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Effects of Intraoperative Precedex in the Post-Anesthesia Care Unit

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Abstract

Precedex is a common sedative used for procedural sedation and as an adjunct in general anesthesia. This project uses a retrospective chart review to determine if intraoperative Precedex boluses increase the length of stay in the postoperative anesthesia care unit (PACU). This project focuses on pediatric patients, 2-12 years old, undergoing tonsillectomy and/or adenoidectomy surgery. Indiana University Arnett Hospital and its associated ambulatory surgery center (ASC) are the sole facilities of this project implementation. Neuman's Systems Model Theory guides the framework for this project determining patient stressors and appropriate interventions.

Effects of Intraoperative Precedex in the Post-Anesthesia Care Unit

This project is submitted to the faculty of Marian University Leighton School of Nursing as partial fulfillment of degree requirements for the Doctor of Nursing Practice, Certified Registered Nurse Anesthesia (CRNA) track. Adenoidectomy and tonsillectomy are common childhood procedures performed in outpatient surgery centers. These procedures are associated with increased incidence of postoperative emergence delirium (POED), hemorrhage, and postoperative nausea and vomiting (Bediril et al., 2017). Each of these complications are potential causes for prolonged post-anesthesia care unit (PACU) recovery times. Recently, Precedex is gaining popularity in prophylactic treatment of POED, especially in children. The significance of POED is the psychological and physical harm a patient may endure while going through the recovery phase from anesthesia. POED is more common among pediatric patients than adults. It is a transient, dissociated state of consciousness characterized by crying, inconsolability, restlessness, uncontrollable flailing of arms, and agitation in children that begins with emergence from anesthesia and continues through the early recovery period (Lerman, 2020). The complications associated with POED may increase the duration of a patients' stay in the PACU. However, the side effects of Precedex may be the causative factor in prolonging PACU stays. The purpose of this project is to determine if intraoperative Precedex administration prolongs PACU recovery times.

Background

Reducing postoperative complications reduces length of PACU stay, reduces cost, and improves patient outcomes. Decreased PACU stays are associated with fewer postoperative complications and readmissions (Mann-Farr et al., 2019). The incidence of POED varies between 10% and 80% of pediatric patients undergoing surgery (Moore & Anghelescu, 2017). It

is one of the most common complications following pediatric surgery and may increase the risk of additional complications such as bleeding and self-harm. Risk factors for POED include the presence of preoperative anxiety, the child's temperament, and the presence of postoperative pain (FitzSimons et al., 2017).

The exact cause of emergence delirium is unknown but considered multifactorial in origin. One of the greatest risk factors for emergence delirium is the use of anesthetic gases during surgery. The rapid onset and offset of these gases make them ideal for outpatient surgeries to decrease turn over time and time to discharge. The preferred inhalational and maintenance anesthetic for pediatric surgery is Sevoflurane. Sevoflurane causes less irritation to the airway compared to other inhalational anesthetics, induces anesthesia quickly, and results in a faster recovery (Bediril et al., 2017; Koceroglu et al., 2020). The rapid awakening from Sevoflurane places the patient at an increased risk for POED due to the interruption of the physiologic sleep cycle.

Children frequently require medication for anxiolysis preoperatively. The drug of choice to reduce preoperative anxiety in children is oral midazolam. This medication has proven to be effective in assisting with inhalational induction and reducing preoperative anxiety and agitation. However, this drug has also shown to increase the incidence of POED. This drug works on the Gamma-aminobutyric acid (GABA) receptors and will create a hazy state of consciousness and anterograde amnesia (FitzSimons et al., 2017). When the patient arises from this state, they may be confused and become combative, agitated, or anxious. Despite this, it is still common practice to use oral midazolam as a first-choice anxiolytic preoperatively.

Precedex works on the alpha-2 adrenergic receptors. Studies have suggested the use of an alpha-2 agonist may decrease the incidence of POED because it mimics a normal sleep cycle

(FitzSimons et al., 2017). Precedex works as a sedative, analgesic, and anxiolytic. Providers continue to use midazolam and Sevoflurane for preinduction treatment and maintenance of general anesthesia (GA), respectively. The use of these drugs should encourage the use of alpha-2 agonists to decrease the incidence of POED. However, the use of Precedex to treat POED in pediatric patients is not yet approved by the Food and Drug Administration (FDA) (Taylor, 2016). Additionally, several studies have shown Precedex to prolonged emergence times and PACU stays (Bediril et al., 2017; Manning et al., 2020)

Problem Statement

POED is well documented in pediatric patients undergoing ear, nose, and throat surgeries. These patients are at increased risk for psychological stress and intentional self-harm in the postoperative period, thus prolonging their PACU stay. The question this project aims to answer is: in pediatric patients (ages 2-12 years old) undergoing a tonsillectomy and/or adenoidectomy, how do intraoperative Precedex boluses compared with no Precedex boluses affect PACU length of stay?

This quality improvement project will entail a retrospective chart review. Patient age and weight are included in the data analysis. Pediatric patients undergoing tonsillectomy and/or adenoidectomy are the target population for this project. This project aims to prove the use of Precedex decreases the PACU length of stay in pediatric patients undergoing tonsillectomy and/or adenoidectomy.

Organization “Gap” Analysis of Project Site

The ambulatory surgery center (ASC) associated with Arnett Hospital in Lafayette, Indiana provides care for outpatient pediatric surgeries daily. This makes it an ideal facility to implement this quality improvement project. Indiana University Arnett Hospital and the

associated ASC began regularly using Precedex boluses intraoperatively within the past twelve months. Current practice at Arnett is to use intraoperative infusions for cases lasting longer than 60 minutes. There are no current practice guidelines for intraoperative Precedex boluses at these facilities.

Recently, pharmacy began distributing 5 milliliter (mL) syringes containing 20 micrograms (mcg) of Precedex making it more readily available to anesthesia personnel at these facilities. This recent change has increased the use of intraoperative boluses, however there are barriers to its administration. Barriers to implement best practice are staff resistance to change, lack of staff knowledge regarding Precedex bolus administration, delayed emergence from anesthesia, and prolonged PACU recovery times.

Search Methodology

Research for supporting evidence for this review was provided through Cumulative Index Nursing & Allied Health Literature (CINAHL) and PubMed databases. The initial database search retrieved 5,215 articles and abstracts. However, only 206 articles were eligible for inclusion. Results were narrowed to include abstracts and full manuscripts published in English or translated to English within the last five years of this review (2015-2020). This review analyzes nine articles in total. For inclusion in analysis, study subjects were 2-12 years old, human, and receiving Precedex perioperatively. Exclusion criteria for this review were laboratory studies and adult patients. No exclusion criteria were included for gender, sample size, drug dose, drug route, or type of surgery. Keywords and search terms included *Precedex*, *dexmedetomidine*, *emergence agitation*, and *emergence delirium*. Boolean searches included *pediatric emergence delirium and dexmedetomidine*, *pediatric emergence delirium and Precedex*, *prolonged PACU stays*, and *pediatric emergence delirium*.

Review of the Literature

Advantages of Precedex

Precedex is gaining popularity as an anesthetic of choice due to its many advantageous properties. Advantages of Precedex include anxiolysis, experiencing a natural sleep pattern, analgesia, volatile agent-sparing properties, and minimal respiratory depressant effects (Fitzsimmons et al., 2017; Mahmoud & Mason, 2015). Precedex has shown potential organ protective effects. It creates a neuroprotective effect against hypoxemia and ischemic injury by decreasing cerebral blood flow in proportion to a decrease in cerebral metabolic rate (Mahmoud & Mason, 2015). A suggested nephroprotective mechanism of Precedex includes increased diuresis by reducing vasopressin secretion, enhanced renal blood flow, and improved glomerular filtration. (Mahmoud & Mason, 2015).

Perhaps the greatest advantage to Precedex is its ability to create a cooperative and arousable sedative state rather than a cloudy, confused state of consciousness. This mimics a natural sleep pattern without significant respiratory depression (Cao et al., 2016; Mahmoud & Mason, 2015; Moore & Anghelescu, 2017). Some patients have been observed to be arousable and alert with stimulation and therefore require an adjunct anesthetic (Taylor, 2016).

Most anesthetic plans in the operating room involve volatile agents. Precedex has been shown to decrease the requirement of volatile agents by 17% to 50%, depending on the dose (Fitzsimmons et al., 2017). Sevoflurane is the most used volatile agent for pediatric patients undergoing adenotonsillectomy. Faster recovery time is what makes Sevoflurane a desirable anesthetic. One of the main benefits to the use of Precedex is reduced POED (Hauber et al., 2015). Preschool-age children between the ages of two and six years old are at greatest risk for developing POED (Lerman, 2020). The incidence of POED diminishes with increased age.

In addition to diminishing volatile agent requirements, Precedex was found to lessen opioid consumption. Young children have decreased pain thresholds and exaggerated responses to pain (Fitzsimmons et al., 2017). Precedex significantly lowered opioid consumption when compared to control groups in pediatric patients (Cao et al., 2016; Hauber et al., 2015; Koceroglu et al., 2020; Mahmoud & Mason, 2015). Precedex works as an analgesic by supraspinal mechanisms and direct action on the spinal cord. This serves to augment the effects of exogenous opioids and thus reduce narcotic use by 30% to 50% (Fitzsimmons et al., 2017).

Further advantages of Precedex are minimized oxygen desaturation and significantly reduced nausea and vomiting. Improved extubating conditions such as decreased apnea, coughing, and desaturation were found with Precedex administration (Koceroglu et al., 2020). There are no known active or toxic metabolites and no absolute contraindications to Precedex in the literature or package insert. However, Mahmoud and Mason (2015) recommend that the use of Precedex be avoided in children receiving digoxin, β -adrenergic blockers, calcium channel blockers, or other agents that predispose the patient to bradycardia or hypotension.

Disadvantages of Precedex

The most significant adverse effects of Precedex are bradycardia, hypotension, and sinus arrest (Mahmoud & Mason, 2015). Bradycardia, or a decrease in resting heart rate (HR), is a predicted physiological response with the use of Precedex. Up to a 30% reduction in baseline HR is a normal finding (Mahmoud & Mason, 2015). In comparison, Hauber et al. (2015) found a rapid bolus of 0.5 mcg/kg of Precedex lowered HR by 22% compared with 10% in the control group. These moderations in HR are rarely significant enough to warrant an intervention. Moore and Angheliescu (2017) reported a dose-dependent reduction in HR and blood pressure (BP) believed to be caused by increased vagal activity. Two studies found intraoperative HR was

significantly lower in the Precedex group when compared to a control group receiving 0.9% normal saline (Coa et al., 2016; Hauber, 2015). However, Cao et al. (2016) found mean diastolic blood pressure (DBP) and systolic blood pressure (SBP) were not statistically different between groups. Some studies reported increased doses caused a transient hypertension intraoperatively (Hauber et al., 2015; Mahmoud & Mason, 2015; Taylor, 2016). Hauber et al. (2015) found a biphasic blood pressure response with a Precedex bolus of 0.5 mcg/kg over two to three seconds. A significant transient increase in SBP was seen at one minute followed by a significant decrease below baseline at three, four, and five minutes after a Precedex bolus. This change in BP was not enough to cause hemodynamic collapse or warrant pharmacological resuscitation (Hauber et al., 2015; Mahmoud & Mason, 2015).

Recovery time was found to be significantly prolonged in patients receiving Precedex bolus or infusion near the end of surgery (Bediril et al., 2017; Cao et al., 2016). However, patients receiving Precedex boluses early perioperatively did not have prolonged recovery times (Cao et al., 2016). Hauber et al. (2015) found a discrepancy in post-anesthesia care unit (PACU) phase 1 recovery times. There was no significant prolonged recovery time in the Precedex group when compared to the control group in the main hospital. However, the surgical satellite campus saw prolonged PACU phase 1 recovery in the Precedex group. This is believed to be caused by other confounding variables such as different staff, fewer PACU resources, and patient populations. In addition to prolonged recovery times, prolonged extubation times were observed in two studies (Bediril et al., 2017; Koceroglu et al., 2020)

Two pediatric deaths were filed between December 1999 through May 2015. 25 serious non-fatal adverse events (i.e. syncope, cardiac failure, Torsades de pointes, QT prolongation, and supraventricular tachycardia) with Precedex administration were reported in this same time

frame. It is noted these serious adverse events and deaths were confounded by serious patient comorbidities and may not be directly linked to the administration of Precedex (Taylor, 2016).

Precedex versus alternative pharmacology

The anesthetic choice is a contributing risk factor for POED. Multiple studies have shown increased incidence of POED among patients receiving volatile anesthetics (i.e. Sevoflurane, Isoflurane, Desflurane, and Halothane) (Bediril et al., 2017; Fitzsimmons et al., 2017; Lerman, 2020). The rapid emergence from anesthesia is considered the main risk factor in emergence delirium. Moore and Angheliescu (2017) conclude the most effective to least effective anesthetics for prevention of POED are Precedex, fentanyl, ketamine, clonidine, and a propofol bolus at the end of an anesthetic.

Two studies reviewed the effects of Precedex versus the effects of tramadol on preventing POED. In a randomized control trial (RCT) of 60 pediatric patients undergoing adenotonsillectomy, the Precedex group had significantly lower HR and BP compared to the tramadol group (Koceroğlu et al., 2020). Another RCT of 77 patients compared these drugs in patients undergoing adenotonsillectomy and found significant hypotension, bradycardia, prolonged sedation, and prolonged PACU stay with Precedex administration. Postoperatively, there was no difference in SBP, DBP, or HR between groups (Bediril et al., 2017). These studies found differing results on Precedex versus tramadol in preventing POED. Koceroğlu et al. (2020) determined Precedex was more effective at reducing POED when compared to tramadol. However, Bediril et al. (2017) found no difference in POED between these two groups.

When intranasal Precedex was compared to oral midazolam (a benzodiazepine class drug), patients were less likely to wake up with POED after receiving Precedex (Fitzsimmons et al., 2017). Fitzsimmons et al. (2017) predict the reason for this improvement in POED is the

ability of Precedex to mimic a natural sleep cycle. Midazolam works on GABA receptors and is unable to produce such a sleep-like state, thus interrupting the natural sleep cycle owing to its POED effects (Fitzsimmons et al., 2017).

Literature suggests the use of Precedex is advantageous in preventing POED. Further advantages of Precedex are multifactorial and include minimal respiratory depressant effects, organ protective effects, decreased opiate consumption, decreased volatile agent use, decreased incidence of postoperative nausea and vomiting, improved extubating conditions, and a mimicked natural sleep cycle. Disadvantages of Precedex include hypotension, bradycardia, sinus arrest, and prolonged extubation and recovery times. The risks of Precedex should be weighed against the benefits on a per patient basis. patient basis.

Theoretical Framework

Neuman's Systems Model nursing theory helps define the framework for this project. This model provides a comprehensive approach to nursing care for patients undergoing stressors. The focus of Neuman's Systems Model is maintaining systemic stability which is created by forces and stressors from the person and the environment that surrounds them (See Appendix A). Stressors are separated into three categories under this nursing model: intrapersonal, interpersonal, and extrapersonal. Intrapersonal stressors are internal reactions to one's own appearance. Interpersonal stressors are the environmental events that occur around the individual. Extrapersonal stressors are uncontrollable events that occur on a societal level (Health Research Funding, 2020). Precedex administration perioperatively focuses on intrapersonal and interpersonal stressors. Patients enter a sedative, yet arousable state following Precedex administration (Moore & Anghelescu, 2017). This intervenes and prevents intrapersonal and interpersonal stressors from offsetting systemic balance.

Three prevention areas contribute to maintain systemic wellness (Petiprin, 2016). Primary prevention is initiated in patient assessment and intervention. Secondary prevention is applied after the patient shows signs and symptoms of stress. The third prevention is initiated following the stressor when the patient enters the maintenance phase back to primary prevention (Petiprin, 2016). Precedex administration focuses on primary prevention. The goal of Precedex perioperatively is to prevent POED and prolonged PACU stays. Proving successful, Precedex will prevent the patient from experiencing intrapersonal and interpersonal stressors and ultimately prevent the need for secondary prevention strategies lessening the PACU recovery period.

Goals, Objectives, and Expected Outcomes

The goal of this project is to determine if intraoperative Precedex boluses extend the length of stay in the PACU. The target population for this project is pediatric patients, 2-12 years old, undergoing tonsillectomy and/or adenoidectomy surgery. Charts from January 2018 to July 2021 were included in a retrospective chart review. It is expected that patients who received Precedex will have a longer PACU stay than patients who did not receive Precedex. Additionally, it is expected patients receiving greater than a 0.5mcg/kg dose of Precedex will have a prolonged PACU stay.

Project Design

This quality improvement project entails a practice intervention. This project will gather quantitative data using a retrospective chart review. The results of this project may encourage a practice change among practitioners at the Arnett facilities to incorporate Precedex boluses intraoperatively or administer Precedex preoperatively.

Project site and Population:

This project will be completed at Indiana University Arnett Hospital and Ambulatory Surgery Center (ASC) in Lafayette, Indiana. The ASC provides same day, outpatient surgeries. This center includes six fully equipped operating rooms and two endoscopy suites (Indiana University Health, 2020). Various surgeries are offered at this site including general surgery, orthopedics, urology, pain management procedures, gastroenterology, otolaryngology, and podiatry. A variety of patient demographics are cared for in this facility, including pediatrics. The population of Lafayette is estimated to be 71,721 with persons under five years old accounting for 7.5% of the population and persons under 18 years old accounting for 22.2% of the population. 84.1% of the population is Caucasian, while 8.9% of the population is African American (United States Census Bureau, 2019).

The stakeholders for this project include the ASC staff including PACU nurses, anesthesia providers, surgeons, and financial executives. PACU nurses may care for patients longer postoperatively following Precedex administration. Anesthesia personnel may experience fewer calls to PACU for POED and related symptoms following Precedex. Surgeons may have patients with improved emergence and thus greater satisfaction following surgery. Financial executives may see decreased cost with Precedex administration. Although this is an added medication cost, it may decrease cost of other concomitant medications (i.e. opioids, antiemetics, and volatile agents). However, PACU times may be prolonged with Precedex administration and therefore increase cost.

Methods

Senior clinical analysts from IU Health gathered data for this project electronically. Data gathered from 797 patient charts between January 2018 through July 2021 were obtained. Inclusion criteria for this project were patient ages 2-12 years old undergoing tonsillectomy,

adenoidectomy, or both. Data collected for each chart included: procedure type, Precedex dose administered, date of surgery, minutes spent in PACU, patient weight and birthdate, and start and stop time of surgery.

Data Analysis

Pediatric patients undergoing adenoidectomy and/or tonsillectomy are included in this project, regardless of Precedex administration intraoperatively. Children were not randomly assigned to either group. Determination of which child received Precedex was solely provider preference. Statistical Package for the Social Sciences (SPSS) software was used to interpret the data. Frequencies and distributions were calculated for patient demographics. Data are presented as mean and standard deviation, median and range when appropriate. Pearson Correlation Coefficients and independent samples t-test were used to analyze data on Precedex administration and other factors affecting PACU stays. The primary outcome analyzed was PACU length of stay. Confounding variables analyzed were total Precedex dose administered intraoperatively, Precedex dose per kg, and length of surgery.

Results

Patient Demographics

Patient weight was included for 782 participants, no weight measurement was provided for 15 patients. The mean weight was 27.5 kg (see fig.1). The 25th percentile for weight was 16.7 kg, 50th percentile was 22.8 kg, and 75th percentile was 33.7kg for this population. Ages ranged from 2 to 12 years old. 16.1% of the population were 3

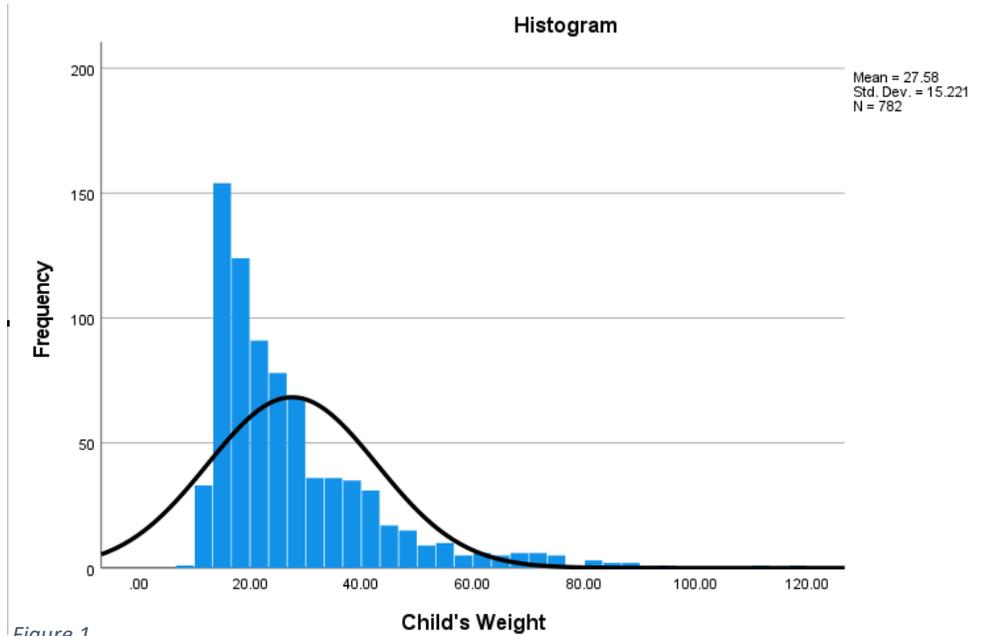


Figure 1

years old at the time of surgery, while only 3.9% of patients were 12 years old. The median age was 5 years old at the time of surgery and the mean age was 5.8 years old (see fig.2). No information was provided on patient gender, American Society of Anesthesiologists (ASA)

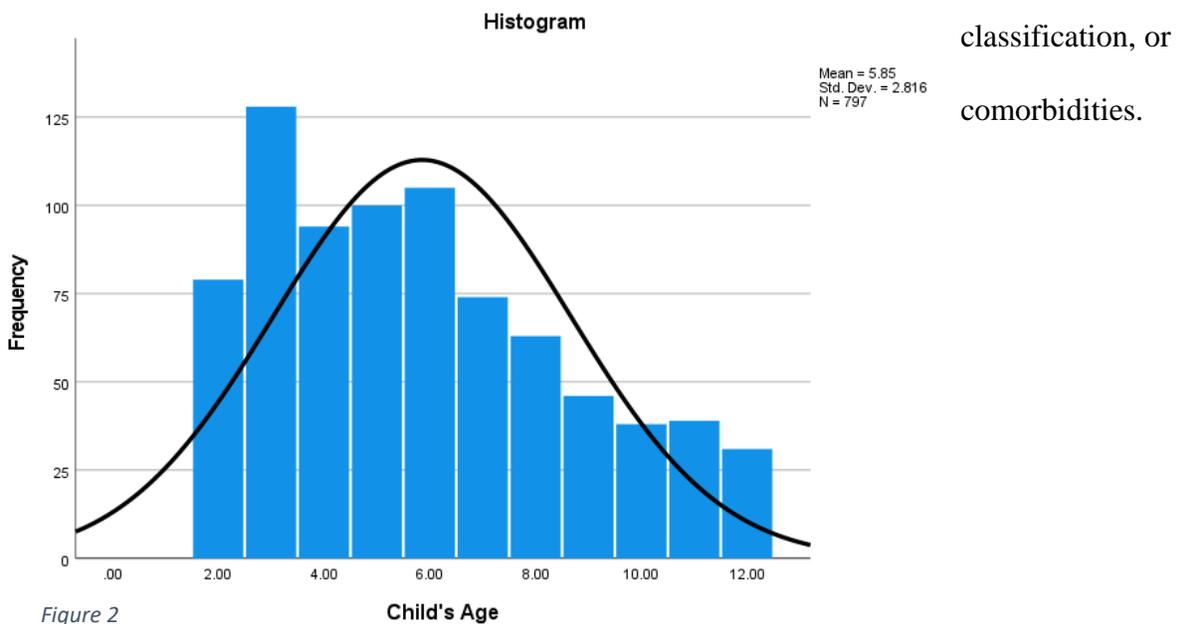


Figure 2

classification, or comorbidities.

Precedex Administration

A total of 797 charts were reviewed for this project. Of these, 91 patients (11.4%) received Precedex intraoperatively. No patients received Precedex prior to September 2020. The mean dose of Precedex administered was 0.37 mcg/kg. The minimum and maximum doses of Precedex administered were 0.09 mcg/kg and 1.14 mcg/kg, respectively (see fig. 3). The only information provided on Precedex administration is the total dose

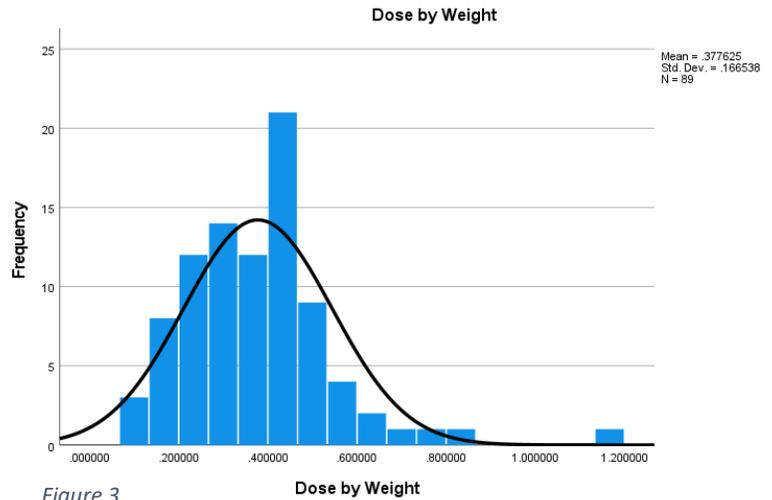


Figure 3

given. It is unknown whether Precedex was given in multiple boluses throughout the procedure or in one single dose. Additionally, it unknown whether the doses were given early or late in the operative period.

The mean PACU stay, regardless of Precedex administration, was 99.5 minutes. An independent-Samples *t* test comparing the mean PACU stays of the Precedex group versus the non-Precedex group found there was no significant difference ($t(795)=0.761, p >.05$). The mean duration of stay of the Precedex group ($M= 102.07, sd=30.27$) was not significantly different from the mean of the non-Precedex group ($M=99.27, sd= 33.25$) (See Table 1).

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means							
		F	Sig.	t	df	Significance		Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
						One-Sided p	Two-Sided p			Lower	Upper
PACU Stay	Equal variances assumed	.035	.851	.761	795	.223	.447	2.79256	3.66756	-4.40667	9.99180
	Equal variances not assumed			.819	119.796	.207	.415	2.79256	3.41143	-3.96196	9.54708

Table 1

Additionally, a Pearson Correlation Coefficient was calculated for the relationship between total Precedex dose administered and duration of PACU stay. A weak correlation that was not significant was found ($r(2)=0.013, p >.05$) (See Table 2). Precedex dose is not related to duration of PACU stay.

Correlations

		PACU Stay	total Precedex Dose
PACU Stay	Pearson Correlation	1	.013
	Sig. (2-tailed)		.900
	N	797	91
total Precedex Dose	Pearson Correlation	.013	1
	Sig. (2-tailed)	.900	
	N	91	91

Table 2

Type of Surgery

Of the 797 charts reviewed, 541 procedures (67.9%) completed were tonsillectomy and adenoidectomy (T&A) combined. 45 procedures (5.6%) were tonsillectomy, and 211 procedures

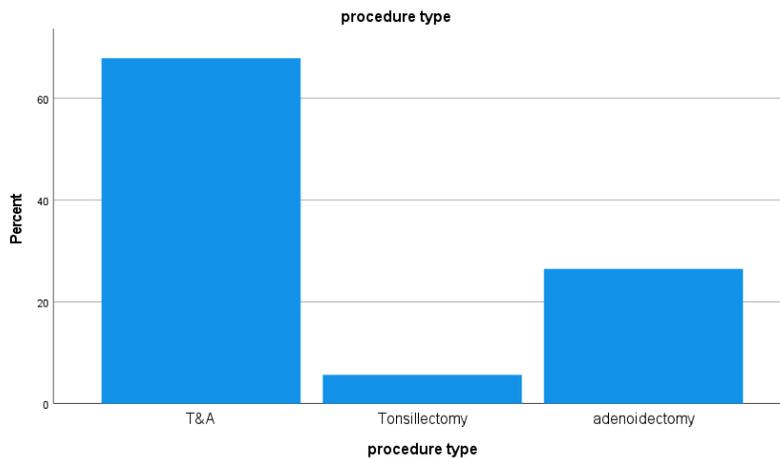


Figure 4

(26.5%) were adenoidectomy (see Fig. 4). A one-way ANOVA comparing the PACU length of stay of participants who underwent tonsillectomy, adenoidectomy, or T&A was completed. A significant

difference was found among the procedures ($F(2, 794)=27.32, p<0.05$) (see Table 3). Tukey’s HSD was used to determine the nature of the difference between the procedures. This analysis revealed patients who underwent

T&A had longer PACU stays ($M=104.89$ minutes, $sd=34.37$)

ANOVA

PACU Stay	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	55541.181	2	27770.591	27.320	<.001
Within Groups	807089.291	794	1016.485		
Total	862630.472	796			

Table 3

than tonsillectomy patients (M=100.69 minutes, sd=34.87). Patients undergoing adenoidectomy (M=85.77, sd=23.46) had the shortest PACU duration (See Tables 4&5).

Post Hoc Tests

Multiple Comparisons

Dependent Variable: PACU Stay
Tukey HSD

(I) procedure type	(J) procedure type	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
T&A	Tonsillectomy	4.20205	4.94646	.672	-7.4128	15.8169
	adenoidectomy	19.11843*	2.58773	<.001	13.0421	25.1947
Tonsillectomy	T&A	-4.20205	4.94646	.672	-15.8169	7.4128
	adenoidectomy	14.91638*	5.23508	.012	2.6238	27.2089
adenoidectomy	T&A	-19.11843*	2.58773	<.001	-25.1947	-13.0421
	Tonsillectomy	-14.91638*	5.23508	.012	-27.2089	-2.6238

*. The mean difference is significant at the 0.05 level.

Table 4

Descriptives

PACU Stay

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
T&A	541	104.8909	34.37135	1.47774	101.9881	107.7938	18.00	287.00
Tonsillectomy	45	100.6889	34.87433	5.19876	90.2115	111.1663	32.00	232.00
adenoidectomy	211	85.7725	23.46477	1.61538	82.5881	88.9570	41.00	189.00
Total	797	99.5922	32.91970	1.16608	97.3033	101.8812	18.00	287.00

Table 5

Duration of Surgery

The mean duration of surgery was 14 minutes. Surgery times range from 1 minute to 47 minutes (See Figure 5). A Pearson Correlation Coefficient was calculated for the relationship between length of surgery and duration of PACU stay.

A weak correlation that was not significant was found ($r(2) = .079, p > .05$) (see Table 5). Length of surgery is not related to PACU stay duration. A scatterplot with a linear regression model is shown in figure 6. The coefficient of determination ($R^2 = .006$) indicates PACU stay cannot be explained by the length of surgery.

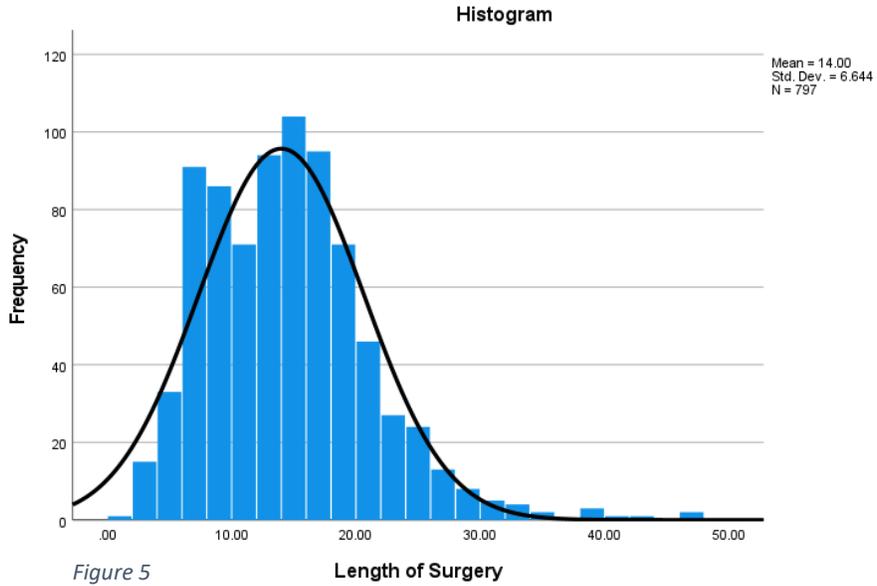


Figure 5

		PACU Stay	Length of Surgery
PACU Stay	Pearson Correlation	1	.079*
	Sig. (2-tailed)		.026
	N	797	797
Length of Surgery	Pearson Correlation	.079*	1
	Sig. (2-tailed)	.026	
	N	797	797

*. Correlation is significant at the 0.05 level (2-tailed).

Table 5

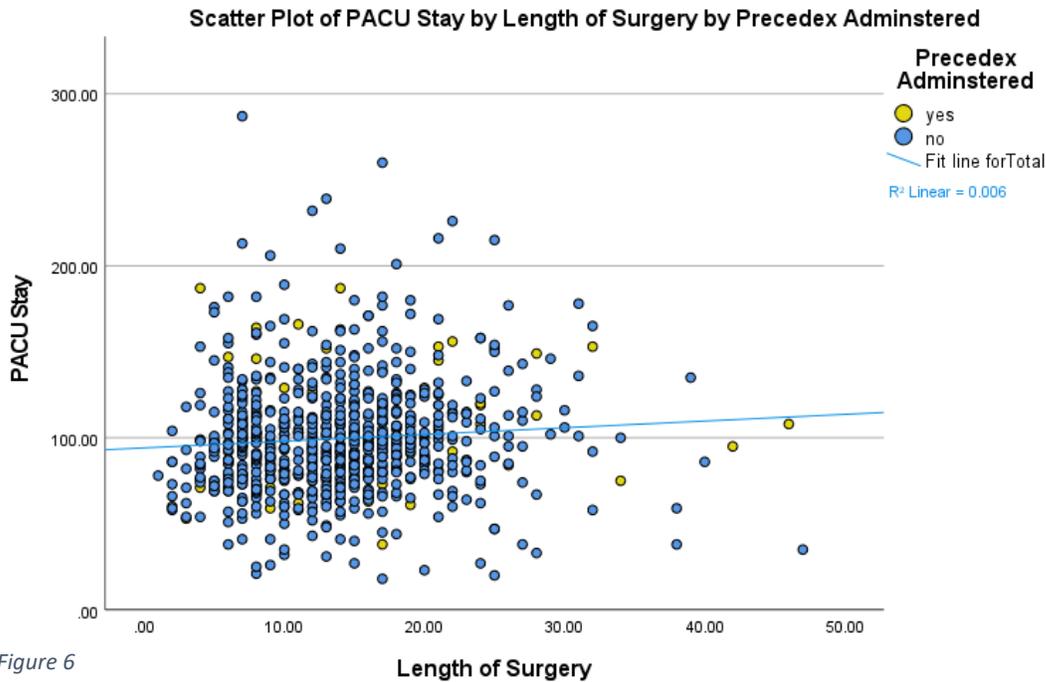


Figure 6

Discussion

This project found no significant impact of Precedex administration on duration of PACU stay. The average PACU time was 102 minutes for patients receiving Precedex and 99 minutes for those not receiving Precedex. This was not statistically significant. Total Precedex dose administered was then studied for its effect on PACU stay. Again, there was no statistically significant ($p > .05$) effect on PACU stay with higher doses of Precedex administered.

The type of surgery was analyzed for its effects on duration of PACU stay. A Significant difference was found between T&A, adenoidectomy, and tonsillectomy PACU stays. T&A patients stayed in PACU the longest for a mean duration of 104 minutes, while adenoidectomy patients stayed an average of 85 minutes, and tonsillectomy patients stayed an average of 100 minutes. There is no clear understanding why T&A patients stay longer in the PACU.

Next, length of surgery was compared with PACU stay. A weak correlation was made between longer duration of surgery and prolonged PACU stays. However, this was not statistically significant.

Assumptions

It is assumed all procedures were done under general anesthesia using Sevoflurane. It is also assumed all patients were endotracheally intubated for these procedures. Lastly, it is assumed these patients were not paralyzed. Thus, patients did not require reversal medications that could alter hemodynamics. From this it is also assumed these patients did not suffer from inadequate ventilation due to inadequate paralytic reversal.

Strengths and Limitations

This project's major strength is the large retrospective dataset obtained through electronic medical records. Additional strengths include data on patient weight, dosing of Precedex per

kilogram, and age of the patient. There are few strengths to this project and several confounding variables that are not accounted for. Any associations or correlations made in this project are weakly supported.

One major limitation to this project is the last dose of Precedex is unknown. Studies have shown Precedex given within 60 minutes of the end of a procedure prolongs PACU stays (Koceroğlu et al., 2020; Manning et al., 2020). Next, there is no information regarding patient status in the PACU. Prolonged PACU stays could be due to nonclinical reasons such as lack of transportation, staff availability, and staff education or comfort level. Additionally, prolonged stays could be due to clinical reasons such as pain, postoperative nausea and vomiting, POED, uncontrolled bleeding, intraoperative complications, patient comorbidities, hemodynamic instability, or adjunct medications (i.e. opioids, benzodiazepines, volatile anesthetics, etc.).

Another limitation to this project is the data was limited to one institution and its associated ASC. Precedex was never administered in the first year of data included in this project. This is in part due to the limited availability of Precedex at this institution prior to 2020. Staff education and comfort level could be a limiting factor to the reliability of this data. Additionally, staff turnover may be prominent at this institution. It is unknown whether the same perioperative staff members were caring for these patients throughout the 3 years included in this project. These are variables that are unaccounted for in this project.

One large variation in this project is surgery time. Surgery time does not include total time under anesthesia. One procedure had a documented surgery time of 1 minute. The longest surgery time documented was 47 minutes. These two outliers may skew the data. Additionally, a 47-minute case could have unforeseen complications that are not included in this project. Surgery time does not account for time to extubation. Different anesthesia providers may have

their patients fully awake prior to PACU arrival, while others may take their patients the PACU heavily sedated and minimally arousable. This would alter the data as this would take away from charted PACU recovery time. This project does not account for extubation to PACU arrival time. Turnover time from OR to PACU could be prolonged and thus not account as PACU time although the patient was already recovering from anesthesia.

Patient data is limited to weight and birthdate. Additional medical history for patients was not provided. This includes comorbidities, mental health concerns, and daily medications. It is unknown whether these patients received a tonsillectomy and/or adenoidectomy due to recurrent infections or obstructive sleep apnea (OSA). OSA is one of the most common indications for this surgery. OSA places patients at an increased risk postoperatively for respiratory complications (Cao et al., 2016). Additionally, if a patient is extremely anxious or fearful in the preoperative setting, they will likely experience these same feelings postoperatively (FitzSimmons et al., 2017). Daily medications can alter the patient's metabolism of volatile anesthetics and other medications given. They may require higher dosing, potentially more narcotics, and thus achieve a deeper level of sedation in the PACU.

Lastly, there is no intraoperative hemodynamic data provided. Intraoperative complications may lead to prolonged PACU stays. One study found the use of intraoperative Precedex prolonged PACU stays due to the hemodynamic instability (bradycardia and hypotension) the patient experienced intraoperatively (Haobo et al., 2021).

Conclusion

There are a vast number of confounding variables to make any significant conclusions from this project. Further research on the use of Precedex in pediatric patients is required. Longer, more complex cases may help determine the effect of early versus late dosing of

Precedex and its effect on PACU length of stay. Additionally, further studies on perioperative medications in addition to Precedex will help determine appropriate sedation levels to decrease length of PACU stays. Precedex may safely be used in pediatric patients undergoing tonsillectomy and/or adenoidectomy. Its side effects are not measured directly in this project however, it did not prolong PACU stays in this cohort.

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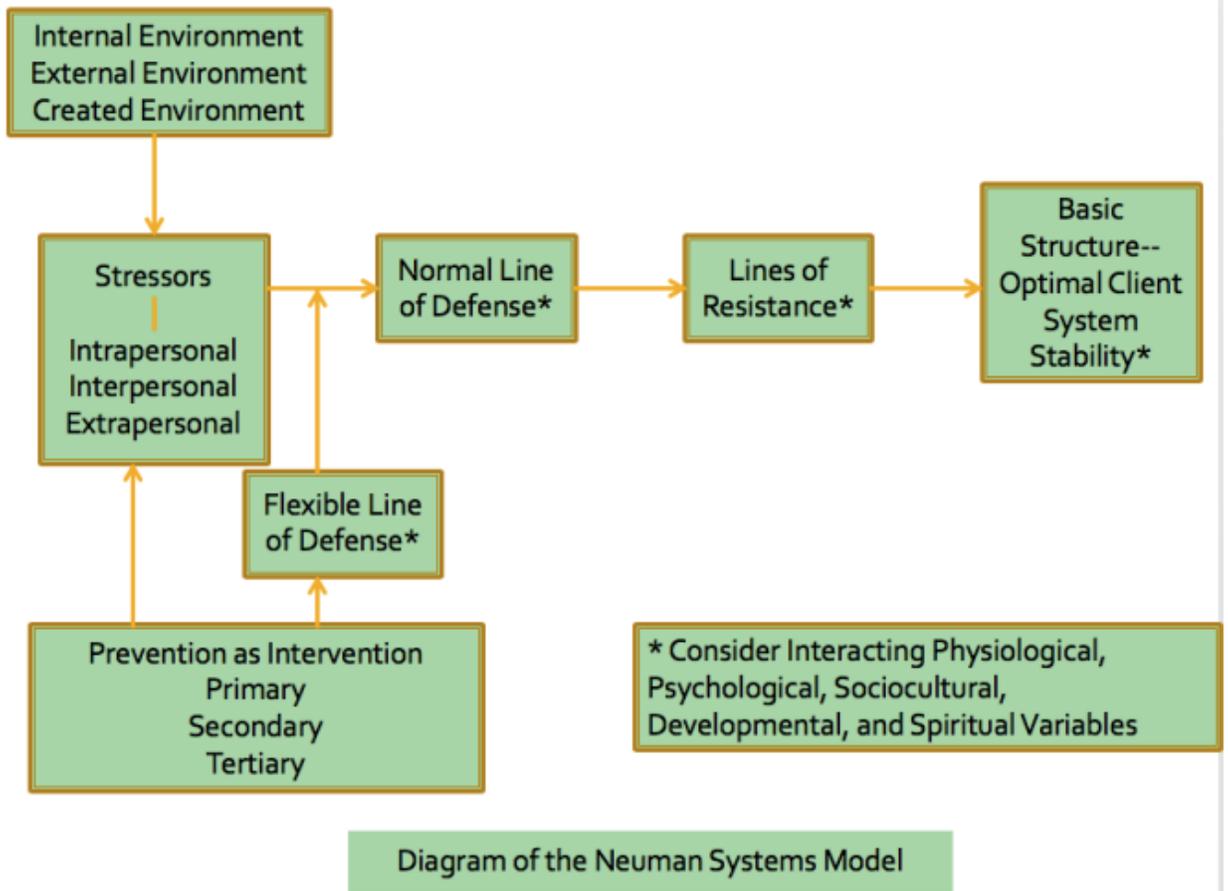
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APPENDIX A: Neuman's Systems Model



Reference in APA format	Level of Evidence	Variables	Sample	Instruments	Results
References					
<p>Bediril, N., Akcabay, M., & Emik, U. (2017). Tramadol vs dexmedetomidine for emergence agitation control in pediatric patients undergoing adenotonsillectomy with sevoflurane anesthesia: prospective randomized controlled clinical study. <i>BMC Anesthesiology</i>, 17(41), 1-7. https://doi.org/10.1186/s12871-017-0332-4</p>	Level II	<p>tramadol administration intraoperatively, dexmedetomidine administration intraoperatively</p>	<p>77 patients, aged 2-12yo undergoing adenotonsillectomy with sevoflurane anesthesia</p>	<p>observational pain scale, Pediatric Anesthesia Emergence Delirium (PAED) scale, Aldrete scoring</p>	<p>dexmedetomidine caused intraoperative hypotension, bradycardia, prolonged extubation time, and residual sedation with prolonged PACU stay. Both dexmedetomidine and tramadol were effective in controlling postoperative pain and emergence agitation. intraoperative infusion of dexmedetomidine is sufficient anesthesia for patients undergoing tonsillectomy with or without adenoidectomy. Significant side effects (prolonged extubation time, bradycardia, and hypotension) and a lower incidence of OPS scores was observed with dexmedetomidine infusions. However, a significantly lower incidence of POED in the</p>
<p>Cao, J., Pei, Y., Wei, J., & Zhang, Y. (2016). Effects of intraoperative dexmedetomidine with intravenous anesthesia on postoperative emergence agitation/delirium in pediatric patients undergoing tonsillectomy with or without adenoidectomy. <i>Medicine</i>, 95(49), 1-6. http://dx.doi.org/10.1097/MD.00000000000005566</p>	Level II	<p>1 mcg/kg dexmedetomidine infusion over 10 minutes vs. 0.9% normal saline infusion over 10 minutes (control group)</p>	<p>68 patients aged 2-8yr of American Society of Anesthesiologist physical status I or II, scheduled for tonsillectomy with or without adenoidectomy under general anesthesia</p>	<p>Pediatric Anesthesia Emergence Delirium (PAED) scale, objective pain score (OPS), summary statistics for HR, SBP, DBP, recovery time, and extubation time.</p>	

dexmedetomidine group was not observed.

FitzSimons, J., Bonanno, L. S., Pierce, S., & Badeaux, J. (2017). Effectiveness of preoperative intranasal dexmedetomidine, compared with oral midazolam, for the prevention of emergence delirium in the pediatric patient undergoing general anesthesia : a systematic review. *JBIR Database of Systematic Reviews and Implementation Reports, 15*(7), 1934–1951. <https://doi:10.11124/JBISRIR-2016-003096>

Level I

preoperative oral midazolam, preoperative intranasal dexmedetomidine

117 articles which reviewed pediatric patients aged 3-7yo with an American Society of Anesthesiologists (ASA) classification of I or II who underwent general anesthesia for elective/ambulatory surgery

Pediatric Anesthesia Emergence Delirium (PAED) scale

There is insufficient evidence to prove the use of intranasal dexmedetomidine, when compared to oral midazolam, is effective in preventing emergence delirium

<p>Hauber, J. A., Davis, P. J., Bendenl, L. P., Martyn, S. V., McCarthy, D. L., Evans, M., Cladis, F. P., Cunningham, S., Lang, R. S., Campbell, N. F., Tuchman, J. B., & Young, M. C. (2015). Dexmedetomidine as a rapid bolus for treatment and prophylactic prevention of emergence agitation in anesthetized children. <i>Anesthesia Analgesia</i>, 121(5), 1308-1315. https://doi.org/10.1213/ANE.0000000000000931</p>	<p>Level II</p>	<p>dexmedetomidine bolus, heart rate, systolic blood pressure, diastolic blood pressure, respiratory rate, blood oxygen saturation, emergence delirium</p>	<p>400 pediatric patients, aged 4-10yo undergoing tonsillectomy with or without adenoidectomy, with or without myringotomy, and/or tympanostomy tube insertion</p>	<p>Pediatric Anesthesia Emergence Delirium (PAED) scale</p>	<p>Rapid IV bolus administration of dexmedetomidine in children improved their recovery by reducing the incidence of emergence delirium. A statistically significant change in hemodynamics was observed, but no patients required any intervention for hemodynamic changes. Dexmedetomidine reduced the incidence of postoperative opioid administration, and a trend of fewer adverse events was observed. patients in dexmedetomidine group had significantly lower heart rates than the tramadol group. Dexmedetomidine group had improved extubating conditions (fewer periods of not breathing, no coughing, and less desaturation). Extubation time was significantly longer in the dexmedetomidine group.</p>
<p>Koceroglu, I., Devrim, S., Tanriverdi, T. B., & Celik, M. G. (2020). The effects of dexmedetomidine and tramadol on post-operative pain and agitation, and extubation quality in paediatric patients undergoing adenotonsillectomy surgery: A randomized trial. <i>Journal of Clinical Pharmacy and Therapeutics</i>, 45(2), 340-346. https://doi.org/10.1111/jcpt.13080</p>	<p>Level II</p>	<p>tramadol vs dexmedetomidine administration intraoperatively, hemodynamics (BP, HR), extubation time, post-operative pain, agitation, adverse events</p>	<p>60 patients, aged 2-9yo undergoing adenotonsillectomies</p>	<p>pain point system scale (PPSS), Riker Sedation-Agitation Scale (SAS)</p>	

pediatric
 perioperative use
 of
 dexmedetomidine
 (airway procedures,
 cardiac surgery,
 dental procedures,
 regional
 anesthesia,
 ambulatory
 surgery, painful
 procedures) and
 end-organ effects
 of
 dexmedetomidine

(kidney and brain)
 POED, PONV, time
 to emergence (or
 awakening), PACU
 length of stay,
 analgesic
 requirements,
 incidence of
 bradycardia and
 HoTN

anesthesia
 techniques
 (propofol,
 benzodiazepines,
 opioids,
 gabapentin,
 ketamine and
 Dextromethorphan,

127 published
 scholarly articles

7 published scholarly
 articles

99 published
 scholarly articles

NA

PAED, Watcha
 Scale, 5 point
 scale

Faces Legs
 Activity Cry
 Consolability
 scale (FLACC),
 Pediatric
 Anesthesia
 Emergence
 Delirium (PAED)
 scale

Dexmedetomidine
 provides sedation that
 parallels natural sleep,
 anxiolysis, analgesia,
 sympatholysis, and an
 anaesthetic-sparing effect
 with minimal respiratory
 depression. It has organ
 protective effects. High
 dose, rapid bolus will
 cause bradycardia and
 hypotension. Decreases
 postoperative pain scores.

DEX immediately after
 induction of anesthesia is
 beneficial. DEX prevents
 POED in pediatric patients.
 DEX lessens need for
 opioids and decreases
 PONV.
 Interventional algorithm
 developed for preventing
 emergence delirium (ED).
 There are two options for
 reducing the risk of ED.
 The use of propofol as a
 single-agent anesthetic or
 add an adjuvant (e.g.,
 dexmedetomidine,

Mahmoud, M. & Mason, K. P. (2015).
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 considerations of paediatric perioperative and
 periprocedural applications and limitations. *British
 Journal of Anaesthesia*, 115(2), 171-182.
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Level I

Level I

Level I

alpha-2 agonists,
regional blocks)

fentanyl, ketamine,
clonidine, propofol bolus
at the end of anesthesia)
to an inhalational
anesthetic.