Journal of Perioperative & Critical Intensive Care Nursing

Lee, J Perioper Crit Intensive Care Nurs 2017, 3:2
DOI: 10.4172/2471-9870.10000140

Review Article Open Access

Paediatric Emergence Delirium: An Approach to Diagnosis and Management in the Postanaesthesia Care Unit

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Abstract

Approximately 20-30% of children display emergence delirium in the post-anaesthesia care unit (PACU). This complication of exposure to volatile anaesthesia is largely predictable, preventable and treatable. A proposed approach to the delirious child in the PACU is presented, focusing on the exclusion of more serious causes of agitation.

Keywords: Anaesthesia; Paediatrics; Emergence delirium; Emergence agitation

Abbreviations: PACU: Post-Anaesthesia Care Unit; ASA: American Society of Anaesthesiologists' Physical Status Classification; ED: Emergence Delirium; TIVA: Total Volatile Intravenous Anaesthesia; ENT: Ear Nose and Throat; MRI: Magnetic Resonance Imaging; PAED: Pediatric Anesthesia Emergence Delirium Scale; FLACC: Face, Legs, Activity, Cry, Consolability Scale; CVA: Cerebrovascular Accident

Introduction

The post-anaesthesia care unit (PACU) or recovery room, is designed to be a place where patients can safely recover from anaesthesia under the care of highly trained nursing staff until they are awake, orientated and physiologically stable enough to return to their ward. Arguably the noisiest complication of this period facing PACU staff is when a child, who was asleep just minutes before, starts incoherently screaming, pulling out his intravenous line, looks like he's about to fall out of his bed, and can't be consoled or reasoned with.

This syndrome of "post-anaesthetic excitement", characterized by "restlessness, disorientation, crying, moaning, irrational talking", and "wild thrashing about together with shouting and screaming", was described by Eckenhoff et al. in 1961 [1]. They described it as occurring in 5.3% of patients across the age spectrum, noting that the highest incidence (13%) was in children from 3-9 years of age, and found that the risk factors for this excitement were healthy patients (ASA I), a barbiturate and scopolamine premedication, adenotonsillectomy and thyroid surgery, the use of cyclopropane or ether, and the "preoperative psychological state" (he felt that "factors operating in the subconscious", such as "fear of disfigurement, cancerphobia and feeling of suffocation", could cause excitation). He noted that prevention and treatment were best achieved with the injection of a narcotic.

56 years later, despite an abundance of literature, Eckenhoff's observations seem to hold true.

Definition

Emergence delirium (ED) can be defined as a "dissociated state of consciousness in which the child is irritable, uncompromising, uncooperative, incoherent and inconsolably crying, moaning, kicking or thrashing" [2].

The incidence of ED is unclear, but has been reported as anywhere from 2-80%. When pain and other confounders are adequately controlled, the incidence is probably around 20-30% [3], maybe higher in at-risk groups and possibly varying across population groups [4].

Causes and Risk Factors

The cause of emergence delirium remains unknown. Various theories suggest excitation of certain pathways by the volatile agents, possibly in the locus coeruleus (an area of the brain stem involved in the response to stress and panic) or amygdala (part of the limbic system involved in memory and emotion), in the setting of a specific neurodevelopmental stage of the brain [5].

The contributing factors are consistent throughout the literature:

Age

While emergence delirium can be seen into adulthood, its peak incidence is in younger children (2-7 years of age) [6].

Preoperative anxiety and behaviour

Children who exhibit signs of anxiety preoperatively are significantly more likely to develop emergence delirium and other maladaptive behavioral changes postoperatively [7]. These anxious children are also more likely to have anxious parents [7].

Children at risk of emergence delirium are also likely to be more emotional, more impulsive and less social [7].

Type of anaesthesia

The most consistent predictor of emergence delirium is the use of volatile anaesthesia, with significantly lower incidences being reported with the use of total intravenous anaesthesia (TIVA). While most reports focus on the use of sevoflurane, emergence delirium has been reported with all inhalational agents. There doesn't seem to be a relationship between depth and the duration of anaesthesia and emergence delirium [8].

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Received August 14, 2017; **Accepted** August 24, 2017; **Published** August 31, 2017

Citation: Lee CA (2017) Paediatric Emergence Delirium: An Approach to Diagnosis and Management in the Postanaesthesia Care Unit. J Perioper Crit Intensive Care Nurs 3: 140. doi:10.4172/2471-9870.10000140

Pain

Adequate perioperative analgesia reduces the incidence of emergence delirium-like behaviour in the recovery room [9].

Type of surgery

Although higher incidences have been reported after ENT procedures [3], the type of surgical procedure is thought by some not to affect the risk of ED, as long as the child is adequately analgesed [6]. ED can be seen following non-painful procedures, such as MRI, where the incidence is similar to that following surgical procedure [10].

Prevention

Preoperatively, managing anxiety, whether pharmacologically or non-pharmacologically, is part of the holistic care of any child. While some centres have hospital tours, videos, virtual reality programmes, psychologists and child life specialists to help achieve this, many centres don't. Preoperatively, we should give children and their parents' information about their anaesthetic and procedure in a way they understand and take time to answer their questions. It is worth finding out what strategies the child has to cope with anxiety, such as needing a favorite teddy or wearing a particular shirt, and ensure that he has those when he comes to the operating room. Parents should be warned about the risk of emergence delirium in children at risk.

Pharmacological anxiolysis may be prescribed in the form of midazolam, ketamine, clonidine or dexmedetomidine. It should be noted that midazolam is not an effective anxiolytic in all children, and may cause paradoxical excitation and distress.

Parents should be allowed to be present at induction of anaesthesia, which should happen in a calm quiet environment.

Intraoperative strategies to reduce the incidence and severity of ED include [9]:

- The use of propofol, either as total intravenous anesthesia or as a bolus dose of 1-3 mg/kg at the end of surgery
- Adequate perioperative analgesia, including in the form of regional techniques
- The use of opiate analgesics
- The use of the alpha-2 agonists, clonidine or dexmedetomidine, either as premedication or given intraoperatively
- Ketamine, either as premedication, intravenous infusion or intravenous bolus
- Magnesium sulphate - A 30 mg/kg iv bolus of magnesium sulphate, followed by an infusion of 10 mg/kg/h, has been shown to reduce the incidence and severity of ED in children undergoing adenotonsillectomy [11].
- Gabapentin, melatonin and acupuncture have all shown effectiveness in trials, but are not regularly used.

Diagnosis

ED is a clinical diagnosis based on certain behaviours that are present in the postoperative period.

Clinical features: Children with ED may move around in a non-purposeful way and fail to establish eye contact or interact normally with parents or caregivers. They might avert their eyes or stare, seem confused and disorientated and pull at monitors, iv lines and dressings. This usually resolves within 15 to 30 minutes.

Differential diagnosis includes pain (most common), hypoxia, hypotension, hypocarbia, hypercarbia, hypothermia, hypoglycaemia, full bladder, and raised intracranial pressure [6].

Despite it being a clinical diagnosis, a number of rating scales have been developed for the diagnosis of ED. The Pediatric Anesthesia Emergence Delirium (PAED) scale, Watcha scale and Cravero scale have all been shown to correlate with each other to some degree, but each have their own advantages and disadvantages [12].

The Pediatric Anesthesia Emergence Delirium (PAED) scale (Table 1) was described by in 2004 [13] and is the recognized standard for the diagnosis of ED.

The scores for each of the five listed behaviours are added to achieve a total score (maximum score of 20). A score of ≥ 10 displays 64% sensitivity and 86% specificity and a score of >12 yields 100% sensitivity and 94.5% specificity for the diagnosis of ED [6].

While widely validated and an excellent research tool, the PAED scale is not quick and easy to use in clinical practice.

The Watcha scale (Table 2) is said to have the highest overall sensitivity and specificity [12] and is more user-friendly for use in a recovery room. A child with a score of >2 on the Watcha score can be considered to have emergence delirium.

If the Cravero scale (Table 3) is used, ED is considered likely when a child scores 4 or 5 for at least 3 min.

While both the Watcha and Cravero scores are simple to use, they do not rule out differential diagnoses such as pain or a full bladder. It can be difficult to distinguish between pain and ED in the recovery room, as children with both pain and ED can be crying, restless and inconsolable. When using the PAED score, the two factors that point

Criteria	Not at all	Just a little	Quite a bit	Very much	Extremely	Score
The child makes eye contact with the caregiver/parent	4	3	2	1	0	
The child's actions are purposeful	4	3	2	1	0	
The child is aware of his/her surroundings	4	3	2	1	0	
The child is restless	0	1	2	3	4	
The child is inconsolable	0	1	2	3	4	
Total score						

Table 1: Paediatric anaesthesia emergence delirium scale.

Behaviour	Score
Asleep	0
Calm	1
Crying, but can be consoled	2
Crying, but cannot be consoled	3
Agitated and thrashing around	4

Table 2: Watcha scale.

Behaviour	Score
Obtunded with no response to stimulation	1
Asleep but responsive to movement or stimulation	2
Awake and responsive	3
Crying (for >3 min)	4
Thrashing behavior that requires restraint	5

Table 3: Cravero emergence agitation scale.

to ED rather than pain are a child who doesn't make eye contact and is not aware of his surroundings [14]. Pain should be routinely assessed in the PACU by a validated tool such as the FLACC or Wong-Baker scales.

We use the Watcha scale as a first line PACU screening tool – if ED is suspected, and the score on the Watcha scale is >2, the anaesthesia provider is called for further assessment and treatment.

Clinical Approach to an Agitated or Delirious Child in the PACU

Adequate handover from the anaesthesia provider is essential as it may provide clues as to the causes of agitation. This information might include whether or not the child was extremely anxious preoperatively, whether they may have a full bladder (or obstructed urinary catheter) or whether they have had a particularly painful procedure. Handover should not take place until the monitors are attached and the vital signs are stable.

The first priority in assessing a child with agitation in the PACU is to ensure their safety by placing pillows or padded boards around the patient and securing iv lines and dressings. While doing this, other causes of delirium should be considered and excluded, in particular life-threatening hypoxia [15]. An A-B-C approach reduces the risk of missing important signs:

A: The airway should be assessed for patency and airway manoeuvres such as a jaw thrust, the insertion of a Guedel airway or suctioning performed if there is any doubt.

B: Observe the child's breathing pattern and chest movement – are the chest and abdomen moving together or is there the paradoxical "see saw" movement that indicates upper airway obstruction or laryngospasm? Is breathing adequate or is the child hypoventilating? This could be secondary to central depression of respiration because of opiates, or because of inadequate reversal of muscle relaxants, either of which can cause both hypoxia and hypercarbia. If this is suspected, oxygen should be connected and ventilation supported while definitive treatment is administered.

C: Could this child be confused because he or she is hypotensive? Consider the type of surgery and blood loss involved, and check the child's blood pressure. Is the child moving all limbs and is this movement symmetrical (for example, a procedure in the cardiac cath lab could have resulted in a CVA)?

If the above are normal, consider whether the child may be hypoglycaemic ("D" for "dextrose") and check a blood sugar level.

And then the "fifth vital sign", pain. Consider what procedure the child has had, what analgesia they have received, assess their pain score using a standardized tool (such as FLACC) and treat accordingly.

If the above are excluded, and the child exhibits the features described, he probably has emergence delirium. Most cases of ED in children resolve spontaneously within around 20 min of onset without lasting sequelae (as far as we know). Treatment may however be required if there is a risk of patient injury, damage to a surgical site, or significant parental distress. A single dose of iv propofol (0.5-2 mg/kg), midazolam (0.1 mg/kg), fentanyl (1-2 mcg/kg) or dexmedetomidine (0.3 mg/kg) have all been shown to effectively sedate children in this setting (note that analgesics might work as a sedative or as a treatment for undiagnosed pain) [6].

The child should then be allowed to recover in a calm and quiet environment, preferably with as little auditory stimulation as possible (as hearing is the first sense to recover after anaesthesia, some have postulated that ED is an exaggerated response to auditory stimuli [4]).

Summary

Eckenhoff's 1961 description of emergence delirium as a "transition stage between surgical anaesthesia and complete orientation" has not been well clarified, over 50 years later. This phenomenon, akin to night terrors and occurring largely in the preschool age group, seems to have something to do with an imbalance in synaptic inhibition and excitation in a young brain that takes time to "reboot" [16]. Immediate management of the delirious child in recovery should be to keep him safe and prevent injury, and rule out life-threatening causes of delirium such as hypoxia. Pain should always be assessed and treated. Treatment for the delirium, in the form of intravenous propofol, fentanyl, midazolam, clonidine or dexmedetomidine, may be required.

Declaration of Interest

None declared.

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