Literature Review for a Scientific Research Paper

Use of Propofol and Emergence Agitation in Children: A Literature Review

In 1961, Eckenhoff, Kneale, and Dripps described the phenomenon of emergence agitation (EA), reporting signs of hyperexcitation in patients emerging from ether, cyclopropane, or ketamine anesthesia. EA during recovery from general anesthesia has been identified as a frequent problem in the pediatric population. In children, EA has been described as a mental disturbance that consists of confusion, hallucinations, and delusions manifested by moaning, restlessness, involuntary physical activity, and thrashing about in bed (Sikich & Lerman, 2004). The overall rate for EA in children is in the range of 10% to 67% (Aouad & Nasr, 2005), which includes a period of severe restlessness, disorientation, and/or inconsolable crying during anesthesia emergence (Cole, Murray, McAllister, & Hirschberg, 2002).

EA was reported as a problem in general anesthesia recovery before the development of the modern inhalational agents (sevoflurane and desflurane), and EA has been shown to occur with the use of all anesthetic gases. The increased use of sevoflurane and desflurane in recent years has been associated with a higher incidence of EA compared with isoflurane and halothane. It is suggested that substituting sevoflurane and isoflurane for maintenance of anesthesia significantly reduces the incidence of EA in preschool children (Bortone et al., 2006), and that the use of adjunctive agents such as propofol added to sevoflurane can reduce the incidence of EA compared with sevoflurane alone (Abu-Shahwan, 2008; Aouad et al., 2007; Uezono et al., 2000). The goal of this literature review is to compare three categories of anesthesia techniques and their associated incidence of EA in children.

Sevoflurane Inhalational General Anesthesia

Sevoflurane was released in 1994, and has beneficial anesthetic properties such as a rapid onset of anesthesia, no pungent odor, and rapid emergence from anesthesia (Baum, Yemen, & Baum, 1997). Sevoflurane is currently the inhalational agent of choice for pediatric anesthesia because of its rapidity of induction and pleasant, nonirritating odor (Moore et al., 2003). While the incidence of EA in children who receive a sevoflurane anesthetic was noted to be as low as 20% for ear, nose, and throat surgery (Nakayama, Furukawa, & Yanai, 2007), it has been found as high as 60% in circumcision populations (Tazeroualti et al., 2007). It has been suggested that sevoflurane causes epileptogenic activity that contributes to EA behaviors. Clinically observed seizures, as well as seizures proved by electroencephalography, have been reported during sevoflurane induction, maintenance, and recovery in both children and adults, whether epileptic or not (Veyckemans, 2001).

Propofol and Sevoflurane General Anesthetic

Propofol is an intravenously administered general anesthetic released for use in 1989. Propofol has been studied in adult populations as well as in pediatric surgical, ophthalmologic, urologic, radiologic, gastrointestinal endoscopy, and dental procedures (Kaddu, Bhattacharya, Metriyakool, Thomas, & Tolia, 2002). Propofol has several advantages and can be used in many settings in anesthesia, including inpatient and outpatient procedures. General anesthesia with propofol is characterized by a rapid recovery and a calm, sometimes euphoric state (AbuShahwan, 2008).

Propofol has been demonstrated to be effective as an adjunct to sevoflurane inhalational general anesthesia in reducing the incidence of EA (Abu-Shahwan, 2008; Aouad et al., 2007). Aouad et al. (2007) demonstrated that propofol as an adjunct decreased the incidence of EA in children to 19.5% of study participants compared with 47.2% in patients who received sevoflurane alone. Abu-Shahwan (2008) found that a subhypnotic dose of propofol significantly decreased the incidence of EA. The propofol group had a 4.8% incidence versus a 26.8% incidence for sevoflurane alone group (Abu-Shahwan, 2008). These findings suggest that the use of propofol with sevoflurane can help reduce the rate of EA.

Propofol Total Intravenous Anesthesia

Propofol total intravenous anesthesia (TIVA) techniques have also demonstrated a reduction in EA in children. In the study by Cohen, Finkel, Hannallah, Hummer, and Patel (2003) of sevoflurane inhalational anesthesia versus a propofol TIVA technique, there were significantly higher rates of EA in the sevoflurane group compared with the propofol group (23.1% versus 3.7%). In a study by Picard, Dumont, and Pellegrini (2000) of the quality of recovery in children, a sevoflurane inhalational anesthetic and propofol TIVA techniques were compared, with a reduction in EA rates observed in the propofol TIVA group (46% versus 9%, respectively). A reduction in EA from 42% to 11% was seen in children 2 to 5 years of age with propofol TIVA compared with sevoflurane inhalational general anesthesia (Nakayama, Furukawa, & Yanai, 2007). In a small study of children presenting for eye surgery (n = 16), a propofol TIVA technique had an EA incidence of 0%, in contrast to a cohort managed with sevoflurane inhalational general anesthetic, which produced an EA incidence of 38% (Uezono et al., 2000). Together, these studies indicate that the use of a propofol TIVA technique can significantly reduce the incidence of EA in children.

Discussion

A thorough review of the literature revealed the incidence of EA to be reduced with the use of a propofol TIVA technique compared with a sevoflurane inhalational general anesthetic. Also, the incidence of EA was reduced significantly with propofol as an adjunct to a sevoflurane inhalational general anesthetic (Abu-Shahwan, 2008; Aouad et al., 2005; Aouad et al., 2007).

According to the literature evidence base, there is an advantage to either propofol TIVA or adjunctive propofol with sevoflurane (compared with sevoflurane alone). We conclude, based on the current evidence, that the use of propofol is associated with a reduction in the incidence of emergence agitation.

In the current literature review, a major limitation discovered is the need for the consistent use of a validated scale for assessing EA across all studies. Numerous studies of EA have used a variety of scales, which measure EA by different criteria. According to Sikich and Lerman (2004), the Pediatric Anesthesia Emergence Delirium (PAED) scale is a reliable and valid tool based on the scale's reliability, content, and initial construct validity profile determined through their study. Aouad and Nasr (2005) recommended that the PAED scale can be used as a reliable and valid tool that would minimize measurement error in the clinical evaluation of EA. If future studies use the same validated assessment scale (such as the PAED), results can be more easily compared and strengthened.

Conclusion

EA is an important issue in pediatric anesthesia and has increased in occurrence with the use of sevoflurane inhalational anesthesia. The goal of this literature review was to compare three general anesthesia techniques in children and their associated incidence of EA. The three techniques were (a) sevoflurane inhalational general anesthetic, (b) propofol as an adjunct to sevoflurane inhalational general anesthetic, and (c) propofol TIVA techniques. The reviewed literature suggests that there are advantages to the use of propofol TIVA techniques and adjunctive propofol anesthetics when combined with a sevoflurane inhalational technique. This reduction in EA with propofol use in conjunction with or separately from sevoflurane has been widely documented throughout the literature (Abu-Shahwan, 2008; Aouad et al., 2005; Aouad et al., 2007). Current research supports the use of propofol, as discussed above; however, a continuation of current research with consistent and strengthened methodologies will help justify its use and application in clinical practice.