Is one acceleromyographically measured train-of-four ratio sufficient after sugammadex to identify residual curarization in postoperative awake patients?

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Editor—I have read with great interest the study by Brueckmann and colleagues describing the elimination of postoperative residual neuromuscular curarization (PORC) in the postanaesthesia care unit using sugammadex antagonism after abdominal surgery. This is an important finding. The methodology nonetheless deserves consideration and clarification.

First, a train-of-four (TOF) ratio (TOFR) was recorded for each patient in the postanaesthesia care unit by a blinded assessor, indicating the level of recovery from neuromuscular block. After calibration of the acceleromyographic measurement (TOF Watch SX) in calibration 1 mode, one TOFR was recorded. According to my understanding, it does not make sense to calibrate at a potentially paralysed muscle (adductor pollicis muscle) with a probably submaximal stimulation current (30 mA). In narcotized patients, a single, uncalibrated, acceleromyographic TOFR does not reliably detect low degrees of residual curarization as an isolated test (sensitivity 70%, negative predictive value 47%). Not even two isolated, non-calibrated, acceleromyographic measurements are accurate enough to quantify the level of residual curarization in postoperative, awake patients, because it may be affected by extra movements of the thumb. Furthermore, missing preload impairs the precision of acceleromyographic measurements are accurate enough to quantify the level of residual curarization in postoperative, awake patients, because it may be affected by extra movements of the thumb. Furthermore, missing preload impairs the precision of acceleromyographic measurements are accurate enough to quantify the level of residual curarization in postoperative, awake patients, because it may be affected by extra movements of the thumb.

Second, unblinding of the anaesthetist to the study medication may bias the results. There is no exact information about maintenance of anaesthesia or modifications of anaesthetic practice. It is a known phenomenon that interindividual recovery time is much longer after neostigmine during sevoflurane anaesthesia compared with propofol anaesthesia. Furthermore, the authors did not provide details about the number of patients undergoing laparoscopic and open abdominal surgery. This would be a valuable information for the reader.

Third, it is not clear to the reader whether the timing of the sugammadex administration was based on the anaesthetist’s clinical judgement or on qualitative or quantitative neuromuscular monitoring. Use of TOF monitoring was not mandatory in the study protocol and left to the discretion of the anaesthetist. This is an important issue, especially for the usual care group, because it is a well-known fact that neostigmine is unable to antagonize profound neuromuscular block. Even at moderate block (return of T2), antagonism with neostigmine (0.05 mg kg−1) has a 95% confidence interval of 14.2–24.4 min to reach a TOFR of 0.9. The authors report that 32% of patients in the usual care group were antagonized in the absence of documented TOF count or at deep neuromuscular block (TOF count 0 or 1). This conflicts with the definition of deep neuromuscular block (no response to TOF stimulation; but a response to post-tetanic count ≥1), which is described in the Methods. In addition to this, extubation was performed 15.2 min (range 13.2–17.5 min; median 14 min) after neostigmine administration. This was based on the decision of the anaesthetist. But it is not clear on which criterion this decision was based (clinical judgement or objective neuromuscular monitoring).

Nevertheless, this study underscores the importance of neuromuscular monitoring in antagonism of rocuronium-induced neuromuscular block during anaesthesia before extubation to detect PORC.

Declaration of interest
None declared.

References

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Sugammadex and residual neuromuscular block: what is acceptable normal practice?

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Editor—I read with interest the recent article by Brueckmann and colleagues comparing the incidence of residual paralysis in the postanaesthesia care unit in patients randomized to either sugammadex or neostigmine antagonism of rocuronium neuromuscular block. However, I am concerned about several aspects of the trial design and conduct.

I was first struck by the large difference in the incidence of residual paralysis between the two antagonism groups (0 vs 43%). Although a 40–60% incidence of residual paralysis has been reported, this is typically in an environment either in which no intraoperative neuromuscular monitoring was used or in which only qualitative assessments of block were made. However, Brueckmann and colleagues state that ‘The level of neuromuscular blockade during surgery was determined via neuromuscular monitoring using acceleromyography (TOF-Watch SX . . .)’. They also state that such monitoring was used in 87% of patients. The use of quantitative monitoring should have resulted in a much lower incidence of residual paralysis in patients given neostigmine. For example, Murphy and colleagues conducted a randomized trial of quantitative intraoperative monitoring (also using the TOF-Watch) vs standard monitoring and showed that the incidence of residual paralysis after antagonism with neostigmine was 15%, compared with 50% in the standard care group. Our own observational work, using quantitative EMG monitoring and antagonism with neostigmine, demonstrated that the near-universal use of quantitative monitoring resulted in residual paralysis in the postanaesthesia care unit [train-of-four (TOF) ratio <0.9 incidence of 13% (vs 43% in the present study), with only 5% of patients having a TOF ratio <0.8 (vs 23% in the present study)]. This suggests that, in the study by Brueckmann and colleagues, quantitative monitoring was not, in fact, being used or, if it was being used, then providers were extubating patients without regard to the adequacy of antagonism (at least when neostigmine was given). The 0% incidence of residual paralysis with sugammadex is also somewhat better than expected, given that Kotake and colleagues reported an absolute incidence of residual block of 4.3% (with an upper 95% confidence interval of almost 10%) after sugammadex in an unmonitored or qualitative monitoring environment. This suggests that more careful monitoring was being used in the sugammadex group. I would therefore ask the authors to clarify the intraoperative use of quantitative monitoring and its use in determining suitability for extubation or supplemental doses of antagonistic agents.

In addition to the above points, Sasaki and colleagues recently reported a prospective observational study of 3000 patients, examining the relationship between residual paralysis and various postoperative respiratory problems. This study was not prospectively controlled, and monitoring was predominantly qualitative, and yet the reported incidence of residual paralysis in patients given neostigmine was only 20.9%, compared with 18.5% in patients not given neostigmine. It is difficult to understand how a well-controlled prospective, randomized trial of neuromuscular blocking agents and antagonism performed in presumably the same institution could result in a much higher incidence of residual paralysis than in an uncontrolled observational series of observations.

In looking further, I was struck by the fact that in 58% of patients, antagonism with neostigmine was attempted in the presence of fewer than four twitches. The ability of sugammadex to antagonize even a profound degree of neuromuscular block is well known, as is the difficulty in antagonizing a similarly profound block with neostigmine. I would argue that this ‘usual practice’ (as noted by the authors) is essentially guaranteed to result in a high incidence of inadequate antagonism with neostigmine unless providers actively monitor the TOF ratio and verify an adequate level of antagonism before extubation and leaving the operating room. I also found it surprising that providers were routinely dosing rocuronium in a fashion that results in such a profound level of neuromuscular block at the completion of the procedures. Since implementation of quantitative monitoring at the University of Iowa, attempted antagonism in the face of anything less than four twitches (and a TOF ratio less than 0.15–0.20) has become uncommon.

Lastly, I was surprised that no effort was made to blind the providers regarding the assigned antagonistic agent, particularly given that the group assignments were apparently made before surgery. The authors argue that ‘The anaesthesiologist was unblinded to the study drug, as he/she needed to be able to adjust the anaesthesia and neuromuscular blockade according to the treatment group . . .’. However, the reported protocol did not call for any antagonistic agent-specific adjustments to the anaesthetic or to intraoperative block. There were, however, twitch-