

EMERGENCE DELIRIUM AND MANAGEMENT IN CHILDREN



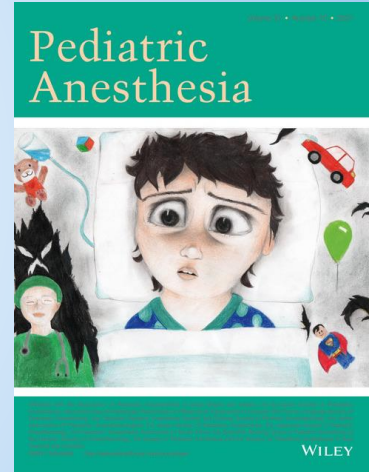
R3 RAWIWAN FAISAMRIT
AJ NATTHAPHONG PHUVACHOTERODJANAPHOKIN



It is based on the Editorial
.....ED may not just be a recovery room problem.....

.....Emergence delirium is present in
a significant number of young children

.....It may effect not just short term but also for
medium or long term postoperative negative
behavior



VOLUME 31, ISSUE 10 :
OCTOBER 2021

A bright yellow sun with rays is in the top left corner. A white cloud is to its right. A dotted line curves from the sun towards the title. Another white cloud is in the top right corner, with a dotted line curving from it towards the title.

EMERGENCE DELIRIUM

Definition

.....Behavior occurring after a general anesthetic, characterized by wild or poorly controlled motor activity & disorientation with an altered response to individuals, stimuli or comfort measures.....

A cartoon illustration of a brown teddy bear sitting on a white cloud. The bear is wearing a blue and white checkered bow tie.

Emergence agitation (EA) :

Umbrella term that includes ED , pain, and several other factors



INCIDENCE

- Overall postoperative patients is 5.3%
- More frequent in children being 12-13%
- ED after inhalation ranges 2-55%

Clinical Presentation

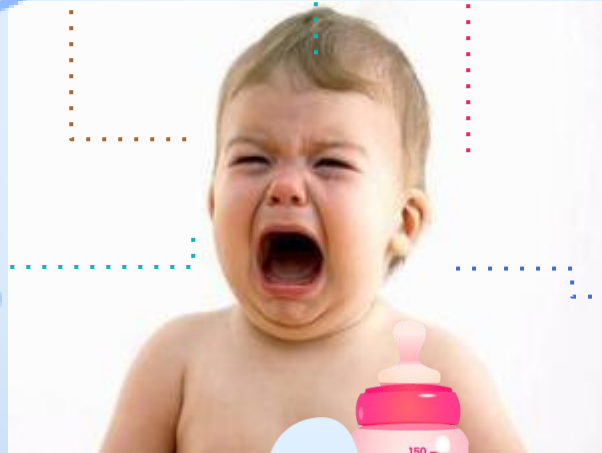
Inconsolable crying

Shouting / Incoherent
without recognizing
environment or caregiver

Non-purposeful
movement

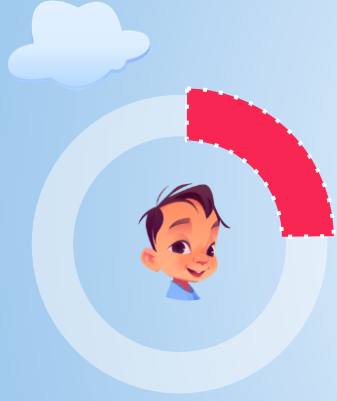
Thrashing or
Kicking

Irritable



EMERGENCE DELIRIUM

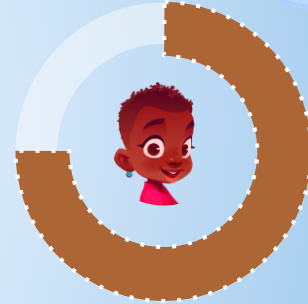
HOW LONG DOES IT SHOULD BE ?



Occur within **30 min**
after GA stopping



Last fore **15-30 min**



Resolve spontaneously
within around **20 min**

DO WE MISS SOMETHING ?

EMERGENCE DELIRIUM

Hypoactive Delirium

- ¼ children suffering from different feature of ED
- **Clinical present**
 - Quiet
 - Confused
 - Disorientation
 - **Do not make eye contact**
 - **No aware of the surrounding**
 - Minimal movement when awake
 - Non-communication or not respond to social interactions



Mixed delirium

Pediatric Anesthesia / Volume 31, Issue 4 / p. 429-435

RESEARCH REPORT

An observational study of hypoactive delirium in the post-anesthesia recovery unit of a pediatric hospital

Paul F. Lee-Archer ✉, Britta S. von Ungern-Sternberg, Michael C. Reade, K.C. Law, Deborah Long

First published: 06 January 2021

<https://doi.org/10.1111/pan.14122>

Citations: 3

Emergence delirium

Hypoactive delirium



- 4424 children recovered at a tertiary pediatric hospital,
 - Using the Cornell Assessment of Pediatric Delirium(CAP-D) to detect the incidence of ED

Hypoactive delirium is often missed without active screening, suggests hypoactive delirium warrants further investigation.

DOES IT MATTER?



Risk of harming caregivers



Risk of having maladaptive behavioral change



Risk of harming self and surgical wound dehiscence

Parent/Nurse/Provider less satisfied

- More nursing resource required
- Potential S/E of physical or pharmacological restraint
- May prolong recovery room stay/discharge

Maladaptive behavioral change

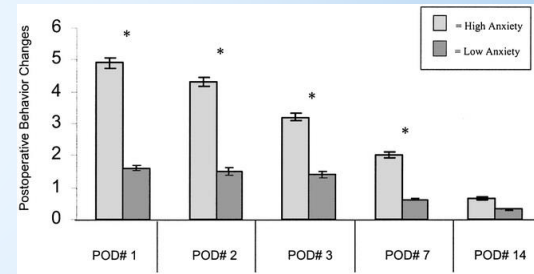
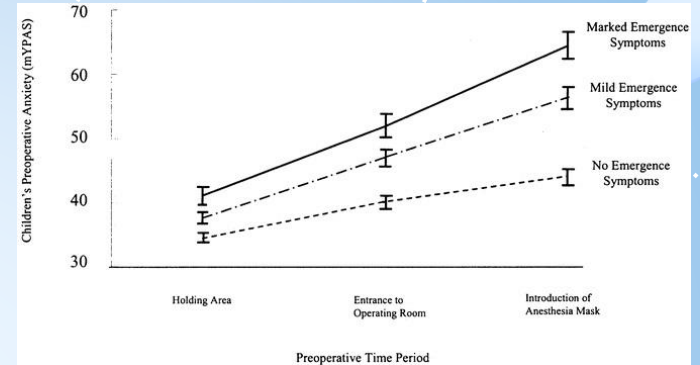
PEDIATRIC ANESTHESIA: RESEARCH REPORT

Preoperative Anxiety and Emergence Delirium and Postoperative Maladaptive Behaviors

Kain, Zeev N. MD, MBA; Caldwell-Andrews, Alison A. PhD; Maranets, Inna MD; McClain, Brenda MD; Gaal, Dorothy MD; Mayes, Linda C. MD; Feng, Rui MS; Zhang, Heping PhD

Author Information 

Emergence delirium



- 791 Children(ASA 1-2) Underwent sx. and GA using sevoflurane/O₂/N₂O with no midazolam
- Anxiety was assessed preoperatively with mYPAS, emergence delirium was assessed with PAED

Regression analysis : the odd ratio of having new-onset postoperative maladaptive behavior changes was 1.43 for children with marked emergence status

Maladaptive behavioral change

- 100 preschoolers (2–7 years) elective surgery in 2 tertiary university hospitals.
- Preoperative anxiety level was assessed using mYPAS & PAED ≥ 12 used for conclusion of ED

RESEARCH REPORT

Behavioral changes after hospital discharge in preschool children experiencing emergence delirium after general anesthesia: A prospective observational study

Jonghae Kim, Sung Hye Byun, Jun Won Kim, Ji-Yoon Kim, Yun Jin Kim, Nayeon Choi, Bong Soo Lee, Seungcheol Yu, Eugene Kim ✉

First published: 26 July 2021

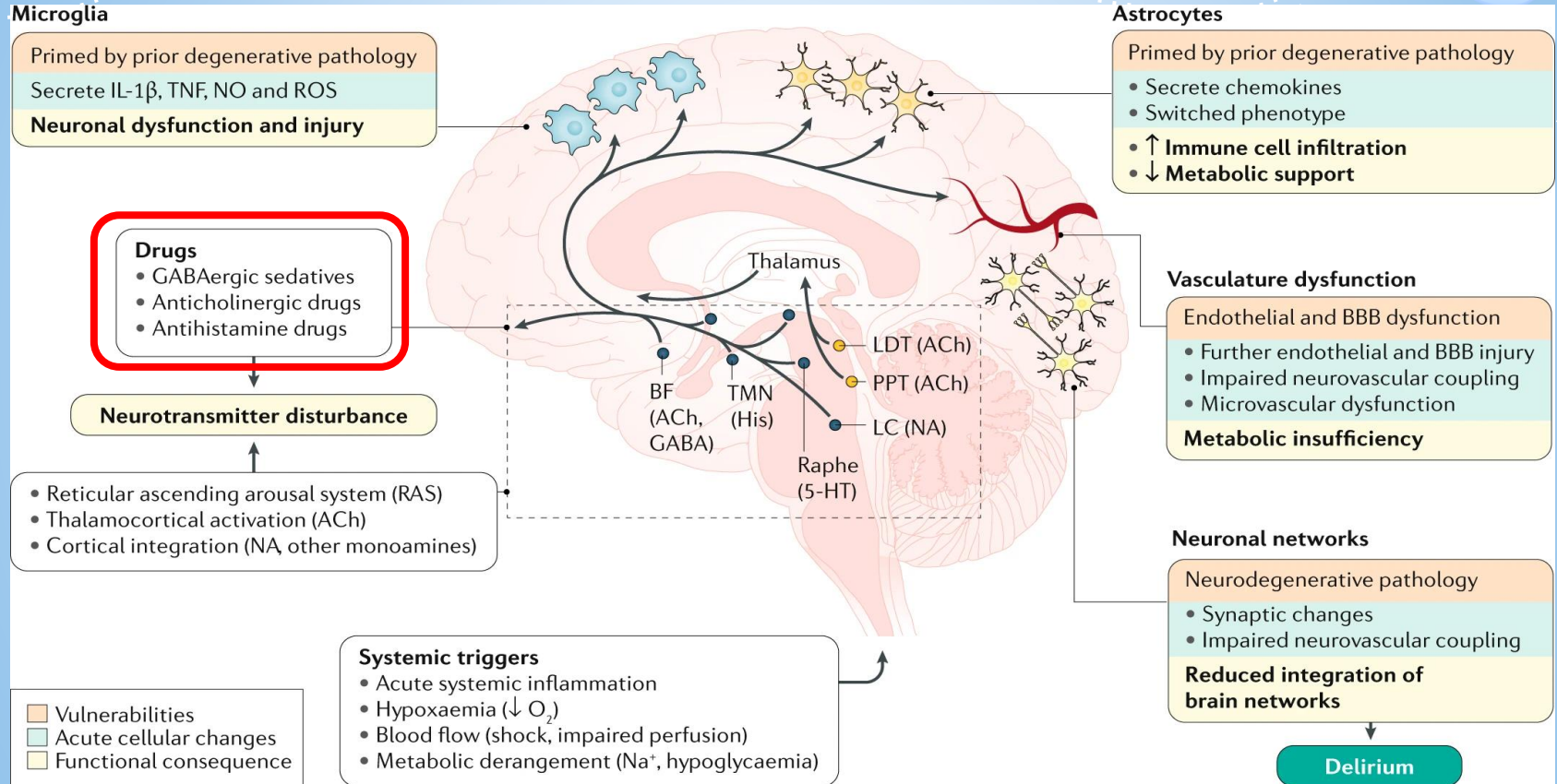
<https://doi.org/10.1111/pan.14259>

Citations: 1

Jonghae Kim, Sung Hye Byun two authors equally contributed to this work.

Children with ED developed more severe behavior changes 1 week after surgery
High preoperative anxiety level and emergence delirium scores were associated with posthospital behavioral changes.

Major mechanisms in delirium pathophysiology





Possible Risk Factor for ED

Risk factor	Children
Patient related	Preschool age (2–5 years)
	No previous surgery
	Hospitalization or high number of previous interventions
	Poor adaptability
	Attention-deficit hyperactivity disorder
	Patient preexisting behavior
	Psychological immaturity
	Preoperative anxiety
	Parental anxiety
	Patient and parent interaction with healthcare providers
Anesthesia related	Lack of premedication (with midazolam)
	Paradoxical reaction to midazolam stated in child's medical history
	Use of inhalational anesthetics with low blood–gas partition coefficients (e.g., sevoflurane and desflurane)
	Excessively rapid awakening (in a hostile environment)
Pain	
Surgery related	Type of surgery



Possible risk factor for ED

Use of Inhalation Anesthesia agent

- 136 healthy children
- Compare between desflurane and sevoflurane in unpremedicated pediatric ambulatory urologic surgery patients
 - ❖ The incidence and severity of emergence agitation
 - ❖ Recovery profile
 - ❖ Adverse events

Comparison the Incidence of Emergence Agitation between Sevoflurane and Desflurane after Pediatric Ambulatory Urologic Surgery

Maliwan Oofuvong MD*,
Sirikarn Siripruekpong MD*, Jumras Naklongdee RN*,
Rewadee Hnookong RN*, Chareefar Lakateb RN*

** Department of Anesthesiology, Faculty of Medicine, Prince of Songkla University, Hat Yai, Songkhla, Thailand*

The occurrence of EA and adverse events between sevoflurane and desflurane were not different, except that the overall of intraoperative respiratory events was higher in desflurane group.

EMERGENCE DELIRIUM

✗ Child make eye contact

✗ Purposeful actions

✗ Awareness of surroundings

**EMERGENCE
DELIRIUM**



PAIN

Abnormal facial expression

Crying

Inconsolability

Hypoxemia

**Hemodynamic
Instability**

Emergence delirium

Hypoglycemia

Other to think about

Pain



Full Bladder

Hypothermia

Hypo or Hypercarbia

Raised ICP



Prediction and assessment tools

Preinduction

- # m-YPAS
- # STAIC



During induction

- # A biomarker(BDNF)
- # Specific electroencephalogram
- # The pediatric Anesthesia Behaviour score



After emergence

- # PAED score
- # Watcha scales
- # Cravero scale
- # CAP-D

EMERGENCE DELIRIUM

Pediatric Anesthesia Emergence Delirium Scale

Scored Factor	SCORING				
	0	1	2	3	4
Child makes eye contact with caregiver	Extremely	Very much	Quite a bit	Just a little	Not at all
Child's actions are purposeful	Extremely	Very much	Quite a bit	Just a little	Not at all
Child is aware of surroundings	Extremely	Very much	Quite a bit	Just a little	Not at all
Child is restless	Not at all	Just a little	Quite a bit	Very much	Extremely
Child is inconsolable	Not at all	Just a little	Quite a bit	Very much	Extremely
<i>Total score^a</i>					

^aPreliminary evidence suggested that a total pediatric anesthesia emergence delirium score greater than 10 defined emergence delirium, but later evidence suggested that a total score greater than 12 might be more specific.

The Cornell Assessment of Pediatric Delirium(CAPD)

EMERGENCY DELIRIUM

Cornell Assessment of Pediatric Delirium (CAPD) revised						
RASS Score__(if -4 or -5 do not proceed)						
Please answer the following questions based on your interactions with the patient over the course of your shift:						
	Never 4	Rarely 3	Sometimes 2	Often 1	Always 0	Score
1. Does the child make eye contact with the caregiver?						
2. Are the child's actions purposeful?						
3. Is the child aware of his/her surroundings?						
4. Does the child communicate needs and wants?						
	Never 0	Rarely 1	Sometimes 2	Often 3	Always 4	
5. Is the child restless?						
6. Is the child inconsolable?						
7. Is the child underactive—very little movement while awake?						
8. Does it take the child a long time to respond to interactions?						
TOTAL						



Prediction and assessment tools

Preinduction

- # m-YPAS
- # STAIC



During induction

- # A biomarker(BDNF)
- # Specific electroencephalogram
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After emergence

- # PAED score
- # Watcha scales
- # Cravero scale
- # CAP-D

The approaches for safety when it occur

- Excluding life – threatening condition (THE A – B – C - D)

- Placing pillows or padded board around the patient to protect further injuries

- Secured lines and dressing

THE STRATEGIES TO DECREASE ED

- **A**nxiety reduction
- **D**istracted on the day of surgery
- **V**ideo modelling & education
- **A**dding parents
- **N**o excessive reassurance
- **C**oaching of parents by staff
- **E**xposure/shaping of the child via mask practice

Non-Pharmacological management



Non - pharmacological prevention

Intervention	Results	Difference (95%CI)
Parental presence	No significant differences in child anxiety compared with not having a parent present	Standardized mean difference (SMD) 0.03, 95% CI -0.14 to 0.20
Mask induction	No significant differences in child anxiety	RR 0.59, 95% CI 0.31 to 1.11
Video games before induction	Significantly less anxious at induction	mYPAS mean difference(MD) -9.80, 95% CI-19.42 to -0.18
A video fairytale or music therapy	No significant differences in cooperation at induction	
Video of the child's choice was played during induction	Significantly less anxious than controls	mYPAS 31.2, 95% CI 27.1 to 33.3
Clowns/ clown doctors & sedative premedication	No significant differences in child anxiety in the operating room between clown VS medication	mYPAS MD -9.67, 95% CI -21.14 to 1.80

Non - pharmacological prevention

EMERGENCE DELIRIUM



Primary outcome

- Saliva cortisol

Secondary outcomes

- W-B scoring
- Consumed morphine concentration
- Duration at (PACU)

PD group received significantly less morphine ($P = 0.014$)
Children who received the PD had significantly lower salivary cortisol concentrations postoperatively ($P = 0.003$)

The PD's caring, continuity, and on-going dialogues were associated with low concentrations of salivary cortisol postoperatively and reduced morphine consumption

Pediatric Anesthesia

ORIGINAL ARTICLE

The perioperative dialogue reduces postoperative stress in children undergoing day surgery as confirmed by salivary cortisol

Berith Wennström, Carl-Johan Törnhage, Salmir Nasic, Hans Hedelin, Ingrid Bergh

First published: 20 July 2011 | <https://doi.org/10.1111/j.1460-9592.2011.03656.x> |

The strategies to decrease ED

Benzodiazepine

Opioid

Propofol

Ketamine

α 2- agonist

Gabapentin

Magnesium

Regional anesthetic technique



**Pharmacological
management**

Perioperative Medicine | June 2014

Comparison of the Effects of 0.03 and 0.05 mg/kg Midazolam with Placebo on Prevention of Emergence Agitation in Children Having Strabismus Surgery **FREE**

Eun Jung Cho, M.D.; Seung Zhoo Yoon, M.D., Ph.D. ✉; Jang Eun Cho, M.D., Ph.D.; Hye Won Lee, M.D., Ph.D.

Midazolam premedication IV before the end of surgery

- Reduce EA without delay emergence time

1. Benzodiazepine



ELSEVIER

British Journal of Anaesthesia

Volume 104, Issue 2, February 2010, Pages 216-223



Paediatrics
editor's choice

Pharmacological prevention of sevoflurane- and desflurane-related emergence agitation in children: a meta-analysis of published studies

S Dahmani 1 ✉✉, I Stany 1, C Brasher 1, C Lejeune 1, B Bruneau 1, C Wood 1, Y Nivoche 1, I Constant 2, I Murat 2

Administration of midazolam IV before induction

- Not protective effect against ED

Pediatric Anesthesia

SYSTEMATIC REVIEW

Effects of intravenous fentanyl around the end of surgery on emergence agitation in children: Systematic review and meta-analysis

Namo Kim, Jin Ha Park, Jong Seok Lee, Taeyang Choi, Min-Soo Kim ✉

First published: 04 July 2017 | <https://doi.org/10.1111/pan.13181> | Citations: 7

2.Opioid

Compared fentanyl (1 $\mu\text{g}/\text{kg}$) and placebo
Fentanyl significantly decreased EA incidence

But time of given drug may asso. With a prolonged PACU stay & nausea vomiting

EMERGENCE DELIRIUM PHARMACOLOGICAL PREVENTION

3. Propofol

British Journal of Anaesthesia 104 (2): 216–23 (2010)
doi:10.1093/bja/aep376 Advance Access publication January 3, 2010

BJA

PAEDIATRICS

Pharmacological prevention of sevoflurane- and desflurane-related emergence agitation in children: a meta-analysis of published studies

S. Dahmani^{1*}, I. Stany¹, C. Brasher¹, C. Lejeune¹, B. Bruneau¹, C. Wood¹, Y. Nivoche¹,
I. Constant² and I. Murat²

Propofol prophylactic effect in preventing EA

Review > AANA J. 2010 Dec;78(6):468-73.

Use of propofol and emergence agitation in children: a literature review

K Logan Key¹, Christopher Rich, Claire DeCristofaro, Shawn Collins

Use of propofol is associated with a reduction in the incidence of emergence agitation.

Sevoflurane inhalational GA

Propofol as an adjunct to sevoflurane GA

Propofol TIVA techniques





Clinical Research Article

Korean Journal of Anesthesiology 2010;58(5):440-445.

Published online: May 29, 2010

DOI: <https://doi.org/10.4097/kjae.2010.58.5.440>

The effect of ketamine on the incidence of emergence agitation in children undergoing tonsillectomy and adenoidectomy under sevoflurane general anesthesia

Yoon Sook Lee, Woon Young Kim, Jae Ho Choi, Joo Hyung Son, Jae Hwan Kim, Young Cheol Park

Department of Anesthesiology and Pain Medicine, Ansan Hospital, Korea University College of Medicine, Ansan, Korea.

EMERGENCE DELIRIUM

PHARMACOLOGICAL PREVENTION

4.KETAMINE

- Saline (group C),
- Ketamine 0.25 mg/kg (group K0.25)
- Ketamine 0.5 mg/kg (group K0.5).

- ❑ Incidence of emergence agitation was low in the K0.25 and K0.5 groups
- ❑ **No significant** difference in the incidence of emergence agitation between **K0.25** and **K0.5** groups
- ❑ **Postoperative pain scores** showed significant differences between the three groups
 - ❑ K0.5 group showed a lower pain score than K0.25 group.

Free Access

Premedication with clonidine is superior to benzodiazepines. A meta analysis of published studies

S. DAHMANI, C. BRASHER, I. STANY, J. GOLMARD, A. SKHIRI, B. BRUNEAU, Y. NIVOCHÉ, I. CONSTANT
... See all authors ▾

First published: 25 February 2010 | <https://doi.org/10.1111/j.1399-6576.2009.02207.x> | Citations: 90

PHARMACOLOGICAL PREVENTION

5.1) α_2 - agonist : **Clonidine**

- ❑ Premedication with clonidine was found to be superior to premedication with midazolam for EA attenuation
- ❑ Clonidine 2 microg/kg IV after anesthetic induction effectively reduces the incidence of agitation without resulting in clinically relevant bradycardia and hypotension

The α_2 adrenoceptor agonist (α_2 aa) clonidine : exhibit anesthetic, sedative, sympatholytic and analgesic properties.

Meta-Analysis of Dexmedetomidine on Emergence Agitation and Recovery Profiles in Children after Sevoflurane Anesthesia: Different Administration and Different Dosage

[Min Zhu](#), ¹ [Haiyun Wang](#), ^{1,*} [Ai Zhu](#), ¹ [Kaijun Niu](#), ² and [Guolin Wang](#) ¹

Chang-Qing Gao, Academic Editor

PHARMACOLOGICAL PREVENTION

5.2) α_2 -agonist : Dexmedetomidine

- Dexmedetomidine decreased the incidence of EA, incidence of nausea and vomiting and number of patients requiring an analgesic .
- Dexmedetomidine had a significantly delayed effect on the emergence time, time to extubation, and time to discharge from recovery room .
- Compared with fentanyl and midazolam , dexmedetomidine has no significantly difference on the incidence of EA, postoperation pain which implied that its analgesia effect might play an important role in decreasing the incident of EA. No evidence of publication bias was observed.



Gabapentin premedication for postoperative analgesia and emergence agitation after sevoflurane anesthesia in pediatric patients

Pediyatrik hastalarda ameliyat sonrası analjezi ve sevofluran anestezisi sonrası derlenme ajitasyonu için gabapentin premedikasyonu

Akgün Ebru SALMAN, Aynur CAMKIRAN, Sabiha OĞUZ, Aslı DÖNMEZ



Agitation scores were significantly lower in gabapentin group compared to saline in the postoperative 20th and 30th minutes ($p < 0.01$, 0.05 respectively)

Analgesic requirement in postoperative 24 hour was significantly lower in group G ($p < 0.01$)

EMERGENCE DELIRIUM

PHARMACOLOGICAL PREVENTION

6. Gabapentin & Magnesium

Anaesthesia

Peri-operative medicine, critical care and pain



Association of Anaesthetists

Original Article | [Free Access](#)

The effect of magnesium sulphate infusion on the incidence and severity of emergence agitation in children undergoing adenotonsillectomy using sevoflurane anaesthesia

M. Abdulatif , A. Ahmed, A. Mukhtar, S. Badawy

First published: 03 August 2013 | <https://doi.org/10.1111/anae.12380> | Citations: 41

Magnesium sulfate 30 mg/kg bolus with continuous infusion of 10 mg/kg/h reduced the incidence and severity of EA in pediatric patients

EMERGENCE DELIRIUM

PHARMACOLOGICAL PREVENTION

7. Regional anesthesia technique



British Journal of Anaesthesia

Volume 118, Issue 3, March 2017, Pages 335-343



Review Articles

Editor's Choice

Paediatric emergence delirium: a comprehensive review and interpretation of the literature

K.P. Mason  

Controversy, favor to decrease EA/ED

EMERGENCE DELIRIUM

Benzodiazepine

Opioid

Propofol

Ketamine

α 2- agonist

Gabapentin

Magnesium

Regional anesthetic technique



What should be use?

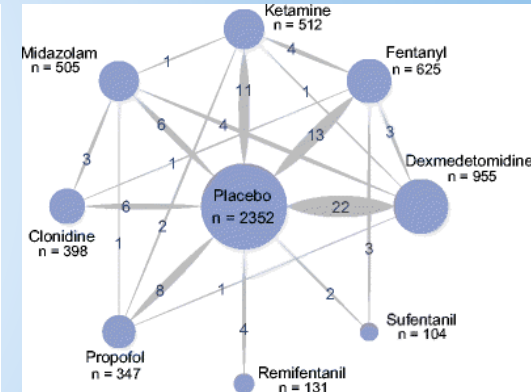
Preventing Emergence Agitation Using Ancillary Drugs with Sevoflurane for Pediatric Anesthesia: A Network Meta-Analysis

Xin Wang^{1,2} · Qi Deng^{2,3} · Bin Liu² · Xiangdi Yu¹

Received: 18 April 2016 / Accepted: 16 October 2016 / Published online: 4 November 2016
© Springer Science+Business Media New York 2016

Network of randomized controlled trials comparing different adjuvant therapies for anesthesia emergence agitation.

Comparison	OR (95 % CI)	P-heterogeneity	I-squared	Tau-squared
Dexmedetomidine vs. placebo	0.34 (0.27, 0.43)	0.697	<0.01 %	<0.001
Fentanyl vs. placebo	0.40 (0.29, 0.54)	0.723	<0.01 %	<0.001
Ketamine vs. placebo	0.37 (0.26, 0.52)	0.790	<0.01 %	<0.001
Midazolam vs. placebo	0.63 (0.40, 0.99)	0.211	29.90 %	0.092
Clonidine vs. placebo	0.49 (0.28, 0.85)	0.160	37.00 %	0.169
Propofol vs. placebo	0.50 (0.33, 0.77)	0.146	35.40 %	0.126
Remifentanil vs. placebo	0.63 (0.45, 0.87)	0.814	<0.01 %	<0.001
Sufentanil vs. placebo	0.56 (0.30, 1.02)	0.660	<0.01 %	<0.001



Dexmedetomidine was found to be the most effective drug for prevention of EA compared to others

PHARMACOLOGICAL PREVENTION

kja KOREAN JOURNAL of ANESTHESIOLOGY

pISSN : 2005-6

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Korean J Anesthesiol > Volume 73(6); 2020 > Article



Review Article

Korean Journal of Anesthesiology 2020;73(6):471-485.

Published online: March 25, 2020

DOI: <https://doi.org/10.4097/kja.20097>

Emergence agitation: current knowledge and unresolved questions

Seok-Jin Lee¹, Tae-Yun Sung¹

Department of Anesthesiology and Pain Medicine, Konyang University Hospital, Konyang University College of Medicine, Daejeon, Korea

Prospective randomized controlled studies with multimodal analgesic regimens are needed to identify drug combinations with better EA preventive effects and fewer adverse effects.

EMERGENCE DELIRIUM



International Journal of Pediatric

Otorhinolaryngology

Volume 79, Issue 5, May 2015, Pages 671-676



The effect of KET'ODEX on the incidence and severity of emergence agitation in children undergoing adenotonsillectomy using sevoflurane based-anesthesia

Sally M. Hadi¹, Amin J. Saleh¹, Yong Zhong Tang², Ahmed Daoud³, Xi Mei⁴, Wen Ouyang⁵

Effects of ketamine and midazolam on emergence agitation after sevoflurane anaesthesia in children receiving caudal block: a randomized trial ☆

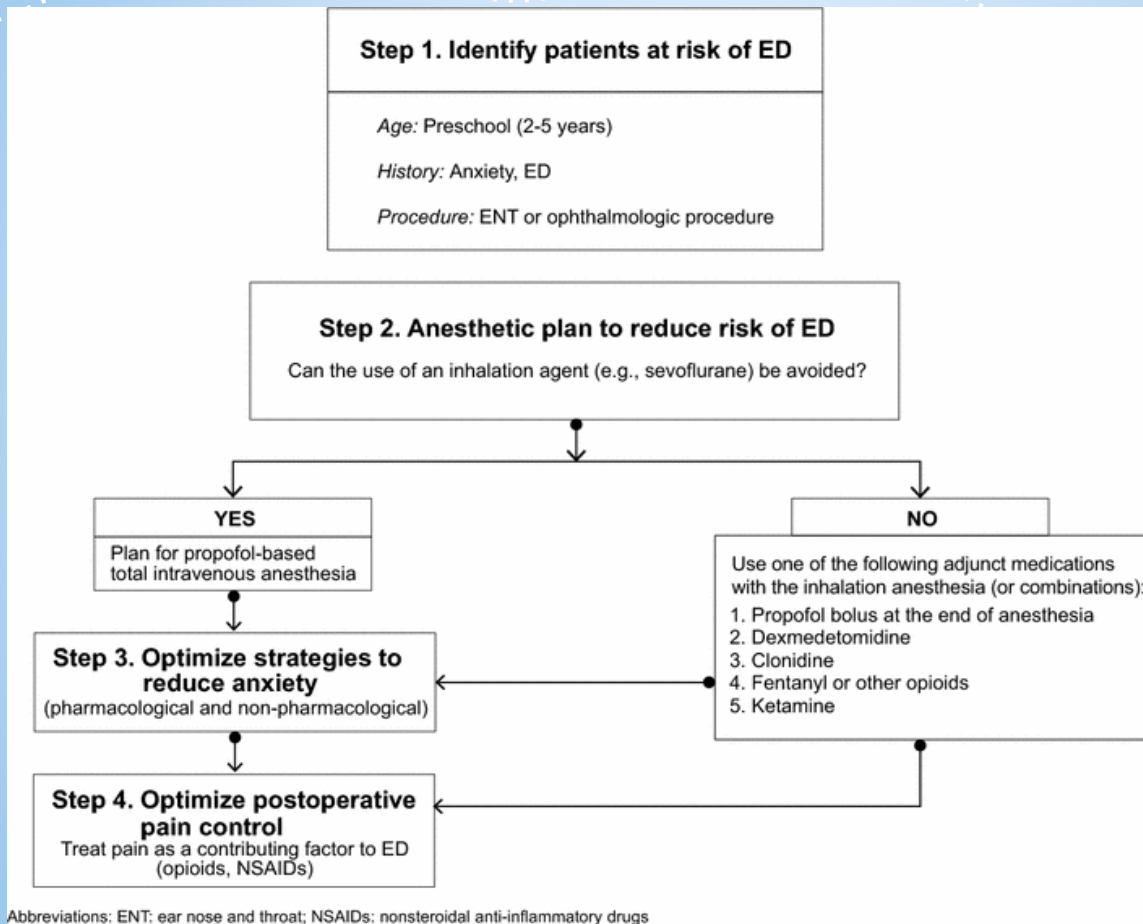
Ayşe Özcan¹, Ayşe Günay Kaya², Namik Özcan³, Gul Meltem Karaaslan⁴, Esen Er⁵, Bulent Baltacı⁶, Hülya Basar⁷

Pediatric Anesthesia

Clonidine for the prevention of emergence agitation in young children: efficacy and recovery profile

SHOBHA MALVIYA MD, TERRI VOEPEL-LEWIS MSN RN, RADHAMANGALAM J. RAMAMURTHI MD, CONSTANCE BURKE BSN RN, ALAN R. TAIT PhD

Management of emergence agitation and delirium





KEY POINT

ED is a transient dissociated state of consciousness after anesthesia, **marked by irritability and psychomotor agitation**, sometime Hypoactive or Mixed delirium

It is commonly seen in **preschool age**

Patient – anesthetic – surgical factors are all been identified as playing important roles in ED.

To date, **the most effective prophylactic treatments are dexmedetomidine**, efforts at establishing a good patient rapport and using nonpharmacologic techniques to decrease anxiety.

Understanding the risk factors and treatment options is critical to the management of ED which may prevent maladaptive behavioral change.

THANK YOU FOR YOUR ATTENTION



