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Belgian anesthesiologists' overconfidence in their perceived understanding of neuromuscular blockade management

J.R. Renew (*), R. Nemes (**), G. Cammu (***), M. Van de Velde (****), S.J. Brull (*), M. Naguib (*****)

Abstract : *Background :* The incidence of postoperative residual weakness remains unacceptably high and essentially unchanged over decades. It is puzzling why anesthesiologists are resistant to accept the concepts of safe management of neuromuscular blockade and reversal. It appears that pervasive misconceptions regarding appropriate implementation of neuromuscular blockade monitoring and management continue to be a substantial obstacle in addressing this issue.

Methods : We conducted a 10-question survey composed of true/false options to determine the respondents' knowledge regarding neuromuscular blockade management. Surveys were made available during an unannounced 90 minute period of a national anesthesiology conference in Belgium. Participants were also asked to rate their confidence in their responses.

Results : One hundred and fifty-seven anesthesiologists (69 certified anesthesiologists and 88 anesthesiologists-in-training) completed the 10-question survey. Respondents were correct 72% of the time, yet rated their mean confidence significantly higher as 80%.

Conclusions : The surveyed anesthesia providers conveyed overconfidence in their understanding of neuromuscular blockade management. Such misconceptions represent a substantial challenge to improving the standards of neuromuscular blockade management throughout the anesthesia community.

Keywords : Neuromuscular blockade management ; quantitative neuromuscular monitoring ; postoperative residual weakness ; misconception ; overconfidence.

Introduction

Postoperative residual neuromuscular blockade (PRNB) persists as a threat to patient safety. Despite an abundance of literature describing this issue, the incidence of PRNB remains unchanged in the past 20 years (40-60%) (1-5). PRNB has been implicated in critical respiratory events, oropharyngeal dysfunction, a prolonged and subjectively worse clinical recovery in the postoperative period, as well as disrupting the function of peripheral chemoreceptors that stimulate breathing in hypoxic patients (6-9).

Several strategies have been suggested to minimize the incidence of PRNB. Utilizing reversal agents such as neostigmine or sugammadex to antagonize the effects of neuromuscular blocking agents (NMBAs), unless complete recovery (a train-of-four ratio ^{3}0.9) has been demonstrated with quantitative monitoring, serves as an effective technique to minimize the risk of PRNB (10, 11). The use of quantitative monitoring is the only reliable method to confirm adequate recovery prior to extubating the trachea (12, 13). Unfortunately, universal implementation of quantitative neuromuscular blockade monitoring is still challenging.

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GC is a principal consultant for MSD (Merck Sharp & Dohme).
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MN has served as a consultant for GE Healthcare (Chicago, IL, USA) in 2018

While the lack of available technologies may be partly to blame, anesthesiologists' knowledge regarding optimal, evidence-based neuromuscular blockade management presents another substantial obstacle. A recent large, international survey of anesthesiologists demonstrated significant gaps in knowledge and overconfidence in managing neuromuscular blockade, appropriate monitoring, and techniques to minimize PRNB (14). Respondents to this 9-question survey had a significant gap between the accuracy in their responses and their level of confidence in answering these questions (57.1% vs 83.5%, respectively, P <0.001). Through this series of thoroughly-vetted true/false questions, Naguib et al. demonstrated major barriers to improving care as patient safety advocates will not only have to combat tightly held misconceptions about neuromuscular blockade management, but also to overcome a substantial overconfidence in their knowledge with this topic (14).

We conducted a similar survey in Belgium that included anesthesiologists-in-training along with qualified anesthesiologists, in an effort to further assess the knowledge and confidence within the Belgian anesthesia community.

Methods

A 10-question survey was made available to all attendees at the Annual Meeting of the Society for Anesthesia and Resuscitation of Belgium (SARB) in Brussels on November 23-24, 2018. The surveys were provided in the French (supplemental material 1) and Dutch (supplemental material 2) languages, the national languages in Belgium. Questionnaires were handed out unannounced at the start of a morning educational session unrelated to neuromuscular blockade management and collected at the end of the session, 90 minutes later. Permission for the questionnaires was granted by the individual authors from the original paper (14), as well as from the Publisher (Anesthesia & Analgesia, Wolters Kluwer Health, Inc., License Number 4433240390145, License date Sep 20, 2018).

The survey questions were identical to the previously reported international survey (14), with the exception of an additional question that dealt with the role of neostigmine in reversing deep levels of vecuronium-induced neuromuscular blockade. These questions were developed utilizing rigorous methods that have been previously described (14). Briefly, questions were composed based on peer-reviewed literature investigating optimal neuromuscular blockade management. Additionally,

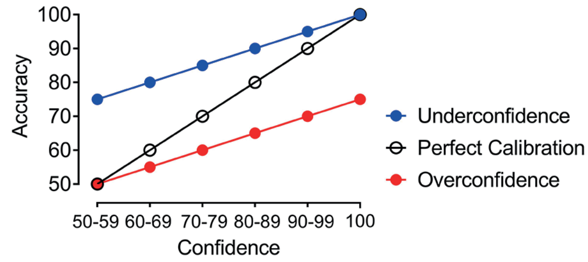

Fig. 1. — Calibration Curve : The black line represents perfect calibration of confidence ; each confidence level is appropriate for each level of accuracy. The red and blue lines represent over- and underconfidence, respectively.

these questions were also screened and validated during two small pilot studies in an effort to develop questions that had 'indisputable answers'.

The survey questions were entirely comprised of 'true/false' options and respondents were asked to document their level of confidence using a percentage between 50% (completely unsure) and 100% (completely confident). These confidence levels were documented by respondents freely transcribing these values.

The rationale for a two-choice question has been addressed and is very common in the decision-making literature. With only two choices to select from, a respondent would never rate their confidence as less than 50%, given a blind guess still yields a 50% change of being accurate. This allows for perfect alignment between the two factors of interest : accuracy and confidence (Fig. 1) (14).

Statistical methods

As previously described (14), calibration represents a measure of the correspondence between confidence and accuracy. In order to calculate calibration, the average proportion of the questions answered correctly is subtracted from the average confidence assigned to the answers for that question. A 1-tailed t-test was performed to determine significance between accuracy and confidence, otherwise known as overconfidence (14).

Slope represents the difference between the confidence assigned to the incorrect answers and the confidence assigned to the correct answers. Overall slope was calculated, as was individual slope for each question. A P value < 0.05 was considered to be statistically significant.

Results

One hundred and fifty-seven respondents completed some portion of the 10-question survey.

Twenty-five surveys were ultimately excluded from determining overall accuracy, confidence, overconfidence, and slope, due to incomplete responses. However, incomplete surveys were included when analyzing individual questions, if the respondent provided an answer and confidence score for that particular question. Most respondents (88/157, 56%) were anesthesiologists-in-training.

The 132 respondents who completely responded to the survey answered correctly an average of 72.4% of the 10 questions. The mean confidence assigned to these responses was 79.8% (95% CI : 77.8%-82.0%), which was greater than their accuracy of 72.4% (95% CI : 69.5%-75.4% ; t_{132}=5.07, P < 0.001). The magnitude of overconfidence was thus 7.5% (95% CI : 6.6%-10.3%). Of the 157 respondents, 110 (70%) were overconfident in their responses, while 39 (24.8%) were underconfident, and 8 (5.1%) were perfectly calibrated. Figure 2 presents the calibration curves for each question, while Figure 3 presents the overall calibration curve for all questions combined. These graphs were constructed by grouping confidence levels into 6 percentage groups (50-59%, 60-69%, 70-79%, 80-89%, 90-99%, and 100%) and plotted against the mean accuracy.

On average, respondents expressed overconfidence on every question except for question 8, in which the average confidence was lower (68.9%) than the average accuracy (82.1%). When survey respondents were 100% confident in their response, they were only accurate 81.7% of the time. When they were completely unsure of their response (i.e. 50% rated confidence), they were correct 49.5% of the time.

The slope was then calculated for the respondents' confidence ratings. As previously described (14), slope represents the difference between the confidence assigned to the correct and incorrect responses. The average confidence for correct answers was found to be 84.0%, and the average confidence for the incorrect responses was 73.3%, yielding a slope of 10.8 (95% CI : 8.95%-12.56% ; t_{132}= 11.7, P <0.001). For each question, the slope was positive, except for question 9, in which the slope was -17.6. A negative slope signifies that when respondents answered a question wrong, they were more confident in being correct of their answer than when they were actually correct.

Discussion

The results of this survey assessing anesthesiologists' knowledge and confidence with

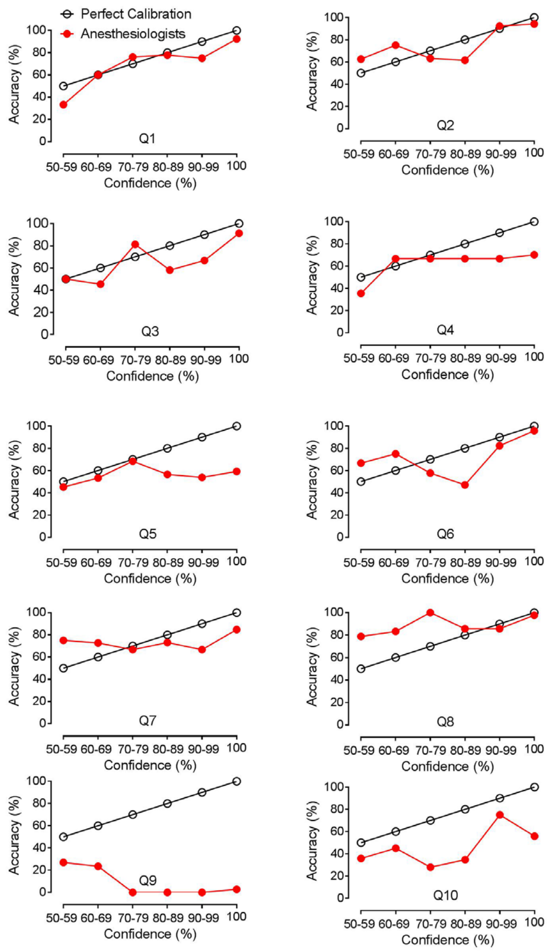

Fig. 2. — Calibration curves for individual questions with the black lines indicative of perfect calibration with concordance of accuracy and confidence while the red lines represent the responses from survey participants. Responses below the calibration curve represent overconfidence.

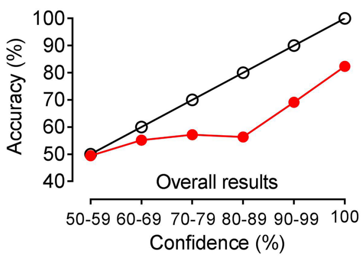

Fig. 3. — Calibration curve for the overall responses. The black line indicates perfect calibration with concordance of accuracy and confidence while the red line represents the responses from survey participants.

neuromuscular blockade management confirmed that misconceptions and lack of knowledge persist as an obstacle in reducing the incidence of PRNB. Overall, our respondents were accurate 72.4% of the time when asked straightforward, evidence-based questions regarding optimal neuromuscular blockade management. Furthermore, the respondents conveyed significantly higher confidence (79.8%)

than accuracy ($p < 0.001$). This combination of inaccuracy and overconfidence provides insight into the mechanism for PRNB persisting as a patient safety threat over the past 20 years (1-3).

Our results must be placed in the context of the recently completed, large international survey of anesthesiologists being asked mostly the same questions (14). When compared to this earlier work, our respondents were more accurate (72.4% vs 57%) and less confident (80% vs 84%). Although directly attributing this increased accuracy to differing societal guidelines is challenging, this discrepancy warrants further discussion. Neither the European Society of Anaesthesiology nor the American Society of Anesthesiologists have guidelines addressing optimal neuromuscular blockade management. Interestingly, the Belgian Professional Association of Specialists in Anesthesia and Resuscitation have published standards that mandate each anesthesia workstation be equipped with 'a monitor of neuromuscular function' (15). While this increased accuracy among the Belgian community is somewhat encouraging, our results still support the conclusion that 'overconfidence may be partially responsible for the failure to adopt routine perioperative neuromuscular monitoring'(14). This conclusion is also supported by the fact that when respondents were absolutely certain their response was correct (100% confidence rating), they were actually correct 81.7% of the time. Additionally, overall slope was found to be higher in the current survey when compared to the previous survey (10.8 versus 5.8, respectively). This difference is mostly due to a lower average confidence attributed to incorrect answers in the current survey than the previous survey (73.3% versus 79.7%, respectively). Regardless of this discrepancy between the two surveys, absolute confidence (of one's knowledge and practice) combined with inaccuracy likely serves as a significant impediment to changing clinical practice.

While our survey utilized mostly the same questions, there were some differences between this effort and the original work. We utilized 10 questions, rather than 9, with the additional question dealing with the role of neostigmine in reversing deep levels of vecuronium-induced neuromuscular blockade. This question was included as the authors felt this to be an important topic, particularly with the increased use of sugammadex and its use in antagonizing deep levels of neuromuscular blockade. Additionally, this survey was conducted in-person during a national conference, a characteristic that has the potential to reduce selection bias that could have existed with the previous large, electronic international survey. In other words, our survey captured a random segment of all participants who were present, providing a snapshot of the anesthesia community, independent of their interest in the topic or willingness to respond to an email and complete a survey regarding neuromuscular blockade management. Naguib et al acknowledge that perhaps anesthesiologists 'confident in their accuracy of their answers or interested in neuromuscular monitoring would attempt the survey', although this self-selection bias appears to have had little impact on their results as the amount of clinical experience of their participants did not impact their results (14). The previous survey was designed to be completed in < 10 minutes, while the respondents to this survey were afforded up to 90 minutes to compose their responses. Such temporal differences suggest responses in the previous work may have resulted from intuitive processing whereas less time pressure allows for more deliberate and analytical strategies (16). Also, our survey included a majority of anesthesiologists-in-training (56%), while the previous work only included anesthesiologists that had completed training. As this population was in training, they may have been recently exposed to evidence-based updates in anesthesia practice, which can account for the increase in their response accuracy. However, very little difference in accuracy was appreciated between respondents that had completed their formal anesthesia training and those that had not (72% versus 73%, respectively). Being closer to training with less clinical experience than seasoned anesthesiologists can also account for the respondents' having overall less confidence in their responses. Again, opening up the survey to all members of the anesthesia community facilitated obtaining heterogeneous data independent of training duration from all anesthesia providers and their approach to neuromuscular blockade management.

This study has several limitations. Given the similar design, it is prone to the same limitations of the previous work (14). While the questions used in both surveys were designed to investigate knowledge of quantitative neuromuscular monitoring, the specific verbiage dealt with NMBA and antagonism. However, this content has significant overlap and a foundation in pharmacology is paramount to understanding quantitative monitoring, leaving the survey questions particularly pertinent. Also, neither surveys questioned respondents about their own experience with quantitative neuromuscular monitors. While these surveys demonstrate gaps in knowledge, the ability of such awareness to drive improvements in clinical practice remains unclear. Additionally, the current survey has a smaller sample size than the previous work. However, given that this effort was completed at a single point in time at the occasion of a national conference, we are able to provide a denominator for the population that was available to be surveyed as well as the number of actual participants who completed the survey. Finally, this survey investigates a unique population as it ascertains perceptions with neuromuscular blockade management, regardless of whether the anesthesiologists have completed their formal training.

Indeed, postoperative residual neuromuscular blockade persists as a patient safety threat, despite several strategies being reported to reduce its incidence. With two substantial surveys demonstrating significant gaps in basic knowledge regarding NMBAs and their antagonism, long-held misconceptions must be addressed with (re) education to avoid complications such as critical respiratory events in the postoperative period. Unfortunately, the authors fear that such instruction could prove futile in the setting of an inappropriately overconfident anesthesia community, who may be less willing to adjust and ultimately improve their practice. An international panel of experts recently released a consensus statement addressing this issue (17) ; however, expansive educational efforts must continue. We hope that the insights from these surveys can serve as a catalyst for improvement in the Belgian and international community alike, and enable providers to deliver optimal anesthetic care.

Contribution of authors :

- JRR participated in data analysis and writing the manuscript.
- RN participated in data analysis and writing the manuscript.
- GC participated in writing the protocol of the study, data collection, data analysis, and writing the manuscript.
- SJB participated in writing of the manuscript.
- MVV participated in writing the protocol of the study and data collection.
- MN participated in writing of the manuscript.

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