Mivacurium or Vecuronium for paediatric ENT surgery

Clinical experience and cost analysis

Abstract

Background: The present study compared the quality of neuromuscular block and costs after equipotent doses of mivacurium and vecuronium in the context of paediatric ENT surgery.

Methods: A total of 30 children undergoing elective tonsillectomy were included and randomised in two groups (n=15 for each) according to the neuromuscular blocking agent (NMBA) used. Anaesthesia was induced with alfentanil (15 µg/kg), propofol (3 mg/kg) and either 0.2 mg/kg mivacurium or 0.14 mg/kg vecuronium. For maintenance of anaesthesia propofol (8–12 mg/kg/h) was given. Neuromuscular block was assessed by electromyography using train-of-four stimulation and the following parameters were quantified: Twitch height (T1) 2 min after the initial bolus of the myorelaxant; duration until recovery to 10% T1, number and duration of bolus injections of the myorelaxant needed to maintain neuromuscular block to a T1<10%. In addition, the intubating conditions, number of patients needing pharmacological reversal at the end of surgery, adverse reactions and the costs for neuromuscular block and pharmacological antagonization were assessed.

Results: Intubation conditions were comparable between both study groups: mivacurium – excellent: 7; good: 5; not acceptable: 1; vecuronium – excellent: 11; good: 4 (n.s.). T1 at 2 min was 16 (15)% for mivacurium and 6 (9)% for vecuronium (P<0.05). Time to 10% T1 recovery was 6.1 (1.7) min for mivacurium and 21.8 (3.7) min for vecuronium (P<0.01). In the mivacurium group 7 repetitive doses (range: 4–18) were needed to maintain T1<10% during surgery, whereas children treated with vecuronium needed only 1 maintenance dose (range: 0–2) (P<0.01). Two children in the mivacurium group and 11 in the vecuronium group required pharmacological reversal of the NMB at the end of surgery (P<0.01). The overall costs of NMB were significantly higher in the mivacurium group as compared to vecuronium 12.88 (4.5) Euro vs 9.96 (2.4) Euro; P<0.05.

Conclusions: In conclusion, mivacurium-induced NMB is of very short duration in paediatric patients, and therefore repetitive doses are required to maintain a deep neuromuscular block. Nevertheless, residual paralysis is less frequent after mivacurium. The neuromuscular block after mivacurium was more expensive and residual paralysis less frequent compared to vecuronium.

Key words

Anaesthesia, paediatric · Neuromuscular blocking agents, mivacurium, vecuronium · Anaesthetic techniques, total intravenous anaesthesia, propofol, alfentanil · Measurement techniques, electromyography · Cost analysis

Patients and methods

The study was approved by the institutional ethics committee. Informed consent was obtained from children's parents. Thirty children (ASA physical status 1 or 2) 3 to 9 year old and undergoing elective tonsillectomy were included. Patients were excluded if they were known to have neuromuscular disease, receiving medications known to influence neuromuscular function or known for abnormal plasma cholinesterase activity. Patients were premedicated with

Mivacurium chloride is a nondepol-polarising neuromuscular blocking agent recently introduced in clinical practice. It has a bis-benzylisoquinolinium dierst structure and is hydrolysed by plasma cholinesterase. In adults the compound is characterised by a short duration of action and fast recovery of neuromuscular block [8, 13, 19], its histamine-releasing properties are comparable to those of atracurium [2]. Several studies assessed the pharmacodynamics of mivacurium in paediatric patients. They found that children required higher doses than adults to achieve comparable degrees of neuromuscular blockade [12, 14–18] and, despite this higher dosage, the duration of action was even shorter in children than in adults [14,16]. By consequence, mivacurium has been proposed by several authors for surgical procedures of short duration [3, 11, 21]. Therefore our purpose was to evaluate the pharmacodynamic properties of mivacurium in the context of paediatric ear-nose-throat-surgery and to compare them with those of vecuronium, the neuromuscular blocking agent actually used at our institution (Geneva University Hospital, Switzerland) for this indication. In addition, we assessed the costs of NMB after mivacurium and vecuronium.

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Mivacurium oder Vecuronium für HNO-Eingriffe im Kindesalter. Klinische Erfahrungen und Kostenanalyse

Zusammenfassung

Fragestellung: Die Untersuchung verglich die Qualität und die Kosten der neuromuskulären Blockade nach equipotenten Dosen von Mivacurium und Vecuronium bei HNO-Eingriffen im Kindesalter.

Methodik: 30 Kinder, die sich einer elektiven Tonsillektomie unterzogen, wurden untersucht. Entsprechend dem Muskelrelaxans (Mivacurium oder Vecuronium) wurden diese in zwei Gruppen zu je 15 Patienten randomisiert. Zur Einleitung der Anästhesie wurde Alfentanil (15 µg/kg), Propofol (3 mg/kg) und Mivacurium (0,2 mg/kg) bzw. Vecuronium (0,14 mg/kg) verwendet; die Aufrechterhaltung der Narkose erfolgte durch Propofol (8–12 mg/kg). Die neuromuskuläre Blockade wurde mittels Elektromyographie und Train-of-four-Stimulation gemessen; folgende Parameter wurden erfasst: Twitch height (T1) 2 min nach der Intubations dosis des Muskelrelaxans, die Dauer der T1-Erholung auf 10% des Ausgangswerts, Anzahl und Dauer der Nachinjektionen um eine neuromuskuläre Blockade – 10% des T1-Ausgangswerts – aufrechtzuerhalten. Darüber hinaus wurden die Intubationsbedingungen, die Anzahl der Patienten, deren Restblockade antagonisiert werden musste sowie Nebenwirkungen und Gesamtkosten der neuromuskulären Blockade ermittelt.

Ergebnisse: Die Intubationsbedingungen waren in beiden Gruppen vergleichbar: Mivacurium – sehr gut bei 7 Patienten, gut bei 5 und nicht akzeptabel bei 1 Patienten. Vecuronium: sehr gut bei 11 und gut bei 4 Patienten (n.s.). T1 2 min nach der Intubationsdosis von Mivacurium betrug 16±15% und 6±9% nach Vecuronium (p<0,05). Das Zeitintervall bis zu einer Erholung von T1 auf 10% des Ausgangswerts betrug 6,1±1,7 min nach Mivacurium und 21,8±3,7 min nach Vecuronium (p<0,01). In der Mivacuriumgruppe waren durchschnittlich 7 Nachinjektionen (Spannbreite 4–18) nötig, um eine Muskelblockade – 10% des T1-Ausgangswertes – aufrechtzuerhalten, in der Vecuroniumgruppe lediglich eine Nachinjektion (Spannbreite 0–2; p<0,01). Am Ende der Operation musste die Restblockade bei zwei Kindern in der Mivacuriumgruppe und bei elf in der Vecuroniumgruppe antagonisiert werden (p<0,01). Die Gesamtkosten der Muskelblockade waren nach Mivacurium höher als nach Vecuronium (12,88±4,50 Euro vs. 9,96±2,40 Euro); p<0,05.

Schlussfolgerung: Bei pädiatrischen Patienten ist nach Mivacurium mit einer sehr kurzen neuromuskulären Blockade zu rechnen, deshalb sind auch bei kurzen Eingriffen mehrere Nachinjektionen nötig, um tiefe Muskelblockaden aufrechtzuerhalten. Ver gleichen mit Vecuronium sind Restblockaden nach Mivacurium seltener, die Kosten der Muskelrelaxierung jedoch höher.

Originalien

Schlüsselwörter

Anaesthesie im Kindesalter · Neuromuskuläre Blockade · Mivacurium · Vecuronium · Anästhesiologische Techniken · Propofol, Alfentanil · Anästhesietechnik · Elektromyographie · Kostenanalyse


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0,3–0,5 mg/kg diazepam rectally 1 h before induction of anaesthesia.

Anaesthesia was induced with alfentanil (15 µg/kg), propofol (3 mg/kg) and maintained with propofol (8–12 mg/kg/h) and 40% nitrous oxide in oxygen. Neuromuscular transmission was assessed by electromyography (Datex Relaxograph Helsinki, Finland) of the right ulnar-nerve hypotenar-muscle using transcutaneous electrodes. Measurement started once anaesthesia was induced. The Relaxograph was set to deliver supramaximal stimuli (0.1 ms duration) of train-of-four at 2 Hz every 20 s. The first of the four evoked responses was considered as T1. To minimize movement’s induced changes in the twitch response during electromyography, the patient’s hand was immobilized. When the twitch response had stabilized (e.g. after 5–10 min), the control T1 was determined (=baseline value). Patients then received either 0.2 mg/kg mivacurium or 0.14 mg/kg vecuronium, and the following parameters were measured: T1 two minutes after injection of the neuromuscular blocking agent, duration of the initial dose of myorelaxant until T1-recovery to 10%. In addition, once the neuromuscular block recovered to 10% T1 a repetitive bolus of mivacurium (100 µg/kg) or vecuronium (70 µg/kg) was given. The total number of the repetitive doses needed and the time intervals between this successive bolus doses were also recorded. If 10 min after the end of surgery adequate spontaneous recovery of NM blockade to a train-of-four ratio (TOFR) of 0.75 had not taken place, the NMB was pharmacologically antagonized with neostigmine 20 µg/kg and atropine 10 µg/kg. Children in whom the EMG device did not recover to 95% of the initial control T1 were also excluded.

The trachea was intubated 2 min after the injection of the NMBA by the same experienced anaesthetist, blinded to the treatment. Intubating conditions were evaluated using six variables [24]; these related to jaw relaxation and perceived resistance to the laryngoscope blade (laryngoscopy component), position of the vocal cords and residual movement of the vocal cords (vocal cord component), coughing in response to intubation or limb movement in reaction to intubation (reaction to intubation component). Each of these variables was rated as excellent, good or poor. Intubating conditions were excellent when all variables were excellent, they were good when all variables were good or excellent and they were poor when any variable was poor [24].

In order to assess the overall costs of the NMB, we included the following variables: neuromuscular blockade costs – ampoules of mivacurium or vecuronium needed for each patient, supplemental costs for disposable material and saline (we utilized a final concentration of 1 mg/ml mivacurium and 0,4 mg/ml vecuronium); antagonization costs – ampoules of atropine and neostigmine needed for each patient, supplemental costs for disposable material and saline (we used a final concentration of 50 µg/ml of both, atropine and neostigmine). The smallest available ampoules of each of the mentioned drugs were used: mivacurium 10 mg/ampoule, vecuronium 4 mg/amp-

<table>
<thead>
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<th>Demographic characteristics</th>
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<tr>
<td>Mivacurium</td>
<td>Vecuronium</td>
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<tr>
<td>Age (yr)</td>
<td>5 (3–8)</td>
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<tr>
<td>Weight (kg)</td>
<td>20 (13–25)</td>
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Values are median and range