Mivacurium for Muscle Relaxation in a Child with Duchenne’s Muscular Dystrophy

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In a 5-yr-old boy with Duchenne’s muscular dystrophy (DMD), the repeated administration of mivacurium 0.13 mg/kg was associated with a normal dose-response relationship and time from end of injection to twitch recovery to 25% of control (DUR25%) and a twofold normal recovery index (time from 25% to 75% recovery). There was no difference between electromyogram (EMG) and mechanical twitch tension recording. Thus, the characteristics of mivacurium neuromuscular block in patients with DMD may be more favorable than those of atracurium and vecuronium previously reported in the literature.

In patients with Duchenne’s muscular dystrophy (DMD), after atracurium and vecuronium, the recovery from neuromuscular block is 3–6 times longer than that in healthy individuals (1,2). Similar results in patients with dystrophia myotonica led to the recommendation to use the shortest acting nondepolarizing muscle relaxant available (3). Mivacurium is the shortest acting nondepolarizing muscle relaxant in current clinical use. There has been no account in the literature of its use in patients with DMD. We describe a patient with DMD in whom mivacurium was used for muscle relaxation monitored by simultaneous recording of the evoked twitch tension and the evoked compound EMG.

Case Report

A 5-yr-old boy (104 cm, 19 kg) presented for dental surgery. DMD had been diagnosed previously by identification of a deleted exon 17 in the dystrophin gene. Clinical examination showed normal posture, normal joint movement, and muscle reflexes. The patient was, however, only able to stand by supporting his hands on his legs (Gower’s maneuver). Auscultation of his heart and lungs, as well as electrocardiography, showed no pathological findings. Laboratory tests were normal except for a creatine kinase of 8400 U/L.

The child was premedicated with 7.5 mg of midazolam administered orally 45 min before the induction of anesthesia. Anesthesia was induced IV with propofol 50 mg and an infusion of remifentanil started at a rate of 0.4 \( \mu \text{g} \cdot \text{kg}^{-1} \cdot \text{min}^{-1} \). After a 5-min ventilation via face mask with pure oxygen, the patient’s trachea was intubated without the aid of a muscle relaxant. Anesthesia was maintained with propofol and remifentanil infused at rates of 85–160 and 0.25–0.4 \( \mu \text{g} \cdot \text{kg}^{-1} \cdot \text{min}^{-1} \), respectively. Mechanical ventilation with 30% oxygen in air was adjusted for a 36-mm Hg end-tidal carbon dioxide partial pressure. No inhaled anesthetic was used. Neuromuscular transmission was monitored by simultaneous recording of the evoked twitch tension and the evoked compound EMG of the left adductor pollicis muscle in response to supramaximal train-of-four (TOF) stimulation (2 Hz/2 s every 15 s) of the ulnar nerve at the wrist as previously described (4–6). After a 6-min stable baseline recording, an initial dose of mivacurium 0.13 mg/kg, i.e., 1.2 × the 95% effective dose in healthy children (7), was injected IV over 15 s. Repeat doses were given whenever the first twitch response of a TOF (T1) had attained 25% of control. The twitch and EMG recordings were evaluated for the variables specified in Results.

Results

The patient received four doses of mivacurium 6, 10, 7, and 9 min apart. The second dose was inadvertently 0.27 mg/kg instead of 0.13 mg/kg, as in Doses 3 and 4. Within 180 s, the first dose led to a 90% suppression of T1 in both the twitch and EMG recordings. The maximal intensity of neuromuscular block in response to Doses 2, 3, and 4 for twitch versus EMG suppression was 100% vs 90%, 100% vs 93%, and 100% vs 93%, respectively. In the twitch and the EMG recording, the time from 25% to 75% recovery after Dose 4 was 8 min, and a TOF ratio of 0.7 was regained within 23 and 20 min, respectively. After the last injection, complete recovery of T1 was observed nearly simultaneously in both recordings: 32 and 29 min twitch versus EMG. The skin temperature remained stable at the thenar eminence (33.1–34.0°C) and rectally (36.4–36.6°C).

Discussion

Published reports on the effect of muscle relaxants in patients with DMD focus on vecuronium (1,8) and...
atracurium (2). The use of mivacurium in such patients has not yet been documented. In two children with DMD anesthetized with nitrous oxide-halothane, the 90% effective dose values of vecuronium was 43 and 57 µg/kg (1). These values were similar to those of healthy children, yet the recovery indices of 14 and 22 min in the EMG and twitch response, respectively, were 3 times longer than normal. In eight other children with DMD, the dose of vecuronium required to reduce the TOF ratio <0.1 was 50% less than that in a control group. The ensuing time for the TOF ratio to recover from 0.1 to 0.25 was 6 times longer than normal (8). In a 7-year-old boy with DMD who received atracurium 143 µg/kg (0.7 × 95% effective dose [ED95]) during nitrous oxide-isoflurane anesthesia, the EMG revealed a time of onset of six minutes, a 90% maximal twitch suppression, and a recovery index of 28 minutes, which is approximately 3 times the corresponding value in healthy children (2). The data on both vecuronium and atracurium indicate that DMD may grossly delay the complete recovery of neuromuscular transmission despite a normal ED95 or individualized dosage.

Our patient’s data are similar to these findings. His recovery index was approximately twice as long as that after 1.8 × ED95 of mivacurium in normal children (7), although both the dose-response relationship and the DUR25% were within normal limits. In absolute terms, after a total of approximately 6 times the normal ED95 of mivacurium, complete recovery of T1 took only 32 minutes after the last injection. This is a considerable improvement compared with atracurium and vecuronium neuromuscular block, which, in children with DMD, took approximately 20 and 30 minutes longer, respectively, to attain 75% recovery of T1.

In the reports of vecuronium administered to patients with myasthenia gravis (9) or DMD (1), it is emphasized that the evoked twitch tension may be much slower to recover than the EMG (10). Thus, neuromuscular monitoring by EMG, which is more convenient to use in the clinical setting than twitch recording, may ultimately lead to overestimation of the contractile force available to maintain both upper airway patency and spontaneous respiration. No such discrepancy was found in our patient with mivacurium neuromuscular block.

In conclusion, our case report suggests that, in patients with DMD, the characteristics of mivacurium neuromuscular block remain close to normal. This single clinical observation of mivacurium in patients with DMD needs to be validated in a future study.

References