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Sugammadex versus Neostigmine for Reversal of Neuromuscular Blockade in Obese Patients and Patients with Obstructive Sleep Apnea: A Systematic Review and Meta-analysis

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ADMINISTRATIVE INFORMATION

Support - No specific financial support was received for this systematic review and meta-analysis.

Review Stage at time of this submission - Completed but not published.

Conflicts of interest - None declared.

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 9 August 2026 and was last updated on 9 August 2026.

INTRODUCTION

Review question / Objective In adult patients with obesity, including those undergoing bariatric surgery, and/or patients with obstructive sleep apnea, does reversal of rocuronium-induced neuromuscular blockade with sugammadex, compared with neostigmine, reduce postoperative respiratory adverse events and improve neuromuscular and postoperative recovery outcomes?

Rationale Obesity and obstructive sleep apnea are associated with reduced respiratory reserve and an increased risk of perioperative respiratory complications. Residual neuromuscular blockade may further impair upper-airway function, ventilatory responses, swallowing, and respiratory muscle performance, thereby increasing the risk of hypoxaemia, airway obstruction, respiratory insufficiency, postoperative pulmonary complications, and delayed recovery. These effects may be particularly relevant in obese patients and patients with obstructive sleep apnea. Neostigmine is widely used for reversal of neuromuscular blockade, but its effect may be incomplete or less predictable. Sugammadex selectively binds aminosteroidal neuromuscular blocking agents such as rocuronium and provides rapid and reliable reversal. Although several studies have suggested faster neuromuscular recovery and improved postoperative outcomes with sugammadex, the available evidence in obese and obstructive sleep apnea populations is heterogeneous. This systematic review and meta-analysis therefore evaluates whether sugammadex, compared with neostigmine, reduces postoperative respiratory adverse events and improves neuromuscular and postoperative recovery outcomes in these high-risk patients.

Condition being studied The review focuses on adult patients with obesity, including morbid obesity and patients undergoing bariatric surgery, and/or patients with obstructive sleep apnea.

These populations are characterized by reduced functional residual capacity, increased oxygen consumption, diminished respiratory reserve, and increased susceptibility to upper-airway obstruction and postoperative respiratory complications. Incomplete recovery from neuromuscular blockade may further increase this perioperative risk.

METHODS

Search strategy PubMed/MEDLINE, Embase, and the Cochrane Central Register of Controlled Trials (CENTRAL) were searched from database inception to June 2026. The search combined Medical Subject Headings and free-text terms related to sugammadex, neostigmine, obesity, bariatric surgery, and obstructive sleep apnea. The principal search strategy was: ("sugammadex" AND "neostigmine") AND (obesity OR obese OR "morbid obesity" OR bariatric OR "obstructive sleep apnea" OR OSA). No restrictions regarding language, publication year, geographical location, or study setting were applied. Reference lists of eligible studies and relevant review articles were also manually screened to identify additional potentially eligible publications.

Participant or population Adult patients aged 18 years or older with obesity (BMI ≥30 kg/m²), including morbid obesity (BMI ≥40 kg/m²), patients undergoing bariatric surgery, and/or patients diagnosed with obstructive sleep apnea. Patients were included regardless of sex, provided that sugammadex and neostigmine were compared for reversal of rocuronium-induced neuromuscular blockade.

Intervention Sugammadex administered for reversal of rocuronium-induced neuromuscular blockade in adult patients with obesity, patients undergoing bariatric surgery, and/or patients with obstructive sleep apnea. Studies using clinically accepted sugammadex dosing regimens were eligible.

Comparator Neostigmine administered for reversal of rocuronium-induced neuromuscular blockade in the same target population. Studies were eligible when neostigmine served as the active comparator to sugammadex.

Study designs to be included Randomized controlled trials, prospective cohort studies, retrospective cohort studies, propensity score-matched observational studies, and prospective studies using matched or historical comparator groups were eligible. Only full-text peer-reviewed studies reporting extractable comparative outcome data were included.

Eligibility criteria Eligible studies included adult patients (≥18 years) with obesity (BMI ≥30 kg/m²), morbid obesity (BMI ≥40 kg/m²), patients undergoing bariatric surgery, and/or patients with obstructive sleep apnea, and directly compared sugammadex with neostigmine for reversal of rocuronium-induced neuromuscular blockade. Studies were required to report at least one perioperative respiratory or recovery-related outcome and provide extractable comparative data. Randomized controlled trials and comparative observational studies were eligible. Paediatric studies, reviews, editorials, letters, case reports, conference abstracts without sufficient data, studies without a neostigmine comparator, duplicate publications of the same cohort, and studies without extractable outcome data were excluded.

Information sources PubMed/MEDLINE, Embase, and the Cochrane Central Register of Controlled Trials (CENTRAL) were searched from database inception to June 2026. In addition, reference lists of all eligible studies and relevant systematic reviews were manually screened to identify further potentially eligible studies. Only full-text peer-reviewed comparative studies with sufficient extractable data were included.

Main outcome(s) The primary outcome was postoperative respiratory adverse events occurring during the immediate postoperative and post-anesthesia recovery period, as defined by the individual studies. Events included postoperative pulmonary complications, respiratory insufficiency, hypoxaemia and/or oxygen desaturation, postoperative continuous positive airway pressure (CPAP) requirement, reintubation, and other reported respiratory adverse events. For quantitative synthesis, dichotomous respiratory outcomes were expressed as pooled risk ratios (RRs) with 95% confidence intervals (CIs) using a random-effects model. Statistical heterogeneity was quantified using the I^2 statistic.

Additional outcome(s) Secondary outcomes included time to recovery of a train-of-four ratio ≥0.9, postoperative residual neuromuscular blockade, extubation time, post-anesthesia care unit length of stay, time to fulfil postoperative recovery criteria such as an Aldrete score ≥9, postoperative nausea and vomiting, and postoperative pain scores. Continuous outcomes were summarized using mean differences with

95% confidence intervals where quantitative pooling was possible.

Data management Retrieved records were screened independently by two reviewers. Full-text eligibility assessment and data extraction were performed using a standardized data extraction form developed before study selection. Extracted variables included study characteristics, population characteristics, sample size, body mass index, surgical procedure, neuromuscular reversal regimen, reported outcomes, and duration of follow-up. The independently extracted datasets were cross-checked for accuracy and completeness, and discrepancies were resolved by discussion and consensus. Quantitative outcome data were entered into Review Manager (RevMan; The Cochrane Collaboration) for statistical synthesis.

Quality assessment / Risk of bias analysis The methodological quality of randomized controlled trials was assessed using the Cochrane Risk of Bias 2 (RoB 2) tool. Non-randomized studies were evaluated using the Risk Of Bias In Non-randomized Studies of Interventions (ROBINS-I) tool. Risk-of-bias assessment was performed independently by two reviewers. Disagreements were resolved through discussion and consensus. Overall risk-of-bias judgments were assigned according to the recommendations of the respective assessment tools.

Strategy of data synthesis Quantitative synthesis was performed when at least two studies reported sufficiently comparable outcomes. Random-effects meta-analysis was used because clinical and methodological heterogeneity across study populations and study designs was anticipated. For dichotomous outcomes, pooled risk ratios (RRs) with 95% confidence intervals (CIs) were calculated. Continuous outcomes were summarized using mean differences (MDs) with 95% CIs. When continuous variables were reported as medians and interquartile ranges, established conversion methods were used to estimate means and standard deviations where appropriate. Between-study heterogeneity was assessed using Cochran's Q statistic and quantified using the I^2 statistic. I^2 values of approximately 25%, 50%, and 75% were interpreted as indicating low, moderate, and high heterogeneity, respectively. Sensitivity analyses were performed using a leave-one-out approach. Publication bias was not formally assessed when too few studies were available for reliable assessment. Statistical analyses were performed using Review Manager (RevMan), with two-sided $P < 0.05$ considered statistically significant.

Subgroup analysis No formal subgroup analysis was predefined or performed because of the limited number of eligible studies and the heterogeneity of study populations and reported outcomes. Potential differences according to study design, obesity versus obstructive sleep apnea population, and bariatric versus non-bariatric surgical setting were considered qualitatively during interpretation of the results.

Sensitivity analysis Sensitivity analyses were performed using a leave-one-out approach. Each study contributing to the pooled analysis was sequentially excluded and the meta-analysis was repeated to assess the influence of individual studies on the overall effect estimate. The direction of the pooled effect remained generally consistent, indicating that the primary findings were not driven by a single study.

Language restriction No language restrictions were imposed.

Country(ies) involved Hungary.

Keywords Sugammadex; neostigmine; obesity; morbid obesity; obstructive sleep apnea; bariatric surgery; neuromuscular blockade; postoperative respiratory complications; meta-analysis.

Dissemination plans The results of this systematic review and meta-analysis will be submitted for publication in a peer-reviewed international anesthesiology journal. The findings may also be presented at relevant scientific meetings and conferences. The registered protocol and resulting publication will provide a transparent record of the review methods and findings.

Contributions of each author

Author 1 - Zsombor Márton - Contributed to study selection, data extraction, interpretation of the results, and drafting and revision of the manuscript.
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