

## Use of rocuronium in a pregnant patient with an open eye injury, receiving magnesium medication, for preterm labour

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### Summary

We present a case where rocuronium 80 mg ( $3 \times \text{ED}_{95}$ ) was used in a rapid sequence induction in a 80-kg pregnant patient with an open eye injury. The patient was also receiving magnesium  $2 \text{ g h}^{-1}$  i.v. for preterm labour. The expected duration for neuromuscular block of rocuronium in the absence of magnesium would be approximately 53 min; with infusion of magnesium, the duration of neuromuscular block was prolonged four-fold (215 min). It is important to remember that magnesium potentiates the effects of all non-depolarizing neuromuscular blocking agents, including rocuronium. (*Br. J. Anaesth.* 1996; 77: 669–671)

### Key words

Neuromuscular block, rocuronium. Ions, magnesium. Complications, eye injury.

Magnesium is used frequently in the USA both for pre-eclampsia as an anticonvulsant and for preterm labour. For the treatment of preterm labour, magnesium inhibits myometrial activity, but the mechanism of its tocolytic effect is unknown<sup>1</sup>; presumably myometrial contractility is depressed by modulating calcium uptake, binding or distribution in smooth muscle cells.<sup>2</sup> Serum concentrations of 4–8 mmol litre<sup>-1</sup> are required. Maternal side effects include nausea, vomiting, ileus, visual blurring, diplopia, headaches and the potential for pulmonary oedema.<sup>3</sup> Magnesium also causes increased sensitivity to neuromuscular blocking agents.<sup>4</sup> We present the first report of magnesium prolonging the neuromuscular blocking effect of rocuronium. Rocuronium was chosen as this patient also had an open eye injury with the concern that suxamethonium increases intraocular pressure.

### Case report

The patient was a 31-yr-old parturient with a 28-week gestation and an unremarkable prenatal course who presented for repair of a penetrating eye injury. The patient was involved in a motor vehicle accident in which she was an unrestrained passenger. She suffered temporary loss of consciousness, but presented to the emergency room with a Glasgow coma scale of 15. Her injuries included laceration to the

left forehead, corneal scleral laceration and prolapsed vitreal tissue of the left eye, and a left styloid fracture. Initial vital signs on presentation were: arterial pressure 140/88 mm Hg, heart rate 95 beat min<sup>-1</sup>, temperature 36.5 °C and ventilatory frequency 18 bpm. Her height was 162 cm, weight 80 kg. She was placed in a cervical collar.

A CT scan of the head and neck revealed a ruptured left globe with medial wall fracture. The view of the cervical spine was unable to exclude injury. Other laboratory values included haemoglobin concentration 12.3 g dl<sup>-1</sup>, packed cell volume 36.1%, blood urea nitrogen concentration 7 mg dl<sup>-1</sup>, creatinine concentration 0.6 mg dl<sup>-1</sup>, prothrombin time 12.2 s, activated partial thromboplastin time 28.3 s and fibrinogen concentration 358 mg dl<sup>-1</sup>. Tocodynametry and continuous Doppler fetal heart tones were commenced to monitor uterine contractile activity and fetal heart rate, respectively. Fetal heart rate was 130–140 beat min<sup>-1</sup> with good long- and short-term variability. Uterine contractions were occurring every 3 min, for which she received a loading dose of magnesium 4 g, and a continuous infusion of  $2 \text{ g h}^{-1}$  was started.

She was transferred to our hospital for operative management. Additional laboratory studies before induction of anaesthesia included a magnesium concentration of 5.8 mmol litre<sup>-1</sup> (therapeutic range 4–8 mmol litre<sup>-1</sup>). In the operating room, a 16-gauge i.v. catheter was inserted into her right forearm. ECG, end-tidal carbon dioxide, pulse oximetry, fetal heart rate and uterine contraction monitoring with a tocodynameter, and neuromuscular block monitoring using a Neurotechnology peripheral nerve stimulator were commenced.

The patient was premedicated with sodium bicitrate 30 ml orally and metoclopramide 10 mg i.v. After placement in left uterine displacement and 5 min of preoxygenation with 100% oxygen, anaesthesia was induced with fentanyl 200 µg, thiopentone 400 mg and rocuronium 80 mg ( $0.9 \text{ mg kg}^{-1}$ ,  $3 \times \text{ED}_{95}$ ). At 60 s, her train of four had disappeared and her trachea was intubated under direct laryngoscopy with a 7.0 tracheal tube. The patient did not cough during intubation and arterial pressure did not

increase. Her oxygen saturation decreased to 90% but returned to 100% after intubation. Anaesthesia was maintained with isoflurane in oxygen and fentanyl.

Five minutes after induction, there was a decrease in short-term variability on the fetal heart rate monitor, with a heart rate of 140–150 beat  $\text{min}^{-1}$ . We could not detect post-tetanic facilitation until 110 min after induction and the first twitch in the train of four was detected 215 min after administration of rocuronium. When surgery was completed 6 h after induction, the patient had received a total of rocuronium 80 mg, fentanyl 450  $\mu\text{g}$  and normal saline 1300 ml. The patient was transferred to the labour suite and was weaned from the magnesium infusion over the next 24-h period. The patient was discharged 6 days later with some return of vision in the left eye and no apparent adverse effects on the fetus.

## Discussion

This case highlights an anaesthetic challenge of securing the airway in a pregnant patient with an open eye injury. In a pregnant trauma patient with a 28-week gestation, aspiration is a high risk. Pain from injury delays gastric emptying. The enlarging uterus during pregnancy displaces the stomach, altering the competence of the gastro-oesophageal sphincter.<sup>5</sup> Hormonal changes delay gastric emptying,<sup>6</sup> while gastrin excreted by the placenta increases the acidity of the maternal stomach contents.<sup>7</sup> The usual means of securing the airway in such a patient would be an awake intubation or rapid sequence induction using an induction agent, suxamethonium and cricoid pressure. However, our patient also had an open eye injury. Securing the airway by awake intubation is associated with an increase in intraocular pressure via venous congestion of the orbital veins associated with straining or coughing.<sup>8</sup> Suxamethonium also has been shown to increase intraocular pressure<sup>9</sup> with one case report of extrusion of vitreous from this increase.<sup>10</sup> Although pre-treatment with a non-depolarizing neuromuscular blocker such as 3 mg of curare or vecuronium 1 mg has been advocated, this does not reliably prevent the increase.<sup>11</sup> The risk of extrusion of intraocular contents in a patient with an open eye injury given suxamethonium is rare; however, we chose to perform a rapid sequence induction using rocuronium as the neuromuscular blocking agent.

Rocuronium is a new steroidal neuromuscular blocking drug related chemically to vecuronium. However, unlike vecuronium, it is less potent with a shorter time to onset.<sup>12</sup> Given this shorter onset period, its use for rapid sequence induction has been investigated. Huizinga and colleagues demonstrated comparable intubating conditions with suxamethonium 1.5 mg  $\text{kg}^{-1}$ , at 60 and 90 s after administration of rocuronium 0.6 mg  $\text{kg}^{-1}$  ( $2 \times \text{ED}_{95}$ ).<sup>13</sup> Tryba and colleagues found that similar intubating conditions could be obtained with rocuronium 0.6 mg  $\text{kg}^{-1}$  or suxamethonium 1.5 mg  $\text{kg}^{-1}$ , provided the dose was administered immediately before administration of thiopentone; the conditions were less

optimal if administered immediately after thiopentone.<sup>14</sup> Finally, Abouleish and colleagues investigated its use during Caesarean delivery. With a dose of 0.6 mg  $\text{kg}^{-1}$ , intubating conditions were poor with a thiopentone dose of 4 mg  $\text{kg}^{-1}$ ; however increasing the dose of thiopentone to 6 mg  $\text{kg}^{-1}$  improved intubating conditions.<sup>15</sup> If rapid securing of the airway in a patient with a contraindication to suxamethonium is necessary, rocuronium seems to be a good choice for neuromuscular block.

Rocuronium has been shown not to increase intraocular pressure.<sup>16</sup> Abouleish demonstrated no adverse effects on the neonate and pregnancy did not enhance its neuromuscular blocking properties. Given the gestational age of the fetus (second trimester), teratogenicity was not a concern. The dose chosen for our patient (0.9 mg  $\text{kg}^{-1}$ ) was higher than the doses used in the above studies. By increasing the dose from 0.6 to 0.9 mg  $\text{kg}^{-1}$  ( $2 \times \text{ED}_{95}$  to  $3 \times \text{ED}_{95}$ ), the onset time decreased from  $271 \pm 129$  s to  $135 \pm 79$  s with excellent intubating conditions at 60 s. The duration to recovery of 25% of twitch increased from  $27.3 \pm 8.2$  min to  $53.0 \pm 15.2$  min.<sup>17</sup> We felt that rapid securing of the airway was important in this patient, as became evident from the decrease in oxygen saturation pulse oximetry reading, and we were willing to tolerate the prolonged duration. Although administration of a priming dose has been shown to reduce onset time,<sup>18</sup> we were concerned as the patient was receiving magnesium which increases sensitivity to non-depolarizing neuromuscular blocking agents.<sup>19</sup> A priming dose may have been sufficient to result in profound weakness in an awake patient.

Our patient was receiving concurrent magnesium therapy for preterm labour. Although the mechanism is unclear, magnesium has become the traditional agent used for the treatment of preterm labour. Side effects of magnesium include pulmonary oedema, sedation and potentiation of neuromuscular block. Therapeutic plasma concentrations are 4–8 mmol  $\text{litre}^{-1}$ . Our patient's magnesium concentration at the time of induction was 5.8 mmol  $\text{litre}^{-1}$ . The mechanism of its blocking effects at the neuromuscular junction is suppression of acetylcholine release at the neuromuscular junction or decrease in the depolarizing action of acetylcholine at the motor end-plate.<sup>20</sup> The time to achieve post-tetanic facilitation in this patient was 110 min and the time to achieve one twitch of a train of four was 215 min. Assuming that at 25% recovery of a twitch is when the first twitch of a train of four is perceptible, the duration was more than six times greater, supporting the contention that magnesium also prolongs the duration of action of rocuronium. Although isoflurane has also been shown to prolong the duration of rocuronium,<sup>21</sup> this effect cannot account for the dramatic increase in this our patient.

We were surprised by the obstetrician's concern for the loss of short-term variability on the fetal tracing after induction. This phenomenon has been described previously<sup>22</sup> and is attributed to the baby becoming anaesthetized. We do not feel that this can be attributed to rocuronium.

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