South Afr J Anaesth Analg. 2022;28(3):104-108
https://doi.org/10.36303/SAJAA.2022.28.3.2746

South Afr J Anaesth Analg
ISSN 2220-1181 EISSN 2220-1173

ORIGINAL RESEARCH

Anaesthetists' knowledge and frequency of use of neuromuscular monitoring at the University of the Witwatersrand

MK Setsomelo, LT Lushiku, S Dingezweni

Department of Anaesthesiology, School of Clinical Medicine, Faculty of Health Sciences, University of the Witwatersrand, South Africa
Corresponding author, email: *mikekese@yahoo.com*

Background: The use of neuromuscular blocking agents (NMBA) during general anaesthesia (GA) can result in postoperative residual neuromuscular blockade (PRNMB). Studies have shown that PRNMB can be reduced with the use of neuromuscular monitors (NMM). Data from South Africa about the knowledge and use of NMM is scarce. Therefore, this study aimed to determine the knowledge and the frequency of use of NMM in the Department of Anaesthesia at the University of the Witwatersrand (Wits).

Methods: A prospective, contextual study design was employed using a self-administered online questionnaire developed by the researcher with the assistance of senior anaesthetists. The study population consisted of all anaesthetists working in the Department of Anaesthesia at Wits. A convenience sampling method was used and a completed returned online questionnaire implied consent. Adequate knowledge was defined as a score of 65.5%, as determined by the Angoff method.

Results: From a total of 208 anaesthetists, 126 completed the questionnaire. There was an inadequate level of knowledge of NMM among anaesthetists in the department. Sixty-four per cent (64%) of the participants achieved less than the score of 65.5% as set by the Angoff method. The participants' mean score for the questionnaire was 57%. The level of knowledge differs significantly among participants, depending on professional designation, with a p-value < 0.009. Medical officers and second-year registrars scored significantly below the Angoff score with p-values of 0.0005 and 0.02, respectively. First-year registrars recorded the highest score, followed by fourth-year registrars. The frequency of use of NMM in the department was low at 13%.

Conclusion: The level of knowledge among anaesthetists regarding NMM was inadequate. There is a need for the improvement of knowledge regarding NMM use, by ongoing education in the department. The use of NMM in the department was also low. The most common reason for not using NMM was the unavailability of these monitors.

Keywords: anaesthetists, knowledge, frequency, use, neuromuscular monitoring

Introduction

Neuromuscular blocking agents (NMBA) cause muscle relaxation and are often used during general anaesthesia (GA) to improve endotracheal intubation as well as the surgical condition.[1,2] The introduction of these agents in the early 1950s initially resulted in a higher mortality rate due to their inadequate reversal.[3] In 1965, Churchill-Davidson[3] demonstrated that a peripheral nerve stimulator (PNS) was the only method to assess the degree of neuromuscular blockade after NMBA were used.

There are mainly two types of neuromuscular monitoring (NMM) available for perioperative monitoring of neuromuscular blockade, namely: qualitative NMM and quantitative NMM. Qualitative NMM, also called a PNS, is a medical device that provides an electrical current to a peripheral nerve, causing the response of the muscle innervated by that nerve. The evaluation of the evoked response from the innervated muscle is done subjectively by the anaesthetist either through visual or tactile perception as the muscle responds to the electrical stimulation.[4,5] Quantitative NMM is a medical device that can objectively measure and display an evoked impulse, or a derivative of the measurement such as a train-of-four ratio (TOFR).[4,5]

A quantitative NMM is recommended over a qualitative NMM because of the ability to objectively pick up TOFR above 0.9.[3-6] In instances where a quantitative NMM is not available, a PNS should be used.[3]

NMM should be used in all patients who receive NMBA to reduce the risk of postoperative residual neuromuscular blockade (PRNMB).[3,5-7] The evaluation of clinical signs such as head lift and hand grip for five seconds in timing the adequate reversal of NMBA is inaccurate and unreliable.[3,5]

Baillard et al.[8] demonstrated that NMM use at their centre decreased PRNMB from 62% to 3%. In South Africa, Nell et al.[9] reported in 2004 that 43% of patients had PRNMB after the use of NMBA. Chetty et al.[10] conducted a study in South Africa in 2020 on 55 patients who received NMBA at Chris Hani Baragwanath Academic Hospital (CHBAH) and described an incidence of 45% of PRNMB. The same study by Chetty et al.[10] revealed that 6% of patients who received NMBA were monitored for PRNMB.

It is important to use NMM in patients who receive NMBA, but only few countries around the world have included NMM into their standard of care practice.[6] The American Society of Anesthesiologists (ASA) standard of intraoperative monitoring, which was affirmed in 2015, did not include routine NMM.[11] The South African Society of Anaesthesiologists (SASA) recommends the use of a peripheral neuromuscular transmission monitor when NMBA are used.[12]

The use of NMM decreases the incidence of postoperative complications caused by NMBA.[4,5,13] Studies from high-income countries (HICs) showed that a limited number of anaesthetists used NMM routinely in their daily practice, despite ample information supporting routine NMM in patients who received NMBA.[3,5-7,14] The knowledge of anaesthetists from HICs on NMM varies greatly.[14-16]

There is a scarcity of literature on the knowledge and frequency of use of NMM, especially in the middle- and low-income countries (LMICs). The knowledge as well as the frequency of use of NMM among anaesthetists in South Africa, specifically at the University of the Witwatersrand (Wits), are unknown. Therefore, the aim of this study is to determine the knowledge and frequency of use of NMM by anaesthetists working in the Department of Anaesthesia at Wits.

Methods

The study followed a prospective, contextual study design. Permissions to conduct the study were obtained from the Human Research Ethics Committee (Medical) (Certificate No: M200807 MED 20-07-154), the Graduate Studies Committee and the Academic Head of the Department of Anaesthesia at Wits.

The questionnaire was developed from reviewed literature and with the help of a local senior anaesthetist with a special interest in NMM. Permission to adapt and use some questions from a published questionnaire was also obtained from the author.[17] An extensive literature review was done to have a representative questionnaire on the topic, with additional face validity added by three senior anaesthetists working in the Department of Anaesthesia at Wits. The questionnaire consisted of two questions on demographics, 15 questions on NMM knowledge and five questions on frequency of use of NMM.

The study population comprised all consenting anaesthetists working in the Department of Anaesthesia at Wits. A convenient sampling method was used. During the time of the study, the Department of Anaesthesia at Wits had 208 anaesthetists who all received the questionnaire via email. The biostatistician determined that a minimum response rate of 125 (60%) is required for this study. Medical interns were excluded from participating.

The questionnaire was loaded onto Google forms and distributed to the participants via email because of the COVID-19 pandemic. The participants were required to complete the questionnaire and make the submission online. By returning the questionnaire, their consent to participate in the study was implied. Blank questionnaires were excluded from the study.

The Angoff method[18,19] was used to assess the adequacy of knowledge among participants and an Angoff score of 65.5% was determined by three consultants in the Department of Anaesthesia at Wits.

Data were analysed using Statistical Package for the Social Sciences (SPSS; Version 25, IBM Corporation). Categorical variables were reported using frequencies and percentages while data were described and analysed using descriptive and inferential statistics.

The Kolmogorov–Smirnov test was used to assess normality. An analysis of variance (ANOVA) test was used to compare whether professional designation would make a difference in level of knowledge. Also, one sample t-test was used to compare if the mean score of the questionnaire per professional designation differs significantly from the set Angoff score. A *p*-value of 0.05 was considered statistically significant.

Results

A total of 208 anaesthetists were available during the three months period of data collection. After multiple reminders, 128 anaesthetists replied to the online questionnaire. Of the 128 completed questionnaires received, two were excluded as they were returned blank. Therefore, 126 questionnaires were included in this study, which is more than the estimated sample size of 125 (60%) required when assuming an alpha value of 0.05.

The largest cohorts were medical officers with 29 (23%), followed by consultants with 25 (20%). The distribution of participants according to their professional designation is illustrated in Table I.

Table I: Participants' distribution according to professional designation

Professional designation	*n*	%
Consultant	25	20
Career medical officer	3	2
Registrar year 4	18	14
Registrar year 3	24	19
Registrar year 2	15	12
Registrar year 1	12	10
Medical officer	29	23
Total	126	100

Of the 126 participants, 45 (36%) showed an adequate level of knowledge based on the set score of 65.5% using the Angoff method. Of the 45 participants with adequate knowledge, 10 (22%) were consultants. The distribution of the Angoff scores according to professional designation is shown in Table II.

Table II: Angoff scores according to professional designation

Professional designation	Angoff score	
	Pass *n* (%)	Fail *n* (%)
Consultant	10 (40)	15 (60)
Career medical officer	1 (33)	2 (67)
Registrar year 4	9 (50)	9 (50)
Registrar year 3	9 (37.5)	15 (62.5)
Registrar year 2	4 (27)	11 (73)
Registrar year 1	6 (50)	6 (50)
Medical officer	6 (21)	23 (79)
Total	45 (36)	81 (64)

Table III: Distribution of mean score according to professional designation

Professional designation	*n*	Mean (SD)	*p*-value
Consultant	25	59 (17.2)	0.55
Career medical officer	3	42 (21.4)	0.20
Registrar year 4	18	63 (18.0)	0.55
Registrar year 3	24	61 (18.6)	0.28
Registrar year 2	15	53 (17.1)	0.02
Registrar year 1	12	66 (10.9)	0.99
Medical officer	29	47 (21.2)	< 0.0005
All anaesthetists	126	57 (19.1)	< 0.0005

The mean score attained by the participants was 57% (SD 19.1). Medical officers and second-year registrars scored significantly below the Angoff score of 65.5% with *p*-values of 0.0005 and 0.02, respectively. First-year registrars recorded the highest score. The distribution of mean score according to professional designation is shown in Table III.

The participants performed well in six of the questions and did not do well in three questions of the questionnaire. The proportion of correct and incorrect answers to specific questions are shown in Table IV.

The ANOVA test was used to compare whether the professional designation made a difference in the level of knowledge. The level of knowledge differs significantly depending on professional designation with *p*-value < 0.009.

First-year registrars showed the best knowledge of all the professional designations. Table V shows the comparison of level of knowledge across professional designations.

Table V: Comparison of level of knowledge across professional designation

Professional designation	Level of knowledge Percentage mean (SD)	*p*-value
Consultant	59 (17.2)	
Career medical officer	42 (21.4)	
Registrar year 4	63 (18.0)	
Registrar year 3	61 (18.6)	0.009
Registrar year 2	53 (17.1)	
Registrar year 1	66 (10.9)	
Medical officer	47 (21.2)	

Of the 126 participants, 110 (87%) do not use NMM. Only 16 (13%) mostly use NMM in their daily practice. The frequency of use of NMM by participants is shown in Figure 1.

Of the 126 participants, 91 (72%) reported not using NMM due to unavailability of it. Table VI shows reasons participants gave for not using NMM.

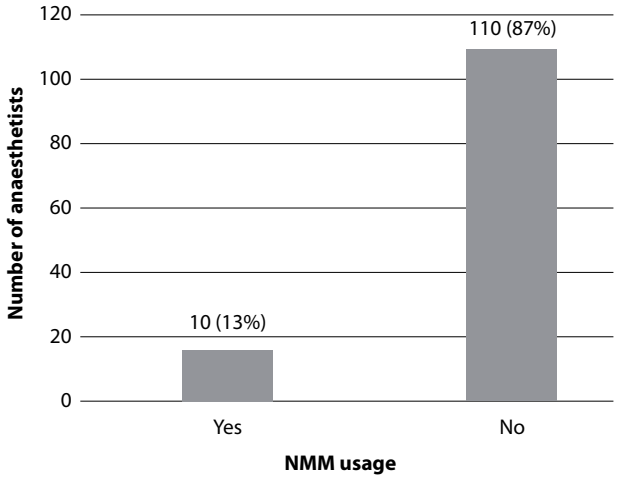

Figure 1: Use of NMM by participants

Table IV: Questions and proportion of correct and incorrect answers

Questions	Answers		*p*-value
	Correct	Incorrect	
1. Supramaximal stimulus definition	33 (26)	93 (74)	< 0.0005
2. Recommended site for neuromuscular monitoring	106 (84)	20 (16)	< 0.0005
3. Definition of postoperative residual neuromuscular blockade	72 (57)	54 (43)	0.13
4. Train-of-four description	74 (59)	52 (41)	0.61
5. Neostigmine administration	109 (87)	17 (13)	< 0.0005
6. Fade	94 (75)	32 (25)	< 0.0005
7. Return of airway reflexes	58 (46)	68 (54)	0.42
8. Double burst stimulus description	27 (21)	99 (79)	< 0.0005
9. Posttetanic count description	70 (56)	56 (44)	0.25
10. Posttetanic count application	77 (61)	49 (39)	0.02
11. Definition of deep block by posttetanic count	81 (64)	45 (36)	0.02
12. Factors that produce optimal nerve stimulation	65 (52)	61 (48)	0.79
13. Train-of-four prior to extubation	93 (74)	33 (26)	< 0.0005
14. Most common method to monitor neuromuscular block	68 (54)	58 (46)	0.42
15. Requirements to eliminate skin resistance in a nerve stimulator	44 (35)	82 (65)	0.01

Table VI: Reasons for not using NMM

Reasons	*n* (%)
Lack of availability of neuromuscular monitors	91 (72.2)
Limited knowledge on neuromuscular monitoring use	18 (14.3)
Time consuming	4 (3.2)
I use reversal agents in all patients who receive neuromuscular blocking agents	13 (10.3)
Total	126 (100)

Discussion

This study determined the level of knowledge and frequency of use of NMM among the anaesthetists working in the Department of Anaesthesia at Wits. The results show that the level of knowledge was inadequate among them, with 64% of the participants achieving less than the set Angoff score of 65.5%. The mean score of the questionnaire was 57%. This inadequate knowledge may be attributed to poor availability of objective NMM in the department as well as the lack of guidelines on the use of NMM in the department. A contributory reason for these low scores could be the lack of regular training, education and testing of anaesthetists on the subject.

A study conducted by Phillips et al.[14] in Australia and New Zealand in 2011, identified a lack of knowledge in the area of NMM among anaesthetists. More than 70% of the anaesthetists did not know a safe criterion to exclude PRNMB before extubation or the shortcomings of clinical sign use when NMBA were administered. This was mainly due to a lack of awareness on current literature on NMBA and NMM use.[14] The study emphasised that for the lack of knowledge to be addressed, there is need for availability of NMM accompanied by education.

In our study, 64% of the participants showed inadequate knowledge; also, there is poor availability of objective NMM as well as regular re-education on the use thereof. These are the same reasons highlighted in the Phillips et al.[14] study as factors to be addressed to improve knowledge on NMM. This is of concern, as PRNMB is high.[6,13] Naguib et al.[15] conducted a worldwide study in 2019 to explore anaesthetists' confidence in their knowledge of the core concept in NMM, the respondents obtained 57% in that questionnaire. The respondents' confidence in getting the answers right, however, was high. Our anaesthetists achieved the same percentage, with both questionnaires being focused on the core concepts of NMM.

In a Danish study conducted by Söderström et al.[16] in 2017, the anaesthetists were found to have adequate knowledge on NMM. Seventy-one per cent (71%) of their anaesthetists knew that TOFR needs to be above 0.90 to exclude PRNMB. In another two previously mentioned studies, the knowledge of participants varied widely (27–57%).[14,15]

Participants' adequate knowledge was attributed to the availability of NMM in Danish hospitals. In our department, we have poor availability of both objective NMM and PNS; therefore, the availability of these devices could help to improve the level of knowledge on the subject among our anaesthetists.

Regarding professional designations, this study has shown that first-year registrars had adequate knowledge with a mean score of 66%, which was above the set Angoff score. This could be attributed to the fact that most first-year registrars in our department had just written the first part of the Fellowship of the College of Anaesthetists (FCA) examination or completed their preparation to write this examination. Fourth-year registrars followed with better knowledge at 63%, which could be explained by the preparation for their exit examination. Career medical officers scored the least; however, the statistical significance was negligible because the sample size was too small for this group. Medical officers followed with significantly lower scores. This could be because most of the medical officers who joined the department were novices to the anaesthetic field. Second year registrars had a low score after medical officers; of importance to note is that this group of participants have both attempted their first part of the FCA examination as well as gained experience in anaesthesia. We could not find a reasonable explanation for the low score in this group of participants.

The use of NMM is recommended perioperatively whenever NMBA are used.[3,5,6,20] PRNMB can only be assessed by NMM as clinical signs are very unreliable.[7,21-23] Although there is consensus in the literature showing the need for NMM, the frequency of use remains low even in HICs.[24] This study has shown that the frequency of use of NMM in the department is low (13%), which is similar to the findings by Teoh et al.[7] However, their study indicated low use despite the availability of NMM, while finding that the lack of re-education as well as the unavailability of NMM in each theatre leads to its lack of use.

This is in keeping with our study, which showed that 72% of the anaesthetists do not use NMM because it is unavailable. It is important to note that the same study found that there was a discrepancy between high knowledge base on use of NMM and actual practical use of monitoring among the participants.

In 2020, a study conducted by Lin et al.[25] in Singapore found 18% of NMM use among their anaesthetists. This is in keeping with our study findings. The reason for the low rate of use of NMM in their study was found to be multifactorial and included undermining of the negative consequences and the incidence of PRNMB, inadequate training, the poor availability and the confidence in using PNS.[25] In our study, the two most common reasons stated were the unavailability of NMM (72%) and the lack of knowledge on NMM use (14%).

More studies show typical results on the use of NMM around the world, with 17% in a study in Australia and New Zealand, 8% in a study in Hungary and Romania and 10% in a study in the United Kingdom (UK).[14,21,26]

These study results show that the of use of NMM is low and this is congruent with 13% NMM use in the Department of Anaesthesia

at Wits. These findings raise a serious concern as PRNMB is high, with estimations at 20–50%.[6,13]

The possible limitations of this study are that it was done among anaesthetists in the Department of Anaesthesia at Wits, and it does not necessarily represent the level of knowledge and frequency of use of NMM among anaesthetists in South Africa. Academic knowledge does not necessarily translate to changed clinical practice. In determining the frequency of use of NMM in the Department of Anaesthesia at Wits, anaesthetists were not asked whether they use NMM in all the cases where NMBA were administered. The Angoff score was set at 65.5% pass mark by three anaesthetists with special interest in the subject. Perhaps with a larger group of experts, the pass mark would have been different as seen in other studies.[14-16]

Conclusion

The level of knowledge among anaesthetists with respect to NMM was inadequate. There is a need for improvement of knowledge regarding NMM use, by ongoing education in the Department of Anaesthesia at Wits. Formulating evidence-based guidelines which support the use of NMM in all patients who received NMBA will be beneficial. The use of NMM in our department is also low.

The most common reason for not using NMM was the un-availability of these monitors. Healthcare authorities have the obligation to increase the availability and accessibility of NMM. A national study on this subject is warranted to see if this is any different among anaesthetists across South Africa.

Acknowledgement

This research was done in partial fulfilment of a Master of Medicine degree at Wits.

Conflict of interest

The authors declare no conflict of interest.

Funding source

No funding was required.

Ethical approval

The study was approved by the Human Research Ethics Committee (Medical) and the Graduate Studies Committee of the University of the Witwatersrand (Certificate No: M200807 MED 20-07-154).

ORCID

MK Setsomelo https://orcid.org/0000-0002-0491-6038
LT Lushiku https://orcid.org/0000-0002-8492-861X
S Dingezweni https://orcid.org/0000-0002-9300-7724

References

1. Boon M, Martini C, Dahan A. Recent advances in neuromuscular block during anesthesia. F1000Res. 2018;7:167. https://doi.org/10.12688/f1000research.13169.1.
2. Barash PG, Cullen BF, Stoelting RK, Cahalan MK, Stock MC, Ortega R. Clinical anesthesia. 7th ed. Philadelphia, USA: Lippincott Williams & Wilkins; 2013. p. 524.
3. Naguib M, Brull SJ, Johnson KB. Conceptual and technical insights into the basis of neuromuscular monitoring. Anaesthesia. 2017;72(S1):16-37. https://doi.org/10.1111/anae.13738.
4. Murphy GS. Neuromuscular monitoring in the perioperative period. Anesth Analg. 2018;126(2):464-8. https://doi.org/10.1213/ANE.0000000000002387.
5. Brull SJ, Kopman AF. Current status of neuromuscular reversal and monitoring: challenges and opportunities. Anesthesiology. 2017;126(1):173-90. https://doi.org/10.1097/ALN.0000000000001409.
6. Duțu M, Ivaşcu R, Tudorache O, et al. Neuromuscular monitoring: an update. Rom J Anaesth Intensive Care. 2018;25(1):55-60. https://doi.org/10.21454/rjaic.7518.251.nrm.
7. Teoh W, Ledowski T, Tseng P. Current trends in neuromuscular blockade, management, and monitoring amongst Singaporean anaesthetists. Anesthesiol Res Pract. 2016;2016:1-6. https://doi.org/10.1155/2016/7284146.
8. Baillard C, Clec'h C, Catineau J, et al. Postoperative residual neuromuscular block: a survey of management. Br J Anaesth. 2005;95(5):622-6. https://doi.org/10.1093/bja/aei240.
9. Nell WT, Stevenson N, Ridgard T, et al. Post-operative neuromuscular function of patients receiving non-depolarising muscle relaxants at Universitas Hospital, Bloemfontein, South Africa. S Afr J Anaesth Analg. 2014;10:6-8. https://doi.org/10.1080/22201173.2004.10872344.
10. Chetty S, Hassim S, Perrie H, Parker M. Unrecognised postoperative residual curarisation in developing countries remains a common problem. S Afr Med J. 2020;110:1134-8. https://doi.org/10.7196/SAMJ.2020.v110i11.14759.
11. American Society of Anesthesiologists. Standards for basic anesthetic monitoring [Internet]. Washington, DC: American Society of Anesthesiologists; 2015. Available from: http://www.asahq.org/standards-and-guidelines/standards-for-basic-anesthetic-monitoring. Accessed 25 Oct 2019.
12. South African Society of Anaesthesiologists. Practice guidelines 2018 revision. S Afr J Anaesth Analg. 2018;24(2):S81. Available from: https://sasaapi.sasaweb.com//Newsletters/SAJAA(V24N1)2061SASAPracticeGuidelines_V12.pdf_636803073976212768.pdf. Accessed 14 Jun 2020.
13. Domenech G, Kampel MA, García Guzzo ME, et al. Usefulness of intra-operative neuromuscular blockade monitoring and reversal agents for postoperative residual neuromuscular blockade: a retrospective observational study. BMC Anesthesiol. 2019;19(1):143. https://doi.org/10.1186/s12871-019-0817-4.
14. Phillips S, Slewarl PA, Bilgin AB. A survey of the management of neuromuscular blockade monitoring in Australia and New Zealand. Anaesth Intensive Care. 2013;41(3):374-9. https://doi.org/10.1177/0310057X1304100316.
15. Naguib M, Brull SJ, Hunter JM, et al. Anesthesiologist's overconfidence in their perceived knowledge of neuromuscular monitoring and its relevance to all aspects of medical practice: An international survey. Anesth Analg. 2019;128(6):1118-26. https://doi.org/10.1213/ANE.0000000000003714.
16. Söderström CM, Eskildsen KZ, Gätke MR, Staehr-Rye AK. Objective neuromuscular monitoring of neuromuscular blockade in Denmark: an online-based survey of current practice. Acta Anesthesiol Scand. 2017;61(6):619-2. https://doi.org/10.1111/aas.12907.
17. Naguib M, Kopman AF, Lien CA, et al. A survey of current management of neuromuscular block in the United States and Europe. Anesth Analg. 2010;111(1):110-9. https://doi.org/10.1213/ANE.0b013e3181c07428.
18. Bellara A. Modified Angoff method. In: Bruce BF, editor. The SAGE encyclopedia of educational research, measurements and evaluation. 4th ed. Thousand Oaks: SAGE Publications; 2018. p. 1082-3.
19. Assessment strategies inc. The Angoff method of standard setting [Internet]. Ottawa: Assessment strategies inc; 2014. Available from: https://www.bcrsp.ca/sites/default/files/documents/Angoff%20Method%20Article.pdf. Accessed 7 Oct 2019.
20. Invernizzi JRR, Gopalan PD. Postoperative neuromuscular function following non-depolarising muscle blockade in patients at Inkosi Albert Luthuli Central Hospital, Durban. S Afr J Anaesth Analg. 2016;22(4):121-4. https://doi.org/10.1080/22201181.2016.1201293.
21. Pongracz A, Nemes R, Breazu C, et al. International survey of neuromuscular monitoring in two European countries: a questionnaire study among Hungarian and Romanian anaesthesiologists. Rom J Anaesth Intensive Care. 2019;26:45-51.
22. Di Marco P, Della Rocca G, et al. Knowledge of residual curarization: an Italian survey. Acta Anesthesiol Scand. 2010;54(3):307-12. https://doi.org/10.1111/j.1399-6576.2009.02131.x.
23. Fabregat López J, Candia Arana CA, Castillo Monzón CG. Neuromuscular monitoring and its importance in neuromuscular blockade. Rev Col Anest. 2012;40(4):293-303. https://doi.org/10.1016/j.rcae.2012.05.001.
24. Locks GdF, Cavalcanti IL, Duarte NMC, Da Cunha RM, De Almeida MCS. Use of neuromuscular blockers in Brazil. Braz J Anesthesiol. 2015;65(5):319-25. https://doi.org/10.1016/j.bjane.2015.03.001.
25. Lin XF, Yong CYK, Mok MUS, Ruban P, Wong P. Survey of neuromuscular monitoring and assessment of postoperative residual neuromuscular block in a postoperative anaesthetic care unit. Singapore Med J. 2020;61(11):591-7. https://doi.org/10.11622/smedj.2019118.
26. Grayling M, Sweeney BP. Recovery from neuromuscular blockade: a survey of practice. Anaesthesia. 2007;62(8):806-9. https://doi.org/10.1111/j.1365-2044.2007.05101.x.

Appendices available online.