Crazy kids in recovery

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Introduction

There is considerable variation in behaviour of children during recovery from anaesthesia. Some children appear to be "crazy" - they are excited, distressed and may harm themselves. This lecture covers the definitions, the causes and management of craziness.

Understanding behaviour in young children is made difficult by their inability to communicate. Distinct patterns of behaviour can be described but often there will be features from more than one pattern. Nevertheless it is useful to group theoretical behaviour patterns under the following four headings. In all these behaviours, autonomic signs of tachycardia and hypertension are probably related to the level of distress.

1. Distress is commonplace. It has both obvious and hidden causes and is manifested by crying when consciousness returns and restlessness beforehand. Pain is the foremost factor that sometimes cannot be excluded until an analgesic is administered. Headache and sore throat are possible in all patients. Hunger and thirst are also common. Fear is likely. Cuddling, comforting and reassurance often helps; parents are usually useful.
2. Confusion can be defined as loss of sense of time, place and people. On awakening, brief confusion may occur in almost all patients but prolonged

confusion is unusual. Hypoxia and cerebral irritation are the most serious common causes followed by pain and full bladder. Other important but uncommon causes include electrolyte and metabolic disturbances.

3. Continuation of "normal" behaviour should be expected. Children with behavioural difficulties often require anaesthesia for brain imaging, hearing tests and dental treatment. Children with severe mental and physical handicaps from cerebral palsy may not have difficult behaviour normally but assessment of their behaviour after surgery is often more difficult than in non-handicapped children.
4. Delirium occurs usually in clear consciousness. There is excitement, agitation and distress that are inappropriate or disproportionate to the situation(1-3). Pain is not a major component. There maybe features of delusion(4). Acute psychosis is possible but rare.

Craziness may be a combination of all of the above four behaviour patterns and it is helpful to try to determine which behaviour is dominant.

Principles of Management

Standard recovery protocol should help with the diagnosis and management of craziness. Oxygen administration, standard monitoring, and one-to-one nursing are essential. Relevant details of the patient and the procedure must be communicated to the recovery staff. Common and obvious causes of distress should be treated, for example when the adequacy of a local anaesthesia block is uncertain, prompt opioid rescue analgesia may be necessary. Dangerous causes of distress such as hypoxia and cerebral irritation must be excluded. Many children settle in a few minutes but others will continue to cause a problem. Having excluded all other possibilities, delirium may be the correct diagnosis.

Definition of Delirium

Important key words used in the literature, in addition to delirium, include agitation (or emergence agitation), paradoxical, excitement and confusion. The definition of delirium

depends upon a choice of words that is agreed amongst experts. In broad terms, validation is agreement that the words used are accepted to describe the subject. Valid observational scoring or scaling tools have been developed and used to measure delirium. Two main problems exist with scales. First, rigorous validation, based on accepted methods of obtaining consensus, is unfortunately unusual in publications. Second, scales need to be reliable; for example scores should be the same for all observers – the inter-rater variability should be checked in all studies.

Observational scales

A practical 7 point "Riker" scale has been used in adults (5). For children a simple scale has been described by Watcha et al (6) to estimate delirium (0= child is asleep, 1 = calm, 2 = crying, but can be consoled, 3 = crying, but cannot be consoled, 4 = agitated and thrashing around). Another simple scale was developed by Keegan and colleagues(6;7) and has been used by Kain in his study of maladaptive postoperative behaviour(8). It has 3 levels: a score of 1 denotes no symptoms of emergence delirium, 2 represents mild symptoms (e.g., occasional movement or crying, no need for restraint), and 3 represents marked symptoms of emergence delirium (e.g. thrashing and/or needs restraint and/or constant crying). These are amongst 16 scales (and 2 visual analogue scales) reviewed by Sikich and colleagues(9) who considered them to be not specific, valid nor reliable enough. They developed a validated and reliable scale called the "**Pediatric Anesthesia Emergence Delirium (PAED) scale**" in which they determined that there were 5 important characteristics: lack of eye contact, purposelessness of actions, lack of awareness of surroundings, restlessness and inconsolability. Each is scored on 4 levels so that maximum delirium has a score of 20. Only recent publications have used the PAED scale(10). Another scale, derived from psychiatric diagnostic terms for perceptual disturbance, hallucination and agitation, has been used and may also be useful(11).

Incidence

In adults emergence agitation may have an incidence of approximately 5% and has been associated with preoperative benzodiazepines (not related to anxiety) prolonged surgery, breast and abdominal surgery(12). In children, the incidence has been reported to be between 25(13)-80% (14) but these reports depend heavily upon the definition of the problem.

Cole and colleagues estimated that 13% of 260 children (aged 10m to 6y) experienced a period of severe restlessness and disorientation on arrival in the recovery unit and this decreased to 8% 20 minutes later(15). Some children became delirious later. Analgesia and surgery were not related to the score. Age seemed to be important but was related to midazolam premedication.

Voepel-Lewis, Malviya and Tait audited 521 children (aged 3 to 7y) and 18% had emergence agitation(16). Of these 42% need restraint by 2 or more nurses, 48% became calm before any drugs became necessary and 52% were given opioids. Agitation was more common in the youngest children and if awakening was rapid.

Associations and causes

Many factors may influence postoperative behaviour.

Anxiety and pain

The data of Kain (8) and others (17) show that preoperative anxiety may be a major risk factor for emergence delirium (ED). Pain may also be important and fentanyl can be effective (18-20) - but not always (21). ED can occur even when there is effective caudal analgesia (22). Indeed ED can occur when there has been no surgery(13) – although other discomforts are possible.

Rapid recovery

The incidence of ED is similar in children recovering from sevoflurane whether or not they have rapid or slow emergence(23).

Benzodiazepines

Although benzodiazepines do reduce anxiety their effect on ED is uncertain(24-26). It is well-known that benzodiazepines, in the absence of other drugs, cause paradoxical excitement in adults and children(27-29) and most of the cases are described in the dental and gastroenterological literature. Moreover in the series of Cole et al of 22 children who had delayed ED 21 had had midazolam premedication compared with the overall premedication rate of 55%(15). Further, ED was more common in *older* premedicated children.

Barbiturates

Thiopental has not been associated with paradoxical excitement but, in a sedation scenario, pentobarbital (30) and secobarbital (31) have.

Ketamine

Ketamine is famous for causing disturbing dreams or hallucinations and may contribute to paradoxical excitement. The incidence of disturbed behaviour after ketamine is variable and uncertain. It is not prevented by midazolam(32). Indeed children excited by midazolam can be calmed by ketamine(33). ED following desflurane is reduced by ketamine (34).

Sevoflurane and other inhalational agents

When sevoflurane was introduced ED was noted as a potential side effect(13;22;35-37). It causes more ED than propofol anaesthesia (38). Initially insufficient analgesia and rapid recovery was blamed for the increased incidence of ED but this does not appear to be true(13). In addition ED can occur after all inhalational agents and sevoflurane may not be any worse that halothane (39;40)or isoflurane (41). Desflurane may be associated with the highest incidence(39).

Constant and colleagues recorded EEG during sevoflurane anaesthesia and their data suggest that ED may be associated with slow EEG frequencies at induction when 8% sevoflurane is used(42).

Management of delirium

General

Restraint maybe necessary until the ED is controlled. Vital signs must be monitored and adequate oxygenation and blood pressure ensured. Intravenous access maybe extremely useful and should be preserved. Dangerous causes for delirium must be excluded. Pain may be an important component of the child's distress and should be treated promptly. Benzodiazepines may control acute anxiety reactions but there is evidence to suggest that they do not reduce or control ED and may indeed be the causative factor.

Specific

The following three drugs are available and can be used to calm children in some circumstances.

Flumazenil

Flumazenil, an imidazobenzodiazepine, antagonises all actions of benzodiazepines. It has a high affinity for benzodiazepine receptors and is a weak partial agonist. Small doses can reverse paradoxical excitement (0.1 to 0.4 mcg/kg) and at these doses sedative and amnesic effects may persist(43-47). In respect to paradoxical excitement after intravenous midazolam in children, Massanari et al found the incidence was 1.4%, the mean onset time was 17 minutes and that flumazenil could reverse it in approximately 14 minutes [12]. Flumazenil should be used cautiously, if at all in patients who are taking medications associated with a reduced seizure threshold, these include tricyclic antidepressants theophylline and isoniazid. It should also be avoided in patients taking benzodiazepines as part of anticonvulsant medication(48).

Ketamine

Children with paradoxical excitement caused benzodiazepines may be calmed by ketamine(33).

Alpha 2 agonists

Both clonidine(49) and dexmedetomidine (0.2 mcg/kg/h) (50-52) are sedatives that have been used to control ED.

$5HT_3$ antagonists

Tropisetron (0.1mg/kg) may be useful (more than clonidine (1.5 mcg/kg)) in ED after sevoflurane(53).

Conclusion

ED following routine anaesthesia is common but mostly brief and self limiting. More prolonged ED, that may require specific management, should occur in much less than 10% of children. Staff should be trained to recognise and manage it; there should be a protocol (54).

Five questions

1. What are the common behaviour patterns of "craziness" during recovery from anaesthesia?
2. How should a child be managed?
3. What dangerous conditions must be excluded?
4. What are the characteristic features of post-anaesthesia delirium?
5. What are the potential causes and risk factors of post-anaesthesia delirium?

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