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Assessing Patient Recovery with Neuromuscular Monitoring

Announcer: You're listening to ReachMD. Welcome to this Medical Industry Feature, "Assessing Patient Recovery with Neuromuscular Monitoring." The following program is brought to you by Merck Sharp & Dohme Corp., a subsidiary of Merck & Co., Inc., and is intended for healthcare professionals.

Dr. Caudle: Neuromuscular blockade refers to the muscle relaxant component of anesthesia, which helps to keep muscle in its relaxed state by interfering with the action of the neurotransmitter that signals muscle fibers to contract.

Recovery from neuromuscular blockade can be measured either qualitatively or quantitatively. The focus of today's panel discussion is the importance of using quantitative or objective measures to monitor patient recovery from neuromuscular blockade.

This is ReachMD, and I'm your host Dr. Jennifer Caudle. Joining me are my guest experts, Drs. Roy Soto and George Williams. Dr. Soto is an anesthesiologist with Beaumont Health in Royal Oak, Michigan, and Dr. Williams is Associate Professor, Vice Chair and Division Chief of Critical Care Medicine at the University of Texas McGovern Medical School in Houston, Texas.

Doctors, welcome to the program.

Dr. Soto: Thank you for having me today.

Dr. Williams: Yes, thanks so much; we're excited to be here.

Dr. Caudle: Dr. Soto, starting with you, can you share with us the main goals of neuromuscular monitoring in assessing patient recovery?

Dr. Soto: Sure, the three main aims of neuromuscular monitoring are to monitor neuromuscular blockade, to reduce the potential complications of residual neuromuscular blockade, and to evaluate the recovery of neuromuscular function.

Dr. Caudle: Now turning to you, Dr. Williams, what are your thoughts on using clinical tests to assess recovery from neuromuscular blockade. Are they effective, in your view?

Dr. Williams: Well there is considerable variability in the sensitivity among different clinical tests. For example, head lift or a hand grip, swallowing, clenching of the teeth, airway obstruction, and tongue protrusion. This variability can make it difficult to assess clinically relevant recovery.

Dr. Caudle: Dr. Soto, do you have anything to add to that?

Dr. Soto: Yea that's all right because qualitative or subjective clinical tests alone may not confirm clinically relevant recovery, assessment of neuromuscular blockade recovery should include the use of objective monitoring to calculate the train-of-four, or TOF ratio. Patients can begin to show signs of recovery with a TOF ratio as low as 0.4 but a TOF ratio of ≥0.9 is considered clinically relevant and should be used in conjunction with the clinical tests.

Dr. Caudle: And, what would you both say are frequently used peripheral nerve stimulation patterns? Let's start with you, Dr. Williams.

Dr. Williams: Yes, the TOF which we just talked about, and post-tetanic count, which is also called PTC, are frequently used nerve stimulation patterns but are used in different situations.

Dr. Caudle: Let's touch upon those situations. Dr. Soto, can you summarize the use applications for TOF and PTC stimulation patterns?

Dr. Soto: With the TOF stimulation, four stimuli are applied to peripheral motor nerve at 2 hertz every half second and are repeated every 10 to 20 seconds. This type of stimulation pattern may be used during induction of anesthesia or surgery to measure moderate degrees of neuromuscular blockade, or to verify recovery.

PTC, on the other hand, includes 50 hertz tetanic stimulation for 5 seconds, followed by single-twitch

stimulation of 1 hertz given 3 seconds later. This type of stimulation pattern is mainly used during intense or deep neuromuscular blockade when there is no response to TOF or single-twitch stimulation.

Dr. Caudle: Thanks for that overview, Dr. Soto, and let's also come back to the TOF ratio that you described earlier. Dr. Williams, can you help explain the TOF ratio to our listeners in a bit more detail?

Dr. Williams: Sure. Counting the number of twitch responses to stimulation helps assess the depth of muscle relaxation and determine the presence of return to normal muscle function. Now TOF stimulation can be used to measure and calculate the TOF ratio and neuromuscular recovery when objective monitoring is used. These monitors actually measure and quantify the force of muscle contraction and display the results of the TOF ratio from 0 to 1.0, or another way of saying this is from 0% to 100%. Neuromuscular recovery is generally defined as a TOF ratio of ≥0.9 or 90%, which is a threshold for determining when to extubate a patient. So, TOF ratio is really an indicator of the presence or absence of fade, which is calculated by comparing the amplitude of the fourth twitch to that of the first twitch in response to TOF stimulation.

Dr. Caudle: Great, thanks, Dr. Williams. Let me ask you both now: what factors do you take into consideration when choosing a monitoring site? Dr. Soto let's start with you.

Dr. Soto: Well, the nerve must have a motor element and it must be close to the skin. It's also important that contractions in the muscle or muscle group that the nerve supplies must be visible or accessible to monitor the evoked response. Do you have anything to add, Dr. Williams?

Dr. Williams: Thanks, Dr. Soto. Really just a word of caution really. It's important to realize that, due to different muscle groups having different sensitivities to neuromuscular blocking agents, results that you obtain from the monitoring site can't be automatically extrapolated to muscles at the surgical site. So, for instance, some muscles, such as those in the diaphragm, are less sensitive to the effects of neuromuscular blocking agents. Also, some muscles may experience faster onset of neuromuscular blockade or recovery of function.

Dr. Caudle: And what's a frequently used nerve for monitoring neuromuscular blockade?

Dr. Williams: Well in clinical anesthesia, the ulnar nerve is a frequently used monitoring site chosen for neuromuscular monitoring.

Dr. Caudle: I want to return to an important point you both made earlier, that when assessing muscle responses to peripheral nerve stimulation, relying on subjective measures alone can be insufficient for assessing clinically relevant recovery. And we know that there are several quantitative methods available to more accurately measure the muscle's response to stimulation, so let's focus on some of

these methods now. Dr. Soto, can you share some options?

Dr. Soto: Sure. Electromyography records the compound action potentials that occurs during muscle contraction whether that be voluntary or evoked and is most often obtained by stimulating the ulnar or median nerves.

Acceleromyography, on the other hand, measures acceleration of the contracting muscle. With acceleromyography, the adductor pollicis is stimulated, causing the thumb to move and the attached transducer produces a voltage proportional to its acceleration. The voltage is converted into an electrical signal and is then calculated or displayed on appropriate equipment.

Dr. Caudle: Dr. Williams, are there any other options we should know more about?

Dr. Williams: Yes, there is a third option, which is called kinemyography, which measures movement of the thumb with a small piezoelectric sensor positioned between the index finger and thumb. And the stimulation leads to muscle contraction, which generates a voltage which is proportional to the amount of stretching or bending of the sensor between the index finger and thumb.

Dr. Caudle: Dr. Williams, continuing with you, how do you evaluate the strength of response to peripheral nerve stimulation in clinical practice?

Dr. Williams: Well the characteristic patterns of response to TOF or PTC stimulation can be used to determine the level of neuromuscular block following injection of a non-depolarizing neuromuscular blocking agent through recovery.

Dr. Caudle: And how can anesthesiologists assess clinically relevant recovery from neuromuscular blockade? Dr. Soto?

Dr. Soto: When assessing clinically relevant recovery, it's important to remember that during the recovery period, responses to subjective clinical tests can vary greatly among patients, making it difficult to determine the degree of recovery.

Dr. Williams: Yea, that's right and as we talked about earlier, when using a visual or tactile methods, patients can begin to show signs of recovery with a TOF ratio as low as 0.4. So, only objective monitoring equipment can measure and calculate a TOF ratio of ≥0.9, which is considered to be clinically relevant recovery.

Dr. Caudle: So, from your respective experiences, what would you say has been the incidence of incomplete recovery from neuromuscular blockade?

Dr. Soto: You know I think it would be insightful to know what percentage of our listeners think their

patients experience residual neuromuscular blockade, that is a TOF ratio of <0.9. It's interesting...Some clinicians estimate the incidence of residual block to be as low as 1%, but it occurs more often than we think.

Dr. Williams: Yea I agree and to add to that, some recent findings actually estimated the incidence of residual neuromuscular block to be between like 20 to 40% in the post anesthesia care unit. And some studies have even show that the incidence can actually range over 50%.

Dr. Caudle: That sounds like a sizeable discrepancy between our estimations and the possible reality of residual neuromuscular block. So, to round our discussion, then, how can anesthesiologists try to decrease the risk of residual neuromuscular blockade?

Dr. Soto: As we've stressed during this discussion, objective monitoring methods are needed to accurately calculate a TOF ratio of ≥0.9. Clinical signs and symptoms of residual neuromuscular block should be considered in relation to the response to the nerve stimulation.

Dr. Caudle: With that, I would like to thank my guests, Drs. Soto and Williams, for their insights on the importance of quantitatively measuring patient recovery from neuromuscular blockade. Doctors, it was great having you on the program.

Dr. Soto: Thank you very much for having me today.

Dr. Williams: Yes, thanks so much it was a pleasure.

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