minimal risk of tracheal rupture are some of the benefits of uncuffed tubes; while lesser air leaks, lower tube exchanges, and more accurate monitoring, among others, are the advantages of cuffed tubes.[5,6] Most were already backed-up by clinical trials and reliable analysis to support these results.[7-10]

Endotracheal Tube (ETT) in Pediatric Anesthesia

Airway management is an important part of routine anesthesia practice. This allows protection of airway, ventilation and oxygenation, pulmonary toileting, as well as a mode of delivering anesthetic gas.[11] Endotracheal intubation is one technique usually used during such procedures.

Endotracheal intubation is the process of inserting a tube, called ETT into the mouth down into the airway. The ETT will then be connected to a machine or ventilator that will assist in breathing. ETT is needed when a patient is in deep sedation because the anesthesia paralyzes the muscles of the body, including the diaphragm. They will not be able to breathe on their own or will not be able to provide adequate oxygen enough for the needs of the body without assistance. Usually, the ETT is removed after surgery. However, at times, the breathing tube can remain connected to the ventilator longer when the patient is in a condition that needs more assistance in oxygenation or having difficulty breathing on his/her own.

Pediatric airway management is more complex compared to that of the adult because of several reasons. Debates are flourishing regarding the anatomy of pediatric larynx. The airway of pediatric patients continues to develop as they grow. The narrowest section of their larynx is in the level of the cricoid cartilage until the age of 8 years old. It is funnel-shaped unlike of an adult. This is the part where anesthesiologists choose the type, size and length of the ETT that they are going to use; in contrast to adults where the space between the vocal cords is the determinants.[12] However, over the years, debates are rising on whether the pediatric larynx is really funnel-shaped or is it cone-shaped, like that of an adult.[5,13,14] Because of these reasons, the pediatric airway has a higher risk of swelling that may result to increased airway resistance.[12] Also, if an incorrect ETT size and length is used, this may lead to repeated intubation causing excessive pressure on tracheal mucosa and potential airway damage.[13]

The use of cuffed or uncuffed ETT among children is still on controversy. Typically, ETTs without cuffs have been recommended for kids under the age of eight. This method is effective at increasing the breathing tube's internal diameter, reducing airway resistance, and reducing the likelihood of edema formation from cuff-related mucosal damage.[12] The size of the uncuffed tube to be used in children is computed using the Cole's formula, which is internal diameter of uncuffed ET in mm = (age in years / 4) + 4.[15] However, as the concept of airway anatomy in children has evolved, a change in the thinking that the pediatric larynx is cone-shaped in the transverse dimension also changed. Its narrowest portion is already said to be located at the rima glottidis, which is cylindrical in the anteroposterior dimension and non-changing throughout the child's development.[11,16] The use of cuffed ETTs is also gaining popularity among physicians; as it is associated with deceased risk of aspiration and leak around the tube.[13] The size of cuffed ETT size can be computed using the Khine formula, which is internal diameter of cuffed ETT in mm = (age in years / 4) + 3.[15]

Uncuffed and cuffed ETTs have their own advantages and disadvantages. Advantages of uncuffed ETTs are, but not limited to: cause minimal mucosal pressure, no risk of tracheal rupture, less resistance to air flow, ease of suctioning, less blockage by secretions caused by larger internal diameter for age. However, it is associated with repeated laryngoscopies, increased cost because of high tube exchange, airway injury caused by oversized tube-related pressure on cricoid mucosa and undersized tube-related precipitate movement trauma, inaccurate respiratory monitoring, high gas consumption, wasted inhaled anesthetics, possible aspiration, and possible operating room air contamination caused by air leaks. On the other hand, cuffed endotracheal tubes are said to be chosen by some physicians because of: smaller external diameter for age causing less pressure on cricoid mucosa, reduced aspiration risk, more accurate ventilation and ventilator monitoring and lower tube exchanges, which makes it fewer laryngoscope-requiring and cost-effective. However, its disadvantages include: increased resistance to air flow, blockage by secretions and difficult suctioning caused by tubes with smaller internal diameter for age, airway injury brought by glottis injury and tracheal rupture or mucosal ischemia, increased chance of bronchial intubation, additional monitoring of the cuff pressure, occasional design flaws, and higher tube prices compared to uncuffed ETs.[5]

Studies Comparing Uncuffed and Cuffed Endotracheal Tubes in Pediatric Anesthesia

Several studies compared the use of uncuffed and cuffed endotracheal tubes during surgeries under general anesthesia in children. In the meta-analysis of De Orange et al., they assessed the benefits and risks of uncuffed versus cuffed ETTs during general anesthesia among children up to 8 years old until March of 2017. Three trials were included comprising of 2804 children. Two of three trials found no difference between the groups for post-extubation stridor (RR=0.93; 95% CI 0.65-1.33; 2734 children; very low quality of evidence). Also in those trials, it was found out that there were significantly lower rate of ETT exchange in the cuffed endotracheal tube group (RR=0.07; 95% CI 0.05-0.10; 2734 children; very low quality of evidence). On the other hand, in one of the trials, the use of cuffed ETT was found to be lower in cost per case (mean difference=EUR 19.0 lower, 95% CI 24.23-

13.77 lower; 70 participants; low quality of evidence). This was explained by the offset of savings made with anesthetic gases as to higher cost of cuffed tubes.[7]

A more recent meta-analysis was done by Chen et al., which included six studies comprising of 4141 cases. There were no changes in the length of intubation, the frequency of reintubation, the rate of unintentional extubation, the incidence of croup, or the use of racemic epinephrine during intubation. There were also no differences on laryngospam and stridor occurrence after extubation. However, it was seen that more tube exchange is present in uncuffed tubes compared to cuffed tubes (OR=0.07; 95% CI=0.05 to 0.10; p<0.00001).[8]

No significant difference was seen in post-extubation laryngospam and stridor among children aged 2 to 12 years old who used uncuffed ETT (8.8%) and cuffed ETT (9.4%), p=0.15. This was the result of a randomized clinical trial conducted on children ages 2 to 12 years old (n=110 patients) that underwent cleft palate surgery from April 2014 to March 2015. However, incidence of sore throat was significantly higher in children aged 2 to 12 years old who used uncuffed group (31.6%) compared to cuffed group (9.4%), p=0.005. The mean time to achieve normal voice was shorter in those who have cuffed ET (14.34 hours) compared to uncuffed ETT (16.46 hours), p=0.008.[9]

Xiao et al., on the other hand, conducted a meta-analysis in November 2014 among pediatric patients who received endotracheal intubation both in the operating room and in the intensive care unit. Two random control trials and two cohort studies with 3782 patients (1803 patients with uncuffed ETT and 1979 patients with cuffed ETT) were included in the analysis. Results showed no significance difference in the stridor after extubation between the two groups (RR=0.88; 95% CI 0.67-1.16; p=0.36). The duration of intubation and the need for reintubation also did not differ significantly between the two groups, (weighted mean difference=3.31 hours; 95% CI -9.96-16.49; p=0.62) and (RR=0.76; 95% CI 0.19-3.02; p=0.07). However, there were lower tube exchange among those who had cuffed ET compared to those who received uncuffed tubes (RR=0.07; 95% CI 0.05-.10; p<0.00001).[10]

OBJECTIVES

General Objective

To describe the current attitudes and practices of anesthesiologists regarding the use of cuffed and uncuffed endotracheal tubes in pediatric patients.

Specific Objectives

1. To describe the percentage of anesthesiologists who prefer the use of cuffed or uncuffed ETT.
2. To identify factors that affect the anesthesiologists' decision in choosing the type of ETT in pediatric patients during general anesthesia.
3. To enumerate the criteria used by anesthesiologists in the selection of pediatric ETT size.

METHODS

Inclusion Criteria

Population, or participants and conditions of interest

Anesthesiologists handling pediatric cases for endotracheal intubation

Interventions or exposures

Uncuffed or cuffed endotracheal tubes during general anesthesia

Comparisons or control groups

None.

Outcomes of interest

Attitudes and practices of anesthesiologists regarding the use of uncuffed or cuffed ETT in children.

Setting

Any setting

Study designs

Any randomized clinical trial or observational study. This was selected since we expect a small number of studies that have been done in the topic. Although we intend to include RCTs, no relevant trials were found on the topic.

Exclusion Criteria

Case reports, case series, reviews, and practice guidelines will be excluded.

Information Sources

Cochrane Reviews, Medline, Pubmed, and EMBASE were searched from May 2020 to November 2020 using keywords ("cuffed" OR "uncuffed") AND ("ET tube" OR "endotracheal tube" OR "endotracheal intubation") AND ("attitude" OR "practice") AND ("Anesthesiologist" OR "Anesthesiology"). Backward searching of references cited in included studies was done. No hand searching of journals was done. Searches covered all studies published until June 2020. A study protocol has been pre-approved by the University of the Philippines Philippine General Hospital Department of Anesthesia prior the actual review.

Data Collection Process

Titles and abstracts generated from the electronic searches were reviewed against the inclusion criteria by two reviewers and a third one in case of disputes. The studies were grouped into two categories: 1. Potential for inclusion (studies which met the inclusion criteria and to be evaluated further) and 2. Excluded (studies which did not meet the inclusion

criteria). Studies for potential inclusion were then evaluated using full text copies in terms of methodology, outcomes measurement, and appropriateness for final inclusion.

Study Risk of Bias Assessment

Two investigators assessed each study's risk of bias independently. Upon instance of disagreements between the two, the research adviser would resolve the conflict and provide a consensus. Newcastle-Ottawa risk of bias tool for cross-sectional study was used for quality assessment.

Data Extraction

Data from studies were extracted into Review Manager (RevMan 5.3). Information included were author, year of publication, setting, percentage who preferred cuffed or uncuffed, factors that affect the anesthesiologists' decision in choosing the type of ETT, and criteria used by anesthesiologists in the selection of pediatric ETT size. The extraction was done between two reviewers and disputes will be resolved by a third author.

Narrative Synthesis

The selected studies were synthesized using a narrative review that discussed trends, similarities, and differences across studies on the proportion of anesthesiologists who prefer the use of cuffed or uncuffed ETT per patient age group, factors that affect the anesthesiologists' decision in choosing the type of ETT, and criteria used by anesthesiologists in the selection of pediatric ETT size.

Meta-analysis

Not applicable.

Grading Evidence

Not applicable.

RESULTS

As seen in Figure 1, a total of five studies were included in the systematic review after screening for 120 studies from the database search. A total of 114 studies were excluded because they do not involve the assessment of attitude and practice on the use of cuff or uncuffed ET in pediatric anesthesia. After full-text review another study was excluded because it was a review article only. Meta-analysis was not conducted since the studies varied greatly in methodology and measurement of outcomes reported.

Characteristics of Studies Included in the Review

Table 1 summarizes the characteristics of studies included in this review. In 2001, Orliaguet et al. conducted a survey to evaluate the proportion of senior pediatric anesthesiologists who use cuffed ETT versus those who use uncuffed ETT for tracheal intubation among the pediatric population. Also, the study aimed to identify the factors

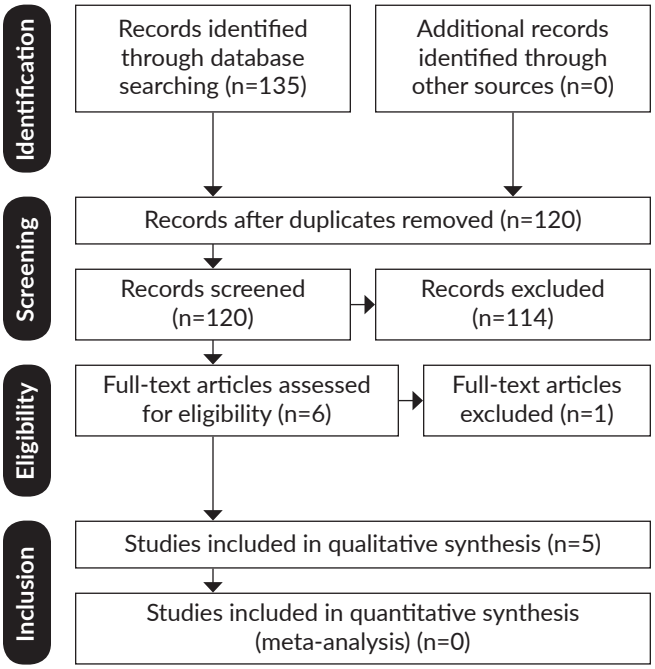

Figure 1. PRISMA flowchart of studies included in the study.

influencing their choice of the ETT. A total of 130 pediatric anesthesiologists (32 working in district general hospitals; 84 working in teaching hospitals; and 14 from those working in private hospitals) who were affiliated with the Association Des Anesthesistes Reanimateurs Pediatriques d'Expression Francaise practicing in France.[16]

Another survey study was done in 2008, where Flynn et al. sent questionnaires via e-mail to pediatric intensive care unit and anesthetic department clinicians in all UK specialist pediatric hospitals with a pediatric intensive care unit (n=30 where 20 pediatric intensive care units and 15 anesthetic questionnaires were returned). The study aimed to identify the current pattern of using cuffed ETT among children in specialist pediatric centers in the United Kingdom.[1]

In 2015, a similar study was done where an online survey was sent to 845 members of the Association of Paediatric Anaesthetists of Great Britain and Ireland (APAGBI) and 235 members of the Section of Paediatric Anaesthesia in the Netherlands (SKA); with an overall response rate of 34% noted. This was done to compare the current practice of using cuffed versus uncuffed ETTs in pediatric anesthesia.[3]

A self-structured questionnaire was also used by Murphy and colleagues to identify the patterns of type of tracheal tube usage among pediatric anesthesia in Ireland. This time the questionnaires were distributed during anesthesia conferences and departments in the country from March to August 2012, and it gathered a total of 231 respondents.[2]

With similar objectives of identifying the most recent attitudes and clinical practices on using pediatric ETT management, this time in Japan; Shibakasi et al., conducted a two-phase study. They conducted surveys on the institutional

attitudes in pediatric ETT management in 63 hospitals where councilors of Japanese Society of Pediatric Anesthesiology (JSPA) work. Also, data sheets of each institution and each patient in Japan were used to identify the practices regarding ETTs. Response of 42 (10 general hospitals, 22 university hospitals and 10 children's hospitals) out of 63 hospitals and data sheets of 915 cases (366 females, 548 males and 1 unknown) from the 42 hospitals were received.[4]

Since the study is descriptive in nature, some dimension of the quality assessment tool did not apply (Table 2). Overall, the selected studies were at risk for non-response bias and recall bias. Non-response bias may occur if the participants who opted out of the study differed significantly in characteristics with those who participated in the study which may yield to totally different results. In recall bias, participants who self-reported their preference and practice

Table 1. Characteristics of Studies Included in the Review

Author, Year	Country	Study Objectives	Study Design	Population and Sample Size	Results
***Orliaguet*, 2001**[16]	France	To look into the factors considered when choosing a tube and how the cuff is inflated when a cuffed tracheal tube (CTT) is utilized.	Cross-sectional	130 pediatric anesthesiologists	The presence of a leak, the type of surgery linked with the leak's presence, and the patient's age associated with the surgery's type and the leak's presence were the three key factors used to determine whether a cuff should be inflated. Few pediatric anesthesiologists frequently intubate children with cuffed tracheal tubes, and even fewer actually employ pressure monitoring equipment.
***Flynn*, 2008**[1]	United Kingdom	To examine current cuffed tracheal tube use in kids and compare it to UK practice for tracheal intubation in specialized pediatric facilities.	Cross-sectional	15 pediatric anesthesiologists and 20 pediatric intensivists	In children under the age of 8 years, only 5% of intensivists and 7% of anesthesiologists frequently utilize a cuffed tube. There is little advantage over utilizing an uncuffed tracheal tube, which was the most often mentioned justification for not employing a cuff in both groups. The most frequent specific indication for use of a cuffed tube was a reduced lung compliance (60% respondents both groups). In all, 45% of the intensivists and 100% of the anesthesiologists reported that they did not routinely monitor the intracuff pressure when using a cuffed tube.
***Boerboom*, 2015**[3]	United Kingdom and Netherlands	To evaluate and compare current practice in the use of cuffed endotracheal tube in pediatric anesthesia.	Cross-sectional	1080 pediatric anesthesiologists	Nation and setting influence the age at which anesthesiologists first consider using cuffed endotracheal tubes (CETs). In all age groups, CETs are used more often by Dutch anesthesiologists than British anesthesiologists. British and Dutch anesthesiologists have continuing concerns about cuffed tubes, especially about tracheal injury. A cuff pressure above 20 cm H_2O was unacceptable to the majority of British and Dutch anesthesiologists. Of British anesthesiologists, 66.8% never measure cuff pressure. Most Dutch anesthesiologists measure cuff pressure once. Unavailability of equipment was a reason not to measure cuff pressure as well as a reason for British respondents not to use CETs.
***Murphy*, 2016**[2]	Ireland	To ascertain the patterns of tracheal tube usage in pediatric anesthesia in Ireland.	Cross-sectional	231 pediatric anesthesiologists	75% of the 231 respondents routinely used non-cuffed tracheal tubes. Emergency procedures in unfasted children, obesity and planned laparoscopy influenced anesthesiologists to use a cuffed rather than a non-cuffed tube. 66% of respondents were unsure if they would use a high-volume low-pressure cuff. Anesthesiologists with higher pediatric workloads tended to employ a cuffed tracheal tube with a high-volume low-pressure cuff, compared to those with proportionately lower pediatric workloads.
***Shibasaki*, 2019**[4]	Japan	To reveal the most recent attitudes and clinical practices of pediatric ETT management in Japan.	Cross-sectional	915 pediatric patients handled by anesthesiologists	More than half of children older than 2 years of age were intubated with cuffed ETTs; 83.5% of cuffed ETTs were used with the cuffs inflated, and intracuff pressure (ICP) was measured in 80.7% of cuffed ETTs. More than half of ICP measurements were only taken at the time of intubation. Post-extubation stridor was rarely observed in cuffed (0.4%) or uncuffed ETTs (1.2%). Differences were observed in terms of age-based size selection, pressure of air leakage between cuffed (15 - 20 cmH_2O) and uncuffed ETTs (20 - 30 cmH_2O) of different sizes, and in the depth-marking method of insertion length. Continuous measurement of ICP was not common. This study revealed widespread use of cuffed ETTs in children older than 2 years of age, rarely occurrence of post-extubation stridor, inflation of cuffs, and practice of ICP measurement.

in ETT use may answer differently with what they can recall recently in their practice.

Current Attitudes and Practices

Table 3 summarizes the percentage of anesthesiologists who use uncuffed and cuffed ETTs. Orliaguet et al., reported that cuffed ETT was used by 25% of the participants for more than 80% of their patients; while approximately 37% of them use cuffed ETTs in less than 20% of their pediatric patients. It was mentioned that the participants use cuffed ETTs mainly because of: leak (32%), depending on surgery associated with the presence of leak (24%); and according to patient's age, type of surgery to be performed and presence of leak (18%). On the other hand, the cuffs of the ETTs were inflated because of leak (18%) and/or as response to pressure manometer (15%). It was explained that cuffed ETTs may increase the risk of airway mucosal injury and post-intubation tracheal stenosis.[16]

On the other hand, results of the study of Flynn et al., showed that only 7% of the participants who were anesthesiologists routinely use cuffed ETT for pediatric patients below 8 years old. More so, 27% of them did not routinely use cuffed ETTs among children ages 8 to 10 years old. As explained, the use of cuffed ETT has no/minimal benefit over using uncuffed ETTs. However, some indications, such as reduced lung compliance, warranted the use of cuffed ETTs; as reported by 60% of the anesthesiologist respondents. As for routine monitoring of the intracuff pressure of cuffed tubes, 100% of the anesthesiologists included said that they do not monitor it routinely.[1]

Boerboom et al. reported that cuffed ETTs were first used in neonates by Dutch anesthesiologists (47.3%), followed by British anesthesiologists (33.5%); and used more frequently as the patient's age increases. In general, Dutch anesthesiologists use cuffed ETTs more than British anesthesiologists, for all age groups of patients. Nevertheless, most Dutch participants measure intracuff pressure once; while 66.8% of their British counterparts never measure intracuff pressure at all. As for the use of ETTs, 11% of Dutch participants and 41% of British respondents did not perceive any problems with the use uncuffed ETTs.[3]

In Ireland, 75% of the anesthesiologist respondents routinely use uncuffed ETTs in children. Anesthesiologists use cuffed tubes than uncuffed tubes among emergency laparoscopic surgeries, obesity, and unplanned pediatric fasting ($p<0.001$). Anesthesiologists with greater pediatric workloads were inclined to use cuffed tubes with a high-volume low-pressure cuff ($p<0.01$).[2]

Lastly, Shibkasi et al., reported that 55.7% of children with ages more than 2 years of age and admitted in university hospitals were intubated with cuffed ETTs; while 45% of the cases use cuffed ETTs in general hospitals. As per levels of anesthesiologists, 61% of JSA qualified anesthesiologists use cuffed ETTs, 52.8% among JSA board certified anesthesiologists and 55.4% among JSA fellows. More so, 83.5% of the cuffed ETTs were inflated and the intracuff

Table 2. Quality Assessment of Included Studies

Author, Year	Representativeness of the Sample	Sample Size	Non-respondents	Ascertainment of the Exposure	Comparability	Outcome	Statistical Test
Orliaguet, 2001[16]	Somewhat representative	Justified and satisfactory	The response rate is unsatisfactory	Not applicable	Not applicable	Self-report	Not applicable
Flynn, 2008[1]	Somewhat representative	Not satisfactory	Satisfactory	Not applicable	Not applicable	Self-report	Not applicable
Boerboom, 2015[3]	Somewhat representative	Justified and satisfactory	The response rate is unsatisfactory	Not applicable	Not applicable	Self-report	Not applicable
Murphy, 2016[1]	Somewhat representative	Justified and satisfactory	The response rate is unsatisfactory	Not applicable	Not applicable	Self-report	Not applicable
Shibasaki, 2019[4]	Somewhat representative	Justified and satisfactory	Satisfactory	Not applicable	Not applicable	Record linkage	Not applicable

Table 3. Percentage of Anesthesiologists who Use Uncuffed and Cuffed ETTs

	Prefers Cuffed (n, %)	Prefers Uncuffed (n, %)
Orliaguet et al., 2001[16]	25% (33/130) prefers cuffed tube more than 80% of the time	19% (24) usually used uncuffed tube
Flynn et al., 2008,[1] 30 participants (20 intensivists and 15 anesthesiologists)	60% (12) routinely or frequently used cuffed tube among intensivists and 27% (4) frequently used cuffed tube among anesthesiologists	NA
Boerboom et al., 2015,[3] 1080 participants	33.5% of British and 47.3% of Dutch anesthesiologists used cuffed ETTs in neonates	NA
Murphy et al., 2016,[2] 231 participants	11% (26) used high volume low-pressure cuffed tubes	75% (170) used uncuffed tubes
Shibakasi et al., 2019,[4] survey response from 42 hospitals	52.8% to 61% used cuffed tube	70% used uncuffed tubes for neonates

pressures were measured in 80.7% of the cuffed ETTs. Also, 54.5% of the cuffed ETTs had intracuff pressure measured only during the time of intubation, while only 11.3% had continuous intracuff pressure monitoring.[4]

Factors Affecting Choice of ETT

Orliaguet et al., reported that reasons on why participants chose not to use cuffed ETTs include fear of an increased risk of airway mucosa injury and to decrease the incidence of post-intubation tracheal stenosis. More so, when asked on the criteria affecting the choice of ETT, respondents answered because of: personal choice (n=63, 49%), consensus of the Anesthesia Department (n=50, 38%), choice of the Certified Registered Nurse Anesthetist (n=1, 1%) and other reasons (n=16, 12%).[16] When asked of the criteria used for ET size use, participants in the study of Orliaguet et al., answered it was based on formula (n=20, 15%), abacus (n=21, 16%), comparison to the width of the fifth finger (n=28, 21%), abacus and size of the fifth finger (n=14, 11%) and other reasons (n=48, 37%).[16] Conversely, Shibakasi et al., reported that more than half of the hospitals that answered the survey based the cuffed ET size use on age.[4]

On the other hand, Flynn and colleagues mentioned that the most common reasons why anesthesiologists do not use cuffed ETTs were: they have lack of well fitted ETT and no/minimal advantage over uncuffed tubes (36% of babies and 50% of children aged 1 to 8 years are not utilizing cuffed ETs). However, the most common indication for cuffed ETT use was reduced lung compliance (60% of anesthesiologists' reason), followed by control of end-tidal carbon dioxide (27%).[1]

Murphy et al., also reported that anesthesiologist respondents were significantly (p-value<0.001) influenced to use cuffed ETTs over uncuffed type due to obesity, planned laparoscopy or an unfasted child for an emergency procedure.[2]

DISCUSSION

An established piece of anesthetic equipment has gained a relatively new and "simple" feature with the introduction of the cuffed pediatric endotracheal tube into pediatric therapy. The device change itself is minimal, and it has precedence in the long-term use of cuffed endotracheal tubes in adults. However, the use in pediatric anesthesia results in fairly intricate alterations in the 'interfaces' between the patient, ventilator, and the anesthesiologist. As seen in the studies reviewed, pediatric anesthesiologists vary in practice when using cuffed or uncuffed tracheal tubes during prolonged ventilation in intensive care units, and anesthesia during surgery.

The advantages of CETs in children have been further bolstered by recent discoveries about pediatric airway anatomy, which refuted earlier theories that supported unrestricted ETTs. Moreover, it has been demonstrated that they can be used safely, even on neonates. However, important issues remain to be considered by clinicians which include: 1. The condition to insert the cuff using a smaller internal diameter (ID) tube, 2. The requirement for further cuff pressure monitoring and adjustment, 3. The pressure's potential morbidity from the cuff, and 4. The chance of improper tube positioning or cuff herniation.

Common limitations in the evidence reviewed in this paper are the observational nature of study designs, recall bias during surveys among clinicians, and non-randomized sampling of participants from single institutions, which could lead to non-representativeness with the general population of anesthesiologists.

CONCLUSIONS

The current systematic review demonstrated that there is wide variation in current attitudes and practices of anesthesiologists regarding the use of cuffed and uncuffed ETT in pediatric patients. The use of cuffed ETT ranged between 11%-61% in the included studies and all reported that there were no consensus or standard on whether cuffed or uncuffed ETT was better. Likewise, factors affecting choice of ETT and criteria for selection varied in the published literature. Reported factors for cuffed ETT use included: 1. Personal choice, 2. Department protocol, 3. Availability of resources, and 4. Specific conditions such as obesity, planned or emergency procedure, and reduced lung compliance. In terms of ETT size, reported criteria were: 1. Use of a formula, 2. Use of abacus/calculator, and 3. In relation to the fifth finger's width. The results of this systematic review highlight the need for a standard guideline to help clinicians choose if cuffed or uncuffed ETT is better in certain scenarios and to help them decide in selecting the most appropriate ETT size.

Statement of Authorship

All authors certified fulfillment of ICMJE authorship criteria.

Author Disclosure

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