

FEASIBILITY AND SAFETY OF COMBINING DENTAL RESTORATION WITH OTHER PROCEDURES UNDER GENERAL ANESTHESIA IN CHILDREN WITH SPECIAL HEALTH CARE NEEDS

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Abstract

Background: The requirement for dental treatment under general anesthesia (GA) is especially pertinent in children with special health care needs (SHCN) as this patient population often experiences significant anxiety and may have multiple co-morbid conditions that require multiple anesthetic exposures for additional non-dental procedures. The primary aim was to evaluate the safety of combining dental procedures with other surgical procedures under GA among children with SHCN. The secondary aim was to investigate factors associated with perioperative complications and the need for inpatient admission.

Methods: This study was a retrospective review of patients ≤ 18 years of age with SHCN who underwent dental surgery as well as one or more additional non-dental or radiologic procedures under a single GA. Data extracted included demographics, type of procedure, perioperative complications, and discharge disposition (inpatient or outpatient).

Results: Complete records were available 55 patients undergoing a median of 3 procedures under a single anesthetic encounter. Seven patients had minor postoperative complications including postoperative vomiting (n = 4), fever (n = 2), or pain, agitation, and pneumonia (n = 1 each). Twelve of the 55 patients were scheduled for inpatient admission including 4 who had postoperative complications. There were no unplanned admissions. Planned admissions were more common with American Society of Anesthesiologists' (ASA) physical classification 3-4 compared to 1-2 (OR = 4.1; 95% CI: 1.1, 16.1; p = 0.040).

Conclusions: Our preliminary data suggest that dental procedures can be combined with other surgical procedures under a single anesthetic encounter with a limited incidence of perioperative complications without an increased incidence of unplanned admissions.

Keywords: dental surgery; surgery procedures, combined anesthetics

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Introduction

Restorative dental procedures may require general anesthesia (GA) in the pediatric population because of the patients' cognitive level and functional status. The requirement for dental treatment under GA is especially pertinent in children with special health care needs (SHCN). Children with SHCN are those who have or are at risk for chronic physical, developmental, behavioral, and emotional conditions¹. In this population, GA is used for those who are unable to cooperate or experience significant anxiety, when local anesthesia may be ineffective, when the surgical procedure is anticipated to be complex or prolonged, or in the presence of significant co-morbid medical conditions². Restorations placed under GA for the treatment of early childhood have been reported to be of higher quality than those placed using procedural sedation³. However, the cost of scheduled operating room (OR) time for dental surgery under GA may result in a financial burden for families. The 2% of Medicaid-eligible children who receive such treatment account for 25% of Medicaid dental expenditures⁴. Extended OR waiting times can also mean that children are not receiving optimal care. In our institution, waiting times for dental treatment in the main OR under GA are approaching 6 months. Additionally, in children requiring both dental and non-dental surgery, repeated exposure to GA may be a concern due to the inherent risks of GA especially in patients with co-morbid medical conditions as well as the theoretical concerns regarding the potential neurocognitive effects of intravenous and volatile anesthetic agents⁵.

To improve OR efficiency, reduce multiple exposures to GA, and increase cost savings for children requiring both dental and other surgical or radiologic procedures under GA, these procedures may be combined under a single anesthetic encounter. Although it is intuitive that combined procedures should result in cost savings, there are limited data evaluating the feasibility and safety of combining dental procedures with other surgical procedures under a single anesthetic encounter⁶. The current study reviewed the safety of combining dental procedures with other surgical procedures under GA among children with SHCN treated at a tertiary care pediatric hospital. The secondary aim was to investigate

patient or procedure-related factors associated with perioperative complications.

Methods

This retrospective study was approved by Nationwide Children's Hospital Institutional Review Board with a waiver of individual consent. This study involved a retrospective review of the quality improvement database from the Department of Anesthesiology & Pain Medicine at Nationwide Children's Hospital (Columbus, Ohio). Nationwide Children's Hospital is an urban, free-standing, 510 bed tertiary care children's hospital. The electronic medical records (EMR) were reviewed of patients ≤ 18 years of age who had SHCN (chronic physical, developmental, behavioral, and emotional conditions) who underwent a single anesthetic procedure combining dental surgery with one or more additional non-dental surgical or radiologic procedure during a 12-month period. All patients meeting inclusion criteria were included in the analysis.

Data extracted from the EMR included patient demographics (age, sex, weight), type and duration of the surgical or radiological procedure, dental procedures completed, medications administered, post-anesthesia care unit (PACU) length of stay, discharge disposition (inpatient or outpatient), and time to discharge. In separate analyses, demographic and clinical characteristics were compared according to the occurrence of perioperative complications and according to inpatient admission status. Continuous data were summarized as medians with interquartile ranges (IQR), and compared using rank-sum tests, with 95% confidence intervals (CIs) of differences calculated using the Hodges-Lehmann method. Categorical data were summarized as counts and percentages, and compared using logistic regression with odds ratios (ORs) and 95% CI. Data analysis was performed using Stata/13.1 IC (College Station, TX: StataCorp LP) and $P < 0.05$ was considered statistically significant.

Results

A total of 60 combined GA cases were selected

for retrospective review by an anesthesiologist and a dentist. Complete EMR records and results were available from 55 patients (26 boys and 29 girls) with a median age of 5 years undergoing a median of 3 procedures under a single anesthetic encounter (Table 1). The most common procedures performed in combination with a dental procedure were ear tube insertion (n = 13), adenotonsillectomy (n = 7), and bronchoscopy (n = 5). Seven patients had postoperative complications, most commonly postoperative vomiting (4 of 7) followed by fever (2 of 7), pain (1 of 7), agitation (1 of 7), and pneumonia (1 of 7). A total of 12 patients had a pre-planned scheduled inpatient admission. Of these, 4 of the patients had postoperative complications. Planned admissions were significantly related to higher American Society of

Anesthesiologists' (ASA) physical classification 3-4 versus ASA classification 1-2 (OR = 4.1; 95% CI: 1.1, 16.1; p = 0.040; Table 2). There were no unanticipated admissions. The dental procedures involved extractions (n = 33; 5 complications) and hygiene-only or other procedures (n = 21; 2 complications, including 3 hygiene-only cases where 1 involved a complication). No covariates were significantly different between patients developing complications and other patients (Table 3).

Discussion

GA has become an accepted option for pediatric patients undergoing dental restoration procedures². The expense of treatment in the OR and limitations in operating room scheduling and space mandates its judicious use with restriction for specific patient or procedure-related indications⁴. Reimbursement for services may involve the dental procedure itself, anesthesia fees, and facilities fees. The cost of GA and the 3 categories mentioned above are usually covered by Medicaid; however, the reimbursement rate from Medicaid varies considerably from state to state and is often below a profitable margin for those involved in the care (dentists, hygienists, and anesthesia provider)⁷. Despite such issues, care must be provided for these services in this population who often has little other option for such services. Due to these costs and the limited reimbursement which may be available, increased efforts must be made to optimize the utilization of facilities as well as medical and nursing personnel^{8,9}.

Although there are limited data, the performance of multiple surgical procedures under a single anesthetic encounter has been shown to reduce costs without an increase in morbidity^{6,10,11}. A retrospective case series reported a cost savings of approximately 40% when combining dental and urologic procedures in children¹⁰. Stapleton et al. retrospectively reviewed the records of 120 patients, ranging in age from 2 to 21 years (98% of whom had SHCN), who received combined dental care and one other procedure under GA. All were treated as outpatients and the dental procedure included more than just radiographic investigations. Oral surgery (41%) and otolaryngology

Table 1

Characteristics of children undergoing combined dental procedures under general anesthesia (n = 55)

Variable	N (%) or median (IQR)
Female gender	29 (53%)
Age (years)	5 (3, 9)
ASA status	
1-2	33 (60%)
3-4	22 (40%)
Previous anesthesia	44 (80%)
Anesthesia time (minutes)	126 (96, 162)
Oral endotracheal intubation	21 (38%)
Local anesthetic used	24 (44%)
Radiographic images	
0-3	30 (55%)
4-10	25 (45%)
Number of procedures	
2	27 (49%)
3-6	28 (51%)
Type of dental procedure	
Extraction	33 (60%)
Other ^a	22 (40%)
Any complication	7 (13%)
Inpatient admission ^b	12 (22%)

ASA = American Society of Anesthesiologists; IQR = interquartile range

^aIncluding 3 hygiene-only cases.

^bNo unplanned admissions.

Table 2
 Characteristics of children undergoing combined dental procedures under general anesthesia,
 according to need for inpatient admission (n = 55).

	Outpatient (n = 43)	Inpatient (n = 12)	OR (95% CI)	Difference of medians (95% CI)	P- value
Variable	N (%) or median (IQR)	N (%) or median (IQR)			
Female	23 (53%)	6 (50%)	0.9 (0.2, 3.1)		0.831
Age (years)	5 (3, 9)	6 (3, 9)		1 (-2, 3)	0.887
ASA status					
1-2	29 (67%)	4 (33%)			
3-4	14 (33%)	8 (67%)	4.1 (1.1, 16.1)		0.040
Previous anesthesia	33 (77%)	11 (92%)	3.3 (0.4, 29.1)		0.276
Anesthesia time (minutes)	126 (97, 147)	141 (96, 182)		15 (-25, 65)	0.488
Oral intubation	17 (40%)	4 (33%)	0.8 (0.2, 2.9)		0.696
Local anesthetic used	21 (49%)	3 (25%)	0.3 (0.1, 1.5)		0.151
Radiographic images					
0-3	23 (53%)	7 (58%)			
4-10	20 (47%)	5 (42%)	0.8 (0.2, 3.0)		0.766
Number of procedures					
2	21 (49%)	6 (50%)			
3-6	22 (51%)	6 (50%)	1.0 (0.3, 3.4)		0.943
Type of dental procedure					
Extraction	26 (60%)	7 (58%)	0.9 (0.2, 3.4)		0.894
Other	17 (40%)	5 (42%)			

ASA = American Society of Anesthesiologists; CI = confidence interval; IQR = interquartile range; OR = odds ratio

(23%) procedures were most frequently combined with dentistry. Estimated mean savings for patients receiving dentistry and third molar extractions in combination were 312 minutes and \$2,177 when compared with performing the procedures under separate GA encounters⁶.

A primary concern with this practice is the potential for increasing the incidence of perioperative complications by extending the single anesthetic encounter. This is especially relevant in children with SHCN who may have a higher ASA physical classification. In our cohort, 22 of the 55 patients (40%) were ASA III or IV. Despite that, the overall complication rate within our data set was limited at 12.7% (7 of 55 patients). All except for one of the

complications, the postoperative pneumonia, would be classified as minor. Four of the 7 patients that had complications had a pre-planned postoperative admission while the remaining 3 were successfully discharged on the same day, as originally scheduled. No associations were found between post-operative complications and pre-operative demographics although children with ASA physical status 3-4 were more likely to have a preplanned inpatient admission.

Limited data exist concerning the potential morbidity or even mortality risks of combined dental and other subspecialty cases. In 2011, The American College of Surgeons National Surgical Quality Improvement Program-Pediatric analyzed 46,281 patient surgical records from 43 institutions within

Table 3

Characteristics of children undergoing combined dental procedures under general anesthesia, according to presence of perioperative complications (n = 55)

	No complications (n = 48)	Any complication (n = 7)	OR (95% CI)	Difference of medians (95% CI)	P- value
Variable	N (%) or median (IQR)	N (%) or median (IQR)			
Female	25 (52%)	4 (57%)	1.3 (0.2, 6.1)		0.802
Age (years)	5 (3, 8)	8 (4, 9)		3 (-1, 4)	0.211
ASA status					
1-2	29 (60%)	4 (57%)			
3-4	19 (40%)	3 (43%)	1.1 (0.2, 5.7)		0.869
Previous anesthesia	37 (77%)	7 (100%)	a		a
Anesthesia time (minutes)	126 (97, 157)	121 (96, 198)		-5 (-68, 32)	0.570
Oral intubation	17 (35%)	4 (57%)	2.4 (0.5, 12.2)		0.279
Local anesthetic used	21 (44%)	3 (43%)	1.0 (0.2, 4.8)		0.965
Radiographic images					
0-3	26 (54%)	4 (57%)			
4-10	22 (46%)	3 (43%)	0.9 (0.2, 4.4)		0.883
Number of procedures					
2	23 (48%)	4 (57%)			
3-6	25 (52%)	3 (43%)	0.7 (0.1, 3.4)		0.650
Type of dental procedure					
Extraction	28 (58%)	5 (71%)	1.8 (0.3, 10.1)		0.513
Other	20 (42%)	2 (29%)			

^aOdds ratio cannot be calculated due to perfect prediction in “any complication” group. P=0.323 by Fisher’s exact test.

ASA = American Society of Anesthesiologists; CI = confidence interval; IQR = interquartile range; OR = odds ratio.

general hospitals or free standing children’s hospitals from 28 states and 1 Canadian province. Cases selected by Current Procedural Terminology codes encompassed procedures within pediatric general, otolaryngologic, orthopedic, urologic, plastic, neurologic, thoracic, and gynecologic surgery. The overall mortality rate was 0.3% with a reported morbidity incidence of 5.8% and a surgical site infection incidence of 1.8%¹². A study encompassing a 10-year time period reported no deaths in 22,000 patients, ranging in age from 1 to 6 years, undergoing dental treatment alone¹³.

In our study cohort, the morbidity rate was approximately twice that reported by The American College of Surgeons National Surgical Quality

Improvement Program; however, our study population was focused, including only patients with SHCN, a significant percentage of whom were ASA physical status III or IV¹². The list of morbidities reported by The American College of Surgeons National Surgical Quality Improvement Program included urinary tract infection, pulmonary embolism, deep vein thrombosis, pneumonia, the need for tracheal intubation after the procedure, renal complications including acute kidney injury, and cardiac arrest requiring cardiopulmonary resuscitation¹². Excluding the one case of pneumonia in our cohort, all of the complications were minor, easily treated or self-resolving, and did not lead to life threatening events¹⁴. Postoperative symptoms such as

pain, agitation, need for analgesics, and sleepiness are common following dental rehabilitation under GA in healthy children¹⁵. The case of pneumonia required antibiotic treatment, but did not prolong hospitalization or require ICU admission. Excluding the other common postoperative symptoms associated with dental procedures using GA, the one case of pneumonia was the only significant and unexpected postoperative complication, resulting in an overall complication rate of 2%. Furthermore, there were no unplanned inpatient admissions and no prolonged postoperative course. In our patient population, the average PACU stay was 59.2 minutes, which is significantly shorter than what is generally reported in the literature. In a prospective study of 1,060 children undergoing a single surgical procedure in the ambulatory setting, the average PACU stay was 85 minutes¹⁶.

In summary, the preliminary results of this study suggest that anesthesia for dental treatment can be combined with a variety of surgical and diagnostic procedures to provide safe, efficient and less expensive care to pediatric patients, particularly those patients with SHCN. One limitation of the current study was a somewhat limited cohort size of 55; however, these

preliminary data should provide the groundwork for more robust prospective trials. Future analysis with a larger patient population including non-SHCN cases is required with the goal of increasing the awareness of the benefits of combined care to patients to other subspecialties leading to a broader utilization of the combined service approach when appropriate. Whenever such care is planned, a multi-disciplinary approach is needed across numerous medical, surgical, and nursing teams to ensure the safe and efficient introduction of this process. Obstacles may include coordination of OR time among various subspecialties. As noted in our cohort, this frequently includes 3 or more surgical teams. Furthermore, as is the case in many hospitals, our radiologic facilities are one floor below our main operating room. Hence, transport from the OR to other sites or vice-versa may be needed to provide this care. However, we suggest that with appropriate preparation, such care not only improves the safety and efficiency of healthcare, but also limits time away from school for patients and work for families thereby adding to the non-financial benefits of this process.

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