Should sevoflurane be used for maintenance of anaesthesia in children?

Sevoflurane is used for inhalational induction of anaesthesia because of its pleasant odour and quick onset. However, its use for maintenance of anaesthesia in children has been questioned because of the risk of emergence delirium.

Emergence delirium is defined by Sikich and Lerman (2004) as a disturbance in awareness of, and attention to, the environment with disorientation and perceptual alterations including hypersensitivity to stimuli and hyperactive motor behaviour in the immediate post-anaesthesia period. Its incidence is between 10 and 80% following general anaesthesia, and it has the potential to cause injury to the child or care provider, may cause intravenous lines or drains to become dislodged, often requires additional nursing support and delays recovery time (Vlajkovic and Sindjelic, 2007).

Some suggest that sevoflurane should be avoided for maintenance of general anaesthesia in children, using an alternative volatile agent such as isoflurane instead.

Sevoflurane should not be used

The speed of offset of anaesthesia may be a risk factor for developing emergence delirium. Newer inhalational agents such as desflurane and sevoflurane have been implicated as a result of their lower blood:gas partition coefficients and faster offset. This means that the child emerges rapidly into an unfamiliar environment which may trigger emergence delirium.

One of the few double-blind randomized controlled trials (Bortone et al, 2006), comparing sevoflurane and isoflurane in subumbilical surgery with regional block in children under 6 years, found a statistically significant higher incidence of emergence delirium with sevoflurane use 52% (95% confidence interval 38–66%) compared to 32% with isoflurane (95% confidence interval 20–46%) (P=0.028).

When compared against desflurane used in ear, nose and throat procedures sevoflurane resulted in a more severe emergence delirium when assessed using the Paediatric Anaesthesia Emergence Delirium scale (Mayer et al, 2006). Kuratani and Oi's (2008) meta-analysis showed that sevoflurane causes more emergence delirium than halothane following paediatric anaesthesia.

Different agent-specific emergence delirium rates could relate to specific intrinsic characteristics of sevoflurane (Vlajkovic and Sindjelic, 2007) and further work into this area may find a cause. Sevoflurane also costs more per ml and has a higher minimum alveolar concentration value than isoflurane and so has financial implications to its use.

Sevoflurane should be used

With the exception of halothane, which has good evidence for its higher emergence delirium incidence, the research comparing sevoflurane to other anaesthetic agents is conflicting. Studies comparing sevoflurane with isoflurane have shown similar emergence delirium incidences. In a comparison during deep extubation isoflurane had statistically similar incidence of emergence delirium as sevoflurane, 40% and 25% (P>0.05) respectively (Valley et al, 1999). Meyer et al (2007) found emergence delirium incidences of 30% and 34% for sevoflurane and isoflurane respectively (P=0.785). Other comparisons with desflurane have shown no difference in incidence between the two drugs in children undergoing adenoidectomy (Cohen et al, 2002).

Many other risk factors are implicated in emergence delirium including age, preoperative anxiety (child and parent), the child's temperament, postoperative pain, surgery type and adjunct medication (Vlajkovic and Sindjelic, 2007).

Conclusions

Emergence delirium is an important problem associated with paediatric anaesthesia. The evidence for and against the use of sevoflurane for maintenance of anaesthesia is still conflicting. Some studies show a statistically higher incidence of emergence delirium and some show no difference. However, no studies show that the incidence of emergence delirium is less with sevoflurane than isoflurane. Until there are more conclusive studies the choice of maintenance agent should consider other aspects such as cost, respiratory and cardiovascular effects and local policies. Other risk factors for emergence delirium should be considered such as adjunctive medications, adequate analgesia and prevention of preoperative anxiety. **BJHM**

Dr Adam Duffen *is ST3 in Anaesthesia in the Department of Anaesthesia, Ealing Hospital, London UB1 3HW and*
Dr Andrew Williams *is Consultant in the Department of Anaesthesia, Whipps Cross Hospital, London*

Correspondence to: Dr A Duffen (adamduffen@yahoo.co.uk)

Bortone L, Ingelmo P, Grossi S et al (2006) Emergence agitation in preschool children: double-blind, randomized, controlled trial comparing sevoflurane and isoflurane anesthesia. *Paediatr Anaesth* **16**(11): 1138–43

Cohen IT, Finkel JC, Hannallah RS, Hummer KA, Patel KM (2002) The effect of fentanyl on the emergence characteristics after desflurane or sevoflurane anesthesia in children. *Anesth Analg* **94**(5): 1178–81

Kuratani N, Oi Y (2008) Greater incidence of emergence agitation in children after sevoflurane anesthesia as compared with halothane: a meta-analysis of randomized controlled trials. *Anesthesiology* **109**(2): 225–32

Mayer J, Boldt J, Röhm KD, Scheuermann K, Suttner SW (2006) Desflurane anesthesia after sevoflurane inhaled induction reduces severity of emergence agitation in children undergoing minor ear-nose-throat surgery compared with sevoflurane induction and maintenance. *Anesth Analg* **102**(2): 400–4

Meyer RR, Münster P, Werner C, Brambrink AM (2007) Isoflurane is associated with a similar incidence of emergence agitation/delirium as sevoflurane in young children--a randomized controlled study. *Paediatr Anaesth* **17**(1): 56–60

Sikich N, Lerman J (2004) Development and psychometric evaluation of the pediatric anesthesia emergence delirium scale. *Anesthesiology* **100**(5): 1138–45

Valley RD, Ramza JT, Calhoun P et al (1999) Tracheal extubation of deeply anesthetized pediatric patients: a comparison of isoflurane and sevoflurane. *Anesth Analg* **88**(4): 742–5

Vlajkovic GP, Sindjelic RP (2007) Emergence delirium in children: many questions, few answers. *Anesth Analg* **104**(1): 84–91

Anaesthetic and critical care dilemmas are coordinated by Dr Pervez Sultan and Dr Kate Adams, Specialist Registrars in Anaesthetics, University College Hospital London
Ideas for future dilemmas can be sent to Rebecca Linssen rebecca.linssen@markallengroup.com