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CLINICAL REPORT

Accidental epidural injection of rocuronium

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Abstract Epidural administration of local anesthetics or opioid during general anesthesia is a widespread method for postoperative analgesia. Despite the availability of this technique, inadvertent administration of nonepidural medications into the epidural space can be associated with serious neurological complications. We report a case of accidental epidural rocuronium injection.

Keywords Accidental · Epidural · Rocuronium

Introduction

Drugs administered inadvertently into the epidural space have caused serious morbidity and mortality by a direct drug or drug-additive neurotoxic, pH, or osmolality effect [1]. Rocuronium, a steroid nondepolarizing neuromuscular blockade (NDNMB), has a rapid onset and an intermediate duration. It is supplied in a sterile, nonpyrogenic, isotonic solution. Isotonicity is obtained with sodium chloride and a pH of 4 by adding acetic acid or sodium hydroxide. Its metabolite, 17-desacetyl-rocuronium, has rarely been observed in the plasma or urine of humans [2].

Accidental epidural injections of vecuronium, atracurium, and cisatracurium have been reported without any neurological or cardiovascular side effects or other symptoms of local or systemic toxicity [3–5].

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Case report

A 48-year-old, 67-kg, ASA physical status I, otherwise healthy man was admitted for radical cystectomy using general anesthesia. For epidural patient-controlled analgesia (PCA), epidural catheter insertion was planned before general anesthesia. After premedication with 3 mg midazolam and 0.2 mg glycopyrrolate intramuscularly and standard anesthetic monitoring, an epidural catheter was located at the L1–L2 interspace, using an 18-gauge Tuohy needle and the "loss of resistance to air technique." A 20-gauge epidural catheter was advanced 3 cm into the epidural space. After a negative aspiration test result for blood or cerebrospinal fluid, the prepared solution (3 ml lidocaine 2% and epinephrine 15 μg) was injected as an epidural test dose. The patient reported some burning feeling during injection. Assisted ventilation was started via facemask with 100% oxygen, and 100 mg propofol was administered for anesthetic induction. At this point, the patient's blood pressure and heart rate were very stable. It was then realized that 40 mg rocuronium had been administered into the epidural space instead of the test dose because of a preparation error. The patient's wife and surgeons were fully informed, and it was decided to perform the operation.

Ten minutes after the epidural rocuronium injection, the patient had shortness of breath and the train-of-four (TOF) response ratio was 25%. The patient was intubated easily with 300 mg thiopental sodium and an additional 30-mg rocuronium intravenous injection. Anesthesia was maintained with sevoflurane and remifentanil infusion with 40% oxygen in air titrated to maintain bispectral index between 35 and 55. Thirty minutes after intravenous rocuronium injection, TOF response ratio was 10%. Subsequently, rocuronium was not administered during anesthetic maintenance.

Two hours after intravenous rocuronium injection, TOF response ratio was 70%.

The surgery was completed 10 h after epidural injection, and neuromuscular blockade was reversed with pyridostigmine 10 mg and glycopyrrolate 0.4 mg intravenously. Five minutes after the reversal, TOF response ratio was 75% and the patient was maintaining an adequate breathing rate and depth; the tracheal tube was then removed. After an additional 10 min, his sustained head lift was longer than 5 s, and he could obey verbal commands. Fifteen minutes after reversal, he was completely awake and oriented without respiratory insufficiency. His neurological findings were normal. There was no motor or sensorial block. Therefore, we administrated an epidural loading dose (fentanyl 100 μg and 6 ml 0.375% levobupivacaine) and a maintenance dose 1.0 ml/h, bolus dose 3 ml (fentanyl 500 μg and 90 ml 0.25% levobupivacaine) for epidural PCA. Within 1 h from the time of the loading dose injection, the patient had no evidence of muscle weakness, back pain, headache, discomfort, fever, or other metabolic, mental, or hemodynamic alterations. On the second day, neurological examination was normal. Twenty-eight days later, he was discharged from the hospital without any complaints. Follow-up for clinical signs of neurotoxicity was negative at 2 months after the operation.

Discussion

Our patient showed 25% of TOF response ratio at 10 min after epidural injection of rocuronium. Considering that the peak plasma concentration was achieved at 13 min after inadvertent intramuscular injection of rocuronium [6, 7], epidural administration of rocuronium in our patient showed a similar onset of action time to intramuscular injection. We assumed that these similar findings are caused by the rich venous plexuses of the epidural space.

A reported case described that the inadvertent injection of a mixture of rocuronium and morphine into the caudal epidural space in an awake patient showed miosis without any neurological abnormality [8]. A possible explanation of the miosis may be the migration of rocuronium and morphine solution from the epidural space into the cerebrospinal fluid, then to the basal cistern, and hence through brain tissue around the fourth ventricle. In humans, morphine especially has a miotic effect, which is generally explained by direct stimulation of preganglionic parasympathetic fibers in the Edinger–Westphal nucleus [8]. Miosis was not seen in our patient postoperatively. The reasons may be the injection of rocuronium only without morphine and the long duration of the operation.

Neuromuscular blocking drugs cause excitement and seizures when introduced into the central nervous system [9, 10]. Acute intrathecal administration of these drugs leads to dose-dependent central nervous system effects in the rat [9]. At 1/100 of seizure dose, decreased locomotor activity and piloerection occurred. At 1/10 to 1/5 of seizure dose, agitation, shivering, splayed limbs, and whole-body shaking resulted. These results may be caused by accumulation of cytosolic calcium from sustained activation of acetylcholine receptor ion channels [10]. Our patient had no evidence of neurological deficit and seizure.

When an inadvertent epidural injection has occurred, some practitioners attempt to dilute the concentration of the drug in the epidural space by flushing with distilled water or saline [1]. Others have used epidural or intravenous corticosteroids to reduce the inflammatory response [1]. These attempts were speculative, however, and they could potentially worsen the situation because of the upward spread of the drugs. Therefore, 10 h 30 min after epidural rocuronium injection, we injected PCA drugs into the epidural space for postoperative analgesia. The period of 10 h 30 min is sufficient time for the elimination of rocuronium.

"Syringe swap," "ampoule error," and epidural/intravenous line confusion were the main sources of error in inadvertent administration of nonepidural medications into the epidural space. Despite all the precautions that are currently undertaken, accidents will inevitably occur [1]. So, to prevent such an accident before we inject drugs, doctors and nurses have decided to double-check. Also, we used nameplates on the syringes for both test dose and drugs.

In conclusion, to prevent the inadvertent administration of rocuronium through an epidural catheter, before drug injections into epidural space we need a careful double check. After epidural rocuronium injection, treatment should include airway management, monitoring of muscle relaxation, hemodynamic stability, and follow-up for neurological examination.

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