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Panel on Monitoring of Neuromuscular Blockade at 2012 New York PGA Meeting, Sponsored by APSF

by Robert C. Morell, MD

On Monday, December 17, 2012, at the New York Society of Anesthesiologists Post Graduate Assembly, Dr. Aaron Kopman, Dr. Lars Eriksson, Dr. Glen Murphy, and Dr. Sorin Brull participated in an APSF sponsored panel titled, "Residual Muscle Relaxant Induced Weakness in the Postoperative Period: Is it a Patient Safety Issue?" Drs. Brull and Robert Stoelting, APSF President, served as co-moderators of this timely panel, which set forth the following goals for audience participants:

1. Enumerate the advantages and disadvantages of utilizing different techniques for monitoring neuromuscular function during surgery
2. Recognize the implications of incomplete reversal of neuromuscular blockade in the postoperative period
3. Incorporate strategies to minimize complications of excessive neuromuscular blockade in the postoperative period.

The panel began with **Aaron F. Kopman, MD**, clinical professor of Anesthesiology (Retired) Cornell University, Weill Cornell Medical College, New York, New York who reviewed the basics of monitoring neuromuscular blockade. Dr. Kopman defined the classic train-of-four (TOF) and shared the history of its use from its origination in 1971 by HH Ali. Dr. Kopman reviewed studies in which volunteers received curare and had vital capacity (VC), negative inspiratory force (NIF), and peak expiratory flow (PEF) measured and correlated with the TOF ratio. Subjects' NIF did not return to >90% of baseline until TOF was greater than 90%.

With TOF of approximately 70%, volunteers reported double vision, were unable to drink from a straw, and could not lift their heads off of the bed for 5 seconds. Even at TOF values of 0.9 there were measurable differences in grip strength.

Dr. Lars I. Eriksson, MD, PhD, FRCA, professor and academic chair, Department of Anesthesiology, Surgical Services and Intensive Care Medicine at the Karolinska Institute and Karolinska University Hospital in Stockholm, Sweden presented the *Clinical Consequences and Outcomes after Incomplete Recovery of Neuromuscular Function*. Dr. Eriksson reviewed the molecular pharmacology of neuromuscular function, blockade and recovery from blockade. Dr. Erikkson discussed the pre- and post-synaptic acetylcholine (ACh) receptors and pointed out how presynaptic ACh receptors (N3-nicotinic) are responsible for mobilization of ACh and maintenance of force over time. A subtype of the ACh receptor is responsible for this, and blockade of that receptor subtype is actually responsible for muscular fade. All neuromuscular blocking (NMB) compounds also cause some presynaptic block, which is responsible for fade. Function of the laryngeal musculature and the diaphragm returns faster than does the function of the adductor pollicis (thumb) muscle. Pharyngeal recovery is very slow as well. Risks of aspiration are increased as TOF ratio decreases, and the elderly are at much greater risk

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of aspiration than young patients with low TOF ratio, particularly because many elderly patients have impaired pharyngeal function at baseline.

It was also pointed out that neostigmine can produce profound weakness when given in the absence of NMB.

Dr. Glen Murphy, director of cardiac anesthesia and clinical research and clinical professor of anesthesiology, University of Chicago Pritzker School of Medicine located in Chicago, Illinois, presented his perspective on *Neuromuscular Management and Postoperative Complications*. Dr. Murphy shared data regarding the association between residual neuromuscular blockade and postoperative pulmonary complications. Patients who experience residual blockade due to the use of longer acting NMB drugs such as pancuronium had worse outcome than patients with residual blockade after short- or intermediate-acting agents, and could have long-term adverse consequences. Dr. Murphy also provided comparisons of patients who were monitored with standard twitch stimulators (subjective evaluation) as opposed to those monitored with the TOF-Watch monitor (objective evaluation). Patients monitored with the TOF-Watch monitor had a lower incidence of residual neuromuscular blockade and a lower incidence of critical respiratory events such as significant oxygen desaturation, pulmonary aspiration or need for emergent tracheal reintubation.

Finally, Sorin J. Brull, MD, FCARCSI (Hon), professor of Anesthesiology at the Mayo Clinic Jacksonville presented *Back to the Future: Trends, Needs, and Developments in Monitoring for Safe Clinical Care*. Dr. Brull discussed subjective techniques for monitoring NMB including visual, tactile, and clinical assessments. Direct visual and/or tactile assessment of the adductor pollicis response requires the ability to see and/or touch the hand and thumb, which is often not accessible. Clinical assessment of leg or head lift or handgrip has been used in the past. Longer duration (10 seconds or more) of head or leg lift or handgrip is more “accurate” than shorter duration assessments. Quantitative assessment of NMB, with baseline assessments prior to administration of neuromuscular blocking drugs, is superior and more accurate than subjective assessments. New devices are on the horizon, including one being developed by Dr. Brull and for which he provided full disclosure regarding any potential conflict of interest.

All presenters agreed that routine careful monitoring of NMB is important and should be performed in all cases in which patients receive neuromuscular blocking agents. Furthermore, all presenters agreed that a TOF ratio of >0.9 is an appropriate goal, and the minimum degree of recovery consistent with adequate neuromuscular function postoperatively. Lesser TOF ratios indicate residual NMB and the potential for adverse events, both long- and short-term. Objective assessment is considered far superior to qualitative or subjective assessments.

Following the presentations, a survey was distributed amongst audience members. Of the 81 respondents, 80 were anesthesiologists and 1 was an anesthesiologist assistant. Sixty-six (81.5%) had more than 10 years of clinical practice, 7 had less than 5 years, and 7 had 5-10 years of practice. Forty-eight (60%) of respondents were in an academic practice model, while 32 (40%) reported being in private practice.

When asked if residual muscle weakness in the PACU is a rare phenomenon, 10 (13.3%) agreed, while 64 (85.3%) disagreed; 1 respondent felt that data were insufficient to have an opinion.

Of the respondents, 73 (90%) disagreed that a TOF > 0.7 confirmed the absence of significant residual drug-induced muscle weakness in the PACU, while 3 individuals agreed; 5 had no opinion. Similarly, 71 respondents (87.7%) felt that normal respiratory and upper airway function in the PACU may not be present until the TOF ratio is > 0.9, while 9 (11.1%) disagreed, and 1 had no opinion. Regarding this question, 8 individuals (9.9%) stated that their response would have been different before attending this panel presentation.
When asked if objective monitoring (twitch measurement) of the intensity of NMB should be utilized intraoperatively on all patients receiving neuromuscular blocking drugs, 64 (87.7%) responded affirmatively, while 8 (10.9%) disagreed and 1 had no opinion. When asked if their response to this question would have been different before attending the panel, 4 (5.5%) said yes.

The eighth question on the survey asked if subjective monitoring (visual or tactile) and clinical tests (head-lift or handgrip) for the presence of residual weakness in the PACU would negate the need for intraoperative objective monitoring. Three (4.2%) of the respondents agreed, while 66 (91.7%) disagreed, and 3 had no opinion due to either insufficient data (2) or the question being outside their area of expertise (1). When asked if their response would have been different before the panel, only 2 respondents said yes.

When the participants were asked if the APSF should encourage the American Society of Anesthesiologists to consider adding neuromuscular function to the ASA Standards for Basic Anesthetic Monitoring (recognizing that standards are considered to be evidence-based), 63 (86.3%) agreed, while 6 (8.2%) disagreed, 1 (1.4%) had no opinion due to insufficient data to have an opinion, and 3 (4.1%) had no opinion due to the question being outside their area of expertise. When asked if their response to this question would have been different before attending this panel, 2 stated yes (2.7%).

Finally, participants were asked if they would support the following addition to the ASA Standards for Basic Anesthetic Monitoring, recognizing that standards are considered to be evidence-based:

Neuromuscular Function
Objective

To aid in the recognition of residual skeletal muscle weakness in the postoperative period owing to the intraoperative administration of neuromuscular blocking (most often nondepolarizing) drugs.

Methods
Qualitative clinical signs such as visual and tactile observations and clinical signs such as head-lift, handgrip, and tidal volume may be helpful, but every patient receiving neuromuscular blocking drugs should have objective monitoring of the intensity of neuromuscular blockade during the intraoperative period and prior to tracheal extubation. Prior to tracheal extubation, pharmacologic antagonism of neuromuscular blockade should be considered based on subjective and objective monitoring to minimize the risk of residual drug-induced postoperative weakness.

Fifty-nine (86.9%) of the respondents agreed, 4 (5.9%) disagreed, 3 (4.4%) had no opinion due to insufficient data to have an opinion, and 2 (2.9%) had no opinion due to this question being outside their area of expertise.

The expert panelists and a majority of the surveyed audience members agree that objective monitoring of neuromuscular blockade should be used routinely in cases where neuromuscular blocking agents are administered. The APSF is very supportive of encouraging the professional associations representing anesthesia professionals to consider this initiative.

Dr. Morell is a private practice anesthesiologist in Niceville, FL and is the co-editor of the APSF Newsletter and a member of the APSF Board of Directors and Executive Committee and attended this panel presentation at the NY PGA Meeting.