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Inhalation Anesthesia vs. Total Intravenous Anesthesia for Ambulatory Dental Surgery in Children

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INHALATION ANESTHESIA VS. TOTAL INTRAVENOUS ANESTHESIA FOR AMBULATORY DENTAL SURGERY IN CHILDREN

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EXECUTIVE SUMMARY

Abstract: The purpose of this study was to compare inhalation anesthesia with sevoflurane versus Total Intra Venous Anesthesia (TIVA) with propofol infusion as it relates to the quality of recovery including postoperative pain, Post Operative Nausea and Vomiting (PONV), and Post Anesthesia Care Unit (PACU) Length Of Stay (LOS) in pediatric patients undergoing ambulatory dental surgery.

Introduction: Pediatric dental procedures are increasingly performed in an outpatient setting under general anesthesia due to inadequate cooperation, circumstantial anxiety, and other behavioral and health issues. Commonly used inhalation anesthetics, such as sevoflurane, can induce hyperalgesia in children. While sevoflurane increases the risk PONV, the time spent in PACU is reduced compared to other methods of anesthesia. Maintenance of anesthesia via TIVA with propofol infusion has been shown to reduce postoperative pain and PONV in pediatric patients. The goal of the study was to determine if pediatric patients anesthetized with sevoflurane displayed more postoperative pain than those patients anesthetized via TIVA with propofol. The study evaluated the incidence of PONV and the duration of PACU length of stay in both groups.

Methodology: The research study used a retrospective, quantitative, randomized case control design at Charleston Area Medical Center in West Virginia. The chart review was conducted on pediatric patients undergoing general anesthesia for ambulatory dental surgery from January 1, 2006 through June 1, 2015. Two groups were developed for the study. The control group (Group S), which were pediatric patients documented as general anesthesia by inhalation with sevoflurane on the intraoperative record, and the case group (Group P), which were pediatric patients documented as general anesthesia via TIVA with propofol on the intraoperative record. These two groups were used for comparison of demographics and clinical characteristics such as postoperative pain, frequency of PONV measured by administration of an antiemetic drug, and PACU LOS.

Results: There was no statistical significance found with patient demographics between the two groups. Patients in Group P had a mean pain score of 0.24 (± 1.207) while Group S had a mean pain score of 1.11 (± 2.313) ($p>.05$). Results of a linear regression analysis from the collected data did suggest a decreased association between average postoperative pain score with the administration of propofol ($p<.05$). Results of the study showed type of anesthesia, gender, age, BMI, ASA, and length of surgery was not associated with the frequency of PONV within the groups. Patients in Group P had a mean PACU LOS of 39.32 (±15.843) minutes while Group S had a PACU LOS of 37.98 (±15.239) minutes ($p<.05$). Results from a linear regression analysis did not show a statistically significant decreased PACU LOS with propofol ($p>.05$). The BMI of the patient did indicate a statistical significance for PACU LOS in Group S where as BMI increased, PACU LOS decreased ($p<.05$).

Discussion: Inhalation with sevoflurane and TIVA via propofol are two methods of maintaining anesthesia with pediatric patients undergoing general anesthesia for ambulatory dental surgery. The results of this study were associated with higher postoperative pain scores with patients in Group S than patients in Group P. These results have been seen in previous studies. Although past research has shown a decreased incidence of PONV with the use propofol, the results of this study did not show the same association between the two methods of anesthesia. Previous research has shown a decreased PACU LOS with the administration of sevoflurane compared to propofol. However, results of this study did show a similar PACU LOS between the two groups.

Conclusion: The use of propofol for maintenance of general anesthesia in pediatric patients was associated with decreased postoperative pain scores compared to maintenance with sevoflurane. TIVA via propofol infusion is an effective method for maintenance of general anesthesia in pediatric dental surgery with an improved quality of recovery.

Implications/Recommendations: With the growing trend of general anesthesia for pediatric patients undergoing ambulatory dental surgery, results from this study suggest favorable outcomes with the use of TIVA via propofol infusion. This study found an association with a decreased postoperative pain score in pediatric patients who received TIVA via propofol infusion. Decreased pain scores not only result in improved patient and parental satisfaction, but less PACU nursing interventions and LOS.

Key Words: Length of stay, Postoperative nausea and vomiting, Postoperative pain, Propofol, Sevoflurane

INTRODUCTION

Background and Significance

Dental caries, or tooth decay, is the most common chronic childhood disease in the United States (HHS, 2000). Without proper treatment, dental caries can lead to loss of function, pain, infection and other preventable diseases (Loochtan, Bross, & Domoto, 2010). The American Academy of Pediatric Dentistry (2012) has recognized that dental care through nonpharmacologic techniques is not a feasible approach with all children. Therefore, pediatric dental procedures are increasingly performed in an outpatient setting under general anesthesia due to disabilities, medical conditions, inadequate cooperation, circumstantial anxiety, and other behavioral issues (AAPD, 2012).

The most commonly used technique for pediatric anesthesia is inhalation anesthesia (Cohen, Finkel, Hannallah, & Goodale, 2004). The prevalent use of inhalation anesthetics for induction or maintenance of anesthesia by anesthetists is due to the effectiveness, reliability, safety, stability, and ease of delivery (Lerman & Johr, 2009). Sevoflurane is the inhalation agent of choice in pediatric patients. With its nonpungency and rapid increases in alveolar anesthetic concentrations, anesthetists can achieve a smooth and rapid induction with sevoflurane in infants and children (Butterworth, Mackey, & Wasnick, 2013). The limited solubility of sevoflurane reduces its potency, and as a result, fast recovery from anesthesia is achieved when the anesthetic is discontinued (Butterworth, et al., 2013).

While inhalation anesthesia with sevoflurane is attributed with numerous advantages, use of this anesthetic can be associated with unwanted side effects as well. Sevoflurane can induce hyperalgesia and increase a patient's peripheral and central

sensitivity to heat, pressure, or surgical incision (Rowley, Daniel, & Flood, 2005). Postoperative Nausea and Vomiting (PONV) is a major concern with an incidence rate of about 20% after inhalation anesthesia (Lerman & Johr, 2009). Anesthetists must maintain a large concentration of sevoflurane during induction of pediatric patients to prevent movement while attempting intravenous (IV) access. If the airway is lost before IV access is established, a potentially life-threatening complication of laryngospasm can ensue (Lee, Milgrom, Starks, & Burke, 2013).

Recently, Total Intra Venous Anesthesia (TIVA) has become an appealing option for administration of general anesthesia in children due to the pharmacodynamics and pharmacokinetic properties of propofol (Mani & Morton, 2010). Propofol enters the body via infusion into the blood stream where it is metabolized and distributed to the peripheral compartments (Mani & Morton, 2010). The increased metabolism of children allows induction of anesthesia with propofol to be achieved within 20-40 seconds (Steur, Perez, & De Lange, 2004). With its antiemetic properties, propofol is effective at reducing the incidence of PONV compared to any of the inhalation anesthetics (Lerman, 2010). Improved quality of emergence from anesthesia can be noted by the smooth and peaceful recovery in children anesthetized with propofol (Key, Rich, DeCristofaro, & Collins, 2010).

Further developments are needed in order for anesthetists to select maintenance of general anesthesia with propofol infusion in children as the routine technique. While agent analyzers can reliably estimate the depth of anesthesia during inhalation anesthesia, there is currently no reliable, noninvasive measure available with TIVA (Eyres, 2004). The arms of children are frequently tucked during surgery, which conceals the IV site. This can make detecting a disconnect in the IV line or a subcutaneous infiltration of TIVA, before a child

reaches awareness, difficult as there is no alarm (Eyres, 2004). TIVA depends on syringe pumps, and the limited availability of infusion pumps and lack of efficiency with dismantling and refilling pumps are key obstacles to the implementation of TIVA (Lerman, 2010).

Literature Review

Until recently, inhalation anesthesia has dominated the practice of general anesthesia in pediatrics; however, TIVA is now being used more frequently in children (Cohen, et al., 2004). With the growing popularity of TIVA, multiple research studies have been conducted comparing the two methods of general anesthesia in children.

A double-blinded, randomized trial by Konig, et al. (2009) studied the quality of recovery from general anesthesia for ambulatory dental surgery in children. A sevoflurane or a propofol-based technique was utilized in 179 pediatric patients. The researchers found the use of sevoflurane significantly increased the incidence of PONV and the number of postoperative nursing interventions compared to propofol. While children anesthetized with propofol required less pain medication, those who received sevoflurane met discharge criteria 10 minutes earlier (Konig, et al., 2009). Of note, the scholars found parental satisfaction was equal with regard to the overall experience with the child's recovery period.

Pieters, et al. (2010) evaluated the effect of sevoflurane versus propofol anesthesia on the quality of recovery in children undergoing adenotonsillectomy. In analyzing the treatment of postoperative pain, the authors found less administration of fentanyl in the Post Anesthesia Care Unit (PACU) with propofol anesthesia compared to sevoflurane anesthesia. A significant difference in the incidence of PONV was observed between the

two groups with 36.8% in the sevoflurane group and 5.4% in the propofol group (Pieters, et al., 2010). The researchers established validation of propofol as a practical alternative to sevoflurane for maintenance of anesthesia in pediatrics with equal parental and PACU nurse satisfaction and total time spent in the PACU.

Chandler, et al. (2013) compared TIVA with propofol and remifentanil to inhalation with sevoflurane in children undergoing strabismus repair. The researchers assessed postoperative pain using the Face, Legs, Activity, Cry, Consolability (FLACC) Scale, which revealed a higher FLACC score in the sevoflurane group compared to the TIVA group. A longer duration of PACU stay was observed in those anesthetized via TIVA compared to those anesthetized with sevoflurane; although, the researchers thought an improved postoperative experience with less pain was of more value than a decreased PACU length of stay (LOS) (Chandler, et al., 2013).

Hasani, Gecaj-Gashi, Llullaku, & Jashari (2013) conducted a randomized, double-blinded study comparing propofol versus sevoflurane anesthesia in children who underwent hernia repair surgery. The primary focus of the research was postoperative analgesia and the hyperalgesic effects of inhalation anesthetics. In the study, the researchers found children anesthetized with propofol reported less postoperative pain and did not require analgesics for the first 120 minutes following the procedure (Hasani, et al., 2013). In contrast, the researchers found children anesthetized with sevoflurane had significantly higher pain scores and required analgesics immediately after surgery. Although the scholars established recovery time was shorter in the sevoflurane group, the incidence of PONV was increased compared to the propofol group.

Tan, Bhinder, Carey, & Briggs (2010) compared propofol versus sevoflurane anesthesia and evaluated postoperative pain along with quality of recovery in laparoscopic day-case surgery. While this study included only adult patients, similar results regarding decreased postoperative pain with propofol use have been shown in comparable studies involving the pediatric population. Patients in the sevoflurane group reported significantly more pain, and in turn, morphine consumption was higher in the postoperative period in the sevoflurane group compared to the propofol group (Tan, et al., 2010). Contrary to other studies, the researchers found the incidence of PONV did not differ between the groups, and the time to discharge was shorter in the propofol group. Results of this study were consistent with the findings of Cheng, Yeh, & Flood (2008) in which patients anesthetized with propofol had less postoperative pain compared to those anesthetized with inhalation anesthetics.

Kol, Egilmez, Kaygusuz, Gursoy, & Mimaroglu (2008) studied the effectiveness of propofol or sevoflurane anesthesia with the laryngeal mask airway for children undergoing Magnetic Resonance Imaging (MRI). Children undergoing MRI must remain completely immobile in order to obtain a high quality picture, which requires the use of a rapid and deep anesthetic technique. Researchers found anesthesia with sevoflurane provided a significantly shorter induction time and recovery time compared to propofol (Kol, et al., 2008). Faster recovery from anesthesia leads to greater efficiency of MRI procedures. A similar study by Bryan, et al. (2009) comparing sevoflurane and propofol in children undergoing MRI scans demonstrated equal induction times between the two groups but a shorter PACU LOS in the sevoflurane group. Overall, results from the two studies verified both anesthetic techniques were equally safe in pediatric patients.

Statement of the Problem and Research Purpose

While the traditional use of inhalation with sevoflurane provides adequate anesthesia to children, anesthetists should be aware of other techniques, like TIVA via propofol infusion, which might provide an improved quality of recovery in pediatric patients (Bryan, et al., 2009). Optimal recovery from anesthesia is vital in the pediatric population since unrelieved pain can increase pain vulnerability later in life and PONV can lead to dehydration with unplanned hospitalization following surgery (Rony, Fortier, Chorney, Perret, & Kain, 2010). Postoperative pain continues to be the single most important problem in pediatric patients following the use of general anesthesia for surgical procedures (Segerdahl, Warren-Stomberg, Rawal, Brattwall, & Jakobsson, 2008). Sevoflurane has been linked with increased postoperative pain upon emergence in young children resulting in increased postoperative interventions and distressed parents. The rapid onset of action and antiemetic properties of propofol make it an excellent agent for outpatient anesthesia (Steur, et al., 2004). Prolonged PACU length of stay from oversedation results in slower discharge of patients, which is not conducive to ambulatory surgery facilities. The goal of this study was to compare methods of pediatric anesthesia to provide anesthetists with information for application of the best practice method.

The purpose of this research was to compare inhalation anesthesia with sevoflurane versus TIVA with propofol infusion as it relates to improved quality of recovery measured by postoperative pain, PONV, and PACU length of stay in pediatric patients undergoing ambulatory dental surgery.

METHODOLOGY

Research Hypothesis

The hypothesis for this research study was that pediatric patients anesthetized via TIVA with propofol for ambulatory dental surgery would have decreased postoperative pain compared to those anesthetized by inhalation with sevoflurane. The second hypothesis for this study was that children in the propofol group would have less frequency of PONV as measured by administration of an antiemetic drug than the sevoflurane group. Finally, the third hypothesis for this study was that children in the propofol group would reach discharge criteria faster, resulting in a decreased PACU LOS.

Research Design and Setting

The design for this research study was a retrospective, quantitative, case control design. This specific design was selected since data could be collected from electronic patient records available at Charleston Area Medical Center (CAMC) (Schulz and Grimes, 2012). A case control design allowed identification of patient demographics and clinical characteristics that would allow comparison of the quality of recovery following general anesthesia between a group of pediatric patients anesthetized with inhalation anesthesia and a group of pediatric patients anesthetized via TIVA undergoing ambulatory dental surgery.

CAMC is a non-profit, academic medical center and regional referral center including four hospitals (CAMC, 2015). The four hospitals comprising the CAMC health system include: CAMC Memorial Hospital, CAMC General Hospital, CAMC Women and Children's Hospital, and CAMC Teays Valley Hospital (CAMC, 2015).

A review of medical records was conducted on pediatric patients admitted to CAMC Memorial, General, Women and Children's, or Teays Valley hospitals for outpatient dental surgical services requiring general anesthesia between January 1, 2006 through June 1, 2015. Two groups were developed for the study. The control group (Group S), which were pediatric patients documented as general anesthesia by inhalation with sevoflurane on the intraoperative record, and the case group (Group P), which were pediatric patients documented as general anesthesia via TIVA with propofol on the intraoperative record. These two groups were used for comparison of demographics and clinical characteristics such as postoperative pain, frequency of PONV measured by administration of an antiemetic drug, and PACU LOS.

Sample Population and Description

Two hundred patients who met inclusion criteria were randomly selected from 10,640 charts from January 1, 2006 through June 1, 2015 were included in the study. The sample included 100 patients anesthetized via TIVA with propofol and 100 patients anesthetized by inhalation with sevoflurane. The patients for the study were identified by The International Classification of Diseases, 9th revision, Clinical Modification (ICD-9-CM) codes; 23 (removal of restoration of tooth), 23.0 (forceps tooth extraction), 23.01 (extraction of deciduous teeth), 23.09 (extraction of other tooth), 23.1 (surgical removal of tooth), 23.11 (removal of residual root), 23.19 (other surgical extraction of tooth), 23.2 (restoration of tooth by filling), 23.3 (restoration of tooth by inlay), 87.11 (x-ray full mouth) (HHS, 1989).

Inclusion criteria:

1. Male or female patients.

2. Patients age between 2 and 12 years old.
3. Patients scheduled for ambulatory dental surgery requiring general anesthesia.
4. Patients with an American Society of Anesthesiology (ASA) physical status I and II.

Exclusion criteria:

1. Patients less than 2 years of age and patients older than 12 years of age.
2. Patients with ASA physical status III, IV, V, VI.
3. Patients with a medical contraindication to the use of any drugs used in the study.
4. Patients with a history of malignant hyperthermia.
5. Incomplete medical record information.

Procedure

A retrospective chart review was completed on pediatric patients who underwent ambulatory dental surgery with general anesthesia from January 1, 2006 through June 1, 2015. Data were collected from patient preoperative, intraoperative, and postoperative records. Patient demographic and clinical variables collected from the anesthesia records included: administration of sevoflurane, administration of propofol infusion, gender, age, Body Mass Index (BMI), ASA physical classification, length of surgery, postoperative pain score, frequency of PONV, and PACU LOS.

The administration of sevoflurane was taken from the intraoperative record. The administration of propofol infusion was taken from the intraoperative record. Gender was classified as male or female. Age was measured in years at the time of arrival to the hospital. BMI was calculated by using the patient's height in meters and weight in kilograms as a predictor for body fat composition (CDC, 2013). ASA classification is a subjective assessment given to each patient by the anesthesiologist based on overall health

information provided by the patient preoperatively. There are six ASA classes: (I) patient is healthy, (II) patient has a mild systemic disease, (III) patient has a non-incapacitating severe systemic disease, (IV) patient has a capacitating disease that is life threatening, (V) patient is not expected to live without surgery, and (VI) patient is brain dead and organs are being donated (ASA, 2014).

Postoperative pain score was obtained from the PACU record using the objective pain scale, which is used when pediatric patients cannot use the numeric scale. Frequency of PONV was obtained from the PACU record as indicated by administration of an antiemetic drug. PACU LOS was collected and contained the time from arrival into PACU until discharge.

Data Collection and Instruments

Each patient's Electronic Medical Record (EMR) was accessed to obtain data for the study (McKesson, 2015). Specific data were collected from the preoperative anesthesia evaluation form, intraoperative operating room record, and PACU records during the patient's admission.

The researcher used Microsoft Excel to develop two data collection worksheets to organize and collect statistical information. Data Collection Tool 1 was used to assign each patient a study number, which separated the patient account number from the data extracted from the EMR and was not linked back to any specific patient identification to protect patient identification and privacy of patient information (Appendix A). Data Collection Tool 2 was used to record patient information including patient study number, gender, age, BMI, ASA physical status, and length of surgery. This worksheet was also used

to record administration of sevoflurane, administration of propofol infusion, postoperative pain score, frequency of PONV, and PACU LOS (Appendix B).

Statistical Design and Analysis

The purpose of this retrospective study was to compare inhalation anesthesia with sevoflurane versus TIVA with propofol infusion in pediatric patients undergoing ambulatory dental surgery. The hypothesis for this research study was that pediatric patients anesthetized via TIVA with propofol for ambulatory dental surgery would have decreased postoperative pain compared to those anesthetized by inhalation with sevoflurane. The second hypothesis for this study was that children in the propofol group would have less frequency of PONV than the sevoflurane group. Finally, the third hypothesis for this study was that children in the propofol group would reach discharge criteria faster, resulting in a decreased PACU LOS. The main independent variables were administration of sevoflurane or administration of propofol infusion. Control variables included gender, age, BMI, ASA physical status, and length of surgery. The dependent variables included postoperative pain score, frequency of PONV, and PACU LOS.

Independent t-tests were performed to compare the means of the two groups for age, BMI, and length of surgery. A cross tabulation was conducted to assess associations between ASA physical status and the administration of sevoflurane or propofol infusion. An additional cross tabulation was conducted to find associations between gender and the administration of sevoflurane or propofol infusion. Logistic regression was performed to assess the relationship between the independent variables of gender, age, BMI, ASA, length of surgery, administration of sevoflurane, and administration propofol with the dependent variable of frequency of PONV. Separate linear regressions were performed to determine

the association between the dependent variables of postoperative pain scores and PACU LOS with the independent variables of gender, age, BMI, ASA, length of surgery, administration of sevoflurane, and administration of propofol infusion. A p-value <.05 was considered statistically significant for this research. The data were statistically analyzed using Statistical Package for the Social Sciences (SPSS) Version 21 (SPSS IBM Company, 2014).

Ethical Considerations

This study was approved by the Charleston Area Medical Center and West Virginia University-Charleston Division Institutional Review Board on July 27, 2015 (Appendix C).

RESULTS

Presentation, Analysis, and Interpretation of the Data

The total study sample consisted of 200 patients, 2-12 years old, presenting to CAMC Women and Children's Hospital, CAMC Memorial Hospital Surgicare, or CAMC Teays Valley Hospital for ambulatory dental surgery requiring general anesthesia. The mean patient age in Group S was 4.87 with a standard deviation of ± 2.394 years versus 4.63 (±2.182) years in Group P. The mean BMI in Group S was 17.18 (±3.704) kg/m^2 compared to 17.08 (±3.540) kg/m^2 in Group P. The average length of surgery in Group S was 54.65 (±29.578) minutes versus 61.42 (±21.645) minutes in Group P. Patients in Group S had a mean pain score of 1.11 (± 2.313) while Group P had a mean pain score of 0.24 (± 1.207). The mean PACU LOS in Group S was 37.98 (±15.239) minutes versus 39.32 (±15.843) minutes in Group P. Of the 200 patients, 89 (45%) were female and 111 (55%) were male. There were no statistically significant differences in the mean gender, age, BMI, length of surgery, postoperative pain score, or PACU LOS (p>.05) (Table 1).

Table 1: Comparison of Patient Demographics and Clinical Data between Sevoflurane Group and Propofol Group in Pediatric Patients Undergoing Ambulatory Dental Surgery Under General Anesthesia

Variable	Study Groups	Mean	Std. Deviation	Statistical Value p-value
Age (years)	Sevoflurane (N=100)	4.87	2.394	
	Propofol (N=100)	4.63	2.182	NS
BMI (kg/m2)	Sevoflurane (N=100)	17.18	3.704	
	Propofol (N=100)	17.08	3.540	NS
Length of Surgery (minutes)	Sevoflurane (N=100)	54.65	29.578	
	Propofol (N=100)	61.42	21.645	NS
Postop Pain Score	Sevoflurane (N=100)	1.11	2.313	
	Propofol (N=100)	.24	1.207	NS
PACU LOS (minutes)	Sevoflurane (N=100)	37.98	15.239	
	Propofol (N=100)	39.32	15.843	NS
Gender Female (45%)	Sevoflurane (47%)			
	Propofol (42%)			NS
Male (55%)	Sevoflurane (53%)			
	Propofol (58%)			NS

NS=Not Significant (p>.05)

Patients included in the study had an ASA physical classification of I-II. There were 114 patients with an ASA physical classification of I and 86 patients with an ASA physical classification of II (Table 2).

Table 2: Cross-tabulation between ASA Classification and Sevoflurane Group and Propofol Group in Pediatric Patients Undergoing Ambulatory Dental Surgery Under General Anesthesia

			Drug Used		
			Propofol	Sevoflurane	Total
ASA Status	1	Count	61	53	114
		Expected Count	57.0	57.0	114.0
		Std. Residual	.5	-.5	
	2	Count	39	47	86
		Expected Count	43.0	43.0	86.0
		Std. Residual	-.6	.6	
Total		Count	100	100	200
		Expected Count	100.0	100.0	200.0

A Chi-square test was performed to assess association between ASA physical status classifications with Group S and Group P. No statistically significant association was found in ASA with Group S and Group P, $p>.05$ (Table 3).

Table 3: Chi-square Analysis between ASA and Sevoflurane Group and Propofol Group in Pediatric Patients Undergoing Ambulatory Dental Surgery Under General Anesthesia

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1.306[a]	1	NS
Continuity Correction[b]	1.000	1	NS
Likelihood Ratio	1.307	1	NS
N of Valid Cases	200		

NS=Not Significant (p>.05)

Of the 200 patients included in the study, Group S had 47 female patients and 53 male patients. Group P had 42 female patients and 58 male patients (Table 4).

Table 4: Cross-tabulation between Gender Classification and Sevoflurane Group and Propofol Group in Pediatric Patients Undergoing Ambulatory Dental Surgery Under General Anesthesia

			Drug Used		
			Propofol	Sevoflurane	Total
Gender	Female	Count	42	47	89
		Expected Count	44.5	44.5	89.0
		Std. Residual	-.4	.4	
	Male	Count	58	53	111
		Expected Count	55.5	55.5	111.0
		Std. Residual	.3	-.3	
Total		Count	100	100	200
		Expected Count	100.0	100.0	200.0

An additional chi-square test revealed no statistically significant association between gender and Group S or Group P, p>.05 (Table 5).

Table 5: Chi-square Analysis between Gender and Sevoflurane Group and Propofol Group in Pediatric Patients Undergoing Ambulatory Dental Surgery Under General Anesthesia

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	.506[a]	1	NS
Continuity Correction[b]	.324	1	NS
Likelihood Ratio	.506	1	NS
N of Valid Cases	200		

NS=Not Significant (p>.05)

A logistic regression analysis was used to determine the association between the frequency of PONV as indicated by administration of antiemetic drug and the use of sevoflurane or propofol, gender, age, BMI, ASA, and length of surgery. The results showed no statistical difference in the association between type of anesthesia, gender, age, BMI, ASA, and length of surgery with the frequency of PONV within the groups (p>.05) (Table 6).

Table 6: Logistic Regression Analysis between PONV and Sevoflurane Group and Propofol Group in Pediatric Patients Undergoing Ambulatory Dental Surgery Under General Anesthesia

		Score	df	Sig.
Step 1	Gender	1.253	1	NS
	Age	1.460	1	NS
	BMI	.004	1	NS
	Length of Surgery	.431	1	NS
	Drug Used	1.005	1	NS
	ASA	1.332	1	NS

NS=Not Significant (p>.05)

A linear regression was performed between the dependent variable postoperative pain score to assess association between gender, age, BMI, ASA, length of surgery, and administration of sevoflurane or propofol, which showed a statistical significance in the drug used (p<.05) (Table 7).

Table 7: Linear Regression Analysis between Postoperative Pain Scores and Sevoflurane Group and Propofol Group in Pediatric Patients Undergoing Ambulatory Dental Surgery Under General Anesthesia

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.901	.852		3.405	NS
	Gender	.047	.266	.013	.179	NS
	Age	-.083	.062	-.100	-1.339	NS
	BMI	-.057	.038	-.109	-1.501	NS
	ASA	.267	.276	.070	.966	NS
	Length of Surgery	.007	.005	.099	1.394	NS
	Drug Used	-.968	.262	-.257	-3.695	***.001**

a. Dependent Variable: Postop Pain Score, *Indicates Statistical Significance (p<.05), NS=Not Significant (p>.05)

A linear regression was also performed between the dependent variable PACU LOS to assess association between gender, age, BMI, ASA, length of surgery, and administration

of sevoflurane or propofol. The BMI of the patient did indicate a statistical significance for PACU LOS and drug used where as BMI increased, PACU LOS decreased (p<.05) (Table 8).

Table 8: Linear Regression Analysis between PACU LOS and Sevoflurane Group and Propofol Group in Pediatric Patients Undergoing Ambulatory Dental Surgery Under General Anesthesia

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	57.440	7.114		8.075	NS
	Gender	.517	2.217	.017	.233	NS
	Age	-.550	.515	-.081	-1.068	NS
	BMI	-.964	.317	-.225	-3.044	***.003**
	ASA	-3.745	2.306	-.120	-1.624	NS
	Length of Surgery	.002	.043	.004	.056	NS
	Drug Used	1.367	2.187	.044	.625	NS

a. Dependent Variable: PACU LOS, *Indicates Statistical Significance (p<.05), NS=Not Significant (p>.05)

DISCUSSION

Discussion of Study Results

Inhalation with sevoflurane and TIVA via propofol are two methods of maintaining anesthesia with pediatric patients undergoing general anesthesia for ambulatory dental surgery. The results of this research showed that patients who received sevoflurane (Group S) were associated with higher postoperative pain scores than patients who received propofol (Group P). Although past research has shown a decreased incidence of PONV with the use propofol, the results of this research did not show the same association between the two methods of anesthesia. Previous studies have shown a decreased PACU LOS with the administration of sevoflurane compared to propofol. However, results of this research did show a similar PACU LOS between the two groups.

The researcher conducting the present study first tested the hypothesis of decreased postoperative pain scores in patients who received propofol. Results of a linear regression analysis from the collected data did suggest a decreased association between average postoperative pain score with the administration of propofol. An increased postoperative pain score with the use of sevoflurane is consistent with the majority of findings in similar studies. Hasani, et al. (2013) found 24.3% of children anesthetized with sevoflurane experienced pain compared to 4.5% anesthetized with propofol. Chandler, et al. (2013) also found higher pain scores with the use of sevoflurane compared to propofol and concluded that TIVA reduces pain scores by facilitating a smoother emergence.

The second hypothesis the researcher tested was patients anesthetized with propofol would have less frequency of PONV as measured by administration of an antiemetic drug. This hypothesis was tested with a linear regression analysis after collection of the data. Results of the analysis did not show an association between frequency of PONV and the type of anesthesia administered. Picard, Dumont, & Pellegrini (2000) tested the quality of recovery in children after sevoflurane versus propofol and found the incidence of PONV was not significantly different as well. However, these results are inconsistent with other similar studies, which have shown a decreased frequency of PONV with the use of propofol compared to sevoflurane. Pieters, et al. (2010) found 5.4% incidence of PONV with propofol anesthesia compared to 36.8% with sevoflurane anesthesia. Only 1 out of the 200 patients included in the present study received an antiemetic drug in the PACU. This finding suggests anesthesia providers are aware of the importance of PONV prevention in the pediatric population and administer antiemetic drugs before complications arise.

PACU LOS was also investigated in this study. The researcher hypothesized the administration of anesthesia with propofol would result in a decreased PACU LOS compared to administration of anesthesia with sevoflurane. Results from a linear regression analysis did not show a statistically significant decreased association between PACU LOS with propofol, but rather a similar average PACU LOS between the two groups. Although results from several previous studies did not concur with this hypothesis, a literature review by Key, et. al. (2010) concluded recovery from general anesthesia with propofol as being rapid with a calm and sometimes euphoric state. The BMI of the patient did indicate a statistical significant association between PACU LOS and drug used where as BMI increased, PACU LOS decreased. This finding could be explained by the tendency of anesthesia providers to under treat overweight/obese patients. Pediatric patients with an increased BMI are more likely to have oxygen desaturation, difficult mask ventilation, PACU upper airway obstruction, and hospital admission following outpatient surgery (Nafiu, et al., 2009). These complications can be enhanced with increased pain medication and sedation, and therefore raise awareness in anesthetists when providing care to overweight/obese patients (Nafiu, et al., 2009).

Study Limitations

There were several significant limitations present throughout this study. Due to the retrospective design of this study, determination of the accuracy of data recorded in the patient records cannot be made and presents a concern with the internal validity of the study. Possible errors in documentation could not be removed. A true representation of a universal study population cannot be made since the patients in the study came from three separate CAMC divisions all owned and governed by the same corporation in West Virginia.

Also, this study was limited to outpatient dental procedures requiring general anesthesia and cannot be generalized to other outpatient procedures.

Patients who received analgesics during the perioperative period were not excluded from the study. Analgesics differ in potency, onset, and duration of action, which could interfere with postoperative pain scores and creates a limitation in this study. Pain scores were documented by the nurse using the objective pain scale for pediatric patients and differ between each individual. A Pediatric Anesthesia Emergence Delirium (PAED) score was not documented on patients upon arrival to the PACU. Without the use of a PAED scale, providers might view agitation or delirium as pain, and a pain score can be inappropriately documented. Patients who received the antiemetic drugs, ondansetron or dexamethasone, during the perioperative period were not excluded as well. The researcher was aware that inclusion of these drugs could have altered the frequency of PONV.

CONCLUSION

In the present study, the administration of propofol for maintenance of anesthesia in pediatric patients undergoing general anesthesia for ambulatory dental surgery resulted in an association statistically significant between reduced postoperative pain compared to patients who receive sevoflurane. Therefore, TIVA via propofol infusion is more likely to be an effective method for maintenance of general anesthesia in pediatric dental surgery with an improved quality of recovery.

IMPLICATIONS AND RECOMMENDATIONS

This study was able to find an association with a decreased postoperative pain score in pediatric patients who received TIVA via propofol infusion. Decreased pain scores not only result in improved patient and parental satisfaction, but less PACU nursing interventions and LOS. An increased PACU LOS results in more cost to the patient and the hospital with less turnover time between patients in a fast paced outpatient setting. While this study does not provide a statistically significant difference association with PACU LOS between the two methods of anesthesia, the average PACU LOS was similar between the two groups providing anesthetists with comparable methods of general anesthesia for an outpatient setting. Results of this research present anesthesia providers with comparable recovery times between the two methods of anesthesia, which can be helpful in formulating the anesthesia plan of care.

With the growing trend of general anesthesia for pediatric patients undergoing ambulatory dental surgery, results from this study suggest favorable outcomes, such as decreased postoperative pain and equal PACU LOS, with the use of TIVA via propofol infusion. Anesthesia providers should be knowledgeable in various techniques of pediatric anesthesia care and tailor the anesthesia plan to each child. The results of this research can enhance the quality of care being provided and improve overall patient safety and satisfaction as well.

APPENDIX A: DATA COLLECTION TOOL 1

Patient Study Number	Patient Identification Number (Account Number)
1	
2	
3	
4	
…	
200	

APPENDIX B: DATA COLLECTION TOOL 2

Study Participant #	Gender	Age	BMI	ASA Physical Status	Length of Surgery	Use of Sevoflurane	Use of Propofol	Postop pain score	Admini-stration of anti-emetic drug	PACU
	M-1/ F-0	(Years)	Kg/m 2	I&II	Times (Minutes)	Y-1/N-0	Y-1/N-0	(1-10)	Y-1/N-0	LOS (Minutes)
1										
2										
3										
4										
....										
200										

APPENDIX C: IRB APPROVAL CERTIFICATE

New study by expedited review: Approved

CAMC INSTITUTE
RESEARCH AND GRANTS
ADMINISTRATION
Institutional Review Board • Institutional Scientific Review Board
Charleston Area Medical Center | Robert C. Byrd Health Sciences Center

July 27, 2015

Cassey Taylor
3110 MacCorkle Avenue, SE
Charleston, WV 25304

RE: Initial Review Submission Packet 07/20/2015 11:43:15 AM EDT regarding study number 15-107 Inhalation anesthesia vs. total intravenous anesthesia (TIVA) for ambulatory dental surgery in children

Dear Dr. Cassy Taylor:

Your request for expedited approval of the new study listed above has been reviewed. This type of study qualifies for expedited review under FDA and DHHS (OHRP) regulations.

This is to confirm that your application is approved.

The accrual goal for chart review is 1000. You must submit a request to the IRB to increase enrollment beyond the approved accrual goal.

You are granted permission to conduct your study as described effective immediately. The study is subject to continuing review on or before 07/26/2016, unless closed before that date.

Please note that any changes to the study as approved must be promptly reported and approved prior to implementation. Some changes may be approved by expedited review; others require full board review.

Also, serious and/or unanticipated adverse events must also be reported as required by law and in accordance with CAMC/WVU Charleston Division IRB policies. Contact CAMC / WVU Charleston Division IRB at (304) 388-9973 or email angel.cinco@camc.org or michelle.rotenberry@camc.org if you have any questions or require further information.

Sincerely,

Christopher Terpening, PhD, PharmD
Chair, CAMC/WVU IRB

CC: Kristin Neal

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