

---

## EDITORIAL

---

### TO REVERSE OR NOT TO REVERSE, DO WE STILL NEED TO ASK THIS QUESTION?

MARIE T. AOUAD<sup>1</sup>

Despite the plethora of articles studying the adequate type and timing of reversal of neuromuscular blockade at the end of surgery, some controversy remains regarding the need for routine reversal with neostigmine despite potential deleterious effects of the latter on muscle strength. A recent report by Murphy et al on the administration of neostigmine after spontaneous recovery of the train-of-four (TOF) ratio of 0.9 to 1 sheds some light on a topic that poses often a clinical dilemma to the practitioner<sup>1</sup>. The administration of neostigmine after full recovery from neuromuscular blockade (NMB) has been an ongoing source of debate in the anesthesia literature. While some authors advocate for its routine use<sup>2</sup>, others caution against this practice based on the fact that the administration of neostigmine in this setting might induce weakness and airway collapsibility<sup>3,4</sup>. Murphy's study mimics real life scenarios and is clinically oriented while some studies advocating against the use of neostigmine after full recovery for its deleterious effects on muscle power are purely experimental<sup>3,4</sup>. In addition to measuring TOF ratios, Murphy et al performed a thorough muscle strength assessment using a comprehensive set of signs and symptoms where they failed to demonstrate any negative effect of neostigmine. Also, TOF recordings did not show any fade as in previous studies<sup>5</sup>, but rather an increase in TOF ratios to values above 1. Therefore, studies showing neostigmine-induced weakness using experimental settings may not translate into measurable clinical consequences in a purely clinical setting. Neostigmine-induced weakness demonstrated in healthy volunteers may be transient and of no clinical consequences in real clinical scenarios.

Some authors also caution against the use of sugammadex in combination with neostigmine based on the fact that sugammadex produces full recovery and therefore, prepares the ground for neostigmine-induced muscle weakness<sup>6</sup>. This general statement seems to be unjustified. At times, reversal with neostigmine might prove to be insufficient<sup>7</sup>. Therefore, a rescue dose of sugammadex may be very useful to achieve full recovery and the clinician should not be afraid of complementing reversal with sugammadex on the assumption that it will be followed by neostigmine-induced weakness. Another situation where combination of neostigmine and sugammadex might prove to be useful is in the setting of budgetary constraints<sup>8</sup>. Using half dose of sugammadex may bring the level of paralysis to a shallower level that is amenable for reversal with neostigmine.

---

<sup>1</sup> M.D. American University of Beirut Medical Center, Beirut, Lebanon.

**Corresponding Author:** Marie T. Aouad M.D. Professor of Anesthesiology, Department of Anesthesiology, American University of Beirut Medical Center. P.O. Box: 11-0236, Beirut Lebanon. Tel: +9611350000. E-mail: mm01@aub.edu.lb

Murphy's report showed TOF ratios of less than 0.9 to be present in 21% of the patients after a dose of one ED<sub>95</sub> of rocuronium and an average duration of anesthesia of 163 min. Therefore, it reinforces the concept that residual muscle paralysis remains a much more serious clinical problem than the theoretical

neostigmine-induced weakness. It also provides the clinician with the flexibility of using and combining reversal agents to address specific clinical scenarios while bearing in mind that neostigmine-induced weakness after low to moderate doses of neostigmine is probably not a clinically relevant problem.

## References

- MURPHY GS, SZOKOL JW, AVRAM MJ, GREENBERG SB, SHEAR TD, DESHUR MA, BENSON J, NEWMARK RL, MAHER CE: Neostigmine administration after spontaneous recovery to a train-of-four ratio of 0.9 to 1.0: A randomized controlled trial of the effect on neuromuscular and clinical recovery. *Anesthesiology*; 2018, 128:27-37.
- MILLER RD, WARD TA: Monitoring and pharmacologic reversal of a nondepolarizing neuromuscular blockade should be routine. *Anesth Analg*; 2010, 111:3-5.
- HERBSTREIT F, ZIGRAHN D, OCHTERBECK C, PETERS J, EIKERMANN M: Neostigmine/glycopyrrolate administered after recovery from neuromuscular block increases upper airway collapsibility by decreasing genioglossus muscle activity in response to negative pharyngeal pressure. *Anesthesiology*; 2010, 113:1280-8.
- CAMMU G, SCHEPENS T, DE NEVE N, WILDEMEERSCH D, FOUBERT L, JORENS PG: Diaphragmatic and intercostal electromyographic activity during neostigmine, sugammadex and neostigmine-sugammadex-enhanced recovery after neuromuscular blockade: A randomised controlled volunteer study. *Eur J Anaesthesiol*; 2017, 34:8-15.
- CALDWELL JE: Reversal of residual neuromuscular block with neostigmine at one to four hours after a single intubating dose of vecuronium. *Anesth Analg*; 1995, 80:1168-74.
- CAMMU G: Sugammadex: appropriate use in the context of budgetary constraints. *Curr Anesthesiol Rep*; 2018, <https://doi.org/10.1007/s40140-018-0265-6>.
- DE MENEZES CC, PECEGUINI LA, SILVA ED, SIMOES CM: Use of sugammadex after neostigmine incomplete reversal of rocuronium-induced neuromuscular blockade. *Rev Bras Anesthesiol*; 2012, 62:543-7.
- AOUAD MT, ALFAHEL WS, KADDOUM RN, SIDDIK-SAYYID SM: Half dose sugammadex combined with neostigmine is non-inferior to full dose sugammadex for reversal of rocuronium-induced deep neuromuscular blockade: a cost-saving strategy. *BMC Anesthesiol*; 2017, 17:57.