The Prevention of Post-Operative Delirium in the Pediatric Population

Nurse Anesthesia Adventist University of Health Sciences

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Abstract

Emergence delirium is a condition in which emergence from anesthesia is accompanied by a state of profound excitation and disorientation potentially resulting in injury. There is an incidence as high as 80% in school age children. Though the etiology of emergence delirium is unknown, researchers have hypothesized it is due to the rapid metabolism of modern inhaled anesthetics such as sevoflurane and desflurane. A review of literature was conducted regarding the etiology of emergence delirium, it's long-term effects, the potential hazards associated with this condition and appropriate evidence-based management techniques. The goal of this scholarly project was to increase the knowledge base of 27 students in the 2019 MSNA ADU cohort assuming no attrition. A pretest was given to a sample size of 26 student register nurse anesthetists before a power point presentation to evaluate their baseline knowledge on emergence delirium prevention. A post-test was then administered to assess an increase in the knowledge base. Data analysis was conducted by means of a paired sample t test, with a predetermined significance of $p < .05$. There was a statistically significant ($t(25) = -5.211$, $p<.001$) increase in the baseline knowledge of the students between the mean pre-test ($M=65.38$, $SD=29.96$) scores and the post-test ($M=92.31$, $SD=9.51$) scores.

Keywords: emergence delirium, children, propofol, dexmedetomidine

Table of Contents

The Prevention of Post-Operative Delirium in the Pediatric Population

Postoperative delirium is a common occurrence in the pediatric population (Bong et al., 2014; Hoff, O'Neil, Cohen, & Collins, 2015). The etiology of emergence delirium (ED) is still widely unknown (Martin et al., 2014; Dahmani, Delivet, & Hilly, 2014). Through a review of the literature, current knowledge was accumulated and explored.

Problem

ED is a cluster of behaviors exhibited in the early postanesthetic period that may have adverse emotional effects for patients and their families (Rosen, Mervitz, Cravero, & Lerman, 2015). The incidence of ED in the pediatric population is estimated to be between 20% and 80%, as determined by the scoring tool used (Abu-Shahwan, 2008; Makkar, Bhatia, Bala, Dwivedi, & Singh, 2016). ED is a quandary faced by the anesthetist, staff nurses, as well as the parents of the child.

ED, however, is of primary concern for the anesthetist, as they are the ones that are responsible for the anesthetic management of the patient. ED has been shown to have adverse consequences for up to six months after surgery (Mountain, Smithson, Cramolini, Wyatt, & Newman, 2011). Additionally, there is an immediate risk that the patient could injure themselves when they are thrashing around in the bed (Mountain et al., 2011).

The staff nurse also faces issues in dealing with ED. It is the nurse's responsibility to control and keep the patient safe while in the post-anesthesia care unit (PACU), this takes increased effort and time from the patient's nurse (Rosen et al., 2015). Parents seeing this behavior in their child, are also likely to become stressed and anxious (Zhu, Wang, Zhu, Niu, & Wang, 2015). Overall, this can create a negative operative experience for the family that could have long-term effects, such as a failure to agree to surgical interventions in the future.

Ultimately, this creates issues within the hospital system. ED has been shown to cause an increase in the utilization of hospital resources, a need for increased nursing supervision, and cause a delay in discharge from the PACU due to treatment, although there is a gap in the literature as to how long of a delay is created (Rosen et al., 2015; Mountain, Smithson, Cramolini, Wyatt & Newman 2011; Zhu et al.,2015). The additional costs incurred are predominately related to increased staffing requirements, while medication and supplies only account for 2% of the overall cost (Dexter & Tinker, 1995). This factor can equate to an increase in medical expenses for the hospital, and the overall increase in health care costs in general (Zhu et al.,2015). Increased medical costs have far-reaching effects for many and is one of the largest problems facing American families, businesses, and public finance (Rother, 2017).

Student Registered Nurses Anesthetists at Adventist University and Health Sciences start rotations in specialty areas such as pediatrics in the Spring 2018 semester. However, at this point in their academic education, they will have limited didactic education on the pediatric population. Additionally, the students will still be in their Junior year and are still developing their knowledge and skill base in the administration of anesthesia. If students enter in to a pediatric clinical rotation without proper knowledge of how to manage ED, then patient safety could be compromised. Therefore, two research questions were developed. One to guide the literature review, the other to address the educational intervention. PICO: In the pediatric population (P) how effective are pharmacological interventions (I) as compared to previously traditional approaches (C) in the prevention of ED (O) in the postoperative period (T)? PICO: In Adventist University student registered nurse anesthetists (P), will a 30-minute (T) educational presentation about the pharmacological prevention of pediatric emergence (I) delirium result in an increase in understanding and knowledge (O)? No comparison necessary.

Literature Review and Synthesis

Etiology of Post-Operative ED

ED has an unknown etiology (Martin et al., 2014; Dahmani, et al., 2014; Hoff et al., 2015). ED has been associated with rapid emergence from volatile anesthetics (Martin et al., 2014). The use of rapidly metabolized anesthetic gases such as desflurane and sevoflurane have shown a greater incidence of ED when compared to halothane and isoflurane (Dahmani et al., 2014). Sevoflurane has been a preferred and widely used anesthetic in the pediatric population due to its fast induction properties, safety, and rapid emergence (Dahmani et al., 2014; Abu-Shahwan, 2008).

One of the largest predictors of ED in pediatrics was shown to be pre-operative anxiety. Approximately 60% of patients and their families experience pre-operative anxiety (Mountain et al., 2011). Pre-operative anxiety has been shown to induce negative behaviors post-operatively such as combative movements, thrashing, excitability, disorientation, inconsolable crying, cognitive and memory impairment (Abu-Shahwan, 2008; Mountain et al., 2011). A link has been identified, however, in pediatric maladaptive behaviors, such as separation anxiety and sleep problems or disorders and ED (Hoff et al., 2015). Additionally, pre-operative anxiety has also been linked to negative behaviors at home such as bad dreams, waking up crying, separation anxiety and, temper tantrums. These behaviors may also persist for as long as up to six months after the surgical procedure (Mountain et al., 2011). Furthermore, another factor thought to contribute to ED is the child regaining consciousness in an unfamiliar place with unfamiliar people (Abu-Shahwan, 2008). Additionally, electroencephalographic (EEG) patterns have been studied to help further identify the pathophysiology of postoperative ED. ED occurred in children that awoke after anesthesia without evidence of sleep, while children that awoke with evidence of sleep did not develop ED (Martin et al., 2014).

Risk of injury in Postoperative Emergence Delirium

ED can lead to unintended self-injury if the child in not carefully watched. ED can present itself with the child thrashing about, in an excited state, and disorientation leading to injury (Hoff et al., 2015). Patients placed on beds or stretchers that have either hard metal or plastic pieces such as arm rails are at risk for harm. ED may lead to the accidental removal of invasive lines and monitors causing incisional damage or bleeding as well as cause an increase in pain (Mountain et al., 2011). ED may also lead to damage of surgical site further creating anxiety for both the pediatric patient and their parents (Mountain et al., 2011; Zhu et al., 2015).

Delayed PACU Time and Recovery

Extended recovery time has been one reason that it is important to understand and try to prevent ED. In a meta-analysis, Zhu et al. (2015), discovered that there was a direct correlation in the treatment of ED and extended PACU time. The emergence of anesthesia was delayed and furthermore the time to extubation was also extended. There exists a gap, however, within the literature regarding the exact length of time patients have been delayed in PACU. Increased duration of stay in the PACU primarily resulted from the patients having to remain in the PACU until the anesthetics have worn off. A delay in emergence attributed to the use of certain medications, these extend the amount of time a recovery room nurse must continually monitor the child (Hoff et al., 2015). Using Propofol as a prophylactic treatment for children with ED raises concerns with delayed awakening and hemodynamic changes such as hypotension bradycardia and apnea (Hoff et al., 2015). Treatments geared towards prevention of ED are not free of side effects and depending on what a provider might choose, the length of recovery is affected.

If a provider prepares for and medicates appropriately to prevent ED, there still may be some delay in discharge from the recovery area due to sedation of the patient. Transfer and

emergence times were greater than that compared to patients who were not treated for ED (Makkar et al., 2016). However, if there were a delay in treatment until an episode of ED, then sedation and recovery time would be extended even further, especially if the child develops and injury.

Contributing Factors to Post-Operative Delirium

According to Dahmani et al. (2014), "Classical predictors of preoperative anxiety in children are young age, parental stress, very few siblings, reduced sociability, few social adaptive capability, poor quality of previous medical experience, lack of enrollment in a day care, surgery and low rating for activity…" (p. 311). ED has also been found to be more common in males than females, and in children with low coping skills (Dahmani et al., 2014). A relationship also existed between preoperative anxiety and the development of ED (Dahmani et al., 2014; Hoff et al., 2015). Being able to identify when the patient was experiencing pain and when there was actual ED has also been problematic. Varied scales have been used. One scale that is more prevalent in the current literature is the Pediatric Anesthesia Emergence Scale (PAED) (Bong et al., 2014; Dahmani et al., 2014; Hoff et al., 2015; Zhu et al., 2015). This scale measures behavior in children suspected of having ED. PAED scale measures, eye contact, actions, awareness of surroundings, restlessness, and finally inconsolability (Bong et al., 2014). It has been difficult for the provider to distinguish between when children are combative and agitated versus ED. Scales such as PAED scale have been instituted to assist in the identification and quantification of ED.

The Timing of Administration of Propofol and Dexmedetomidine.

Propofol and Dexmedetomidine have both been found to be beneficial in the treatment of ED (Bong et al., 2014; Dahmani et al., 2014; Hoff et al., 2015; Zhu et al., 2015). A single bolus dose of Propofol, during emergence, has been proven to decrease the incidence ED, while an initial dose of Propofol in induction does not. This result was attributed to its relatively short half-life

(Dahmani et al., 2014; Hoff et al., 2015). Significant evidence exists, indicating that a maintenance infusion of Propofol may be advantageous in the treatment of ED (Dahmani et al., 2014; Hoff et al., 2015). It has been shown there is a significant reduction of emergence delirium with a single dose of prophylactic Propofol at emergence (Hoff et al., 2015). The timing of administration of both Propofol and Dexmedetomidine correlated with their effect in the treatment of emergence delirium. No correlation has been found in the improvement of emergence delirium when administering a single dose of Propofol or Dexmedetomidine vs. a placebo (Bong et al., 2014). The study acknowledged that a dose of Dexmedetomidine administered at the beginning of the procedure was not effective. The timing of administration differs with most studies that administered their bolus of Dexmedetomidine on emergence (Bong et al., 2014; Dahmani et al., 2014; Zhu et al., 2015). A single dose of 0.3 mcg per kg of Dexmedetomidine administered over five minutes, and given approximately fifteen minutes before the end of the surgery was very successful in reducing the incidence of ED (Makkar et al., 2016). However, this did come at the cost of increased sedation, which will also lead to an increase of time the child will be required to stay in the recovery area (Makkar et al., 2016). Propofol given in sub-hypnotic doses was shown to be effective in reducing ED without causing an increase in recovery time (Abu-Shahwan, 2008).

Therefore, there seems to be a gap in the overall knowledge of practitioners on how to both identify and treat ED as the incidence is still as high at 80% (Abu-Shahwan, 2008). Studies have shown that there have been no standard treatments or identification tools used to identify and treat ED. Some practitioners have used identification tools while others have simply used their observations. Additionally, practitioners have used a variety of at least five different medication to treat ED, while never really standardizing a treatment (Rosen, Mervitz, Cravero, & Lerman, 2015). This scholarly project will be implemented to expand the knowledge base of student

registered nurse anesthetists (SRNA) regarding effective pharmacological interventions for the prevention of ED.

Contribution and Disseminations

This scholarly project was implemented to expand the knowledge base of student registered nurse anesthetists (SRNA) regarding effective pharmacological interventions for the prevention of ED. There is a gap in SRNA knowledge base regarding appropriate evidence-based management techniques. This gap was addressed by the implementation of an educational PowerPoint presented in the Spring of 2018 to the 2019 ADU SRNA cohort. Results will then be disseminated via the ADU NAP Scholarship/Poster presentation day, scheduled for April 9, 2018, from 1:00-3:00 pm.

Project Aims

The aim of this scholarly project was to increase the knowledge base of the ADU SRNA 2019 cohort regarding the etiology of ED, it's long term effects, the potential hazards associated with this condition and appropriate evidence base management techniques, as evidenced by a statistically significant increase in post test scores compared to pretest scores.

Project Methods

This scholarly project employed a quantitative pre-test and post-test design. A convenience sample, consisting of twenty-seven junior SRNAs enrolled in the 2018 MSNA 502 Clinical Conference II course, was selected and presented with ED educational PowerPoint. Inclusion criteria consisted of all junior SRNAs, enrolled in the 2018 MSNA 502 Clinical Conference II course. Exclusion criteria included: SRNAs not enrolled in ADU, those students absent or delayed in attending the course, or those students failing to sign informed consent. After informed consent was obtained students were presented with a 10-question multiple choice test identical to the post test. Data was stored on the scholarly project team member's personal

laptop computer and will only be accessible to the project team member and Dr. Roy Lukman. With the completion of the scholarly project, all pre/post-test will be shredded and electronic data will be deleted from the laptop.

The scholarly project helped to assess the knowledge base of twenty-six SRNAs by providing a pretest before a PowerPoint presentation. The increase in knowledge base post module was evaluated by offering a posttest to the sample population. The power point presentation took place in the Spring 2018 semester. The time of the scholarly project coincided with the pediatric education SRNAs will start to receive from the faculty at Adventist University of Health Sciences (ADU).

Timeline

Implementation occurred in Spring 2018 as determined by the ADU faculty. The time frame purposefully coincided with MSNA 635 Anesthesia Across the Lifespan course, where the students are taught the majority of the MSNA pediatric content. Data collection occurred once the participants complete the informed consent and the initial pre-test to assess their base line knowledge was administered. Implementation ended upon the completion of the post-tests. The presentation to the SRNAs occurred after the initial test through a power point presentation. Results will then be disseminated via the ADU NAP scholarship/Poster presentation day, scheduled for April 9, 2018, from 1:00-3:00 pm.

Data Collection Plan

Data collection and implementation occurred in the 2018 MSNA 502 Clinical Conference II course on Thursday January 18th at 4:00 pm. Data collection occurred on the same day with the pretest administered before the education PowerPoint, utilizing a 10-question multiple choice pre-test. Both pre-test and post-test were labeled with matching numbers, to allow for later

statistical comparison. The anonymity of all participants was maintained. The data collected was amassed an entered into an Excel spreadsheet. An e-mail was then sent to Dr. Roy Luckman, the statistician to, for analysis using SPSS. Results were evaluated using a paired t-test with a predetermined significance level of $p<.05$. There was a total of six exchanges with the students, giving and receiving: the consent, pretest and then post-test.

Evaluation Plan

Participants were evaluated utilizing a 10-question multiple choice pre and post-test. For an accurate measure of the participant's improved base line knowledge, the tests were identical. An e-mail was then sent to Dr. Roy Luckman, the statistician to, for analysis using SPSS. Results were evaluated using a paired t-test with a predetermined significance level of $p<.05$. The statistical data was then analyzed to determine the effectiveness of the scholarly project. Statistical improvement of the pre and post tests showed the effectiveness of the scholarly project. Results will then be disseminated via the ADU NAP scholarship/Poster presentation day, scheduled for April 9, 2018, from 1:00-3:00 pm.

Limitations

Limitations of the scholarly project include the small sample size, single study site, and a homogenous sample. Only increased knowledge base can be assessed as reassessment occurred immediately after the PowerPoint, and the 10-question multiple choice pre and post-test has not been evaluated for reliability and validity.

Results

A paired-sample t-test was conducted to compare mean pre-test scores to mean post-test scores. Mean post-test scores ($M=92.31$, $SD=9.51$) were significantly higher than the mean pre-test scores ($M=65.38$, $SD=29.96$) $t(25) = -5.211$, $p<.001$.

Conclusion

These results suggest that a power point presentation was effective in increasing the knowledge base of the 2019 SRNA cohort regarding the prevention of pediatric emergence delirium. These objectives were clearly met as evidenced by the statistically significant improvement in mean post test scores.

While this project did prove to be successful, there were some limitations. This project was implemented on a small sample size of 26 students, making it difficult to draw strong conclusions. This could have been improved by administering the tests and presentations to multiple students from multiple schools in several different states. However, due to restrictions in time and resources the researchers were unable to perform the project on such a large scale at this point in time. Additionally, the pre and post-tests were only comprised of 10 questions. A less limiting test of more questions may have given a better indication of both the knowledge base of the students before the education as well as the effectiveness of the education. If this research were to be duplicated, it would be recommended to increase both the sample size as well as the size of the pre and post-tests to offer more reliability and validity.

Students gained important knowledge regarding emergence delirium. This included why its' important to prevent emergence delirium as well as common and effective treatment options. It is hoped that the knowledge obtained will assist the 2019 SRNAs when they start their specialty rotations and begin caring for pediatric patients.

An unexpected outcome of this project was an increase in the researcher's ability to collaborate and communicate within a team. This scholarly project required two team members to work closely together throughout all aspects of the project. In order to complete the project successfully, constant communication with each regarding responsibilities and deadlines was

essential. Additional, communication with the project mentor and project chair was also required. Overall this increased the project team's skill in both collaboration and communication. These acquired skills will translate well into the work environment of the nurse anesthetist. As effective communication and collaboration, within the anesthetic team, result in better patient outcomes.

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APPENDIX A
Pre-Test and Post-Test

1. Propofol is presumed to exert its sedative-hypnotic effects through which inhibitory neurotransmitter in brain?

    a. γ-aminobutyric acid (GABAA) receptors although it also has activity at glycine receptors.
    b. Glutamate
    c. Dopamine
    d. Serotonin

2. Propofol contains all the following properties except?
    a. Antiemetic
    b. Antipruritic
    c. Anticonvulsant
    d. Attenuation of bronchoconstriction
    e. Analgesia

3. The most common anesthetic gas used in pediatric anesthesia is?
    a. Isoflurane
    b. Desflurane
    c. Sevolflurane
    d. Halothane

4. Emergence delirium occurs in approximately?
    a. 40-50% of the pediatric population
    b. 10-15% of the pediatric population
    c. 20-80% of the pediatric population
    d. 60-75% of the pediatric population

5. It is best to medicate patients for emergence delirium?
    a. In pre-op
    b. During the emergence period
    c. During anesthesia induction
    d. In the PACU once the patient is symptomatic

6. Which drugs have been shown to be the most effective in preventing emergence delirium?
    a. Precedex, tylenol
    b. Precedex, propofol
    c. Ativan, fentanyl
    d. Fentanyl, versed

7. Precedex is an agonist for which receptor?
    a. Alpha 1

b. Alpha 2
c. Beta 2
d. Gaba
e. Beta 1

8. Propofol may also help reduce the incidence of?
    a. Pruritus
    b. Hypotension
    c. Over sedation
    d. Nausea and vomiting

9. What additional factor may reduce the incidence of emergence delirium?
    a. application of supplemental oxygen
    b. IV toradol
    c**. Total intravenous anesthesia**
    d. supplemental Nitrous oxide

10. Which anesthetic is thought to be most responsible for ED?
    a. Sevoflurane
    b. Halothane
    c. Nitrous oxide
    d. Isoflurane

APPENDIX B

ADU NAP CAPSTONE PROJECT – INFORMED CONSENT

Our names are Tosha Grady, Yadira Venegas and we are MSNA students in the Nurse Anesthesia Program (NAP) at Adventist University of Health Sciences (ADU). We are doing a Capstone Project called *The Prevention of Emergence Delirium in the Pediatric Population.* This project is being supervised by Sarah Snell. We would like to invite you to participate in this project. The main purpose of this form is to provide information about the project so you can make a decision about whether you want to participate.

WHAT IS THE PROJECT ABOUT?

The purpose of this project is to increase the knowledge base of junior SRNAs at ADU, regarding interventions on the treatment of emergence delirium based on current evidence base practice.

WHAT DOES PARTICIPATION IN THIS PROJECT INVOLVE?

If you decide to participate in this project, you will be asked to complete an anonymous pre-assessment, attend a classroom presentation, and then complete an anonymous post-assessment. The assessment will address the treatment of emergence delirium. By further understanding the drugs available, efficacy of those drugs, and the most appropriate timing of drug administration. Your participation by attendance at the presentation and completion of the survey is anticipated to take approximately one hour.

WHY ARE YOU BEING ASKED TO PARTICIPATE?

You have been invited to participate as part of a convenience sample of students currently enrolled in the ADU NAP. Participation in this project is voluntary. If you choose not to participate or to withdraw from the project, you may do so at any time.

WHAT ARE THE RISKS INVOLVED IN THIS PROJECT?

Although no project is completely risk-free, we don't anticipate that you will be harmed or distressed by participating in this project.

ARE THERE ANY BENEFITS TO PARTICIPATION?

We don't expect any direct benefits to you from participation in this project. The possible indirect benefit of participation in the project is the opportunity to gain additional knowledge about emergence delirium based on current evidence base practice.

HOW WILL THE INVESTIGATORS PROTECT PARTICIPANTS' CONFIDENTIALITY?

The results of the project will be published, but your name or identity will not be revealed. To maintain confidentiality of assessments, the investigators will conduct this project in such a way to ensure that information is submitted without participants' identification. The data amassed will be stored on a personal laptop computer and will only be accessible to the study conductors. The data will be kept through the duration of the scholarly project and once is consummated, all data will be perpetually deleted from the laptop.

Thus, the investigators will not have access to any participants' identities.

WILL IT COST ANYTHING OR WILL I GET PAID TO PARTICIPATE IN THE PROJECT?

Your participation will cost approximately an hour of your time, but will require no monetary cost on your part. You will not be paid to participate.

VOLUNTARY CONSENT

By signing this form, you are saying that you have read this form, you understand the risks and

benefits of this project, and you know what you are being asked to do. The investigators will be happy to answer any questions you have about the project. If you have any questions,Tosha Grady (Tosha.Grady@my.adu.edu) and Yadira Venegas (Yadira.Venegas@my.adu.edu), If you have concerns about the project process or the investigators, please contact the Nurse Anesthesia Program at (407) 303-9331.

_____ **Date**

_____

Participant Signature/ Participant Name (PRINTED LEGIBLY)

_____ **Participant Name (PRINTED LEGIBLY)**

APPENDIX C

The Prevention of Post- Operative Delirium in the Pediatric Population

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Project Mentor: Hilary Martino MSNA, CRNA
Project Chair: Sara Snell DNP, CRNA, ADU
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Objective

To increase the knowledge base of the ADU SRNA 2019 cohort regarding:

1. Etiology of emergence delirium (ED)
2. It's long term effects
3. Potential hazards associated with this condition

Clinical Problem

- Emergence delirium (ED) is cluster of behaviors exhibited in the early post anesthetic period.
- **ED occurs in approximately 20-80% of pediatric population**
- It can have adverse emotional effects for up to 6 months post operatively
- It can result in physical injury to the patient
- It can create long term anxiety of surgical procedures among the patient as well as the parents

Clinical Problem

- Creates an increase in utilization of hospital resources
- Increased need for nursing supervision to ensure patient safety
- Delayed PACU discharge times
- Increase in healthcare costs:
  - Increased cost in staffing
  - Delay in PACU turnover

Etiology of Post-Op Delirium

- ED has an unknown etiology
- Associated with rapid emergence from volatile anesthetics.
- **Rapidly metabolized anesthetic gases such as Desflurane and Sevoflurane have shown a greater incidence of ED.**
- **The most common anesthetic gas used in the pediatric population is Sevoflurane.**
- **Avoiding anesthetic gases by using TIVA may be an effective way to actually prevent any ED.**

Case Study

- 3 year old male patient undergoing a inguinal hernia repair
- Nurse anesthetist arrives to take child to operating room
- The child is: anxious, clings to the mother, and is crying
- Sevoflurane is administered via face mask for successful inhalation induction
- The surgery is performed without complication
- The child is: weaned off gasses, returned to spontaneous breathing, extubated, and taken to PACU
- In PACU the child is: restless, agitated, fails to make eye contact, thrashes in the bed, and is inconsolable by their parents

How could this behavior in the PACU have been prevented?

Contributing Factors

- One of the largest predictors of ED in pediatrics was shown to be pre-operative anxiety.
- Pre-operative anxiety has been shown to induce negative behaviors post-operatively :
  - Combative movements
  - Thrashing
  - Excitability
  - Disorientation
  - Inconsolable crying
  - Cognitive and memory impairment

  (Abu-Shahwan, 2008; Mountain et al., 2011).
- Additionally, pre-operative anxiety has also been linked to negative behaviors at home.

Classic Predictors of ED

- Young age
- Parental stress
- Very few siblings
- Reduced sociability
- Few social adaptive capability
- Poor quality of previous medical experience
- Lack of enrollment in a day care
- Surgery
- Low rating for activity

(Dahmani et al., 2014)

- There seems to be a gap in the overall knowledge of practitioners on how to both identify and treat ED as the incidence is still as high at 80% (Abu-Shahwan, 2008).
- Studies have shown that there have been no standard treatments or identification tools used to identify and treat ED.
  - Some practitioners have used identification tools while others have simply used their observations.
- Additionally, practitioners have used a variety of at least five different medication to treat ED, while never really standardizing a treatment (Rosen, Mervitz, Cravero, & Lerman, 2015).

Pediatric Anesthesia Emergence Scale

- One scale that is most prevalent in the current literature is the Pediatric Anesthesia Emergence Scale (PAED)(Bong et al., 2014; Dahmani et al., 2014; Hoff et al., 2015; Zhu et al., 2015).
- This scale measures behavior in children suspected of having ED.
- It has been difficult for the provider to distinguish between when children are combative and agitated versus ED.
- Scales such as PAED scale have been instituted to assist in the identification and quantification of ED.

Pediatric Anesthesia Emergence Scale

- PAED scale measures:
  - Eye contact
  - Actions
  - Awareness of surroundings
  - Restlessness
  - Inconsolability

(Bong et al., 2014)

Clinical Presentation

ED can present itself with the child:

- Combative movements
- Thrashing
- Excitability
- Disorientation
- Inconsolable crying
- Cognitive and memory impairment

(Abu-Shahwan, 2008; Hoff et al., 2015; Mountain et al., 2011).

Risk of Injury

These behaviors can lead to unintended self injury due to:

- Patients placed on beds or stretchers with hard pieces
- Accidental removal of invasive lines
- Damage of surgical site causing bleeding

Delay PACUTime and Recovery

- Patients must remain in the PACU until the anesthetics have worn off.
- A delay in emergence attributed to the use of certain medications.
- Using Propofol as a prophylactic treatment for children with ED raises concerns with delayed awakening and hemodynamic changes:
  - Hypotension
  - Bradycardia
  - Apnea
- Treatments geared towards prevention of ED are not free of side effects.

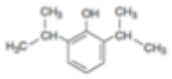
(Hoff et al., 2015).

Treatment of ED

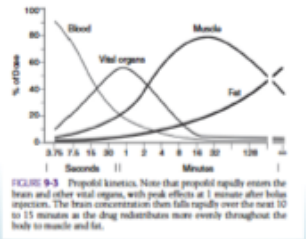
- Propofol and Dexmedetomidine have both been found to be beneficial in the treatment of ED (Bong et al., 2014; Dahmani et al., 2014; Hoff et al., 2015; Zhu et al., 2015).

Propofol

- Propofol is a 2, 6-diisopropyl phenol
- Rapid distribution following an IV (intravenous) bolus dose into the brain and other highly perfused areas results in a fast onset of generally one circulation time.
- Rapid redistribution from the central to the peripheral compartments as the drug more evenly distributes to the entire body produces a quick initial decline in blood levels.



(Nagelhout, 2005, Figure 9-, pg 105)



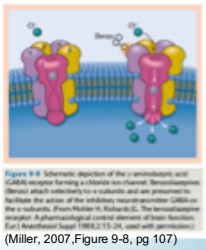
(Nagelhout, 2005 Figure 9-3 pg106)

Properties of Propofol

- Antiemetic
- Antipruritic
- Anticonvulsant
- Attenuation of bronchoconstriction

Propofol

- **Like many other sedatives and anesthetics, propofol appears to exert its effect via an interaction with the inhibitory neurotransmitter γ-aminobutyric acid (GABA) and the GABAA glycoprotein receptor complex.**
- GABA is a major inhibitory transmitter in the central nervous system (CNS).



(Miller, 2007,Figure 9-8, pg 107)

How Effective is Propofol?

- **Title:** Does a prophylactic dose of propofol reduce emergence agitation in children receiving anesthesia? A systematic review and meta-analysis.
- **Authors:** Sophia L. van Hoff, Elizabeth S. O'Neill2, Lianna C. Cohen & Brian A. Collins.
- **Objective:** The objective of this review was to assess the effects of a prophylactic dose of propofol vs placebo on the incidence and severity of ED in children age 0–13 years receiving general inhalational anesthesia.

How Effective is Propofol?

- **Main results**: Of 276 studies screened, nine trials involving 997 children met all inclusion criteria.
  - All were considered low risk of bias.
  - Based on available evidence, prophylactic propofol was associated with decreased incidence of EA
  - And reduced severity of EA as assessed by mean PAED scale, when compared to placebo.
  - In addition, though prophylactic propofol did lengthen the time to awakening, it did not increase recovery time, when compared to placebo. .

How Effective is Propofol?

- **Title:** Transition to propofol after sevoflurane anesthesia to prevent emergence agitation: a randomized controlled trial
- **Authors:** David Costi, James Ellwood, Andrew Wallace, Samira Ahmed, Lynne Waring & Allan Cyna.
- **Objective:** The aim of this randomized double-blinded study was to determine whether transition to propofol for 3 min at the end of sevoflurane anesthesia reduces the incidence of EA in children.

How Effective is Propofol?

- **Main Results:**
- Data were analyzed for 218 children. The incidence of ED was lower in the propofol group on PAED scale.
- Duration and severity of ED were also reduced in the propofol group
- Emergence time and time in PACU were both increased by a mean of 8 min in the propofol group ($P < 0.001$) with no difference in time to discharge home.

Timing of Administration

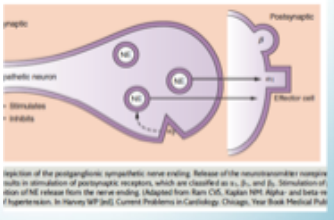
- **A single bolus dose of Propofol, during emergence, has been proven to decrease the incidence ED, while an initial dose of Propofol in induction does not.**
- It has been shown there is a significant reduction of emergence delirium with a single dose of prophylactic Propofol at emergence (Hoff et al., 2015).
- This result was attributed to its relatively short half-life (Dahmani et al., 2014; Hoff et al., 2015).
- Significant evidence exists, indicating that a maintenance infusion of Propofol may be advantageous in the treatment of ED (Dahmani et al., 2014; Hoff et al., 2015).

Dexmedetomidine

- Dexmedetomidine produces a dose-dependent sedation that resembles natural sleep, unlike the classic GABA receptor agonists.
- Patients do not experience respiratory depression and are readily arousable.
- Dexmedetomidine is highly specific for α2 versus α1 receptors at a ratio of 1600:1.
- Alpha-2 presynaptic receptors function as autoreceptors in the negative feedback loop controlling neurotransmitter release.

Dexmedetomidine

- **When α2 receptors are stimulated by an agonist such as dexmedetomidine,** it results in a decreased catecholamine release.
- The main site of action for the sedative actions of dexmedetomidine is the pontine noradrenergic nucleus the locus coeruleus.
- The α2 receptors are G-protein– coupled receptors, which when activated, result in the inhibition of calcium channels, the activation of potassium channels, and the direct modulation of the exocytic release of proteins.
- This produces hyperpolarization of the cells and thus inhibition



(Miller, pg 73, Figure 7-3)

Dexmedetomidine

- Respiratory Effects: A unique advantage of Dexmedetomidine sedation is that respirations are maintained. Brain respiratory responsiveness to carbon dioxide is normal. Airway patency and reflexes are present or only slightly diminished. These properties allow for convenient use in out-of-operating room procedures and difficult airway situations.
- Cardiovascular Effects :The main cardiovascular effects of Dexmedetomidine are hypotension and bradycardia. This results from CNS alpha receptor stimulation and systemic vasodilation.

How effective is Dexmedetomidine?

- **Title:** Meta-Analysis of Dexmedetomidine on Emergence Agitation and Recovery Profiles in Children after Sevoflurane Anesthesia: Different Administration and Different Dosage
- **Authors:** Min Zhu, Haiyun Wang, Ai Zhu, Kaijun Niu, Guolin Wang
- **Objective:** To evaluate the effect of dexmedetomidine on emergence agitation and recovery profiles in children after sevoflurane anesthesia and its pharmacological mechanisms.

How effective is Dexmedetomidine?

- **Main results:**
- A total of 1364 patients (696 in the dexmedetomidine group and 668 in the placebo)
- Compared with placebo dexmedetomidine decreased the incidence of emergence delirium, post operative pain, and nausea and vomiting.
- Dexmedetomidine had a significantly delayed effect on the emergence time, time to extubation, and time to discharge from the recovery room

How effective is Dexmedetomidine?

- **Title:** Dexmedetomidine as a Pediatric Anesthetic Premedication to Reduce Anxiety and to Deter Emergence Delirium
- **Authors:** Mountain, B. W., Smithson, L., Cramolini, M., Wyatt, T. H., & Newman, M.
- **Objective:** Investigated the role of preoperative dexmedetomidine on parental separation anxiety and its effectiveness in reducing the incidence and severity of ED

How effective is Dexmedetomidine?

- **Main results**
- In 41 children, aged 1 to 6 years, undergoing dental surgery
- Subjects received 4 mcg/kg of dexmedetomidine or 0.5 mg/kg of midazolam orally prior to anesthesia induction
- There were no statistically significant differences in parental separation anxiety
- There were also no significant differences in ED occurrence.
- Future studies should examine the use of higher doses of oral dexmedetomidine in reducing anxiety and ED

Timing of Administration

- Several studies acknowledged that a dose of Dexmedetomidine administered at the beginning of the procedure is noteffective.
- **The timing of administration differs with most studies that administered their bolus of Dexmedetomidine on emergence**
- A single dose of 0.3 mcg per kg of Dexmedetomidine administered over five minutes, and given approximately fifteen minutes before the end of the surgery was very successful in reducing the incidence of ED (Makkar et al., 2016).
- However, this did come at the cost of increased sedation, which will also lead to an increase of time the child will be required to stay in the recovery area (Makkar et al., 2016).

(Bong et al., 2014; Dahmani et al., 2014; Zhu et al., 2015).

Comparison of The Two Agents

- **Title:** Prevention of sevoflurane related emergence agitation in children undergoing adenotonsillectomy: A comparison of dexmedetomidine and propofol.
- **Authors:** Monaz Abdulrahman Ali, Ashraf Abualhasan Abdellatif
- **Objective**: This double-blinded randomized prospective study was conducted to compare the effect of administration of a single dose of propofol or dexmedetomidine prior to the termination of sevoflurane-based anesthesia on the incidence and severity of ED as well as emergence and discharge time in children undergoing adenotonsillectomy.

Comparison of The Two Agents

- **Main Results:**
- Dexmedetomidine 0.3 mcg/kg was more effective than propofol 1 mg/kg in decreasing the incidence and severity of ED, When administered 5 min before the end of surgery in children undergoing adenotonsillectomy under sevoflurane anesthesia.

Conclusion

- **Best time to medicate your patient to prevent ED is during the emergence period.**
  - Propofol 1 mg/kg
  - Dexmedetomidine 0.3 mcg/kg IV
- Dexmedetomidine is shown to be more effective in the prevention of ED and with less side effects than propofol.
- Treatment for ED may cause a delay in discharge from PACU, but less than if a patient experiences ED and possibly injures themselves.

Questions?

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Appendix D
Statistical Results Tables

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pre-Test	65.3846	26	29.96408	5.87644
	Post-Test	92.3077	26	9.51113	1.86529

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pre-Test - Post-Test	-26.92308	26.34680	5.16703	-37.56478	-16.28137	-5.211	25	.000