Office-Based Anesthesia: Safety and Outcomes in Pediatric Dental Patients

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The number of children with caries requiring general anesthesia to achieve comprehensive dental care and the demand for dentist anesthesiologists to provide ambulatory anesthesia for these patients is increasing. No current published studies examine the safety and outcomes of ambulatory anesthesia performed by dentist anesthesiologists for dental procedures in pediatric patients, and there is no national requirement for reporting outcomes of these procedures. In 2010, the Society for Ambulatory Anesthesia Clinical Outcomes Registry was developed. This Web-based database allows providers of ambulatory anesthesia to track patient demographics and various outcomes of procedures. Our study is a secondary analysis of data collected in the registry over a 4-year period, 2010–2014. Of the 7041 cases reviewed, no cases resulted in serious complications, including death, anaphylaxis, aspiration, cardiovascular adverse events, or neurologic adverse events. Of the 7041 cases reviewed, 196 (3.0%) resulted in a predischarge or postdischarge adverse event. The predischarge adverse event occurring with the highest frequency was laryngospasm, occurring in 35 cases (0.50%). The postdischarge adverse event occurring with the highest frequency was nausea, reported by 99 patients (5.0%). This study provides strong clinical outcomes data to support the safety of office-based anesthesia as performed by dentist anesthesiologists in the treatment of pediatric dental patients.

Key Words: Dentist anesthesiologist; OBA; Office-based anesthesia; Outcomes; General anesthesia; SAMBA Clinical Outcomes Registry; SCOR; Pediatric dental rehabilitation.

The use of office-based anesthesia (OBA) continues to shape the way surgical procedures are provided in the United States. Today an estimated 1 in every 4 elective surgical procedures is performed in the office-based setting, accounting for over 10 million cases annually.¹ The migration of elective surgeries from hospitals to outside venues began approximately 30 years ago, and has grown exponentially since then. In 1984, approximately 400,000 outpatient procedures were performed in nonhospital settings.² By the year 2000, the number of cases had grown to 8.3 million.² Treatment of patients using ambulatory OBA is associated with several advantages over hospital-based

treatment.³ These advantages include a decrease in cost and increase in access to care when compared with hospital-based treatment, improved patient and provider convenience, greater ease and efficiency of scheduling, and a decrease in wait time for necessary procedures.^{2,4}

The number of children receiving anesthesia for dental procedures in the United States is also increasing. In 2001, it was estimated that approximately 1 million young children required anesthetic management to facilitate their dental treatment.⁵ The guidelines of the American Academy of Pediatric Dentistry outline the specific populations in which deep sedation/general anesthesia (GA) is indicated. These include children and patients with special needs requiring extensive treatment and those with acute situational anxiety, uncooperative age-appropriate behavior, immature cognitive functioning, disabilities, or medical conditions that require deep sedation/general anesthesia.⁶ In 2012,

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the Pediatric Oral Health Research and Policy Center⁷ described general anesthesia as an essential health benefit for the treatment of early childhood caries in a comprehensive technical report for the American Academy of Pediatric Dentistry.

According to the American Hospital Association, in 2005, 55% of outpatient surgeries were completed in physicians' offices or freestanding surgical centers, and this number continues to grow each year.⁸ In 2012, Olabi et al⁹ identified an emerging trend in the use of dentist anesthesiologists in pediatric dental offices in order to expand the depth, scope, and effectiveness of office-based sedation and anesthesia services for the treatment of pediatric dental patients. As hospital operating room time becomes harder for pediatric dentists to obtain, the use of office-based general anesthesia in the treatment of pediatric dental patients will continue to grow.⁴

Despite the rise in non–operating room anesthesia, very little is known about the extent or nature of adverse events in these settings. In 2000, the Institute of Medicine released a report titled *To Err Is Human* that stated, “Little if any research has focused on errors or adverse events occurring outside of hospital settings.”¹⁰ Likewise, a 2014 review of the safety and outcomes of OBA noted a relative paucity of outcomes research in dental OBA, and most of the literature that currently exists on complications following anesthesia for dental procedures has focused on adults.^{11,12} Lee et al¹³ studied the morbidity and mortality for children in the United States subsequent to receiving sedation or general anesthesia for dental treatment based on available media reports, but noted that the most significant limitation of the study was that no database existed to help with estimates of these outcomes.

The need for a national database to collect information regarding patient safety and outcomes following OBA was addressed by the Society for Ambulatory Anesthesia (SAMBA). In 2010, SAMBA developed the SAMBA Clinical Outcomes Registry (SCOR), a Web-based database that allows providers of ambulatory anesthesia to enter information about their procedures and track outcomes. SCOR locations include private practice offices, freestanding ambulatory surgical centers, and hospital-based ambulatory centers. The database collects information including patient medical history, anesthetic technique used, the occurrence of adverse events, American Society of Anesthesiologists (ASA) status, pain control, and postoperative nausea and vomiting (PONV) for approximately 1500 participating physician and dentist anesthesiologists.¹⁴ Providers can use the information obtained by SCOR to identify adverse events and improve anesthesia safety. SCOR currently contains the largest pool of data for

cases of OBA performed by dentist anesthesiologists. The objective of this study is to examine the outcomes of dentist anesthesiologists providing office-based general anesthesia for pediatric dental patients, as recorded in the SCOR database.

METHODS

The data collection instrument was a validated Web-based program completed by volunteer dentist anesthesiologists from the American Society of Dentist Anesthesiologists over a 4-year period extending from 2010 to 2014. All personal and relevant clinical data for both patients and providers were deidentified and approval from the Indiana University Human Subjects Medical Institutional Review Board was obtained. Clinical data points were drawn from the preoperative, intraoperative, and postanesthesia phases of care (Appendix 1). Adverse events were grouped into 3 categories: those occurring predischarge, those occurring postdischarge, and any adverse events (including any event that occurred predischarge or postdischarge). Adverse events belonging to each category are found in Appendix 2.

Data were extracted and imported into Statistical Analysis System v9.3 (SAS institute Inc, Cary, NC) for management and data analysis. The outcome of interest was the frequency of adverse events during ambulatory dental anesthesia procedures in children and their association with patient factors. The study was designed to have 80% power to detect an odds ratio of 1.5 in the analysis of rare adverse events (2% occurrence rate), using a categorical patient characteristic with a 25/75 split, assuming 2-sided tests conducted at a 5% significance level. Categorical patient characteristics with splits closer to 50/50, continuous patient characteristics, and adverse events that occurred more frequently had greater than 80% power. Categorical variables were described with counts and percentages, and continuous variables were summarized with descriptive statistics. Associations of the patient characteristics with adverse events were analyzed using logistic regression, individually for each patient characteristic and in multiple-variable models.

RESULTS

A total of 8322 entries from 25 dentist anesthesiologists from the American Society of Dentist Anesthesiologists were identified in the SCOR. This group represented approximately 10% of the dentist anesthesiologists in the American Society of Dentist Anesthesiologists. Entries for patients above the age of 18 were excluded,

Eighty-five percent of pediatric patients seen by American Society of Dentist Anesthesiologists dentist anesthesiologists were ages 6 or younger, 12% were ages 7–12, and 4% were ages 13–18. The mean age of all patients was 4.7 years (SD = 2.9 years).

as were entries with missing ASA class, age, sex, case duration, anesthesia type, and facility type, leaving 7041 cases available for analysis.

Of the 7041 children, 5960 (84.6%) were age 6 and below, 816 (11.5%) were ages 7–12, and 265 (3.76%) were ages 13–18 (Figure). The mean age was 4.7 years and the mean weight was 20.8 kg. Gender distribution was nearly equal, with 3805 males (54.0%) and 3236 females (46.0%). Greater than 99% of the patients were classified as ASA I or II physical status classification (Table 1). The mean anesthesia time was 58.2 minutes, and the mean recovery to discharge time was 22.5 minutes (Table 1).

Of the 7041 cases, 52 patients (0.74%) gave a prior history of PONV and/or motion sickness, 7 (0.10%) reported documented obstructive sleep apnea, and 71 (1.0%) reported suspected obstructive sleep apnea. Two hundred forty-eight (3.52%) reported a pulmonary comorbidity.

Of the 7041 cases, 4712 patients (66.9%) received dexamethasone, 3967 (56.3%) received a serotonin receptor antagonist, and 4 (0.06%) received another antiemetic either prior to or during the case. The most common airway management technique used was nasal/oral airway, reported in 4459 cases (63.3%; Table 2).

Of the 7041 cases, 5521 patients (74.0%) were given local anesthetic for dental rehabilitation, 86 (1.0%) of which were reported as via peripheral nerve block and 5435 (73.0%) via local infiltration.

A summary of the incidence of adverse events is reported in Table 3. The pre-discharge adverse event occurring with the highest frequency was laryngospasm, occurring in 35 cases (0.50%), followed by nausea or vomiting requiring antiemetic rescue, occurring in 28 cases (0.40%). Twelve pre-discharge adverse events (0.17%) were reported as “other.” Over 85% (30 cases)

Table 1. General Demographic Data

Characteristic	Data
Age, mean $\pm$ SD, y	4.7 $\pm$ 2.9
Gender, %	
Female	46.0
Male	54.0
ASA physical status classification, %*	
I	81.0
II	18.0
III and above	0.37
Anesthesia time, mean $\pm$ SD, min†	58.2 $\pm$ 36.6
Recovery to discharge ready, mean $\pm$ SD, min†	22.5 $\pm$ 15.3

* ASA indicates American Society of Anesthesiologists.

† Anesthesia time is defined as the time between the first face-to-face contact with the anesthesiologist through induction, perioperative time, and emergence, up to the point where the patient recovery begins. Recovery to discharge ready includes recovery time up to the point where the anesthesiologist deems the patient has met adequate discharge criteria and is fit for discharge.

of the total 35 cases of laryngospasms occurred in children 6 and below; 8.5% (3 cases) occurred in children 7–12 and 5.7% (2 cases) occurred in the 13–18-year-old age group. Of the 30 laryngospasm cases in patients age 6 and below, 15 cases each were noted in the intubated group and the nonintubated group (Table 4).

A total of 1991 patients (28.3%) were reached for follow-up by the dentist anesthesiologist following their procedure. Of those, 99 (5.0%) reported experiencing nausea since discharge, 65 (3.26%) reported vomiting since discharge, and 6 (0.30%) reported difficulty voiding since discharge. Of the 99 patients who reported PONV, 83% (82) were age 6 and below, and 19 of those patients (23.1%) received a perioperative antiemetic. Fifteen patients that reported PONV were ages 7–12, and 5 of them (33.3%) received a perioperative antiemetic. Two patients who reported PONV were ages 13–18, and both of these patients received a perioperative antiemetic (Table 5).

Multivariable analysis was performed using a stepwise model selection procedure (Table 6). Five sets of analyses using logistic regression were performed: any adverse events occurring pre-discharge, any respiratory

Table 2. Airway Management Techniques*

Technique	No (%) of Cases
Nasal/oral airway	4459 (63.3)
Endotracheal tube	2747 (39.0)
Laryngeal mask airway	20 (0.28)

* Total percentages exceed 100.0% because multiple airway devices were used in some cases. Supplemental oxygen delivered through a nasal cannula or face mask was considered a method of oxygenation and is not included in this data set.

Table 3. Incidence of Adverse Events

<i>Type of Adverse Event</i>	<i>No (%) of Cases</i>
Predischarge	
Respiratory	
Laryngospasm	35 (0.50)
Bronchospasm	10 (0.14)
Difficult airway	4 (0.06)
Hypoxia	5 (0.07)
Reintubation	1 (0.01)
Malignant hyperthermia	0
Anaphylaxis	0
Aspiration	0
Dental injury	0
Index	
Death	0
Cardiopulmonary resuscitation	0
Disability	0
Wrong site	0
Retained object	0
Air embolus	0
Procedure-related	
Vascular complications	0
Pneumothorax	0
Local anesthetic toxicity	0
Patient safety-related	
Device malfunction	5 (0.07)
Patient fall	0
Fire/shock/burn	0
Recovery-related	
Antiemetic rescue	28 (0.38)
Unplanned urinary catheterization	3 (0.04)
Other	12 (0.17)
Postdischarge	
Vomiting	65 (3.26)
Nausea	99 (5.0)
Difficulty voiding	6 (0.30)

adverse events, any recovery-related adverse events, any postdischarge adverse events, and any adverse events. Statistically significant ($p < .05$) results of analyzing the risk factors individually are reported below.

In the multivariable analysis, a reported prior history of PONV or motion sickness resulted in 12.81 times increased likelihood of experiencing a recovery-related adverse event, 5.94 times increased likelihood of having any predischarge adverse event, and 3.65 times increased likelihood of having any adverse event compared to a patient with no prior history of PONV or motion sickness.

If there was a reported patient history of a pulmonary comorbidity there was 5.13 times increased likelihood of experiencing a respiratory adverse event, 4.04 times increased likelihood of experiencing any predischarge adverse event, and 2.79 times increased likelihood of experiencing any adverse event compared to a patient with no reported pulmonary comorbidity.

If documented obstructive sleep apnea was present, there was 16.67 times increased likelihood of a

Table 4. Laryngospasm by Age

<i>Age, y</i>	<i>Total No.</i>	<i>Intubated, No. (%)</i>	<i>Nonintubated, No. (%)</i>
6 and under	30	15 (42.8)	15 (42.8)
7–12	3	2 (5.7)	1 (2.8)
13–18	2	2 (5.7)	0

respiratory adverse event, 14.29 times increased likelihood of any predischarge adverse event, and 8.33 times increased likelihood of any adverse event compared to no documented history of obstructive sleep apnea.

If the patient airway was managed with an endotracheal tube, there was a 4.36 times increased likelihood of experiencing a respiratory adverse event and a 6.25 times decreased likelihood of experiencing any postdischarge adverse event compared to a patient whose airway was not managed with an endotracheal tube. If the airway was managed with a laryngeal mask airway (LMA) there was a 15.11 times increased likelihood of experiencing an adverse event in recovery and a 6.32 times increased likelihood of experiencing any predischarge adverse event compared to airway management without an LMA. For this analysis, 3 discrete methods of airway management were considered: endotracheal intubation, LMA, and nasal/oral airway. The use of a nasal cannula, nasal mask, or general anesthesia face mask was considered to be a method of supplemental oxygen delivery.

If a serotonin receptor antagonist (eg, ondansetron) was administered there was 2.7 times less likelihood of experiencing an adverse event in recovery compared to when no intraoperative serotonin receptor antagonist was administered. Similarly, if dexamethasone was not administered there was 2.44 times increased likelihood of experiencing any adverse event than if dexamethasone was administered. If no peripheral nerve anesthetic block was given, the likelihood of any adverse event occurring was 1.78 times greater than if a peripheral nerve anesthetic block was given.

In this study, if general anesthesia was administered using an inhalation anesthetic (gas), there was 3.57 times increased likelihood of a respiratory adverse event occurring and 1.37 times increased likelihood of any adverse event occurring than if propofol alone was administered for general anesthesia. Additionally, if general anesthesia was performed with inhalation anes-

Table 5. Postdischarge Nausea and Vomiting by Age

<i>Age</i>	<i>Total No.</i>	<i>Perioperative Antiemetic Given, No. (%)</i>
6 and under	82	19 (23.1)
7–12	15	5 (33.0)
13–18	2	2 (100.0)

Table 6. Multivariable Analysis of Adverse Events*

<i>Adverse Events</i>	<i>Effect</i>	<i>p</i>	<i>Odds Ratio (95% CI)</i>	<i>Variables</i>
Respiratory	Obstructive sleep apnea	.0019	2.56 (0.16, 33.33)	Documented vs suspected
			16.67 (1.20, 100)	Documented vs none
	Pulmonary comorbidity	.0001	5.13 (2.24, 11.79)	Yes vs no
	General anesthesia	<.0001	3.57 (1.22, 11.11)	Gas vs propofol
Recovery			11.11 (4.76, 25.0)	Gas vs gas/propofol
	Endotracheal tube	.0014	4.36 (1.77, 10.73)	Yes vs no
	Time from recovery unit to discharge (actual), min	.0112	1.01 (1.00, 1.02)	Per min
	History of PONV or motion sickness	.001	12.81 (2.82, 58.24)	Yes vs no
	Peripheral nerve block	.0063	5.93 (1.65, 21.29)	Yes vs no
	Laryngeal mask airway	.0105	15.11 (1.89, 120.77)	Yes vs no
	Serotonin-receptor antagonist	.0441	2.70 (1.03, 7.14)	No vs yes
Predischarge	Time from recovery unit to discharge (actual), min	.0056	1.01 (1.00, 1.02)	Per min
	History of PONV or motion sickness	.004	5.94 (1.77, 20.00)	Yes vs no
	Obstructive sleep apnea	.0065	3.85 (0.03, 50.0)	Documented vs suspected
			14.29 (1.61, 100.0)	Documented vs none
Postdischarge	Pulmonary comorbidity	.0004	4.04 (1.87, 8.75)	Yes vs no
	Peripheral nerve block	.0046	4.57 (1.60, 13.05)	Yes vs no
	Laryngeal mask airway	.022	6.32 (1.30, 30.61)	Yes vs no
	Endotracheal tube	<.0001	6.25 (3.33, 12.5)	No vs yes
	Time from recovery unit to discharge (actual), min	.0001	1.01 (1.01, 1.02)	Per min
	History of PONV or motion sickness	.007	3.65 (1.43, 9.35)	Yes vs no
	Obstructive sleep apnea	.0017	1.82 (0.17, 20.0)	Documented vs suspected
Any			8.33 (0.93, 100.0)	Documented vs none
	Pulmonary comorbidity	.0025	2.79 (1.44, 5.42)	Yes vs no
	General anesthesia	.0001	1.37 (0.31, 6.25)	Gas vs propofol
			3.85 (0.86, 16.67)	Gas vs gas/propofol
	No peripheral nerve block	.0242	1.78 (1.08, 2.93)	Yes vs no
	Oxygen/nasal cannula mask	.0006	1.92 (1.32, 2.78)	No vs yes
	Dexamethasone	<.0001	2.44 (1.59, 3.70)	No vs yes

* PONV indicates postoperative nausea and vomiting.

thetic, there was 11.11 times increased likelihood of a respiratory adverse event occurring and 3.85 times increased likelihood of any adverse event occurring than if general anesthesia was performed with gas and propofol.

DISCUSSION

This study is the first to examine clinical outcomes of OBA performed by dentist anesthesiologists on pediatric dental patients. The term *pediatric patient* is often broadly defined, and can encompass patients from neonates to age 21.¹⁵ In this study, approximately 96% of patients were 12 years of age or younger. Patients 6 years of age and below comprised 85% of the patients treated. A 2012 survey of pediatric dentists in private practice reported that 41.4% of their patients were under age 5.¹⁶ Thus, these data are particularly relevant to pediatric dentists, whose practices typically share the same concentration of patients in the preschool range.^{16,17}

In 2012, Forsyth et al⁴ reported a mean general anesthesia and dentist operator time required for pediatric dental procedures at Seattle Children's Hospi-

tal of 110 minutes. The mean anesthesia time of 58.2 minutes reported in our study compares favorably to this and is a significant benefit when comparing OBA to anesthesia performed in an operating room. Rashewsky et al¹⁸ reported similar findings in a 2012 study that concluded that ASA I pediatric patients can receive full-mouth dental rehabilitation utilizing GA under the direction of dentist anesthesiologists in an office-based dental setting more quickly than in a hospital setting. The mean anesthesia time in this study is also remarkably similar to that in other published studies examining dental rehabilitation. In a study of 7945 patients, Carter and Mohammed¹⁹ reported a combined mean operative time of 56.09 minutes for induction, operative procedure, and emergence. Similarly, a 2007 study of OBA for children with special health care needs reported a mean procedure time of 56.2 minutes and compared it to a mean procedure time of 130 minutes for cases performed in a hospital operating room.²⁰

The outcomes reported confirm many associations that are expected by practitioners. For example, the data demonstrate the association between a prior history of obstructive sleep apnea and pulmonary disorders and the increased likelihood of adverse events during

anesthesia procedures. The association found between a prior history of PONV and occurrence of adverse events was also expected, and was supported in the data.

PONV is an important adverse event, and a potential cause of morbidity in children following anesthesia. The incidence of postdischarge nausea and vomiting reported in this study (5.0% for nausea and 3.26% for vomiting) compares favorably to that in other published reports. In 1991, an overall PONV rate of 13.0% was reported in a multicenter study of 551 children returning home after outpatient surgery.²¹ More recent estimates of the overall incidence of PONV in children undergoing all procedures range between 8.9 and 42.0%.²² The 2 main factors that account for this wide variation are age and type of procedure. In 2006, a cohort study of 1401 children identified a baseline rate of PONV in children around age 3 of approximately 3.0%, which increased 0.2–0.8% per year and continued into adolescence.²³ Certain procedures, such as tonsillectomy, strabismus surgery, and otoplasty, have been reported as being associated with an increased risk of PONV; however, controversy exists as to whether this is due to the procedure itself or the use of opioids as part of the anesthetic regimen for these surgeries.²⁴ There are no studies reporting the relative risk of PONV following dental rehabilitation under general anesthesia in children; however, several risk factors, including a tendency for low-grade postoperative bleeding, use of intraoperative opioids and/or nitrous oxide, and an increased opportunity for ingestion of blood, secretions, and foreign materials following surgery, should be considered.

It is noteworthy that a significant amount of postdischarge PONV occurred despite the prior administration of antiemetic agents to over half of the 7041 patients in this study (Table 5), and this is consistent with other published reports. Stewart et al²⁵ reported an overall PONV incidence of 15.6% following tonsillectomy even after the prophylactic administration of 0.4 mg/kg of dexamethasone and 0.1–0.2 mg/kg of ondansetron. However, this compares favorably to an early report of 70% incidence of PONV in children undergoing tonsillectomy when no antiemetic prophylaxis was administered.²⁶ No consensus currently exists for antiemetic dosing guidelines prior to dental rehabilitation. PONV continues to be a significant source of distress for pediatric patients and their caregivers following outpatient anesthesia for all procedures. Further research in this area would be of great interest and value to both the dental anesthesia community and the greater community of anesthesia providers that routinely treat children. The results reported here are limited by the general design of the study and the 28% follow-up rate. Further studies are needed that more specifically address the management of PONV in this population.

Nearly 86.0% of the total number (35 cases) of laryngospasms that occurred in this study occurred in children ages 6 and below (Table 4). This is consistent with several studies that demonstrate significantly higher rates of both reactive airway and laryngospasm in young children.^{27–29} The distribution of laryngospasm also corresponds to the age distribution of the study sample, in which 85.0% of pediatric patients seen by American Society of Dentist Anesthesiologists dentist anesthesiologists were age 6 and younger, 12.0% were between the ages of 7 and 12, and 4% were between the ages of 13 and 18 (Figure). Thus, the incidence of laryngospasm is distributed proportionally across all ages in this sample, consistent with patterns seen in previously published studies.

Interestingly, there was no difference in frequency of laryngospasm found when comparing intubated to nonintubated airways (Table 4). Providing general anesthesia with a nonintubated airway is sometimes thought to make the patient more prone to laryngospasm. This is because secretions, blood, irrigation fluids, and other debris can irritate a glottis that is not protected with an endotracheal tube during the intraoperative, or maintenance, phase of anesthesia. In contrast, it is also known that the physical contact of an endotracheal tube or endotracheal cuff with the vocal cords can cause laryngospasm during light levels of anesthesia and irritate a reactive airway.³⁰ Laryngospasms that occur when endotracheal tube airway management is used are most expected during the induction and emergence phases of anesthesia.³¹ Although a statistically significant association ($p = .0014$) was found in this study between the use of an endotracheal tube and respiratory adverse events, most frequently laryngospasm, the data set in this study is not sensitive enough to distinguish between laryngospasms that occurred during induction, maintenance, and/or emergence. However, the even distribution of laryngospasms found between intubated and nonintubated cases does not support the belief that anesthesia without an endotracheal tube is inherently more prone to laryngospasm than anesthesia with intubation. Further studies are needed to investigate and clarify this observation.

Regarding airway management techniques, the use of nasal cannula, nasal mask, or face mask as a sole means for oxygenation (ie, natural airway) is not clearly described in these data. Overall, it appeared that 7.8% of the cases entered used only a nasal cannula/mask for oxygenating a natural airway. This number is slightly inflated because of 1 outlying center that reported 29.5% of cases. All of the other centers reported rates below 10%, with the average being 5.8%. In contrast to this, only 0.7% reported the sole use of a GA face mask,

with an average of 0.8% and none reporting more than 4%. In practical terms, these 2 categories of natural airway techniques probably represent patients undergoing mask induction for very brief procedures or moderate/deep sedation with a nasal cannula, perhaps being augmented by brief period(s) of GA. Further studies are needed to address questions regarding the preference of airway management techniques by dentist anesthesiologists for OBA.

Similarly, an LMA for airway management was used in less than 1% of cases in this study (Table 2). The data collection instrument did not differentiate between LMAs placed intentionally at the beginning of the case and those placed intraoperatively to correct suboptimal ventilation during nonintubated general anesthesia. For this reason, and because of the low number of cases that included an LMA, it is not possible to determine cause-effect relationships between the use of an LMA and adverse events in this study.

There have been conflicting views as to whether local anesthetic used in conjunction with general anesthesia improves the quality of intraoperative anesthesia and recovery. In a randomized controlled study, Sammons et al³² demonstrated a statistically significant decrease in pain following dental extractions if local anesthetic was used during general anesthesia, although the decrease was significant only for 5 minutes postprocedure. Conversely, Al-Bahlani et al³³ reported an increase in postoperative distress in children recovering from general anesthesia who received infiltration with local anesthetic. In a survey of American Academy of Pediatric Dentistry members, Townsend et al³⁴ reported there is no consensus among members on the use of local anesthesia during dental rehabilitation under general anesthesia. In a separate study, Townsend et al³⁵ surveyed dentist anesthesiologists and 90.0% reported they preferred administration of local anesthesia, citing benefits including stabilization of vital signs/decreased depth of general anesthesia and improved patient recovery. Our findings are consistent with the survey of Townsend et al³⁵ of dentist anesthesiologists, showing a strong predilection for the administration of local anesthesia to young children undergoing general anesthesia administered by a dentist anesthesiologist for general anesthesia. Unfortunately, the data do not distinguish whether the dentist anesthesiologist or the restorative dentist provided local anesthesia.

Our results are consistent with previously published studies that demonstrate a relatively higher incidence of postoperative adverse events associated with inhalation anesthetics versus propofol for general anesthesia.^{36–38} Emergence agitation and airway excitement are known complications of anesthesia induction and maintenance using sevoflurane, and the use of propofol for maintenance

anesthesia is known to provide a smoother recovery.^{36–38} The results of this study are similar to those reported in previous studies in that compared outcomes following inhalation-based anesthesia to propofol-based anesthesia.^{36,38}

The authors recognize that an inherent limitation of this study is that outcomes are self-reported into the SCOR database by the dentist anesthesiologist. Other major outcomes registries in anesthesia share this limitation. For example, the National Anesthesia Clinical Outcomes Registry, which is the source of many published anesthesia outcomes studies, shares this limitation. When the SCOR database was developed, its purpose was to help anesthesia providers track and improve procedural outcomes in their own practices by comparing their outcomes to other, anonymous dental anesthesia practices. The relatively large size of this sample of dentist anesthesiologists also supports the notion that this subset of dentist anesthesiologists reflects the experience of the American Society of Dentist Anesthesiologists.

This study provides strong clinical outcomes data to support the safety of OBA as performed by dentist anesthesiologists. The adverse events noted here compare favorably to the published outcomes studies of comparable office-based anesthetics. Further outcomes studies are encouraged for this emerging group of anesthesia providers to further define their practice and develop evidence-based best practices.

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APPENDIX 1. CLINICAL DATA POINTS DRAWN FROM THE PREOPERATIVE, INTRAOPERATIVE, AND POSTANESTHESIA PHASES OF CARE

1. Preoperative
 - a. Physical characteristics
 - i. Age
 - ii. Weight
 - iii. Gender
 - iv. Type of procedure
 - v. American Society of Anesthesiologists (ASA) physical status (I = normal healthy patient, II = patient with mild systemic disease, III = patient with severe systemic disease, IV = patient with severe systemic disease that is a constant threat to life)
 - b. Patient history
 - i. History of postoperative nausea and vomiting or motion sickness
 - ii. Comorbidities
 1. Documented obstructive sleep apnea
 2. Suspected obstructive sleep apnea
 3. Pulmonary disorders
 4. Diabetes mellitus
 5. Hypertension
2. Intraoperative
 - a. Surgery start time
 - b. Surgery end time
 - c. Airway management technique
 - i. Endotracheal tube
 - ii. Laryngeal mask airway
 - iii. Oxygen nasal cannula/mask
 - iv. Nasal/oral airway
 - v. General anesthesia face mask
 - d. Opioid administered
 - e. Antiemetic administered
 - f. Nonsteroidal inflammatory drugs administered
 - g. Route of local anesthetic administered
 - i. Infiltration
 - ii. Peripheral nerve block
 - h. General anesthesia technique
 - i. Gas only
 - ii. Propofol only
 - iii. Combination of gas and propofol
3. Postoperative
 - a. Time patient entered recovery unit
 - b. Time to fitness for discharge
 - c. Time of actual patient discharge

APPENDIX 2. ADVERSE EVENTS REPORTED BY SOCIETY FOR AMBULATORY ANESTHESIA CLINICAL OUTCOMES REGISTRY PARTICIPANTS

1. PredischARGE adverse events
 - a. Respiratory adverse events
 - i. Laryngospasm
 - ii. Bronchospasm
 - iii. Difficult airway
 - iv. Hypoxia
 - v. Reintubation
 - vi. Malignant hyperthermia
 - vii. Anaphylaxis
 - viii. Aspiration
 - ix. Dental injury
 - b. Index adverse events
 - i. Death
 - ii. Cardiopulmonary resuscitation
 - iii. Cardiovascular
 - iv. Neurologic
 - v. Disability
 - vi. Wrong site
 - vii. Retained object
 - viii. Air embolus
 - c. Procedure-related adverse events
 - i. Vascular complications
 - ii. Pneumothorax
 - iii. Local anesthetic toxicity
 - d. Patient safety-related adverse events
 - i. Device malfunction
 - ii. Patient fall
 - iii. Fire/shock/burn
 - e. Recovery-related adverse events (occurring in the postanesthesia care unit or comparable recovery unit)
 - i. Antiemetic rescue
 - ii. Pain medication or opioid given
 - iii. Unplanned urinary catheterization
 - f. Other adverse events (any event not listed on the Society for Ambulatory Anesthesia Clinical Outcomes Registry data sheet)
2. Postdischarge adverse events
 - a. Vomiting
 - b. Nausea
 - c. Difficulty voiding
3. Any adverse event