Lesson 309: Management of the Child With Emergence Delirium

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Read this article, reflect on the information presented, then go online and complete the lesson post-test and course evaluation before the termination date below. (CME credit is not valid past this date.) You must achieve a score of 80% or better to earn CME credit.

TIME TO COMPLETE ACTIVITY: 2 hours
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Professional Gaps

Emergence delirium occurs commonly in the postanesthesia care unit and its diagnosis and management can be difficult. This manuscript presents a rational approach to a better understanding of the complication and thus improves management.

Learning Objectives

At the end of this activity, the participant should be able to:

1. Recognize the surgical and anesthetic risk factors for emergence delirium.
2. State why the reported incidence of emergence delirium varies widely.
3. Recognize the signs of emergence delirium.
4. List the potential long-term sequelae and costs of emergence delirium.
5. Discuss the proposed etiology and pathophysiology of emergence delirium.
6. Identify pharmacologic techniques to prevent and treat emergence delirium.
7. Identify psychological techniques used to prevent and treat emergence delirium.
8. Describe the differential diagnosis of emergence delirium.
9. Identify the child most likely to experience emergence delirium.
10. Name scales used to diagnose emergence delirium.

Case History

A 5-year-old boy (weight 18 kg; height 110 cm) presented for an adenotonsillectomy for treatment of obstructive sleep apnea. He had no prior anesthetic encounters, had an apnea–hypopnea index of 10, and had no other relevant medical history. The child appeared anxious in the preoperative area, and his mother told the anesthesiologist that he seemed more emotional than her 2 other children. A 9 mg dose of oral midazolam was given preoperatively. Induction continued with sevoflurane and nitrous
oxide 40% in oxygen. A 22 g IV was established in the dorsum of the left hand. Tracheal intubation was achieved following administration of propofol 3 mg/kg after end-tidal sevoflurane reached 4.5%. Maintenance included sevoflurane at an end-tidal concentration of 3% in 100% oxygen, 5 mg of ketamine, and 35 mcg of fentanyl for analgesia. Dexamethasone, 10 mg, and 2 mg of ondansetron were given for antiemesis and to reduce airway swelling. A total of 400 mL of lactated Ringer’s solution was infused. The child was extubated while still deeply anesthetized in the operating room and transported to the postanesthesia care unit (PACU). After the child awoke, the nurse called with concerns that he was thrashing and crying, requiring 2 additional staff members to keep him from injury.

Smessaert et al first described emergence delirium in the 1960s as hyperexcitation after anesthesia with cyclopropane.¹ The study aimed to define characteristics associated with a greater risk for emergence delirium through observation of patient characteristics such as age, sex, anesthetic agents used, duration of anesthesia, and emergent versus routine procedure. From his observations of 1,450 children, Smessaert and colleagues classified the recovery from anesthesia into 3 “modes”: 1) tranquil and uneventful recovery; 2) moderate degree of restlessness; and 3) markedly delirious and uncooperative, requiring special care and restraint. This landmark paper was the first to describe a higher incidence of delirium in patients under the age of 10 years. Since the initial description, further research has delved into defining and characterizing this self-limiting occurrence to improve patient care, educate concerned family members, and improve the safety conditions for staff caring for the patient.

**Definition**

The definition of *emergence delirium* has proven to be challenging, for several reasons. The patient population most commonly affected is often immature and unable to articulate perceived experiences. In addition, symptoms of emergence delirium are nonspecific, making it difficult to differentiate it from other causes of postoperative distress. Most definitions include characteristics such as an altered state of mentation, occurrence in the postoperative period, and duration that is limited.²⁻⁶ One of the most well-accepted definitions, by Sikich and Lerman in 2004, is “a disturbance in a child’s awareness of and attention to his/her environment with disorientation and perceptual alterations including hypersensitivity to stimuli and hyperactive motor behavior.”⁷ Depending on the definition used and the population studied, the reported incidence of emergence delirium varies between 10% and 80%.²⁻⁵,⁶,⁸

Other terms, such as *agitated emergence, emergence agitation, emergence excitement,* or *postanesthetic excitement,* are used interchangeably throughout the literature, but consistency in the definition would add necessary rigor to the study of this subject. According to the *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.), delirium is a psychiatric condition characterized by rapid, acute disturbances of attention, perception, and consciousness. *Agitation* is a more inclusive term that may include restlessness or distress from sources other than anesthesia, such as an absent parent. Studies that require delirium to fulfill diagnostic criteria for emergence distress typically report lower rates than do studies that accept agitation alone or with delirium as case-defining symptoms. For the purpose of this review, the term *emergence delirium,* which requires the presence of delirium, is used to describe this phenomenon.
Etiology

The etiology of emergence delirium remains unknown. Some clinicians suggest that rapid emergence from anesthesia is a potential trigger. The increased incidence of emergence delirium reported with use of short-acting, less soluble volatile anesthetics lends support to a rapid emergence theory.\(^2\) However, maintaining anesthesia at a higher minimum alveolar concentration and decreasing the rate of reduction of anesthetic concentration at the end of surgery to slow awakening is not associated with decreased risk. Use of short-acting IV anesthetics, such as propofol, appears to be protective, suggesting that other factors may be involved.\(^2\) Xenon, a nonvolatile inhaled anesthetic agent that provides a rapid awakening, has been associated with reduced postoperative delirium in adults, but has not been well studied in children.

Other etiologies have been proposed. Risk for emergence delirium appears similar for sevoflurane, desflurane, and isoflurane, but reported rates for halothane are lower. Sevoflurane has been shown to increase activity of excitatory currents via the locus coeruleus. Volatile agents that cause less emergence delirium excite this pathway less. Also α\(_2\) agents that reduce emergence delirium, such as clonidine and dexmedetomidine, reduce this excitatory current.\(^1\) One possible explanation for the difference in excitation of pathways with sevoflurane may be the blockage of gamma-aminobutyric acid A receptor–mediated inhibitory pathways at low concentrations, such as occurs during emergence. Sevoflurane, desflurane, and isoflurane cause similar electroencephalogram (EEG) changes, whereas halothane, which has a lower incidence of emergence delirium, results in a different EEG pattern.\(^1\) Although the EEG patterns do not point to a mechanism, they suggest that certain volatile agents have distinct actions in the brain.

Symptoms and Signs of Emergence Delirium

Within 30 minutes of awakening from anesthesia, behaviors suggestive of emergence delirium include irritability; being uncompromising, uncooperative, or incoherent; and inconsolable crying, moaning, kicking, or thrashing.\(^2\) Some describe having a “glazed-over” appearance or “looking right through you” as hallmarks of emergence delirium.\(^8\) These behaviors typically are self-limiting, with a duration of approximately 5 to 15 minutes.\(^2\)

Although emergence delirium is common in pediatric patients, it is important to rule out other causes of delirium and inconsolable behavior that may manifest in the PACU. Differential diagnosis for a patient with these behaviors includes postoperative pain, hypoxia, hypercarbia, airway obstruction, hypoglycemia, seizures, elevated intracranial pressure, hypo/hyperthermia, extrapyramidal effects, inadequate reversal of muscle relaxants, full bladder, and fear and anxiety.\(^9\)

Anesthetic Involvement

Anesthesiologists may well wonder why they should be concerned about a short and self-limiting complication. Emergence delirium may adversely affect both the patient and personnel caring for the patient. Possible injury to the patient from thrashing, loss of IV access, and damage to dressings or the surgical site may result from any cause of delirium.\(^2\) Personnel are at risk for injury while caring for a thrashing child. Additional staff support often is required to help keep patients safe.\(^3,16\)

Surveyed parents of children with emergence delirium report dissatisfaction with their child’s care and concern that maladaptive behaviors may persist after surgery.\(^14\) A study performed by Kain et al and
verified by Sadhasivam et al revealed a 1.4-fold increased incidence of postoperative maladaptive behaviors that may persist for weeks or months, such as general anxiety, nighttime crying, enuresis, temper tantrums, and separation anxiety, in patients diagnosed with emergence delirium.4,5

**Risk Factors for Emergence Delirium**

Factors that put children at risk for emergence delirium include type of surgery, patient characteristics, and choice of anesthesia.

**Surgical risk factors** include procedures on the thyroid, eye, middle ear, and tonsils. Voepel-Lewis et al reported that approximately 25% of children undergoing otolaryngologic or ophthalmic surgery experience emergence delirium,16 which is greater than twice the rates reported in children undergoing other surgeries, such as general or urologic procedures. Some authors suggest that the feeling of suffocation associated with surgeries around the face may explain this increased incidence of emergence delirium.2

**Patient characteristics** include the child being 2 to 6 years old. Also, a child described as emotional, less social, more impulsive, or less adaptable to environmental changes appears to be at greater risk. No sex-based difference has been observed.2 The presence of preoperative anxiety manifested by either the child or the parent is estimated to increase the risk for emergence delirium by 10%.5 However, accurate assessment of patient anxiety levels before anesthesia can be challenging. The modified Yale Preoperative Anxiety Scale, a measurement tool that assesses 27 behaviors in 5 different domains (activity, use of parent, vocalization, state of arousal, and emotional expressivity) is used by both research and clinical physicians to identify and quantify pediatric anxiety.18 The tool is validated and found to be reliable compared with longer questionnaires such as the State Trait Anxiety Inventory. When anxiety is identified, various nonpharmacologic measures (preoperative use of video games and parental presence) can be used to distract the child and decrease postoperative anxiety.19,20 The combination of identification and treatment of postoperative anxiety also may reduce the incidence of emergence delirium.

**Anesthetic choices** may affect the risk for emergence delirium. Although the complication has been reported after all types of anesthesia, total IV anesthesia appears to decrease the risk compared with volatile anesthetics.18 Halothane is reported to have a lower risk, whereas all other volatile agents appear to carry similar risks for emergence delirium.6,21,22

**Reducing the Risk**

Prophylactic pharmacologic treatment appears to reduce both severity of and risk for emergence delirium. Uncontrolled postoperative pain is an obvious potential confounder when considering emergence delirium as an explanation for untoward symptoms after surgery. Strategies that provide excellent analgesia such as administration of 0.25 mg/kg of ketamine during dental surgery and a caudal block with 1 mL/kg of 0.25% bupivacaine for abdominal procedures significantly reduced the rate.15 Clonidine, provided as a caudal injection (2-3 mcg/kg), IV (2-3 mcg/kg), or in oral form (4 mcg/kg) also reduced the rate of emergence delirium diagnosis.23-25 Patel et al and Aarts et al reported that 0.2 mcg/kg per hour of dexmedetomidine for tonsillectomy and adenoidectomy surgery were beneficial.15,23

It is possible, however, that improved analgesia may have reduced the incidence by eliminating
agitation caused by postoperative pain as well as preventing nonpainful delirium. An additional finding of interest was the reduction of emergence delirium in pain-free magnetic resonance imaging (MRI) after administration of 1 mcg/kg of fentanyl, suggesting that multiple pathways may be involved.¹⁵

Delaying emergence from volatile general anesthesia by administration of an IV agent such as clonidine, dexmedetomidine, or propofol is another prophylactic option. Addition of 1 mg/kg of propofol before withdrawal of inhaled agents significantly decreased the incidence of emergence delirium after pain-free MRI scans.¹⁵ The mechanism of action is not known. Further investigation into these medications and identification of the causes of emergence delirium may clarify how pharmacologic agents can help.

Diagnostic Tools

Many tools can help identify, quantify, and guide treatment of patients experiencing or at risk for emergence delirium.⁶,⁹ For example, scores of 4 or higher on the 5-point Cravero scale are consistent with emergence delirium if symptoms persist for at least 3 minutes despite active measures by staff to calm the patient (Table 1).⁹ Because the Cravero scale measures agitation and sedation, diagnosis of emergence delirium with this metric is greater than scales that require delirium for diagnosis.

The Pediatric Anesthesia Emergence Delirium (PAED) scale was developed by Sikich and Lerman (Table 2).⁷,⁹ This scale is the most commonly used and reliable tool for identification and quantification of emergence delirium. Five criteria are evaluated on a Likert scale to help caregivers differentiate between postoperative pain and delirium. Scores of 10 or higher are consistent with emergence delirium.

The Watcha scale (Table 3) resembles the simplicity of the Cravero scale.⁹ Patient scores of 3 or higher for any duration of time in the postoperative period are consistent with emergence delirium. The Watcha scale more consistently correlates with the PAED scale, and both have slightly higher sensitivity than the Cravero scale.

Routine use of one of these scales will improve identification, although choice of scale may differ based on the anesthetic practice setting. Choosing a scale that best fits a particular practice will aid in its successful use.
Treatment

Several pharmacologic and nonpharmacologic treatments are available, recognizing that no additional treatment may be appropriate given the self-limiting characteristic. Withholding treatment decreases the child’s exposure to additional medications but prolongs the time that the child poses potential harm to him- or herself or staff, and increases parental stress. Pharmacologic approaches include small doses of fentanyl, propofol, clonidine, dexmedetomidine, or midazolam, titrated to sedation. Usually, when additional sedative effects wane, the child rouses but the delirium is no longer present. Avoidance of toxic side effects from the various pharmacologic treatments, such as respiratory depression, sedation, and prolonged stay in the PACU, is possible with careful titration.

Environmental modifications, such as a darkened or quiet environment and parental presence in the PACU, also reduce the incidence and duration of emergence delirium. These modifications are generally easy to implement, are low-cost, and have no adverse effects. A combination of both environmental and pharmacologic approaches may be warranted for some patients.

Patient Identification and Management

High-risk patients include children aged 2 to 6 years who are anxious at baseline and are to undergo potentially painful surgical procedures, and whose parents also are nervous. The ideal approach to provide safe and effective anesthesia must take into consideration the surgery planned, comorbidities, and future needs. Many strategies to reduce emergence delirium, however, arguably should be applied to all patients, including adequate education regarding the expected surgery, pain management, and anesthetic plan all accomplished before the date of surgery; a calming and reassuring preoperative visit; anxiolytic and amnestic premedication; a calm and quiet induction; thorough multimodal analgesia, including local anesthetic and regional techniques; and appropriate pharmacologic management to reduce the likelihood of postoperative residual paralysis, hypoxia, and hypercarbia. Awakening should occur in a calm, quiet recovery area with rapid access to parental presence. In a patient at high risk for emergence delirium, the use of total IV anesthesia with propofol and other

Table 3. Watcha Scale

<table>
<thead>
<tr>
<th>Behavior</th>
<th>Score</th>
</tr>
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<tbody>
<tr>
<td>Asleep</td>
<td>0</td>
</tr>
<tr>
<td>Calm</td>
<td>1</td>
</tr>
<tr>
<td>Crying, but can be consoled</td>
<td>2</td>
</tr>
<tr>
<td>Crying, but cannot be consoled</td>
<td>3</td>
</tr>
<tr>
<td>Agitated and thrashing around</td>
<td>4</td>
</tr>
</tbody>
</table>

Based on reference 9.
prophylactic agents, such as $\alpha_2$ agonists or short-acting opioids, may be preferred.

**Management of the Case Presented**

Assessment of the child is required to exclude critical threats to the child's welfare. It was noted that the child had an adenotonsillectomy for moderate to severe obstructive sleep apnea, which can be associated with postoperative apnea, hypoxia, and hypercarbia. Vital signs indicated that the patient was not oversedated; blood oxygen saturations were 98% on 40% oxygen; and end-tidal carbon dioxide was 41 mm Hg. Local anesthesia was not applied to the surgical site and 2 mcg/kg of fentanyl was given for analgesia. Upon questioning and application of the Wong-Baker FACES scale, pain was not the apparent reason for distress. Confusion was observed and the child described hallucinations. A diagnosis of emergence delirium was made. The IV line was protected with an extra wrap. The child’s mother was permitted to enter the PACU. Airway management devices were assembled and an IV bolus of 2 mcg/kg of clonidine was given. The child calmed and fell asleep, and on second awakening was calm. Alternative medications such as propofol and fentanyl would have been appropriate treatment for emergence delirium, but clonidine has the advantage after tonsillectomy in a patient with significant obstructive sleep apnea because it does not affect the carbon dioxide response curve while still allowing sedation and analgesia.

**Conclusion**

Overall, children are at high risk for emergence delirium, and may require a multimodal approach for prevention or mitigation of emergence delirium. Modalities to pursue include adequate postoperative pain control, prophylactic pharmacologic treatment with the medications discussed, and a soothing PACU environment. Although commonly used, none of the drugs mentioned in this review are approved specifically by the FDA for the management of emergence delirium in children. Through identifying these patients and providing appropriate prophylactic treatments, the need for additional PACU staff and prolonged hospital stays may be reduced, while patient and parental satisfaction and safety improve.

Lessons that can be learned from a review of emergence delirium are summarized in Table 4.
REFERENCES


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**Post-test**

1. The age group most likely to develop emergence delirium is_______.
   a. infants
   b. preschoolers
   c. teenagers
   d. all ages

2. Which set of characteristics is most likely to be related to emergence delirium?
   a. Uncontrolled movements, confusion, fear
   b. Crying, pulling at dressing, complaining of pain
   c. Thrashing, tachypnea, accessory muscle breathing
   d. Confused speech, snoring, respiratory obstruction

3. Which inhaled agent is least likely to cause emergence delirium?
   a. Xenon
   b. Sevoflurane
   c. Isoflurane
   d. Desflurane

4. Which of the following is not a diagnostic criterion for emergence delirium?
   a. Uncontrolled movements
   b. Pain
   c. Confused speech
   d. Pulling at bandages

5. Which of the following pharmacologic agents may contribute to emergence delirium?
   a. Clonidine
   b. Dexmedetomidine
   c. Isoflurane
   d. Fentanyl
6. Which of the following family characteristics may contribute to emergence agitation?
   a. A family that insists on hugging the child at separation
   b. A child with anxious parents crying at separation
   c. A single parent
   d. An adopted child

7. Which of the following characteristics of induction may contribute to emergence agitation?
   a. Parental presence
   b. Inhalation induction
   c. Active resistance at induction
   d. IV induction

8. Which of the following preoperative medication protocols is least effective in decreasing the incidence of emergence delirium?
   a. Preoperative midazolam
   b. Preoperative clonidine
   c. No preoperative medication given
   d. Preoperative diazepam

9. Which of the following anesthetic techniques is least effective in decreasing the incidence of emergence delirium?
   a. Total IV anesthesia with propofol and remifentanil, ketorolac for analgesia
   b. Caudal anesthesia with ropivacaine and clonidine to anesthetize the surgical site combined with general anesthetic
   c. Desflurane combined with oxygen and air, ketorolac for analgesia
   d. Sevoflurane combined with oxygen and air, fentanyl prn in recovery for analgesia

10. Which is not an effective technique for decreasing severity and consequences of emergence delirium?
    a. Parental presence
    b. Restraint with tie-downs
    c. IV fentanyl
    d. IV clonidine