Sedation With a Combination of Dexmedetomidine and Midazolam for Pediatric Dental Surgery

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Intravenous sedation (IVS) is commonly used to complete dental treatment for uncooperative pediatric patients. Propofol (PRO) is widely used for IVS because of its short context sensitive half-time and amnestic effect. However, administering PRO to patients who have a history of egg anaphylaxis is still somewhat controversial. The evidence that supports the potential risks for allergic reactions following PRO use in patients with egg allergies is limited with some anesthesiologists recommending against its use in these patients. Alternative drug regimens for procedural sedation in this population are therefore desirable. Dexmedetomidine (DEX), a selective α -2 agonist, has antianxiety and sedative properties and has been widely used not only for procedural sedation with mild inhibitory effects on respiration but also during minor surgeries for its analgesic effect. In this paper, we describe the successful administration of a combination of DEX and low-dose midazolam (MDZ) for sedation in an uncooperative pediatric patient. Both DEX and MDZ have been reported as safe and useful sedatives for dental treatment, and their combination may provide a helpful option for IVS of pediatric patients for whom PRO is not preferred.

Key Words: Dexmedetomidine; Midazolam; Pediatric sedation; Dental treatment.

Intravenous sedation (IVS) is an effective option for uncooperative pediatric patients. Propofol (PRO) and midazolam (MDZ) are popular sedatives for IVS for dental patients. A previous study reported that PRO is more effective and at least as safe as MDZ for intravenous procedural sedation in emergency medicine¹ and also in dental treatment. Although PRO is likely to be safe in the vast majority of children with egg-related allergies, some anesthesiologists suggest that it should not be administered to these children,² and some case reports have supported this recommendation.^{3,4} However, the evidence is limited,⁵ and most anesthesiologists continue to administer PRO for egg allergic patients. Further, the American Academy of Allergy, Asthma, & Immunology states “patients with soy or egg allergy can receive PRO without any special precautions.” An additional concern with PRO use is PRO infusion syndrome, which has been reported to be associated with the short-term infusion of a large doses of PRO during procedural anesthesia.⁶

Alternative drug regimens for procedural sedation are desirable to address these concerns.⁷

Dexmedetomidine (DEX) is a selective α -2 agonist used for sedation during mechanical ventilation and after ventilator weaning in intensive care unit postoperatively and for sedation during minor surgeries as well as prevention of emergence agitation due to its analgesic, anxiolytic, and sedative effects, accompanied by only mild inhibitory effects on respiration. Compared with PRO or MDZ, DEX has a smaller inhibitory effect on respiration, and its use in pediatric patients has recently increased.⁸ MDZ, on the other hand, exhibits dose-dependent anterograde amnesia and also less cardiac inhibition than the other 2 drugs. Physicians in the postoperative intensive care unit have satisfactorily used a combination of DEX and MDZ following pediatric cardiac surgery.⁹

Here, we report a successful dental treatment case, where we used a combination of DEX and low-dose MDZ on an uncooperative pediatric patient.

CASE PRESENTATION

Dental treatment (vital pulpectomy of left first primary molar tooth) under IVS was scheduled for a 5-year-old

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boy (weight, 16 kg; height, 101 cm) with dental phobia. Radiographically, there was no dental pathology other than this 1 tooth. IVS rather than general anesthesia was chosen due to the minor nature of the planned procedure. His medical history was noteworthy only for an egg-related allergy diagnosed after he developed skin itching and redness following the ingestion of eggs or products containing egg ingredients. He did not suffer adverse effects after vaccinations. He did not receive detailed allergy testing, but his pediatrician advised him to refrain from excessive egg ingestion. We, therefore elected not to use PRO for this patient. He walked into the operating room with his mother. Monitoring with electrocardiography (ECG), pulse oximetry (SpO₂), noninvasive arterial pressure (NIBP), end-tidal CO₂ (EtCO₂), and bispectral index (BIS) monitoring was initiated. Recordings were started prior to induction. Inhalation induction was initiated by incremental doses of up to 5% sevoflurane in a mixture of oxygen and nitrous oxide. Once vascular access was established at a BIS value of 80 under spontaneous ventilation with sevoflurane/nitrous oxide/oxygen, the anesthesia mask was removed and an infusion of DEX was administered 1 µg/kg for 10 minutes as an initial loading dose. In addition, supplemental oxygen was administered at a rate of 5 L/min via nasal cannula. After the 10-minute loading dose, the rate of DEX infusion was reduced to 0.7 µg/kg/h, and 0.5 mg (approximately 0.03 mg/kg) of MDZ was intravenously administered. Local anesthesia (2% lidocaine with 1:80,000 adrenaline) was administered by the pediatric dentist as previously described in a study where IVS with DEX and MDZ was given during a third molar procedure.¹⁰ Sedation was maintained with DEX at a rate of 0.5 to 0.7 µg/kg/h, and the BIS value was maintained between 60 and 80. Twenty-five minutes after the start of the dental treatment, a supplemental dose (0.5 mg) of MDZ was needed because the patient resisted having his mouth opened by the pediatric dentist. ECG, SpO₂, NIBP, and EtCO₂ were monitored and there were no cardiovascular events such as bradycardia or hypotension nor respiratory issues such as upper airway obstruction for the 40 minutes of dental treatment. The patient woke up clear-headed 20 minutes after the end of the dental treatment and was transferred to the recovery room. Once the patient had recovered for 60 minutes and his vital signs were stable, he was allowed to go home.

DISCUSSION

We report that a combination of DEX and low-dose MDZ was a useful sedative for the dental treatment for

an uncooperative pediatric patient requiring minimal treatment. The combination of DEX and low-dose MDZ may provide an effective sedative combination for dental treatment in cases where PRO use is not desired. Even though PRO is seen as a superior sedative because of its short context sensitive half-time, alternatives should be available. The combination of DEX and low-dose MDZ may be well suited for pediatric patients. DEX is an α -2 adrenergic receptor agonist that causes sedation and analgesia with minimal respiratory depression, but with unpredictable amnesia. DEX has recently been used as a sedative for pediatric patients undergoing magnetic resonance imaging (MRI)^{11,12} and computed tomography (CT) imaging,¹³ and for postoperative sedation.¹⁴ However, dental treatment for uncooperative children requires deeper levels of sedation than that required for either MRI or CT imaging. Previous reports have suggested that DEX might be an alternative to MDZ for IVS,¹⁵ and more useful than MDZ for third molar surgery.¹⁶ However, another study reported that DEX has incomplete analgesic properties and will not routinely produce sufficient effects when administered alone for painful procedures in children.¹⁷

A previous paper reported that children were successfully treated with DEX sedation without complications during a dental treatment,¹⁸ but it was frequently difficult to maintain a sufficient depth of sedation using either DEX or MDZ alone. In another study, it was reported that respiratory depression, leading to severe hypoxia, was induced by MDZ in a dose-dependent manner.¹⁹ In this case, we initiated anesthesia with volatile sevoflurane and maintained it with a combination of DEX and MDZ. We think the analgesic effects of DEX reduced the intensity of pain during local anesthesia and dental treatment, and allowed us to complete the procedure although an additional administration of MDZ was needed to compensate for insufficient sedation. As we stated, however, our patient had an inhalation induction and residual effects of that induction may have contributed to good analgesia and sedation for local anesthetic administration. Our patient did not experience any common adverse effects of DEX administration such as bradycardia or hypotension.

We are aware that other drug combinations may be useful and should also be studied in order to expand the range of alternatives for dental procedure sedation in pediatric patients. For example, a combination of ketamine and DEX can provide effective deep sedation during tooth extraction in children.²⁰ Other agents such as nitrous oxide may also be beneficial with DEX for dental treatment.

In conclusion, a combination of DEX and MDZ provided a safe and useful sedative alternative for dental treatment under IVS in a patient with egg-related

allergies. Further studies are needed to establish the optimal doses of DEX and MDZ when used in combination to prevent arousal and maintain a safe cardiovascular and respiratory sedation during dental treatment in pediatric patients.

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