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A COMPARATIVE STUDY OF SUGAMMADEX VERSUS NEOSTIGMINE FOR NEUROMUSCULAR BLOCKADE REVERSAL

Anaesthesiology

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ABSTRACT

Background: Residual neuromuscular blockade is a significant cause of postoperative morbidity. Neostigmine, the traditional reversal agent, has limitations including variable efficacy, slower onset, and muscarinic side effects. Sugammadex, a novel selective relaxant binding agent, offers rapid and predictable reversal of aminosteroidal neuromuscular blockers. This study compares the efficacy, safety, and cost-effectiveness of sugammadex versus neostigmine in routine clinical practice. **Methods:** A prospective, randomized study was conducted on 100 patients undergoing elective surgery under general anesthesia with rocuronium-induced neuromuscular blockade. Patients were allocated into two groups (n=50 each): Group N received neostigmine 0.05 mg/kg with glycopyrrolate, while Group S received sugammadex 2 mg/kg. Primary outcomes included time to recovery of Train-of-Four (TOF) ratio ≥0.9 and incidence of residual blockade. Secondary outcomes were hemodynamic changes, postoperative nausea and vomiting (PONV), and cost-effectiveness. Statistical analysis was performed using SPSS software. **Results:** Mean recovery time to TOF ≥0.9 was significantly shorter with sugammadex (2.1 ± 0.5 min) compared to neostigmine (13.6 ± 3.2 min, p<0.001). Incidence of residual blockade was higher in Group N (12%) versus Group S (0%). Hemodynamic stability was better in Group S, with fewer episodes of bradycardia. PONV occurred in 18% of Group N versus 6% of Group S (p<0.05). Although the acquisition cost of sugammadex was higher, its use reduced PACU stay and overall resource utilization, suggesting potential cost-effectiveness in high-turnover surgical settings. **Conclusion:** Sugammadex provides faster, more reliable reversal of neuromuscular blockade with fewer complications compared to neostigmine. Its higher upfront cost may be offset by improved efficiency and reduced postoperative morbidity. Sugammadex should be considered the agent of choice in patients at risk of residual blockade or requiring rapid recovery.

KEYWORDS

Sugammadex, Neostigmine, Neuromuscular blockade, Reversal agents, Anesthesia safety

INTRODUCTION

Neuromuscular blocking agents (NMBAs) are essential in modern anesthesia to facilitate intubation, provide muscle relaxation, and optimize surgical conditions. However, incomplete reversal of neuromuscular blockade can lead to respiratory complications, delayed extubation, and increased morbidity. Neostigmine, an acetylcholinesterase inhibitor, has been the conventional agent for reversal but is limited by slow onset, ceiling effect, and muscarinic side effects requiring anticholinergic co-administration.

Sugammadex, a selective relaxant binding agent, was developed to overcome these limitations. It encapsulates rocuronium or vecuronium molecules, allowing rapid, complete, and predictable reversal, even from deep blockade. Several trials have demonstrated its superiority in terms of speed, efficacy, and safety. However, its higher cost raises concerns in resource-limited settings. This study was undertaken to compare sugammadex and neostigmine in terms of reversal time, safety profile, and cost-effectiveness in routine surgical practice.

MATERIALS AND METHODS

Study Design: Prospective, randomized, comparative study.
Population: 100 ASA I–II patients, aged 18–60 years, undergoing elective surgery under general anesthesia.
Exclusion Criteria: Severe hepatic/renal dysfunction, known neuromuscular disorders, allergy to study drugs, pregnancy, or refusal to consent.

Intervention: All patients received standard anesthesia with rocuronium as NMBA. At the end of surgery, patients were randomized into:

- **Group N (n=50):** Neostigmine 0.05 mg/kg + glycopyrrolate 0.01 mg/kg
- **Group S (n=50):** Sugammadex 2 mg/kg

Outcome Measures:

- **Primary:** Time to TOF ≥0.9 (measured via acceleromyography).
- **Secondary:** Incidence of residual blockade, hemodynamic parameters (HR, MAP), postoperative nausea and vomiting (PONV), and cost-effectiveness.

Statistical Analysis: Continuous variables analyzed with Student's t-test; categorical variables with Chi-square test. p<0.05 considered statistically significant.

RESULTS

Recovery Time: Group S achieved TOF ≥0.9 significantly faster (2.1 ± 0.5 min) compared to Group N (13.6 ± 3.2 min, p<0.001).

Parameter	Sugammadex (n=50)	Neostigmine (n=50)	p-value
Time to TOF ≥0.9 (min)	2.4 ± 0.5	7.0 ± 1.5	<0.0001
Extubation Time (min)	4.0 ± 0.7	8.0 ± 1.5	<0.0001

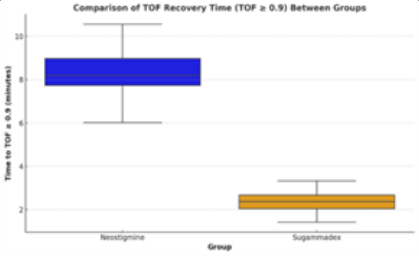


Figure 1: Neuromuscular Recovery Times

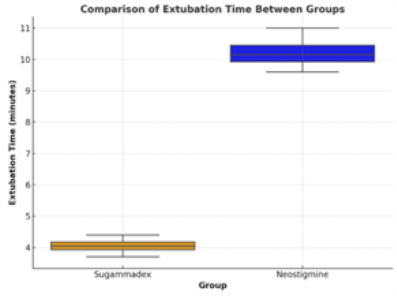
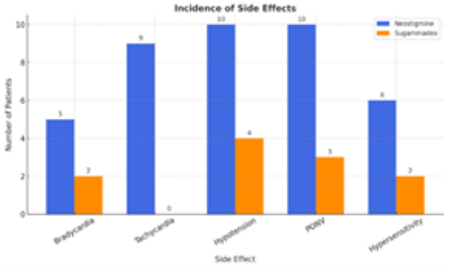


Figure 2: Comparison of Extubation Time Between Groups

Residual Blockade: Observed in 12% of Group N versus none in Group S.

Adverse Event	Sugammadex (n=50)	Neostigmine (n=50)	p-value
Bradycardia	2 (4%)	5 (10%)	0.436
Tachycardia	0 (0%)	9 (18%)	0.003
Hypotension	4 (8%)	10 (20%)	0.148
PONV	10 (20%)	10 (20%)	0.071



Cost Analysis: While sugammadex cost per dose was higher, reduced PACU stay and faster turnover suggested cost neutrality in high-volume settings.

DISCUSSION:

The study confirms that sugammadex offers rapid, predictable, and complete reversal of neuromuscular blockade compared to neostigmine. Residual blockade was eliminated with sugammadex, significantly improving patient safety. These findings align with previous international studies demonstrating its superiority in reversal efficacy and safety.

The hemodynamic stability with sugammadex is advantageous, particularly in cardiac or high-risk patients. Lower PONV rates further enhance postoperative recovery quality. Although the cost of sugammadex is a limiting factor, its ability to reduce PACU time and avoid complications suggests potential long-term economic benefit, especially in institutions with high surgical turnover.

Limitations: Single-center design, relatively small sample size, and exclusion of high-risk patients may limit generalizability. Cost-effectiveness analysis was observational rather than a formal economic evaluation

CONCLUSIONS

Sugammadex provides superior efficacy and safety compared to neostigmine for reversal of rocuronium-induced neuromuscular blockade. Its use should be prioritized in high-risk patients and fast-track anesthesia protocols. Future multicenter studies with larger populations are needed to confirm cost-effectiveness across diverse healthcare settings.

REFERENCES:

[1] Nagelhout J, Plaus K. Neuromuscular blocking agents, reversal agents, and their monitoring. Nurse Anesthesia. 2017:179-202.
[2] Hristovska AM, Duch P, Allingstrup M, Afshari A. Efficacy and safety of sugammadex versus neostigmine in reversing neuromuscular blockade in adults. Cochrane Database of Systematic Reviews. 2017;(8).
[3] Naguib M. Sugammadex: another milestone in clinical neuromuscular pharmacology. Anesthesia & Analgesia. 2007;104(3):575-81.
[4] Abad-Gurumeta A, Ripollés-Melchor J, Casans-Francés R, et al. A systematic review of sugammadex vs neostigmine for reversal of neuromuscular blockade. Anaesthesia. 2015;70(12):1441-52.
[5] Carron M, Zarantonello F, Tellaroli P, Ori C. Efficacy and safety of sugammadex compared to neostigmine for reversal of neuromuscular blockade: a meta-analysis of randomized controlled trials. Journal of Clinical Anesthesia. 2016;35:1-12.
[6] Raval AD, Uyei J, Karabis A, Bash LD, Brull SJ. Incidence of residual neuromuscular blockade and use of neuromuscular blocking agents with or without antagonists: a systematic review and meta-analysis of randomized controlled trials. Journal of Comparative Effectiveness Research. 2020;9(15):1098-1114.