We also thank Dr. Brotman et al. for their comments. Our work demonstrated the utility of suprascapular block as an analgesic alternative to interscalene block for shoulder surgery. It is clear that we did not propose a swift transition to suprascapular block as a new care standard for shoulder surgery. Interscalene block, by virtue of its blockade of the brachial plexus at the level of the roots, continues to be the care standard. With some adjustments to the dose, injectate distribution, and intraoperative sedation level, the interscalene block can provide adequate surgical anesthesia. However, this does not dismiss the ability of interscalene block alternatives to provide surgical anesthesia. In cases where it is desirable to avoid both general anesthesia and phrenic nerve block, and when the number of injections is not a barrier, determined regional anesthesiologists may wish to consider either a combination of (1) suprascapular and infraclavicular blocks, or (2) suprascapular, axillary, supraclavicular, and the lateral pectoral nerve blocks, in order to achieve surgical anesthesia. In our clinical experience, these combinations can provide reliable surgical anesthesia, if needed.

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Competing Interests
The authors declare no competing interests.

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Catching a Unicorn: Neostigmine and Muscle Weakness—Not Neostigmine for All, but Quantitative Monitoring for Everyone!

To the Editor:
We read the paper by Murphy et al. with great interest. Their conclusions that administration of 40 μg/kg of neostigmine after recovery of the train-of-four ratio to greater than 0.9 (measured with acceleromyography) causes no subsequent decrease in the train-of-four ratio, nor clinical signs of muscle weakness at around 15 min after administration, are supported by their well-constructed study. They restate the 2016 editorial “that neostigmine should be routinely administered unless full neuromuscular recovery has been documented with quantitative neuromuscular monitoring.”

However, we would like to respectfully question five areas of the study.

Neostigmine May Cause Weakness Secondary to Depolarizing Neuromuscular Blockade
Neostigmine-induced depolarizing neuromuscular blockade was not excluded in this study because twitch height was not recorded. In 1959, Churchill-Davidson recognized that therapeutic doses of neostigmine could cause neuromuscular block and suggested this was a depolarizing block, evidenced by its similarity to that caused by decamethonium with reduction of twitch height, with no fade.

Chapter 35 of Miller’s Textbook of Anesthesia, edited by Professor Murphy, states: “The adverse physiologic effects of neostigmine in the setting of complete neuromuscular recovery can potentially have negative respiratory consequences in postoperative surgical patients. The mechanisms proposed for this effect include sensitivity of the upper airway muscles to an overabundance of acetylcholine with desensitization of the ACh receptor, depolarizing blockade, or an open channel blockade.”

Clinical Tests for Weakness Are Unreliable
Clinical tests of muscle strength, as used by Murphy et al., to detect residual neuromuscular block are unreliable, insensitive, and may be performed with train-of-four ratios less than 0.5. The authors acknowledge this limitation of their trial, stating, “Although the incidence of observable upper airway events was not increased in patients administered an anticholinesterase, neostigmine might produce more subtle effects on the respiratory system that were not detectable on clinical examination (e.g., upper airway critical closing pressure).” Interestingly, while all patients were able to perform 5-s head lift before extubation, nine patients could not pass this test 15 min after arrival in recovery.

Timing Is of the Essence
Neostigmine-induced clinical weakness is expected to peak at 5 to 10 min after IV administration. This is the likely timeframe not only for tracheal extubation but also impaired upper airway patency and respiratory function due to paradoxical muscle weakness. Murphy et al.’s...
subjective testing was conducted more than 15 min after administration of neostigmine, and so may have missed any ensuing weakness.

**Neostigmine May Have Been Administered before Full Recovery from Blockade**

The choice of acceleromyography to measure the train-of-four ratio was probably a pragmatic one, and certainly better than the information obtained from a subjective peripheral nerve stimulator. However, acceleromyography will return to a train-of-four ratio of 0.9 earlier than when recorded by electromyography and mechanomyography. Some research indicates that the acceleromyography train-of-four ratio for recovery from blockade would be 1.0 plus some time interval perhaps as long as 15 min before recovery could be ensured. Despite a acceleromyography train-of-four ratio greater than 0.9, some of Murphy’s patients may have received the dose of neostigmine while still partially paralyzed, before full recovery from neuromuscular block, potentially mitigating any de novo muscle weakness due to depolarizing block.

**What Use Is Acceleromyography in Awake Patients?**

The accuracy of acceleromyography-derived train-of-four ratio in awake postoperative patients has been questioned, as results may be affected by extra movements initiated by the patient in response to the electrical stimulus. Results obtained by acceleromyography used in this study may not be an accurate representation of the neuromuscular status of the patient.

**Residual Neuromuscular Blockade and Quantitative Monitoring**

The prevalence of residual neuromuscular blockade after the administration of neostigmine remains greater than 40%. The complications of residual neuromuscular blockade have been well documented. However, most anesthesiologists still do not use quantitative neuromuscular function monitoring. Kirkegaard et al. demonstrated that a number of patients still had a train-of-four ratio less than 0.9 more than 30 min after reversal of cisatracurium-induced shallow blockade with neostigmine. Blochner et al. similarly reported that reversal of rocuronium-induced shallow blockade with neostigmine showed a median time of 18.5 min (range, 3.7 to 106.9 min). Without quantitative monitoring, we cannot identify which of these patients will be slow to reverse from shallow blockade with neostigmine. In summary, the results of this study do not support the conclusion. The suggestion that neostigmine should be administered routinely, as it does not cause further neuromuscular blockade with muscle weakness, is not proven by this study. To improve the safety of reversal, routine use of quantitative monitoring of neuromuscular function to guide the selection of the most appropriate reversal agent and to confirm adequacy of reversal should be mandatory.

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**Competing Interests**

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