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Case Report Open Access

Reversal of Vecuronium-induced Neuromuscular Blockade with Sugammadex in a Child with Moebius Syndrome after Accidental Extubation

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Abstract

Sugammadex chemically encapsulates rocuronium and vecuronium, thereby rapidly terminating the neuromuscular blockade induced by these agents. Although the experience with the use of sugammadex in children under 2 years of age is limited, it may be considered in specific clinical contexts.

We present a case where spontaneous efficient respiratory effort was resumed after reversal of vecuronium-induced neuromuscular blockade with sugammadex in a child. A 21-month-old boy with a history of Moebius syndrome and obstructive sleep apnea needing night time noninvasive ventilation support was scheduled for adenotonsillectomy and bilateral myringotomy. Tracheal intubation was anticipated to be difficult and so it was performed using a videolaryngoscope. In the postoperative period the child remained intubated in the intensive care unit sedated and with a continuous infusion of vecuronium. On day 3 accidental extubation occurred. As it was considered an urgent situation, flumazenil, naloxone and sugammadex 2 $mg.kg^{-1}$ were administered with rapid return of spontaneous respiration and consciousness, obviating the need of unnecessary airway manipulation and the inherent risks.

Keywords: Neuromuscular blockade reversal; Sugammadex; Vecuronium; Child

Introduction

Sugammadex, a modified gamma cyclodextrin, is a selective relaxant binding agent specifically designed to encapsulate the steroidal neuromuscular blocking agents (NMBAs) rocuronium and vecuronium [1].

The experience with the use of sugammadex in children under 2 years of age is limited. Nevertheless, in this age group, sugammadex may be useful in airway emergency situations.

We present a case where spontaneous efficient ventilation was resumed after reversal of vecuronium-induced neuromuscular blockade (NMB) with sugammadex in a child with Moebius syndrome, after accidental extubation.

The child's parents granted written consent for publication.

Case Report

A 21-month-old boy, American Society of Anesthesiologists physical status III (Moebius syndrome with obstructive sleep apnea [OSA] needing night time noninvasive ventilation support, and frequent upper respiratory infections medicated with inhaled fluticasone), weight 10 kg, was scheduled for elective adenotonsillectomy and bilateral myringotomy. Airway evaluation revealed facial paralysis, reduced mouth opening and micrognathia. At 2-month-old age he was submitted to surgical treatment of hypertrofic pyloric stenosis. The mother was told by the anesthesiologist that he was very difficult to intubate. Laboratory values where within normal limits.

Intraoperative monitoring included electrocardiogram, non-invasive blood pressure, pulse oxymetry and end-tidal CO_2. After inhalational induction, with a mixture of oxygen and sevoflurane, mask ventilation was possible using an oropharyngeal airway. Successful tracheal intubation was then performed with a videolaryngoscope (Glidescope®). Although we found an omega-shaped epiglottis, tracheal intubation was achieved at first attempt, with subsequent administration of fentanyl 30 μg and rocuronium 2 mg. Anesthesia was maintained with oxygen and sevoflurane. Surgery was uneventful and lasted 30 minutes. Tonsils graded 1 in the tonsillar hypertrophy grading scale and so tonsillectomy was not performed. For postoperative analgesia tramadol 1.5 $mg.kg^{-1}$ and acetaminophen 15 $mg.kg^{-1}$ were administered, and methylprednisolone 2 $mg.kg^{-1}$ for upper airway edema.

The anesthetist and the ENT surgeon decided that the child should remain intubated in the first hours following the procedure. Once in the intensive care unit (ICU), midazolam 0.3 $mg.kg^{-1}.h^{-1}$, fentanyl 4 $\mu g.kg^{-1}.h^{-1}$, and vecuronium 0.1 $mg.kg^{-1}.h^{-1}$ continuous infusions were started. Neuromuscular blockade was not monitored in the ICU due to lack of equipment.

The period of intubation initially planned was extended because of a suspicion of a respiratory infection. Nevertheless, given the favorable respiratory clinical evolution, elective extubation was being considered. On day 3 accidental extubation occurred during nursing care and it was assumed by the ICU senior doctor not to re-intubate the child. Mask ventilation was initiated and the continuous infusions were suspended. Naloxone and flumazenil were administered in the total dose of 800 μg and 200 μg, respectively. As it was considered an

urgent situation, it was decided to give sugammadex 2 $mg.kg^{-1}$ instead of neostigmine. A few minutes after, regular spontaneous respirations and consciousness resumed. The blood gas analysis with supplementary oxygen (9 $Lmin^{-1}$) with Bilevel Positive Airway Pressure (BiPAP) two hours after was as follows: pH 7.44, pCO_2 43.2 mmHg, pO_2 70 mmHg, HCO_3^- 24.1 mEq/L, Sat O_2 96.4%. No signs of re-curarisation were found in the following hours. The patient's remaining hospital course was uneventful and he was discharged at day 8.

Discussion

Pediatric patients differ from adults because the pharmacokinetic and pharmacodynamic profiles of NMBAs may vary as a function of age [2]. Plaud et al. explored the dose-response relationship of sugammadex given at reappearance of the second twitch of the train-of-four stimulation for the reversal of rocuronium-induced NMB in infants, children, adolescents, and adults [3]. The safety of sugammadex in this patient population was also studied. This study showed that sugammadex rapid, effective, and safely, and with similar recovery times reverses rocuronium-induced NMB in infants, children, adolescents, and adults. However, the small number of children less than 2 years of age included didn't allow a reliable interpretation of the efficacy and safety of sugammadex in this age group.

There are no other published pediatric studies on sugammadex. The manufacturer currently recommends that, for lack of safety data, sugammadex should not be used in children under 2 years of age [4]. However, clinicians have successfully used off-label sugammadex in that age group, in selected clinical contexts. Buchanan et al. and Wołoszczuk-Gębicka et al. reported the effective use of sugammadex 4 mg kg^{-1} and 8 mg kg^{-1}, respectively, to reverse vecuronium-induced NMB when intubation was not possible and mask ventilation was becoming difficult, in these children [5,6]. Salas Ballestín et al. and Pickard et al. described the use of sugammadex 4 mg kg^{-1} to reverse residual NMB induced by vecuronium and rocuronium, respectively, in the same age group [7,8].

Moebius syndrome is a rare neurological disorder characterized by immobile facial appearance with various gaze palsies. Facial nerve palsy is usually bilateral and incomplete. It is associated with difficulties in intubation, greater sensitivity to opioids and the occurrence of central apnea postoperatively [9].

The pathophysiology of pediatric OSA is often multifactorial. The incidence of respiratory complications in patients with OSA is as high as 27% [10]. Accepted risk factors for OSA in children include adenotonsillar hypertrophy, craniofacial malformations, hypotonia and micrognathia [11]. Residual anesthetics and opioids administered for postoperative analgesia can lead to changes in airway dynamics resulting in significant airway obstruction. In 2002, the American Academy of Pediatrics recognized a greater risk of respiratory complications in operated children with OSA, and recommended close postoperative vigilance and monitoring of these patients [12]. Later in 2012, the same entity established risk groups likely to present complications post adenotonsillectomy, namely being under 3 years of age, having severe OSA or craniofacial abnormalities [13]. In children with severe OSA, after adenotonsillectomy, the edema that establishes at the operation site, which tends to improve in the first 24 to 48 hours after surgery, also contributes to the increased risk of airway obstruction [14].

Friedman et al. reported the safe and effective use of BiPAP in 9 of 1321 patients predisposed to postoperative airway obstruction that underwent tonsillectomy and/or adenoidectomy [15]. Nevertheless, in this context, there are reported complications such as pneumocephalus and subcutaneous emphysema. The risk of respiratory complications in the immediate postoperative period of adenoidectomy and/or tonsillectomy in children with OSA may justify the need of maintaining intubation and mechanical ventilation.

Conclusion

A post-operative multidisciplinary approach concerning ENT surgery in children with difficult airway and OSA is necessary.

In this specific case, although initial airway management and ENT surgery were uneventful, an accidental extubation occurred in the ICU. As it was considered an urgent situation, although not recommend by the manufacturer to be used at this age, sugammadex 2 $mgkg^{-1}$ instead of neostigmine was administered.

The experience with the use of sugammadex in children under 2 years of age is limited. Nevertheless, recommendations should be adjusted to the existing clinical context. Therefore the use of sugammadex could be considered in this age group and in urgent or emergent situations.

Additional studies to fully determine the efficacy and safety of sugammadex in this special population are needed.

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