

*Editors' Note: This issue contains a series of articles regarding the safe use of nondepolarizing neuromuscular blocking drugs. All anesthesia professionals should understand the importance of appropriately monitoring and reversing neuromuscular blockade. We believe that these articles will increase awareness, provide important educational information, and improve patient safety.*

## Monitoring of Neuromuscular Blockade: What Would You Expect If You Were the Patient?

by Robert K. Stoelting, MD

The Anesthesia Patient Safety Foundation (APSF) believes that residual neuromuscular blockade in the postoperative period is a patient safety hazard that could be addressed partially by better and consistent use of our qualitative standard train-of-four (TOF) nerve stimulator monitors, but will ultimately require quantitative (objective TOF) monitoring along with traditional subjective observations to eliminate this problem completely.<sup>1-2</sup> APSF and other anesthesia professionals believe that every patient receiving nondepolarizing neuromuscular blocking drugs (NMBDs) should have at least qualitative, and preferably quantitative monitoring of the intensity of neuromuscular blockade using a peripheral nerve stimulator during the intraoperative period and assessment of the pharmacologic antagonism of neuromuscular blockade and adequacy of neuromuscular function prior to tracheal extubation.<sup>1-10</sup>

**Table 1: Potential adverse effects of residual neuromuscular blockade in the immediate postoperative period**

Need for tracheal reintubation
Impaired oxygenation and ventilation (may be erroneously attributed to opioids)
Impaired pulmonary function (reduced forced vital capacity and peak expiratory flow rate)
Increased risk of aspiration and pneumonia
Pharyngeal dysfunction
Delayed discharge from the PACU

The peer review literature supports the conclusion that residual neuromuscular blockade in the immediate postoperative period is more common than appreciated. This weakness may contribute to adverse patient events (Table 1).<sup>3-9</sup> Based on quantitative TOF monitoring as many as 40% of patients arriving in the PACU have evidence of residual neuromuscular blockade.<sup>4,9</sup>

Despite the evidence in the peer review literature and a survey of anesthesia professionals in which 90% of respondents agreed that quantitative TOF monitoring should be used routinely for patients receiving nondepolarizing NMBDs prior to transfer to the PACU, quantitative measurements of drug-induced neuromuscular blockade and the

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## Large Anesthesia/Practice Management Groups: How Can APSF Help Everyone Be Safer?

by Robert K. Stoelting, MD

On September 10, 2015, APSF invited representatives of large anesthesia and practice management groups to meet with members of the APSF executive committee to discuss mutually relevant anesthesia patient safety issues. The goal was to help APSF identify and implement patient safety initiatives of particular interest and value to the conference participants.

Thirty-six attendees representing 23 large anesthesia/practice management groups participated in the half-day session (Table 1). These 23 groups represented a wide geographical cross-section of the United States and a variety of practice models

that included all categories of anesthesia professionals. The American Society of Anesthesiologists, which has a committee on Large Group Practice, was represented by Daniel J. Cole, MD, President Elect, and Paul Pomerantz, CEO.

As an introduction to the conference, Robert K. Stoelting, MD, APSF President, reviewed past, current, and possible future APSF patient initiatives and provided "his view" of the three options available for APSF recommendations to become "best practices."

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Dr. Robert Stoelting, moderating.

# We As Patients Would Expect Better

## “Blockade Monitoring,” From Cover

adequacy of pharmacologic reversal have not been widely utilized by anesthesia professionals (Fig. 1).<sup>1</sup> Achievement of the goal of routine qualitative or quantitative monitoring using a peripheral nerve stimulator is difficult when the daily experiences of anesthesia professionals do not predictably demonstrate the existence of a problem that may occur well after the anesthesia professional has turned over care to another health care professional.<sup>4</sup> Universal adoption of quantitative monitoring is further impeded by the limited availability of easy-to-use, reliable monitoring technology. Many anesthesia professionals continue to rely on clinical signs (head lift, hand grip, negative inspiratory force, tidal volume) that are insensitive indicators of residual skeletal muscle weakness and applicable only to awake patients. Likewise, reliance on visual/tactile assessment of the TOF (low sensitivity to detect fade) to titrate the effects and assess the pharmacologic reversal of nondepolarizing NMBD is an insensitive and unreliable monitoring technique. Though double-burst stimulation (DBS) and fade with 100 Hz tetanic stimulation significantly improve the ability to detect residual neuromuscular blockade over single twitch or TOF monitoring or clinical signs, these modalities of assessing neuromuscular blockade are inferior to methods of quantitative monitoring such as acceleromyography.<sup>10</sup>

A recommendation for routine qualitative or quantitative monitoring of neuromuscular blockade with peripheral nerve stimulators as part of the “Standards for Basic Anesthetic Monitoring” has not been promulgated by any of the North American professional anesthesia associations (American Society of Anesthesiologists, American Association of Nurse Anesthetists, American Academy of Anesthesiologist Assistants, Canadian Anesthesiologists’ Society). To date, these anesthesia professional associations are either silent regarding monitoring neuromuscular blockade or limit their statements to (1) “monitor neuromuscular response” [no specific quantitative monitor mentioned] or (2) a “peripheral nerve stimulator should be available when patients receive neuromuscular blockers.”

In contrast, the 2015 “Recommendations for standards of monitoring during anaesthesia and recovery” published by the Association of Anaesthetists of Great Britain and Ireland (AAGBI) mandates that “a peripheral nerve stimulator must be used whenever neuromuscular blocking drugs are given.”<sup>9</sup> These recommendations also list a peripheral nerve stimulator (if neuromuscular blocking drugs are used) as part of the “minimum monitoring for anaesthesia” along with pulse oximetry and capnography.<sup>9</sup> This AAGBI mandate reflects the increasing recognition of the role of NMBDs in adverse postoperative pulmonary events.

In my opinion, there is no compelling reason to ignore this evidence-based patient safety issue and the obvious change in practice (qualitative, or preferably quantitative/objective monitoring with peripheral nerve stimulators to guide pharmacologic drug reversal) that would likely reduce the risk of potential adverse physiologic effects of lin-

### Objective functional monitoring (“twitch measurement”) of the intensity of neuromuscular blockade should be utilized routinely intraoperatively and prior to transfer to PACU.

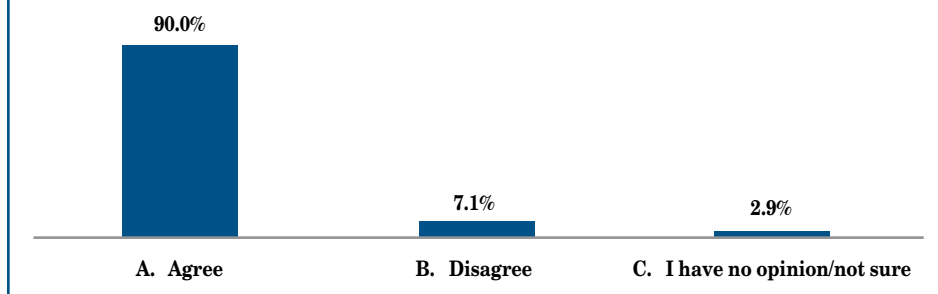


Figure 1: Stoelting RK. APSF survey results: Drug-induced muscle weakness in the postoperative period safety initiative. APSF Newsletter Winter 2013-14;28:69-71. <http://www.apsf.org/newsletters/pdf/winter2014.pdf>

gering drug-induced muscle weakness in the early postoperative period.

What will it take for “North American” anesthesia professionals to accept the reality of this patient safety risk?

Why are “we” so “hesitant” to routinely use qualitative or quantitative assessments of neuromuscular function with peripheral nerve stimulators to guide both the administration and reversal of nondepolarizing NMBDs?

Would “we,” knowing what we know, or should know, regarding the facts relevant to residual weakness due to nondepolarizing NMBDs, expect, at a minimum, qualitative monitoring with peripheral nerve stimulators if we were the patient?

My guess is “we” would expect qualitative, and more likely, quantitative monitoring of neuromuscular blockade as part of our care!

It is time to “Do as I would expect, not as I do!”

Robert K. Stoelting, MD  
President, APSF

#### References

1. Stoelting RK. APSF survey results: Drug-induced muscle weakness in the postoperative period safety initiative. *APSF Newsletter* Winter 2013-14;28:69-71. Available at: <http://www.apsf.org/newsletters/pdf/winter2014.pdf>.
2. Stoelting RK. Residual drug-induced muscle weakness in the postoperative period—a patient safety issue. *ASA Newsletter* 2015;79:64-65. Available at: <http://www.asahq.org/search?q=February%202015%20ASA%20Newsletter>.
3. Brull SJ, Naguib M. What we know: Precise measurement leads to patient comfort and safety. *Anesthesiology* 2011;115:918-920.
4. Todd MM, Hindman BJ, King BJ. The implementation of quantitative electromyographic neuromuscular monitoring in an academic anesthesia department. *Anesth Analg* 2014;119:323-331.
5. Viby-Mogensen J, Claudius C. Evidence-based management of neuromuscular block. *Anesth Analg* 2010;111:1-2.
6. Donati F. Neuromuscular monitoring: what evidence do we need to be convinced? *Anesth Analg* 2010;111:6-8.
7. Kopman AF. Managing neuromuscular block: where are the guidelines? *Anesth Analg* 2010;111:9-10.
8. Gopalaiah VK, Nair AP, Murthy HS, et al. Residual neuromuscular blockade affects postoperative pulmonary function. *Anesthesiology* 2012;117:1234-44.
9. Checketts MR, Alladi R, Ferguson K, et al. Recommendations for standards of monitoring during anaesthesia and recovery 2015: Association of Anaesthetists of Great Britain and Ireland. *Anaesthesia* 2015; Available at <https://www.aagbi.org/sites/default/files/Standards%20of%20monitoring%2020150812.pdf>
10. Capron F, Fortier LP, Racine S, Donati F. Tactile fade detection with hand or wrist stimulation using train-of-four, double-burst stimulation, 50-hertz tetanus, 100-hertz tetanus, and acceleromyography. *Anesth Analg* 2006 May;102:1578-84.



## APSF-Sponsored Conference

Royal Palms Resort and Spa, Phoenix, AZ

### Distractions in the Anesthesia Work Environment: Impact on Patient Safety

Distractions in the anesthesia work environment manifest in many different ways and potentially impact patient safety by compromising the anesthesia professional's vigilance during direct patient care. APSF believes these distractions need to be identified and addressed by open discussion, education, research and appropriate policy statements for individual groups or practice management entities. This 1-day conference will include podium presentations, panel discussions, small group breakout sessions and attendee responses using an “audience response system.”



Save the Date  
Wednesday, September 7, 2016

If you are interested in attending,  
please contact Dr. Stoelting  
([stoelting@apsf.org](mailto:stoelting@apsf.org)) for registration details.