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SECONDHAND SMOKE EXPOSURE AS A RISK FACTOR FOR PERIOPERATIVE AIRWAY COMPLICATIONS IN PEDIATRIC OUTPATIENT PROCEDURES

A Research Project submitted to
the Graduate College of Business
Marshall University

Final defense submitted in partial fulfillment of requirements for the Doctorate of Management Practice in Nurse Anesthesia (DMPNA) degree conferred by Marshall University (MU) in partnership with the Charleston Area Medical Center (CAMC) based on a collaborative agreement between the MU college of Business and the CAMC School of Nurse Anesthesia

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October 29, 2014

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EXECUTIVE SUMMARY

Abstract: The purpose of this study is to assess the risk of perioperative airway complications, analyze extubation times, and PACU Length Of Stay (LOS), and their association with secondhand smoke exposure in pediatric populations receiving outpatient procedures that require general anesthesia.
Introduction: Tobacco Smoke Exposure (TSE), is well documented to cause physiologic changes in lung tissue that are associated with decreased lung function, increased risk of lower and upper respiratory tract illness, exacerbation of asthma or increased risk of asthma, increased prevalence of non-allergic bronchial hyperresponsiveness, sudden infant death syndrome, and a host of other respiratory complications in adult and pediatric patients. Perioperative airway complications are a major cause of morbidity during general anesthesia for the pediatric population and there are limited studies linking TSE and the frequency of adverse airway complications during general anesthesia in pediatric patients.
Methodology: This 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 who presented for outpatient procedures from January 1, 2005 through June 1, 2014. Two groups were developed, the control group which were pediatric patients documented as non-exposed to tobacco smoke on the preoperative screening form and the case group who were acknowledged as Tobacco Smoke Exposed (TSE) on the preoperative screening form. These two groups were used for comparison of demographics and clinical characteristics such as recorded perioperative adverse airway events, Post Anesthesia Care Unit (PACU) recorded adverse airway events, extubation times, and PACU Length Of Stay (LOS).
Results: There was no statistical significance found between the two groups in association with airway complications; 7% in the smoke exposed group and 3% in the non-exposed group. The mean age of the study sample was 4.37 ±(2.4), mean BMI was 17.02 ± (3.2), the mean number of minutes from the end of surgery until successful removal of nasotracheal tube was 6.95 ±(4.8), and the mean minutes until discharge from the PACU was 48.27 ±(13.3),. Of the 200 patients, 109 (55%) were male, 91 (45%) were female. Statistical significance was found in the TSE group for length of time until extubation (approximately 2 min longer) and for discharge from PACU (approximately 4 minutes longer). Also, there was statistical significance between age in years and the length of time spent in the PACU whereas for every year older the patients in the TSE group were in the PACU approximately one minute longer.
Discussion: In the TSE group the average time to successful extubation was 8 minutes (p=.032) compared to the non-exposed group where extubation occurred after 6 minutes. Furthermore, the LOS in the PACU was an average of 50 minutes (P= .041) in the TSE group, as compared to an average of 46 minutes in the non-exposed group. Literature has shown that TSE does increase risks of airway complications, extubation times, and PACU LOS. Several study limitations were identified and discussed.
Conclusion: TSE does increase the time from surgery stop to successful extubation as well as post anesthesia unit length of stay until discharge.
Implications/Recommendations: This study was able to demonstrate an association with an increase in the time to extubation, as well as the time spent in the post anesthesia recovery unit in the group exposed to secondhand smoke. A longer stay in the PACU means that these pediatric patients are requiring longer time to meet discharge criteria which can include prolonged oral airway use, oxygen use, respiratory therapies such as racemic epinephrine and albuterol nebulizers, more cost to the patient and the hospital, as well as delayed achievement of baseline neurological status. While not reaching statistical significance, there was a 7% complication rate in the TSE group and a 3% complication rate in the non-exposed group which can impact perioperative patient care.
Key Words: Airway complications, Extubation time, Length of stay, Tobacco smoke exposure

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INTRODUCTION

Background and Significance

Secondhand smoke has been studied as a risk factor for a variety of respiratory diseases and anesthesia complications. Secondhand smoke is an air pollutant resulting from burning of tobacco products and/or exhaled and contains approximately 7,000 known chemicals (National Cancer Institute, 2012). Components of secondhand smoke are considered harmful because it has numerous amounts of unburnt substances and because the particle sizes contained in secondhand smoke are much smaller, therefore having greater penetrability into pediatric airways (Cheraghi & Salvi, 2009).

Worldwide, approximately 1 billion adults are active smokers and approximately 700 million children, almost half of the world's children, are exposed to secondhand smoke in their homes (World Health Organization, 2010). Pediatric patient populations are among those involuntarily exposed to secondhand smoke by means of their care givers. A study by Chan-Yeung & Dimich-Ward, in 2003, has shown that exposure to secondhand smoke has led to decreased lung function, increased risk of lower-respiratory tract illness, exacerbation of asthma or increased risk of asthma, and increased prevalence of non-allergic bronchial hyperresponsiveness.

Secondhand smoke exposure causes physiologic changes in the lungs which may lead to increased airway risks associated with anesthesia management. Long term secondhand smoke exposure has been shown to cause development of airway hyperreactivity related to enhanced expression of certain contractile proteins within the endothelium of the lung (Cao, Zhang, Coa,

Edvinsson, & Xu, 2012). Also, measured inflammatory cytokine levels have become elevated after acute exposure of secondhand smoke suggesting chronic systemic inflammation in people exposed on a daily basis (Flouris et al, 2009). These physiologic changes that accompany chronic exposure have been associated with an increased incidence of sudden infant death syndrome, asthma, pneumonia, and impaired lung growth (Moss, Lucht, Kip, & Reis, 2010). Physiologic deviations from normal lung tissue and diseases associated with these changes may increase the risk of adverse airway events during anesthesia care and warrant further investigation (Cheraghi & Salvi, 2009).

At baseline, pediatric patients can be challenging anesthesia candidates without the added complications that arise from tobacco smoke exposure. Airway maintenance is balanced by neural mechanisms and anatomical mechanisms which vary greatly between infancy and adulthood (Janson, 2004). Adverse airway events, such as obstruction, can be life threatening in infants and small children with reduced oxygen reserve (Isono, 2006). In pediatric populations, adverse perioperative airway complications are a major cause of morbidity during anesthesia (Mamie, Habre, Delhumeau, Argiroffo, & Morabia, 2004). For this reason, prior to induction, it is imperative for anesthesia personnel to conduct careful medical and surgical histories to anticipate possible difficulties (Isono, 2006). A detailed tobacco-smoke exposure history is crucial to identifying at risk children. Examination of clinical predictors of pediatric anesthetic complications have found that secondhand smoke exposure increased the likelihood of airway complications during anesthesia by a factor of ten (Parnis, Barker, & Van Der Walt, 2001).

Literature Review

Multiple respiratory and non-respiratory related diseases have been linked to secondhand smoke exposure (Moss et al, 2010). However, very few studies have been done connecting that exposure to airway complications during anesthesia. Of the studies that have been done, many have focused on adult mainstream smokers and not secondhand smoke exposure. Most published pediatric studies have compared secondhand smoke exposure and the link to respiratory diseases which can further complicate general anesthesia airway maintenance, but few have focused on smoke exposure and how it contributes to perioperative airway complications during anesthesia (Mamie et al, 2004).

Jaakkola et al's. study (2006) on respiratory health post secondhand smoke exposure showed the prevalence of asthma-like symptoms to be statistically significant. Furthermore, these researchers reported that the risk of increased cough, physician diagnosed bronchitis, upper respiratory infections, and increased incidence of allergies can be related to early-life tobacco smoke exposure. This study also documented that prenatal exposure had a strong implication on both lifetime and current chronic bronchitis, risk of asthma, and wheezing as compared to postnatal exposure. Also, in-utero exposure to maternal smoking was strongly correlated to an asthma diagnosis in school aged children despite no further secondhand smoke exposure after delivery (Jaakkola, et al, 2006). Associations have been made between prenatal maternal smoking and respiratory diseases later in life, which may affirm a need for this question to be part of tobacco smoke exposure screening to assess respiratory risks for anesthesia preoperatively (Parnis et al, 2001).

A double blinded, prospective cohort study of 405 children, by Jones and Bhattacharyya (2006), recorded adverse airway events both intraoperatively and in the recovery unit for patients with and without passive tobacco smoke exposure. A validated questionnaire was answered by caregivers to determine exposure to tobacco smoke. Recorded perioperative and postoperative complications included unusual amounts of airway secretions, breath holding, laryngospasm, bronchospasm, and airway obstruction. The frequency of respiratory complications during anesthesia and postanesthetic recovery was higher for all outcome measures for second-hand smoke exposure, except for recovery room breath holding and intraoperative laryngospasm and airway obstruction which were2.5, 4.9 and 2.8 times more likely with smoke exposure respectively (Jones & Bhattacharyya, 2006).

In addition, a similar study published in 2011 by Seyidov, Elemen, Solak, Tugay, and Toker, reported 58 (15.1% of the study population) children having adverse respiratory events; 50 patients (21.4%) were in the secondhand smoke exposed group and 8 patients (5.3%) were in the non-exposed group. Some patients were excluded from the study which had previous diagnosis of asthma, acute or chronic airway, lung disease, or symptoms associated with upper respiratory infections within six weeks prior to the scheduled surgery. There was evidence that parental smoking increased the frequency of respiratory symptoms and asthma in children (Chan-Yeung & Dimich-Ward, 2003). Therefore, this study may have excluded a number of children already symptomatic as a result of secondhand smoke. In the study by Chan-Yeung & Dimich-Ward in 2003, smoke exposure was determined by information provided by the caregivers and defined as at least one cigarette per day by someone with daily contact to the child in the same room or other rooms within the household. The frequency of laryngospasm

during anesthesia and hypersecretions in the recovery room were significantly increased in the smoke exposed group by 15.1%. (Seyidov et al, 2011).

Contrary to similar studies, Thikkurissy, Crawford, Growner, Stewart, and Smiley (2012) found that environmental tobacco smoke exposure was a poor indicator of general anesthesia respiratory morbidity in pediatric dental procedure patients. However, the authors noted that both groups were otherwise healthy due to prescreening and this process may have prevented participation of children experiencing symptoms related to smoke exposure. In the same study, the secondhand smoke exposed group had a longer Post Anesthesia Care Unit Length Of Stay (PACU LOS) with a mean of 11 minutes more to achieve discharge criteria (Thikkurissy et al, 2012). Secondhand smoke exposure has been well documented to exacerbate many bronchopulmonary diseases, including asthma (Austin, Selvaraj, Godden, & Russel, 2005).

A survey by Peters, Pabelick, and Warner (2013), studied practices in regards to preoperative anesthesia screening of secondhand smoke exposure of pediatric patients and education principles regarding pediatric secondhand smoke exposure and the relationship to anesthesia practice. Among the anesthesia providers that responded to the survey, the authors reported that a minority of respondents always or almost always asked about secondhand smoke exposure or educating the caregivers to reduce the exposure. The authors also reported that a large majority of anesthesia providers either agree or strongly agree that secondhand smoke exposure is clinically significant in that reducing exposure would reduce rates of perioperative complications; however, most participants in the survey also reported education about tobacco cessation or decreasing pediatric secondhand smoke exposure was not provided to smoking caregivers (Peters et al, 2013).

Statement of the Problem and Research Purpose

Secondhand smoke exposure has been well researched and linked to multiple respiratory diseases and comorbidities in children. Few studies documenting increases in respiratory related complications in conjunction with general anesthesia exist. Of the studies that have been published, most focus on adult active or past smokers, rather than secondhand smoke in pediatric patient populations. Further research is needed to determine if there is a relationship between secondhand smoke exposure in pediatric patients and an increase in respiratory complications during general anesthesia. This could improve the ability for Charleston Area Medical Center's (CAMC) anesthesia practitioners to anticipate complications thereby improving patient care for pediatric patients receiving anesthesia during surgical procedures. Also, there is a need, in the anesthesia community, for further studies to create awareness and education related to the effects of secondhand smoke exposure so that anesthesia providers can mitigate the effects of exposure and provide education to caregivers to reduce exposure. The goal of this research study was to determine if pediatric patients exposed to secondhand smoke by their caregivers, increases the likelihood of perioperative airway complications during anesthesia and if exposure increased the time to extubation and/or the time spent in the recovery unit.

The purpose of this study was to assess the risk of perioperative airway complications, analyze extubation times, PACU LOS, and the association with secondhand smoke exposure in pediatric populations receiving outpatient procedures that require general anesthesia.

METHODOLOGY

Research Hypothesis

The hypothesis for this study was that patients in the pediatric population exposed to second hand smoke from their caregivers would display an increased frequency of perioperative airway complications during general anesthesia using similar agents. The second hypothesis for this study was that the time from stop of surgical procedure to time of extubation would be longer in the Tobacco Smoke Exposed (TSE) group. Finally, the third hypothesis for this study was that children in the TSE group would take longer to reach discharge criteria, extending their PACU LOS.

Research Design and Setting

This research study used a retrospective, quantitative, case control design. This particular design was chosen because data could be collected from the Electronic Medical Records (EMR) available at CAMC (Schulz & Grimes, 2002). This case control design allowed identification of patient demographics and clinical characteristics that would allow comparison of perioperative airway complications between a group of secondhand smoke exposed and a group of non-exposed pediatric patients having outpatient surgical procedures requiring anesthesia.

CAMC is a non-profit, academic medical center and regional referral center including four hospitals (CAMC, 2014), Three of the hospitals, CAMC Women's and Children's, CAMC General, and CAMC Memorial, are located in Charleston, West Virginia. The fourth hospital, Teays Valley Hospital, is located in Teays Valley, West Virginia. (CAMC, 2014).

A review of medical records was conducted on pediatric patients admitted to CAMC General, Memorial, or Women's and Children's hospitals for outpatient surgical services requiring general anesthesia between January 1, 2005 through June 1, 2014. Two groups were developed, the control group which were pediatric patients documented as non-exposed to tobacco smoke on the preoperative screening form and the case group who were acknowledged as TSE on the preoperative screening form. These two groups were used for comparison of demographics and clinical characteristics such as recorded perioperative adverse airway events, PACU recorded adverse airway events, extubation times, and PACU LOS.

Sample Population and Description of Sample

There was be a total of 200 patients randomly selected from 4,500 charts from January 1, 2005 through June 1, 2014; 100 documented as TSE and 100 patients documented as non-exposed on the preoperative screening form. The subjects 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) (West Virginia Department of Health and Human Services, 2014).

Inclusion criteria:

1. Male or female patients.
2. Patients age between 1 and 12 years old.
3. Patients scheduled for outpatient surgical procedure requiring general anesthesia.
4. Patients with an American Society of Anesthesiology (ASA) physical class I and II.
5. Patients with documented history of the presence or absence of tobacco smoke exposure

Exclusion criteria:

1. Patients less than 1 year of age and patients older than 12 years.
2. Patients with ASA III, IV, V, VI
3. Patients with a history of a difficult airway or tracheostomy.
4. Patients with any diagnosed respiratory diseases including asthma
5. Incomplete medical record information

Procedures and Protocol

A study was conducted using collected patient records provided by CAMC's EMR data base for those undergoing outpatient procedures requiring general anesthesia. Patient demographic and clinical variables collected from the anesthesia records included: TSE exposure or non-exposure, gender, age, ASA physical classification, Body Mass Index (BMI), recorded airway complications requiring intervention, extubation times, and PACU LOS.

TSE exposure was defined as a single parent (or guardian) or both parents currently smoked at least one cigarette per day or if anyone currently living in the household smoked at least one cigarette per day. Gender was defined as male or female. Age was measured in years at the time of arrival to the hospital. 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). BMI was calculated by a person's weight and height and was used as a predictor for body fat composition (CDC, 2013).

Airway complications evaluated included laryngospasm and bronchospasm. Laryngospasm would be documented by the use of continuous positive pressure ventilation, deepening of anesthetic state, and the use of rapid-acting muscle relaxant during emergence from anesthesia (Barash, Cullen, Stoelting, Cahalan, & Stock, 2009). Bronchospasm would present clinically with wheezing, dyspnea, tachypnea, increased airway resistance, and peak inspiratory pressures and documented by the use of B2-agonists, IV Lidocaine, or additional use of Cholinergics. (Nagelhout & Plaus, 2010).

Extubation times were collected from the anesthesia record which consisted of the time from the end of the surgical procedure until successful removal of the endotracheal tube. PACU LOS was also collected and contained the time from arrival into PACU until discharge.

Data Collection and Instrumentation

Each patient's EMR was accessed to obtain data (McKesson Corporation, 2014). Specific data was collected from the preoperative anesthesia evaluation form, anesthesia record, and PACU records during the patient's LOS.

The researcher developed two data collection worksheets to organize and collect statistical information and protect patient identification and privacy of patient information. Data Collection Tool 1 was used to assign each patient a study number that separated the patient account number from data extracted from the EMR and was unable to be linked back to any specific patient identification (Appendix A). Data Collection Tool 2 was used to record patient information including patient study number, gender, age, BMI, ASA physical status. This worksheet also recorded whether the patients were TSE or non-exposed and the use of Rapid-Acting muscle relaxant (RAMR), Positive Pressure Ventilation (PPV), the use of B2-agonist, and Lidocaine and then these variables were grouped as to their indication of an airway complication. In addition, this worksheet included extubation times and PACU LOS (Appendix B).

Statistical Design and Analysis

The purpose of this study was to assess the risk of perioperative airway complications, analyze extubation times, and PACU LOS, and their association with secondhand smoke exposure in pediatric populations receiving outpatient procedures that require general anesthesia. The hypothesis for this study was that patients in the pediatric population exposed to second hand smoke from their caregivers would display an increased frequency of

perioperative airway complications during general anesthesia using similar agents. The second hypothesis for this study was that the time from stop of surgical procedure to time of extubation would be longer in the TSE group. Finally, the third hypothesis for this study was that the children in the TSE group would take longer to reach discharge criteria, extending their PACU LOS. The main independent variables were whether the patients were exposed to secondhand smoke or non-exposed. Control independent variables included gender, age, BMI, and ASA. The dependent variables included interventions associated with evidence of airway complications, as well as, extubation times and PACU LOS. A Frequency test and histogram analysis was done to determine if PACU LOS followed a normal distribution. The Mann Whitney U test was done to assess the relationship between independent variables and the extubation times. Means of the TSE and non TSE groups were compared using the Independent t-test for age and BMI. Separate linear regressions were performed to determine the association between the dependent variables of extubation times and PACU LOS with the independent variables of age, gender, BMI, TSE, and non-exposure. A p-value <.05 was considered statistically significant. The data was analyzed using 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, 25 2014 (Appendix C).

RESULTS

Presentation, Analysis, and Interpretation of the Data

The total study sample consisted of 200 patients, ages 1-12 years old, presenting to CAMC Women and Children's Hospital for outpatient dental procedures requiring general anesthesia. The mean age of the study sample was 4.4 ±(2.4), mean BMI was 17 ± (3.2), the mean number of minutes from the end of surgery until successful removal of nasotracheal tube was 6.95 ±(4.8), and the mean minutes until discharge from the PACU was 48.3 ±(13.3). Median extubation time was used due to an abnormal distribution . Of the 200 patients, 109 (55%) were male, 91 (45%) were female, and 5% of the study participants had airway complications. (Table 1)

The study sample of 200 patients was then divided into two groups by preoperative documentation of TSE or non-exposure. Both groups included a patient age range of 1-12 years old. The mean age of the TSE group was 4.5 ±(2.2),the mean BMI was 17.1 ±(3.9), the mean number of minutes from the end of surgery until successful removal of nasotracheal tube was 7.68 ±(5.1), and the mean minutes until discharge from the PACU was 50.2 ±(14.6). Also, 7% of the TSE group had airway complications (Table 1). The mean age of the non-exposed group was 4.2 ±(2.5), the mean BMI was 17 ±(2.4), the mean number of minutes from the end of surgery until successful removal of nasotracheal tube was 6.23 ±(4.36), and the mean minutes until discharge from the PACU was 46.35 ±(11.6) Also, 3% of the non-exposed group had airway complications (Table 1).

Table 1: Comparison of Patient Demographics and Clinical Data between the Tobacco Smoke exposed and non-exposed Pediatric Patients undergoing Outpatient Dental Procedures under General Anesthesia

. Variable	Total Sample	Study Groups		Statistical Value
	Total N=200 Mean (SD)	TSE N=100	Non-Exposure N=100	p- Value
Age (years)	4.37(2.39)	4.52(2.24)	4.22(2.54)	NS
Gender N (%)				
Male	55%	52%	57%	NS
Female	45%	48%	43%	NS
BMI (kg/m2)	17.02 (3.24)	17.09(3.92)	16.95(2.39)	NS
Extubation time (minutes)	6.95(4.79) (Mean) **6(4.79) (Median)	7.68(5.12)	6.23(4.36)	*0.032
PACU LOS (minutes)	48.27(13.28)	50.19(14.59)	46.35(11.6)	*0.041
Airway Complication %	5%	7%	3%	NS

*Indicates Statistical Significance, **Indicates use of Mann Whitney U Test, NS=Not Significant (p<.05), SD=Standard Deviation, BMI=Body Mass Index, PACU LOS= Post Anesthesia Care Unit Length Of Stay

The TSE exposed group means were analyzed with an independent t-test for extubation time and PACU LOS with age and BMI. For the TSE group there was a statistically significant association between the extubation times and the PACU LOS. A Man Whitney U Test was performed to analyze the association between the TSE group and their extubation times as extubation times did not follow a normal distribution and it was found to be of statistical significance (p< .05) (Table 2)

Table 2: Independent T-test between Extubation Time and Post Anesthesia Care Unit Length of Stay for the Tobacco Smoke Exposed Group.

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
age	EVA	.683	.410	-.886	198	.377	-.3000	.3388	-.9680	.3680
BMI	EVA	5.858	.016	-.305	198	.761	-.1400	.4595	-1.0462	.7662
EXTUBA TIME	EVA	1.401	.238	-2.159	198	**.**034**	-1.450	.672	-2.775	-.125
PACU LOS	EVA	1.801	.181	-2.060	198	***.041**	-3.840	1.864	-7.516	-.164

*Indicates Statistical Significance at p<.05, **Indicates Use of Mann Whitney U Test, NS=Not Significant (p>.05), BMI=Body Mass Index

A linear regression analysis was performed between the dependent variable indicators of airway complications such as PPV, use of Beta 2 Agonist, and the use of Lidocaine and extubation times with gender, age, BMI, and TSE, which showed a statistically significant association in the TSE group (p<.05) whereas the tobacco smoke exposed group took approximately 1.5 minutes longer to extubate (Table 3).

Table 3: Linear Regression Analysis between Extubation Times and the Tobacco Smoke Exposed Pediatri Patients.

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	5.015	1.863		2.691	NS
	gender	1.756	.681	.183	2.580	NS
	age	-.121	.147	-.060	-.824	NS
	BMI	.041	.106	.028	.390	NS
	TSE	1.537	.674	.161	2.282	***.024**
	PPV	.639	4.761	.009	.134	NS
	BETA	1.226	1.795	.050	.683	NS

	LIDO	-1.338	3.468	-.028	-.386	NS

a. Dependent Variable: EXTUBATIME, *Indicates Statistical Significance (p<.05), BMI=Body Mass Index, TSE=Tobacco Smoke Exposure, PPV=Positive Pressure Ventilation, BETA=Beta 2 agonist, Lido=Lidocaine

A linear regresson analysis was performed between the dependent variable PACU LOS to assess association between gender, age, BMI, TSE, ASA and airway complications such as use of PPV, use of Beta 2 Agonist, and/or the use of Lidocaine which showed a statistical significance in the TSE group (p<.05) (Table 4). The TSE group stayed in the PACU approximately 4 minutes longer. Also, the age of the patient did indicate a statistical significance for PACU LOS in the TSE group where their stay was approxiimately one minute longer for every year older (p<.05) (Table 4).

Table 4: Linear Regression Analysis between Post Anesthesia Care Unit Length of Stay and the Tobacco Smoke Exposed Pediatric Patients.

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	39.892	5.249		7.600	.000
	gender	2.392	1.880	.090	1.273	NS
	age	*.948	.420	.171	2.259	***.025**
	BMI	.064	.301	.016	.214	NS
	TSE	*3.689	1.871	.139	1.971	***.050**
	PPV	-2.871	13.166	-.015	-.218	NS
	BETA	-.580	5.087	-.009	-.114	NS
	LIDO	-16.124	9.572	-.121	-1.685	NS
	ASA	.134	2.087	.005	.064	NS

a. Dependent Variable: PACULOS*Indicates Statistical Significance (p<.05), NS= No Significance BMI=Body Mass Index, TSE=Tobacco Smoke Exposure, PPV=Positive Pressure Ventilation, BETA=Beta 2 agonist, Lido=Lidocaine, ASA=American Society of Anesthesiology Physical Classification System

A logistic regression analysis was also performed between airway complications and age, gender, BMI, ASA, and the TSE group. There were no statistical significance between any of these variables in association with airway complications (p>.05) (Table 5).

Table 5: Logistic Regression Analysis between Airway Complications and Tobacco Smoke Exposed Pediatric Patients.

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	age	-.340	.198	2.942	1	NS	.712
	gender	.731	.726	1.013	1	NS	2.077
	BMI	.018	.117	.024	1	NS	1.018
	ASA	1.352	.744	3.301	1	NS	3.865
	TSE	.859	.749	1.314	1	NS	2.360
	Constant	-4.995	2.323	4.622	1	.032	.007

Variable(s) entered on step 1: age, gender, BMI, ASA, TSE,), NS= No Significance BMI=Body Mass Index, TSE=Tobacco Smoke Exposure, ASA=American Society of Anesthesiology Physical Classification System

DISCUSSION

Discussion of Study Results

This study has identified an association between pediatric tobacco smoke exposure and an increased time to successful extubation of the nasotracheal tube; as well as an increased LOS in the PACU until discharge. In the TSE group the average time to successful extubation was 8 minutes (p=.032) compared to the non-exposed group where extubation occurred after 6 minutes. Furthermore, the LOS in the PACU was an average of 50 minutes (P= .041) in the TSE group, as compared to an average of 46 minutes in the non-exposed group. Also, age in years was statistically significant (p<.05), in regards to longer PACU LOS in the TSE exposed group. It is

possible to infer that the cumulative exposure to tobacco smoke results in a poor baseline pulmonary status. For every year older, the TSE pediatric patients' LOS in the PACU was approximately one minute longer than the non-exposed group. Similarly, Thikkurissy et al. (2012) reported that the environmental tobacco smoke exposed group spent significantly more time in the recovery unit with an average of 11 minutes more than their non exposed group.

Other studies have also indicated an association with an increased number of perioperative airway complications (five times more likely) associated with pediatric patients exposed to passive tobacco smoke (Jones & Bhattacharyya, 2006). A similar study published in 2011 by Seyidov et al. reported 58 patients having adverse respiratory events (15.1%). The caregiver behaviors, including smoking, that increase the child's likelihood of needing interventions for dental decay have also been suggested to increase the likelihood of that child experiencing an adverse respiratory event during the treatment of the decay under general anesthesia (Borchers, Keen, & Gershwin, 2008). Contrary to the above studies, Thikkurissy et al. (2012) found that environmental tobacco smoke exposure was a poor indicator of general anesthesia respiratory morbidity in pediatric dental procedure patients. Analysis of TSE group in this study failed to show a statistically significant relationship between exposure to tobacco smoke and an increased risk of perioperative airway complications. These findings are not surprising considering the highly selective patient population of this study. These children were chosen based on a specific outpatient procedure (dental restorations), who underwent similar anesthetic techniques, and were prescreened for conditions such as asthma, upper respiratory tract infections and sinusitis. These diagnoses have been known to increase the risk of perioperative airway complications and have been associated with tobacco smoke exposure.

Study Limitations

This study had several limitations. The study sample was extrapolated from a single hospital. Therefore it does not represent the universal population. In addition, identification of TSE exposure relies on the child's caregiver's reporting smoke exposure. It is possible that the caregiver may fail to report the smoke exposure for various reasons including personal embarrassment.

For the purpose of generalization in the anesthetic technique used, this study was limited to outpatient dental procedures requiring general anesthesia with nasal intubation while using similar anesthetics. For this reason, this study cannot be generalized for other outpatient procedures. It should also be noted that children requiring treatment under general anesthesia are required to have a physical examination completed by their primary care physician and potentially prevents children who might be symptomatic from undergoing the procedure. The preoperative physical exam may result in a selection bias by excluding children for whom smoke exposure may have displayed more profound respiratory complications. Furthermore, the routine screening for tobacco smoke exposure and the formulation of anesthetic plan by knowledgeable anesthesia providers may prevent occurrences of anticipated airway events already thought to be associated with tobacco smoke.

Another limitation to this study is documentation errors which could lead to inappropriate inclusion or exclusion of study subjects and inaccurate reporting of actual respiratory complications incurred during the procedures. Finally, the use of a retrospective

design allows that data could be misinterpreted and misread. Due to the retrospective study design, a cause and effect relationship could not be used to establish causality.

CONCLUSION

In the present study, the association of tobacco smoke exposure in pediatric patients was statistically significant in relation to prolonged extubation times and prolonged post anesthesia care unit length of stay until discharge.

IMPLICATIONS AND RECOMMENDATIONS

This study was able to demonstrate an association with an increase in the time to extubation, as well as the time spent in the post anesthesia recovery unit in the group exposed to secondhand smoke. Because of the extended time to extubation these children may be experiencing difficulty with spontaneous ventilation, emergence for anesthetic gases or narcotic, evidence of stage two airways spasms, or breath-holding that requires delayed extubation in a surgical procedure that does not require neuromuscular blockade. A longer stay in the PACU means that these pediatric patients are requiring longer time to meet discharge criteria which can include prolonged oral airway use, oxygen use, respiratory therapies such as racemic epinephrine and albuterol nebulizers, more cost to the patient and the hospital, as well as delayed achievement of baseline neurological status.

This study does not provide statistically significant clinical evidence of a relationship between tobacco smoke exposure and perioperative airway complications in pediatric patients requiring general anesthesia for childhood dental carries. While not reaching statistical significance, there was a 7% complication rate in the TSE group and a 3% complication rate in

the non-exposed group which can impact perioperative patient care. The lack of statistical significance in this study, likely stems from the routine preoperative screening that is already implemented among anesthesia personnel with respect to tobacco smoke exposure at CAMC Women and Children's Hospital. The clinical significance of this finding suggests that healthcare personnel are diligent in weighing the risk/benefit ratio for elective outpatient procedures. Selecting healthy candidates will decrease the risk of perioperative complications.

A detailed preoperative history including caregiver tobacco smoke use and the amount of exposure to the child is vital to creating an anesthetic plan. Standardized questionnaires, severity ratings, and the method for gathering accurate information could impact how anesthesia personnel approach each patient. Because of a variety of airway complications that can be associated with smoke exposure, preoperative information allows anesthesia personnel to be prepared for, and/or prophylacticly treat children in this at risk population. Also, adding tobacco control curriculum into training programs for pediatric anesthesia providers would create an opportunity to educate future providers about smoke exposure in perioperative patients and create further interests in future research.

APPENDIX A: DATA COLLECTION TOOL 1

	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	TSE(1)/	RAMR	PPV	B2	Lidocaine	Ext	PACU	Airway Complication
	M-1/F-0	(Years)	Kg/m 2	I&II	Non-TSE (0)	Y-1/N-0	Y-1/N-0	Agonist Y-1/N-0	Y-1/N-0	Times (Minutes)	LOS (Minutes)	Y-1/N-0
1												
2												
3												
4												
….												
200												

APPENDIX C: IRB APPOVAL CERTIFICATE

cerely,

Christopher T rpening, PharmD
C/WVU IRB

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