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How Pediatric Anesthesiologists Manage Children with OSA Undergoing Tonsillectomy

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Abstract

Objective: The purpose of this study was to describe typical anesthesia practices for children with obstructive sleep apnea (OSA).

Study Design: Online survey.

Method: A sample of pediatric anesthesiologists received the survey by email.

Results: 110 respondents were included. 46.4% worked in a free-standing children's hospital and 32.7% worked in a children's facility within a general hospital. 73.6% taught residents. 44.4% saw at least one child with OSA per week, 25.5% saw them daily. On a 100-mm visual analog scale, respondents rated their comfort with managing these children as 84.94 (SD 17.59). For children with severe OSA, 53.6% gave oral midazolam preoperatively, but 24.5% typically withheld premedication and had the parent present for induction. 68.2% would typically use nitrous oxide for inhalational induction. 68.2% used fentanyl intraoperatively, while 20.0% used morphine. 61.5% reduced their intraop narcotic dose for children with OSA. 98.2% used intraoperative dexamethasone, 58.2% used 0.5 mg/kg for the dose. 98.2% used ondansetron, 62.7% used IV acetaminophen, and 8.2% used IV NSAIDs. 83.6% extubated awake. 27.3% of respondents stated that their institution had standardized guidelines for perioperative management of children with OSA undergoing adenotonsillectomy.

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Supplemental Material

Supplemental material for this article is available online.

People who worked in children's hospitals, who had >10 years of experience, or who saw children with OSA frequently were significantly more comfortable dealing with children with OSA ($P < 0.05$).

Conclusion: Apart from using intraoperative dexamethasone and ondansetron, management varied. These children would likely benefit from best practices perioperative management guidelines.

Keywords

pediatric obstructive sleep apnea; tonsillectomy; pediatric anesthesia; opioids

Introduction

Adenotonsillectomy is one of the most frequently performed procedures in children[1–6] with obstructive sleep apnea (OSA) as one of the most common indications.[3–4,7] According to the American Academy of Otolaryngology, Head and Neck Surgery, severe OSA in children is defined by an apnea–hypopnea index of >10 on overnight polysomnography, which is the gold standard for diagnosis of OSA.[3–4,8] There is an increased risk of postoperative respiratory complications following tonsillectomy in children with OSA.[4,6,9–11] These include postobstructive pulmonary edema, pneumonia, airway obstruction, and respiratory failure.[4,10] The risk of these complications increases as the severity of the OSA increases.[4,12] Obesity leads to a fourfold increase in sleep-disordered breathing in children compared to children who are not obese and the risk of OSA increases as BMI increases.[4] Anesthetic management during tonsillectomy can influence outcomes in these children.[12] There is, however, a deficiency in prospective controlled studies that look at ideal anesthesia regimens for children with OSA.[12] Consequently, standardized national guidelines regarding anesthetic management in this setting are lacking. The objective of this study is to describe the current typical management of an otherwise healthy child with severe OSA by pediatric anesthesiologists. We hypothesize that a lack of the lack of prospective controlled studies that look at ideal anesthetic management in this patient population, and the resulting lack of standardized national guidelines, may result in variability in in the practices among pediatric anesthesiologists.

Methods

This study was approved by the West Virginia University Institutional Research Board. An electronic survey designed by two pediatric anesthesiologists trained and working in different institutions and one pediatric otolaryngologist was distributed to pediatric anesthesiologists by email. This was a convenience sample determined by the authors as a request to have the survey distributed by the Society for Pediatric Anesthesia was refused. The reason for this refusal was not provided. The distribution of the survey was therefore limited to anesthesiologists with contact information available to the authors as no national database of pediatric anesthesiologists was available to the authors at the time of the study. The survey was consequently emailed to pediatric anesthesiologists from ACGME contact lists, academic institutions and other pediatric email groups that the authors were part of, and recipients were asked to forward the survey on to their relevant contacts. We are unable

to calculate an exact response rate. All respondents were included, and no sample size calculation was performed.

The survey covered anesthesiologists' management of a child with severe OSA from premedication, intraoperative medications, extubation practices, and postanesthesia care unit (PACU) management. The prompt read "A 6.5-year-old boy with severe sleep apnea presents for adenotonsillectomy. He has a sleep study showing an AHI of 15 and oxygen saturation nadir of 89%. This is interpreted as severe sleep apnea in your institution. He has a normal BMI and is otherwise healthy. The following questions relate to your usual management of this patient for his surgery." Respondents were then queried about how they would change their management if the same child were obese (BMI of 32). Basic demographics were included, such as number of years of experience, work environment, and whether they taught residents. How often they encountered children with OSA and a 0 to 100-point slider visual analog scale (VAS) depicting their comfort level with managing them was included.

Data was analyzed with SPSS 25 (IBM Corporation, copyright 2017) using descriptive statistics and non-parametric comparisons (using a Kruskal–Wallis test). A Bonferroni correction was applied, making the significance level 0.002.

Results

Our study participants included 110 anesthesiologists, all of whom completed the entire survey. This represents approximately 2.7% of all pediatric anesthesiologists practicing in the United States.[13] Due to the methods for distributing the survey, it is impossible to estimate the actual response rate. Demographic information is listed in Table 1. The majority of respondents have been in practice for at least 5 years, with 30.9% being in practice for 5 to 10 years and 41.8% of respondents being in practice for >10 years, and most of the respondents practice in children's hospitals, whether associated with a general hospital or free-standing (32.7% and 46.4%, respectively). The majority of the respondents are involved in resident education (73.6%) and encounter children with OSA on a regular basis. Most respondents deny having any hospital-wide guidance regarding management of children with OSA (58.2%) or are unsure if such guidance exists (12.7%). Any further demographic information, such as geographic distribution, sex and age of respondents, is not available. On a 100-point slider VAS asking how comfortable the respondent was managing children with severe OSA, the mean was 84.94, median 91.0, range 17.0 to 100, and standard deviation 17.59.

Table 2 shows practices related to premedication and induction. Oral midazolam was used by 53.6% for premedication, with the dosage of 0.5 mg/kg being the most commonly used. Fever, productive cough, and wheezing were found to be the most common causes to cancel the case in 93.6%, 92.7%, and 89.1% of respondents respectively.

Medications given during surgery are described in Table 3. Most utilized an intraoperative narcotic, most commonly fentanyl at 1 to 2 mcg/kg. In comparison to a similar weight and age child without OSA, 61.5% reported using a lower dose of intraoperative narcotics for

children with severe OSA, while 22% would give a higher dose and 16.5% would not change it. Only 8.2% of study participants reported using intravenous (IV) NSAIDs routinely during adenotonsillectomy, with ketorolac 0.5 mg/kg being most commonly used.

Table 4 shows extubation and PACU practices. Other PACU medications for children with severe OSA that our participants considered routinely using in their practice included acetaminophen (40.9%), ondansetron (33.6%), and ibuprofen (31.8%).

Table 5 shows how anesthesiologists change their practice for children with severe OSA who are obese (BMI 32 in this case). This table also describes how many respondents dose based on actual or ideal body weight for obese children.

Comparison groups were based on years in practice, main work environment, participation in resident teaching, frequency of seeing children with OSA, and whether they had hospital-wide guidelines for managing OSA in children undergoing tonsillectomy. Table 6 shows comparisons for respondents' comfort with managing children with OSA.

There were few significant differences in responses between these groups at an alpha level of 0.002 (Bonferroni correction). There were no differences at this level of significance in preoperative management. Respondents working in a free-standing children's hospital were more likely to use morphine intraoperatively (56.6% versus 22.2% of those working in a children's hospital within a general hospital and 7.1% of those working in a general hospital, $P < 0.001$). Respondents who participated in teaching residents were more likely to cancel a patient for a fever (98.8% ($n = 81$) of academic anesthesiologists would cancel compared to 78.6% ($n = 22$) of nonacademics, $P < 0.001$).

Children with OSA were most likely to be seen by anesthesiologists working in a children's hospital within a general hospital; 88.9% ($n = 32$) saw them at least weekly. This was followed by 78.8% ($n = 42$) of those in a free-standing children's hospital, 37.5% ($n = 3$) of those working mainly in a surgery center, and 14.3% ($n = 2$) of those working in a general hospital ($P < 0.001$). There was no difference in years of practice or presence of hospital guidelines to manage children with OSA based on work environment, but there were more academic anesthesiologists working in children's hospitals than surgery centers or general hospitals. Here 86.5% ($n = 45$) of those working in free-standing children's hospitals, 72.2% ($n = 26$) of those in children's hospitals within general hospitals, 50.0% ($n = 7$) of those in general hospitals and 37.5% ($n = 3$) of those in surgery centers taught residents.

Discussion

This sample of 110 anesthesiologists showed variation in the perioperative management of children with severe OSA undergoing adenotonsillectomy. Areas of concurrence are the use of IV dexamethasone (98.2%) and ondansetron (98.2%). There is abundant literature about the use of IV steroids in tonsillectomy. A recent systematic review and meta-analysis of randomized controlled studies found that IV steroids provided significant improvement in postoperative nausea and vomiting, in addition to improved pain scores in the first 24 postoperative hours.[14] These results are in line with a prior Cochrane systematic review that found a single intraoperative IV dose of steroids to be safe and efficacious for reducing

morbidity associated with pediatric tonsillectomy.[15] Studies evaluating IV dexamethasone for use in tonsillectomy generally describe a weight-based dose of 0.15 to 1 mg/kg.[14–15] Prophylactic serotonergic antagonists (eg, ondansetron) have also been shown to be efficacious in prevention of postoperative nausea/vomiting in the setting of pediatric tonsillectomy.[16]

Preoperative management typically includes inhalational induction (96.4%). However, premedication with midazolam is not universal as only 59% use it. Preoperative midazolam can reduce anxiety in children undergoing general anesthesia.[17] However, there is evidence to suggest that preoperative midazolam for tonsillectomy has no impact on postoperative oral intake.[18] Additionally, research on nonpharmacologic preoperative anxiolytic techniques (eg, transporting patient in a toy car, video distraction), has shown promising results.[19–20] While midazolam administration can improve pediatric anxiety preoperatively, other adjunctive anxiolytic techniques can also be useful in this setting.[21,22] The incidence of use of midazolam as a premedication cannot be clearly ascertained. Based on the comorbidity, severity of sleep apnea and provider practice pattern; there can be significant variability in its usage.[21,22]

Almost a third of respondents forgo premedication and have the parent present at induction. There is evidence in the literature to support this strategy, as prior research has shown familial presence to decrease the need for pharmacologic preoperative anxiolysis for pediatric surgery.[23] additionally, parental presence may lead to reduced salivary cortisol levels during anesthesia induction as well as in recovery, which would indicate reduced stress in the patient.[24]

Intraoperatively, 62.7% typically use IV acetaminophen for this population. There was early interest in using intraoperative IV acetaminophen to reduce postoperative pain in children.[25–27] However, a recent randomized controlled trial with pediatric patients undergoing adenotonsillectomy has demonstrated no improvement in postoperative pain scores or narcotic dosing when an intraoperative dose of IV acetaminophen was used in patients who also received oral acetaminophen and ibuprofen postoperatively.[28] However, as demonstrated by the results from the current study, IV acetaminophen remains a commonly used analgesic in this setting.

Intraoperative opioid use also varies, with most using fentanyl, and a small percentage using none. Elshammaa et al reported that children receiving ketamine 0.5 mg/kg with or without fentanyl (1 mcg/kg) during tonsillectomy, were found to have better analgesia on arrival to the PACU and needed less supplemental analgesia in comparison with children receiving fentanyl 1 mcg/kg alone.[29] Many practitioners do not utilize ketamine as evidenced by our survey results as it may worsen postoperative agitation and increase secretions.[21,22]

Extubation practices vary, although most (80%) extubate awake. One systematic review and meta-analysis found that deep extubation reduced the overall risk of airway complications (such as cough and oxygen desaturations) in children undergoing general anesthesia.[30] This study found no difference in the rate of laryngospasm with deep versus awake extubation.[30] Deep extubation has been found to be safe in children undergoing tonsillectomy who have

high-risk features (eg, asthma, recent/current upper respiratory infection).[31]Furthermore, research has demonstrated that deep extubation remains as safe as awake extubation in patients with OSA.[32]

Opioid use in the PACU is common, with 87.2% of respondents using them sometimes or typically. Notably, 12.7% do not use opioids in PACU. During the postoperative period, oral analgesics are the primary method of pain control.[33] Concern about postoperative nausea and vomiting and worsening of respiratory depression in children suffering from OSA, has led to the use of nonopioid oral analgesics, such as acetaminophen and NSAIDs, which may be favored in managing post-tonsillectomy pain.[31] Although acetaminophen is considered a safe analgesic at normal doses and is commonly used, it may not provide sufficient pain relief post-tonsillectomy.[33] Therefore, NSAIDs, either exclusively or in conjunction with acetaminophen are being increasingly utilized.[33] As noted in the 2011 American Academy of Otolaryngology, Head and Neck Surgery Clinical Practice Guideline on Tonsillectomy in Children, ibuprofen is widely felt to be safe for use in post-tonsillectomy pain management.[33] This was based on a 2010 update of a 2005 Cochrane Collaboration review, which concluded that administration of NSAIDs did not change postoperative bleeding in comparison to placebo or other analgesics significantly.[33] However, there is newer evidence in the literature that ibuprofen can increase risk of post-tonsillectomy hemorrhage in certain patient populations.[34–35] There is ongoing concern regarding increased postoperative hemorrhage when ketorolac is used for analgesia, but there is conflicting evidence regarding the safety of ketorolac in pediatric tonsillectomy.[36–37]

The anesthesiologists who do use opioids in the PACU for a normal-weight child with severe OSA are most likely to use fentanyl (51.8%) which has a rapid onset and short duration of action.[33] There is an increase in analgesic and respiratory sensitivity to opioids in children with severe OSA.[5] These children may have an equal response to half the dose of opioids than children undergoing tonsillectomy for recurrent tonsillitis.[5] This may be the result of opioid receptor regulation produced by hypoxia that results from OSA.[5] Jaryszak et al reported that a preoperative oxygen saturation nadir of <80% increased postoperative respiratory complications that can be exacerbated by opioid administration.[10] Brown attributed the increase in analgesic sensitivity to opioids in children with a nadir oxygen saturation of <80% to the increase in mu-opioid receptors associated with intermittent hypoxia.[4] With this in mind, a short-acting narcotic may be the safest choice.

Just over 40% of respondents changed their preoperative plan if the child with OSA was also obese. Both young age and obesity increase the risks associated with tonsillectomy.[4,6] Hypoxemia occurs more frequently in young children with OSA during sleep compared to older children.[4] Posttonsillectomy respiratory compromise is associated with a preoperative sleep study oxygen saturation nadir <70% and/or central apnea.[4] Morbidly obese children are more likely to be admitted to the intensive care unit following adenotonsillectomy in order to manage their airways.[4] The degree of obesity and the severity of OSA have not been shown to be significantly correlated.[4] Postoperative respiratory complications are elevated in obese children with a history of OSA who were given opioids postoperatively.[6] Worsening of airway obstruction may occur on the firstnight post-tonsillectomy in these children.[6]

Limitations to our study included the fact that we used a convenience sample of pediatric anesthesiologists. There are about 4048 pediatric anesthesiologists practicing in the USA, so the sample size represents about 2.7% of the population. As well, the group is fairly small so that power to detect a difference in questions with more options is limited. A survey does not measure actual practice. Despite these limitations, our results add new information to the literature.

Conclusion

Our study shows that there is significant variation in anesthetic practices for children who undergo adenotonsillectomy for OSA. Adenotonsillectomy in children with severe OSA requires special attention because of the increased risk for respiratory complications. Adopting an individualized but protocol driven management plan according to the severity of the OSA in addition to identifying other risk factors, such as obesity, is crucial in order to minimize such complications. Reliable studies that establish an anesthesia regimen for children with OSA are lacking, and so it is difficult to establish a generalized management recommendation. Based on the survey results, physicians with >10 years of experience who practice in a teaching institution were most comfortable with taking care of these patients. Anesthesiologists who see children with OSA for tonsillectomy and practitioners in general hospitals were not as comfortable. This correlates with the APRICOT study[38] that found a 2% decrease in risk of severe cardiac critical events per year of experience that an anesthesiologist had. Dedicated teams who routinely provide anesthetic for these procedures in high volume children's facilities maybe the best suited for their care. Establishing standardized guidelines for management may reduce variability and increase safety for these patients. Based on our survey these guidelines could include:

- Adjusting premedication dosage for severity of OSA,
- Using inhalational induction
- Avoiding long acting opioids along with a dose reduction when used
- Routine use of steroids and antinausea prophylaxis
- Avoiding deep extubation
- Adjustment of postoperative pain regimen for ideal body weight
- Consider using teams that routinely provide anesthesia for children who are at high risk for adverse events.

These are all areas of potential research to improve care for children with OSA who are undergoing tonsillectomy.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1.

Demographics of Study Participants (n = 110).

Demographics	Study sample, % (n)
Years in practice	
< 5 years	26.4 (29)
Between 5 and 10years	30.9 (34)
> 10 years	41.8 (46)
Missing, *n*	1
Main work environment	
Free-standing surgery center	7.3 (8)
General hospital	12.7 (14)
Children's hospital with a general hospital	32.7 (36)
Free-standing children's hospital	46.4 (51)
Other	0.9 (1)
Missing, *n*	0
Participation in resident teaching	
Yes	73.6 (81)
No	25.5 (28)
Missing, *n*	1
Frequency of encountering children with OSA	
Rarely or never	0.9 (1)
A few times per year	8.2 (9)
At least 1 per month	20.9 (23)
At least 1 per week	44.5 (49)
Daily	25.5 (28)
Missing, *n*	0
Hospital-wide standard guidelines for preop, intraop, and postop management of children with OSA undergoing adenotonsillectomy	
Yes	27.3 (30)
No	58.2 (64)
Not sure	12.7 (14)
Missing, *n*	2

Table 2.

Premedication and Induction Practices of Study Participants (n = 110).

Practices	Study sample, % (n)
Premedication use	
Oral midazolam	53.6 (59)
IV midazolam	00.0 (0)
No premedication	10.9 (12)
No premedication, and parent present at induction	24.5 (27)
Other	11.8 (13)
Premedication change if child had OSA	
Yes	24.8 (27)
No	75.2 (82)
Missing, *n*	1
Route of induction for a normal-weight 6.5-year-old child with severe OSA	
Inhalation induction	96.4 (106)
IV induction	3.6 (4)
Other	00.0 (0)
Nitrous oxide use for a normal-weight 6.5-year-old child with severe OSA	
Yes, typically	68.2 (75)
Sometimes	20.0 (22)
No	11.8 (13)

Table 3.

Intraoperative Practices During Adenotonsillectomy, Apart from Narcotic Use, in a Normal-Weight 6.5-Year-Old Child with Severe OSA Among Study Participants ($N = 110$).

Practices	Study sample, % (n)
Narcotics	
Fentanyl	68.2 (75)
Morphine	20.0 (22)
Other	3.6 (4)
None	15.5 (17)
IV dexamethasone	
Yes	98.2 (108)
No	1.8 (2)
Dose of dexamethasone, mg/kg	
<0.2	9.3 (10)
Between 0.49 and 0.2	28.2 (31)
0.5	58.2 (64)
>0.5	1.8 (2)
Missing, *n*	3
Glycopyrrolate	
Yes, typically	10.0 (11)
Sometimes	12.7 (14)
No	76.4 (84)
Missing, *n*	1
Dose of glycopyrrolate, mg/kg	
<0.01	3.6 (4)
0.01	16.4 (18)
>0.01	0.9 (1)
Missing, *n*	87
Ondansetron	
Yes, typically	98.2 (108)
Sometimes	0.9 (1)
No	0.9 (1)
IV acetaminophen	
Yes, typically	62.7 (69)
Sometimes	6. 4 (7)
No	30.0 (33)
Missing, *n*	1
Dose of acetaminophen, mg/kg	
<10	0
10	9.1 (10)
11–14	9.1 (10)

Practices	Study sample, % (n)
≥15	50.0 (55)
Missing, *n*	35
IV NSAIDs	
Yes, typically	8.2 (9)
Sometimes	8.2 (9)
No	83.6 (92)
Inhalational anesthetic use	
Sevoflurane	91.8 (101)
Desflurane	7.3 (8)

Table 4.

Practices in the PACU in a Normal-Weight 6.5-YearOld Child with Severe OSA Among Study Participants (n = 110).

Practices	Study sample, % (n)
Typical extubation practice	
Usually extubate deep	13.6 (15)
Usually extubate awake	72.7 (80)
Keep ETT in place to PACU then extubate awake	10.9 (12)
Other	2.7 (3)
Opioid use	
Yes, typically	43.6 (48)
Sometimes	43.6 (48)
No	12.7 (14)
Opioids typically used	
Fentanyl	51.8 (57)
Morphine	39.1 (43)
Hydromorphone	2.7 (3)
Other	2.7 (3)
Routine use of O_2 supplementation	
Yes, typically	69.1 (76)
Sometimes	23.6 (26)
No	7.3 (8)
Other standard PACU medication use	
Acetaminophen	40.9 (45)
Ibuprofen	31.8 (35)
Ondansetron	33.6 (37)
Glycopyrrolate	0.9 (1)
Dexamethasone	10.9 (12)
Other	11.8 (13)

Table 5.

Practices Among Participants if the 6.5-Year-Old Patient with Severe OSA Was Obese (BMI 32) (*n* = 110).

Practice	Study sample, % (n)
Change in anesthesia protocol	
Yes	42.7 (47)
No	57.3 (63)
Missing, *n*	0
Where would you change your protocol	
Premedication	13.6 (15)
Induction	15.5 (17)
Intraop medications	26.9 (24)
Extubation	6.4 (7)
PACU or recovery room	10 (11)
Missing, *n*	0
Dosing premedication in obese children	
Ideal body weight	54.5 (60)
Actual body weight	30 (33)
Other	13.6 (15)
Missing, *n*	2
Dosing narcotics in obese children	
Ideal body weight	60 (66)
Actual body weight	25.5 (28)
Other	14.5 (16)
Missing, *n*	0

Table 6.

How Comfortable Are You Managing Children with OSA (VAS 0 Anchored as “Not Comfortable At All” to 100 Anchored as “Completely Comfortable”)?

	Mean	95% CI	*P*
Work environment			0.006
Free-standing children’s hospital	87.94	84.48–91.40	
Children’s hospital within a general hospital	87.47	82.65–92.29	
General hospital	65.58	46.10–85.07	
Years in practice			<0.001
<5	76.45	67.58–85.33	
5–10	80.97	73.93–88.00	
>10	91.82	88.37–95.26	
Frequency of treating children with OSA			<0.001
Daily	91.56	87.94–95.18	
At least 1 per week	89.11	86.08–92.13	
At least 1 per month	87.03	84.20–89.87	
A few times per year	45.00	17.93–72.07	
Do you teach residents?			0.134
Yes	86.41	82.78–90.05	
No	79.82	70.13–89.50	
Do you have standard hospital guidelines?			0.646
Yes	85.96	78.09–93.83	
No	86.40	82.53–90.28	