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CORRESPONDENCE

Monitoring recovery from neuromuscular block using acceleromyography at the trapezius muscle: problems that must be considered

Christoph Unterbuchner, MD

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To the Editor,

Soltesz *et al.* reported in the *Journal* that acceleromyography (AMG) at the trapezius muscle, by stimulating the accessory nerve, is an acceptable alternative to AMG at the adductor pollicis muscle for estimating residual neuromuscular blockade. The authors concede that AMG at the trapezius muscle may overestimate neuromuscular recovery, but there are some other issues that also deserve further discussion.[1]

The observational, sex-specific study design, with missing randomization of the stimulation sites, may limit the validity of the study. Furthermore, these investigators immobilised the stimulation arm, leaving the thumb free to move.[1] There is good evidence, however, that applying an elastic preload to the thumb (Hand Adapter®; Organon Ltd., Dublin, Ireland), decreases signal variability and can increase the precision of the onset and time course of the neuromuscular block.[2,3]

In their study, calibration of the TOF-Watch SX (Essex Pharma GmbH, Munich, Germany) was performed using the Cal-2-mode with a stimulus impulse width of 0.1 msec - in contrast to the recommended standard width of 0.2 msec.[1,2] This is particularly notable as it reduces the charge (i.e., product of the current intensity and the stimulus impulse width) on the stimulated nerve by 50% and may impair supra-maximum nerve stimulation.

The authors assumed that the AMG signal drift (T1) after calibration was dependent on a change in impedance of the stimulation electrodes. Therefore, following ten minutes of train-of-four (TOF) stimulation, the AMG was recalibrated and ten T1 and TOF ratio values were recorded and served as controls.[1] In my opinion, this is a sign of insufficient signal stabilization. One explanation could be that the staircase phenomenon (frequency-dependent twitch potentiation) caused the signal drift of the control T1.[1,4] Because all T1 values are related to the control T1, low variability of this baseline is important for data precision.[2] A staircase effect rapidly increases T1 during TOF stimulation at the adductor pollicis muscle to 148% ± 19% of the baseline T1 after 15 min and then more slowly to 158% ± 26% after 25 min.[4] In contrast, my own measurements at the trapezius muscle of a 63-yr-old woman (written informed consent was obtained) identified a clearly faster signal increase to 168% of control T1 after six minutes with a slow decrease to a plateau of 145% ± 3% after 16 min (Figure). These varying staircase characteristics could be part of the reason why eight subjects were excluded because of signal drift.[1] Thus, the results of Soltesz *et al.* would be more valid if they had used the recommended 50-Hz tetanic preconditioning before calibration to increase signal stability.[2,4] Nevertheless, the TOF ratio is not influenced by the staircase effect and may be more dependent on an elastic preload (Figure).[2-4]

Furthermore, it is recommended that variations in the control twitch height of T1 and the TOF ratio be considered in addition to normalizing all initial values to equal 100% at time 0 (first T1 and TOF ratio after calibration).[2-4] In Soltesz *et al.*, the control TOF ratio was 108% at the adductor pollicis muscle and 97% at the trapezius muscle. If the terminal TOF values are normalized to obtain the real

This letter is accompanied by a reply. Please see Can J Anesth 2016; 63: this issue.

C. Unterbuchner, MD (✉)
Department of Anaesthesiology, University Medical Centre Regensburg, Regensburg, Germany
e-mail: christoph.unterbuchner@ukr.de

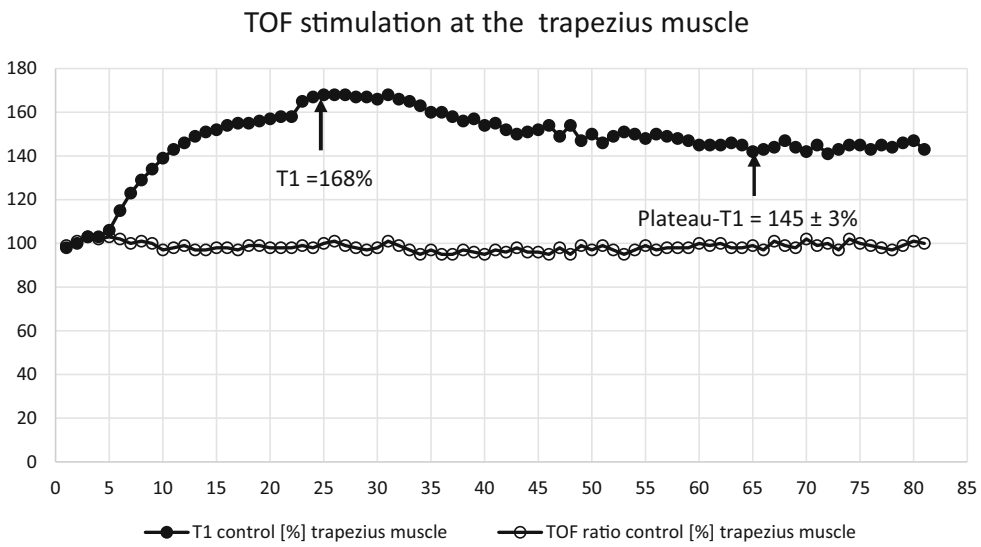

Figure Time course of T1 and train-of-four (TOF) ratio control (%) at the trapezius muscle during TOF stimulation every 15 sec in a 63-yr-old woman. Twitch potentiation was present in T1. After six minutes (27 stimulations), T1 reached a maximum height of 168%. After 16 min (66 stimulations) T1 decreased to a plateau of 145% ± 3%. The TOF ratio was unaffected by the staircase effect

value (terminal value/control value), the results change substantially [adductor pollicis muscle TOF ratio of 90% *vs* the TOF ratio (normalized) of 83% (90/108); trapezius muscle TOF ratio of 90% *vs* TOF ratio (normalized) of 93% (90/98)].[2,3] Thus, the normalized results indicate that the objective AMG value at the trapezius muscle overestimates AMG at the adductor pollicis muscle definitively by 10%.[1] Considering that AMG at the adductor pollicis muscle overestimates electromyographically measured TOF ratios by almost 15%, this newly described stimulation site underestimates residual curarization significantly, with potentially hazardous consequences for the patient (i.e., respiratory complications).[6] Arguably, it might have made more sense to compare the normalised TOF ratio of 100% at both measurement sites or to compare AMG with electromyography results.[5]

Finally, because of the above-noted methodical deficiencies, this observational study might be better considered a hypothesis-generating study. It suggests that AMG at the trapezius muscle may be an acceptable intraoperative alternative to monitoring at the adductor pollicis muscle - but is not interchangeable with it - to estimate the grade of relaxation. Before extubation, postoperative residual curarization must be excluded by an uncalibrated acceleromyographically measured TOF ratio of 100% at the adductor pollicis muscle.[6] Future, randomized trials should verify this hypothesis with particular attention placed on avoiding potential systematic methodological errors.

Conflicts of interest None declared.

Editorial responsibility This submission was handled by Dr. Hilary P. Grocott, Editor-in-Chief, *Canadian Journal of Anesthesia.*

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