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ORIGINAL RESEARCH

Passive smoke exposure as a risk factor for airway complications during outpatient pediatric procedures

Dwight T. Jones, MD, and **Neil Bhattacharyya, MD,** Boston, Massachusetts

OBJECTIVE: Determine if passive smoke exposure (PSE) increases airway complications during outpatient mask anesthesia procedures in children.

METHODS: A prospective cohort of children who underwent surgical procedures under mask anesthesia was studied with the American Thoracic Society children's questionnaire on environmental and respiratory factors. Double-blinded outcomes with respect to adverse airway events were recorded both intraoperatively and in the recovery room for patients with and without passive smoke exposure. Multivariate comparisons assessing the likelihood of these airway complications were conducted between the PSE and nonexposed groups.

RESULTS: Of 405 children, 168 (41.5%) had PSE. The incidence of airway complications during anesthesia or postanesthetic recovery was higher for all outcome measures for PSE children (all $P \leq 0.005$), except for recovery room breath holding ($P = 0.086$). Intraoperative laryngospasm and airway obstruction were 4.9 and 2.8 times more likely with PSE, respectively.

CONCLUSIONS: PSE significantly increases the risk of anesthesia-related airway complications during outpatient pediatric procedures.

EBM rating: A-1b

Passive smoke exposure, also known as secondhand smoke exposure, inadvertently exposes nonsmoking individuals to many of 4000 substances known to be contained in cigarette smoke, many of which are toxic or deleterious to the health of the passive smoker.[1] Many respiratory and nonrespiratory diseases have been linked to passive smoking. Among those exposed to passive smoke, children are especially vulnerable to the negative health consequences of passive smoking. This relates to the inability of the child to recognize the negative health consequences of passive smoke exposure, a general lack of "escape opportunities" from the smoke exposure, and the relative vulnerability of the growing child to respiratory and nonrespiratory consequences of passive smoke exposure. Several otolaryngologic disease entities have been linked to passive smoke exposure including chronic otitis media with effusion, chronic rhinitis, and adenotonsillar hypertrophy.[2]

A strong trend toward outpatient day-surgical pediatric procedures has emerged in the last 2 decades. A significant number of these ambulatory pediatric procedures include primary otolaryngologic surgery that due to concomitant upper and lower airway diseases have been shown to have been already at elevated risk of perioperative airway complications.[3] The presence of passive smoke exposure may further compound the perioperative anesthesia risk for these children. This study was conducted to determine the incidence and association of unfavorable anesthetic and postanesthetic airway complications in ambulatory pediatric surgical patients with and without passive smoke exposure to determine if an elevated risk accompanies passive smoke exposure in this setting.

METHODS

This study was approved by our hospital's human studies research committee and conducted in compliance with the Healthcare Insurance Portability and Accountability Act.

From the Department of Pediatric Otolaryngology (Dr Jones); Children's Hospital, the Division of Otolaryngology (Dr Bhattacharyya); Brigham and Women's Hospital, and Boston Department of Otology and Laryngology (Drs Jones and Bhattacharyya); Harvard Medical School.

Reprint requests: Neil Bhattacharyya, MD, Division of Otolaryngology, 45 Francis St, Boston, MA 02115.

E-mail address: neiloy@massmed.org.

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This prospective cohort consisted of a consecutive series of pediatric patients undergoing elective day surgical procedures at Children's Hospital, Boston. Eligibility criteria included: 1) informed consent to participate in the study; 2) age between 1 and 18 years; and 3) scheduled outpatient surgical procedure to be conducted by the otolaryngology, general pediatric, plastic, urologic, orthopedic, dental, ophthalmologic, or radiology patient care services under general anesthesia with mask ventilation for children with American Society of Anesthesiology (ASA) class I status. Patients were excluded from participation if they had any history of difficult airway or tracheotomy.

On the day of surgery, parents or guardians completed a modified version of the American Thoracic Society standardized children's questionnaire on environmental and respiratory factors.[4] This is a validated questionnaire used to study the impact of various factors on respiratory health by asking patients or their families questions regarding respiratory health, exposure to factors such as pets, environmental allergies, and smoking. A second data sheet was completed by the anesthesiologist and the recovery room nurse who cared for the patient during the course of the day surgery and anesthetic recovery. These medical personnel were masked to the responses on the respiratory health questionnaire and to the status of passive smoke exposure. Five specific airway complications were recorded separately during surgery and postanesthesia recovery as the primary outcome measures: the presence of unusual amounts of upper airway secretions, breath holding, laryngospasm, bronchospasm, and airway obstruction. The occurrence of these complications was assessed intraoperatively (by the anesthesiologist) and in the recovery room (by the recovery room nurse). Each individual airway complication was graded on an ordinal scale as indicated in Table 1, with increasing grades reflecting increasing severity of the airway complication. The specific outcome measures were chosen because they clinically reflect airway responsiveness or hyperresponsiveness during anesthesia and recovery from anesthesia. Typically from a clinical standpoint, one or more of these airway complications often precedes impending respiratory embarrassment including endotracheal intubation.

The overall patient cohort was segregated according to the presence or absence of exposure to passive tobacco smoke (secondhand smoke). Children with passive smoke exposure were compared with children without exposure to secondhand smoke (control group). Children were considered to be exposed to passive smoking if either one or both parents (or guardian) currently smoked at least 1 cigarette per day or had been smoking within the 12 months before surgery.

The 2 patient cohorts were then compared with respect to the incidence of intraoperative and postanesthesia recovery airway complication measures. The association between passive smoking exposure and the incidence of airway complications was examined with chi-square with significance at $P = 0.05$ (two tailed). The relative risk and confidence intervals for the likelihood of each airway complication for children exposed to passive smoking versus those without passive smoking exposure were determined. In addition, bivariate correlation analysis was conducted to determine if the number of cigarettes smoked in the home per day was correlated with the degree of severity of airway complications for those patients with one or more anesthesia airway complications and those patients with one or more recovery room airway complications.

RESULTS

A total of 428 patients completed the survey analysis and the anesthesia and recovery outcomes assessment. Twenty-three patients were excluded because they were beyond the age cutoff of 18 years. Therefore, a total of 405 children were analyzed of which 168 (41.5 %) were exposed to

Table 1
Grading scale system for airway complications

	Grade 0	Grade 1	Grade 2	Grade 3
Breath holding	None	<15 seconds	15-60 seconds	>60 seconds
Laryngospasm	None	5-10 seconds	Partial obstruction or <10 seconds of complete obstruction	>10 seconds of complete obstruction
Bronchospasm	None	End-expiratory wheezes only	Pan-expiratory wheeze with normal oxygen saturation	Pan-expiratory wheeze with reduced oxygen saturation
Hypersecretion	None	Audible or visual secretions that do not require aspiration	Secretions that require aspiration once or twice	Secretions that require more than 2 aspirations
Airway obstruction	None	Mild snoring that requires position change	Oral airway required	Total obstruction with inability to ventilate