

# Severe Obesity and Sleep-Disordered Breathing as Risk Factors for Emergence Agitation in Pediatric Ambulatory Surgery

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**Purpose:** Sleep-disordered breathing (SDB) may be a critical risk factor for emergence agitation (EA). We hypothesized that SDB diagnosis is a predictor of EA in children after general anesthesia for ambulatory surgery.

**Design:** Prospective, observational, cohort study.

**Methods:** Children aged 4 to 17 years were assessed for the occurrence of EA. Differences in probability of EA were assessed using multivariable logistic regression analyses.

**Findings:** Of 1,076 children, 66 (6.1%) had EA. Compared with those without EA, children with EA were younger ( $P < .001$ ), more likely to have had mask induction ( $P < .001$ ) and a preoperative diagnosis of SDB ( $P = .008$ ). On multivariable analysis, SDB, severe obesity, decreasing age in years, increasing first arousal pain score, and intraoperative use of sevoflurane were independently associated with EA.

**Conclusions:** SDB and severe obesity may be critical independent predictors of EA in children. Mechanisms underlying these observations deserve further elucidation.

**Keywords:** children, delirium, agitation, sleep-disordered breathing, obstructive sleep apnea, severe obesity.

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**EMERGENCE FROM GENERAL ANESTHESIA (GA)** is a passive process characterized by gradual return of consciousness after discontinuation of anesthetic drugs at the end of surgery. In the vast majority of children, this is a variable, largely un-

eventful process, whereby patients return to “street readiness”, and are discharged from the postanesthesia care unit (PACU). However, for some children, emergence from GA is complicated by emergence agitation (EA), which covers a broad

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spectrum of behavioral disturbances including agitation, restlessness, crying, moaning, and non-purposeful movements.<sup>1,2</sup> Other terminologies used to describe these physical manifestations include emergence delirium and postanesthesia excitement.<sup>3</sup>

EA in the ambulatory setting can be quite distressing and may blemish the entire perioperative experience. Furthermore, dealing with children manifesting features of EA in the PACU places enormous burden on the PACU nurses, is time consuming and often delays the time the parents are reunited with their children after surgery and it may substantially prolong PACU stay.<sup>3-5</sup> EA could also lead to disruption of surgical wounds, loss of intravenous line, and may predispose PACU nurses to physical injuries especially if they are trying to restrain a combative overweight or obese child.<sup>6,7</sup>

Despite its profound and alarming nature, the etiology of pediatric EA remains largely speculative. Several putative risk factors for EA have been described.<sup>1-3,7-9</sup> Many of these have focused on anesthetic agents, especially volatile anesthetic agents like sevoflurane.<sup>7,8</sup> Very few studies have specifically explored patient-level factors as potential predictors of EA.<sup>6,9</sup> For example, EA is reported to be more common in boys and in younger children.<sup>9</sup> One increasingly prevalent patient-specific factor whose association with EA has hitherto been unexplored is sleep-disordered breathing (SDB).

SDB is increasingly prevalent in the general and the pediatric surgical population.<sup>10</sup> SDB refers to a spectrum of airway and systemic disorders including habitual snoring, obstructive hypoventilation, and obstructive sleep apnea (OSA).<sup>11,12</sup> Given that abnormal sleep behavior (snoring, vocalization, and thrashing around)<sup>12</sup> are features of SDB, and the increasing prevalence of SDB among the pediatric surgical population, the present report describes the incidence of EA in patients undergoing elective ambulatory surgery and specifically explored the relationship between SDB and EA using data from an ongoing prospective observational study. The hypothesis tested was that the proportion of children manifesting features of PACU EA will be higher among those with SDB compared with their peers without SDB.

## Methods

### *Study Design*

This report is an excerpt of a larger ongoing prospective, cross-sectional study to determine the incidence and risk factors for postoperative pain requiring treatment in the PACU among children aged 4 to 17 years undergoing elective, ambulatory surgical procedures at the Mott Children's Hospital (Ann Arbor, MI). The Institutional Review Board of the University of Michigan approved the study. Present analyses included patients recruited from January 24, 2015 to April 04, 2016.

### *Data Source and Subject Profiles*

We enrolled patients on randomly selected weekdays during the preoperative interview. All patients scheduled for outpatient surgery on selected days were approached for possible enrollment. Perioperative caregivers (anesthesiologists and nurses) did not know subject recruitment days in advance nor were they aware of the study's hypotheses. In keeping with routine clinical care, all perioperative interventions were at the discretion of the anesthesia care givers. Trained research assistants (RAs) collected baseline clinical and anthropometric data on study enrollees. Patients with cardiac disease, severe respiratory disorders, or those with severe neurocognitive impairment were excluded from the study.

### *Outcome Measures*

Our primary outcome measure was the occurrence of PACU EA, defined as the presence of non-purposeful movements, restlessness, or thrashing; incoherence; inconsolability; and unresponsiveness.<sup>2,4</sup> EA was recorded as a categorical (yes/no) variable by experienced PACU nurses. Our secondary objective was the association of EA with PACU length of stay, defined as the time in minutes from PACU admission to PACU discharge.

### *Covariates*

Primary exposure variable was SDB, defined as the presence of one or more of the following: history of OSA diagnosis, habitual snoring, or witnessed cessation of breathing during sleep. OSA diagnosis was sought by the specific question, "has your

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