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SCIENTIFIC ARTICLE

Sugammadex versus neostigmine in pediatric patients: a prospective randomized study

Turhan Kara, Ozgur Ozbagriacik, Hacer Sebnem Turk, Canan Tulay Isil*, Ozan Gokuc, Oya Unsal, Emrah Seyhan, Sibel Oba

Department of Anesthesiology and Reanimation, Sisli Etfal Training and Research Hospital, Istanbul, Turkey

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KEYWORDS
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Abstract
Background and objectives: Acetylcholinesterase inhibitors may cause postoperative residual curarization when they are used for reversal of neuromuscular blockade. Sugammadex reverses neuromuscular blockade by chemical encapsulation and is not associated with the side effects that may occur with the use of anticholinesterase agents. Because of increased outpatient surgical procedures postoperative residual curarization and rapid postoperative recovery have a greater importance in the pediatric patient population. The aim of this study was to compare the efficacy of sugammadex and neostigmine on reversing neuromuscular blockade in pediatric patients undergoing outpatient surgical procedures.
Methods: 80 patients, aged 2–12 years, scheduled for outpatient surgery were enrolled in this randomized prospective study. Neuromuscular blockade was achieved with 0.6 mg kg^{-1} rocuronium and monitorized with train-of-four. Group RN ($n = 40$) received 0.03 mg kg^{-1} neostigmine, Group RS ($n = 40$) received 2 mg kg^{-1} sugammadex for reversal of rocuronium. Extubation time (time from the reversal of neuromuscular blockade to extubation), train-of-four ratio during this time, time to reach train-of-four > 0.9, and probable complications were recorded.
Results: There was no significant difference between the patients' characteristics. Extubation time and time to reach train-of-four > 0.9 were significantly higher in Group RN ($p = 0.001$, $p = 0.002$). Train-of-four at the time of neostigmine/sugammadex injection in Group RN were significantly higher than in the RS group ($p = 0.020$). Extubation train-of-four ratio was significantly lower in Group RN ($p = 0.002$).
Conclusion: Sugammadex provides safer extubation with a shorter recovery time than neostigmine in pediatric patients undergoing outpatient surgical procedures.

* Corresponding author.
E-mail: cananonaldi@yahoo.com (C.T. Isil).

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PALAVRAS-CHAVE
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Sugammadex versus neostigmina em pacientes pediátricos: Estudo prospectivo e randomizado

Resumo
Justificativa e objetivos: Os inibidores da acetilcolinesterase podem causar curarização residual no pós-operatório quando usados para reverter o bloqueio neuromuscular. Sugamadex reverte o bloqueio neuromuscular por encapsulação química e não está associado aos efeitos colaterais que podem ocorrer com o uso de agentes anticolinesterase. Devido ao aumento dos procedimentos cirúrgicos ambulatoriais. A curarização residual e a rápida recuperação no pós-operatório são muito importantes para a população de pacientes pediátricos. O objetivo deste estudo foi comparar a eficácia de sugamadex e neostigmina na reversão do bloqueio neuromuscular em pacientes pediátricos submetidos a procedimentos cirúrgicos ambulatoriais.
Métodos: 80 pacientes, com idades entre 2-12 anos, programados para cirurgias ambulatoriais foram incluídos neste estudo prospectivo e randomizado. O bloqueio neuromuscular foi obtido com 0,6 mg kg^{-1} de rocurônio e monitorizado com a interpretação da sequência de quatro estímulos. O Grupo RN ($n = 40$) recebeu 0,03 mg kg^{-1} de neostigmina e o Grupo RS ($n = 40$) recebeu 2 mg kg^{-1} de sugamadex para a reversão de rocurônio. O tempo de extubação (tempo desde a reversão do bloqueio neuromuscular até a extubação), a razão da sequência de quatro estímulos durante esse tempo, o tempo para atingir uma sequência de quatro estímulos > 0,9 e as complicações prováveis foram registrados.
Resultados: Não houve diferença significativa entre as características dos pacientes. Os tempos de extubação e para atingir uma sequência de quatro estímulos > 0,9 foram significativamente maiores no Grupo RN ($p = 0,001$, $p = 0,002$). A sequência de quatro estímulos no momento da injeção de neostigmina/sugamadex foi significativamente maior no Grupo RN que no Grupo RS ($p = 0,020$). A razão entre extubação e sequência de quatro estímulos foi significativamente menor no Grupo RN ($p = 0,002$).
Conclusão: Sugamadex proporciona extubação mais segura com um tempo de recuperação mais curto que o de neostigmina em pacientes pediátricos submetidos a procedimentos cirúrgicos ambulatoriais.

Background

Postoperative residual curarization (PORC) in postoperative patients is a succession of the presence of blocked nicotinic receptors.[1,2] Even in observationally asymptomatic patients, 60–70% of these receptors can be still blocked.[1] PORC can cause delayed recovery, hypoxia, metabolic derangement and rarely death.[2]

Cholinesterase inhibitors are traditionally used for reversal of neuromuscular blockade (NMB). Among these agents neostigmine is the most potent and selective one.[3] It should be kept in mind that cholinesterase inhibitor agents have multi-systemic side effects. Since these agents are not selective to nicotinic receptors and also stimulate the muscarinic system, there can be quite a few serious adverse effects as follows: Bradycardia, QT lengthening, bronchoconstriction, hypersalivation and increased motility.[3] To avoid these effects, concomitant anticholinergic agents, such as atropine or glikopirolat, are administered to the patient before the cholinesterase inhibitors.[3] Today, sugammadex is an alternative to the decurarization procedure, which was traditionally executed with cholinesterase inhibitors. PORC and the muscarinic side effects are not anticipated when using sugammadex, which has been developed so as to be selective for rocuronium and vecuronium.[4–6]

The rudimentary neuromuscular junction, the variability of fibrin fibers, the differences in drug distribution and body volume in children change their neuromuscular conduction. These factors can cause prolonged recovery and increased risk of PORC.[7,8]

Sugammadex is proved to be a safe and superior agent in NMB reversal compared to neostigmine in adults.[4–6] However, there is only one study in the literature concerning sugammadex administration in pediatric patients.[9] The aim of this study was to compare the efficacy of sugammadex and neostigmine on reversing NMB in pediatric patients undergoing outpatient surgical procedures.

Methods

After approval by the local ethics committee and written informed consent was obtained from the person legally responsible for the child, this prospective, randomized, double-blind, controlled study of pediatric patients was performed. Eighty children, American Society of Anesthesiologists (ASA) physical status I, 2–12 years of age who were scheduled to undergo outpatient surgery as elective lower abdominal or urogenital procedures, were included in this study.