A survey of neuromuscular blocking agents prescribing by medical professionals in New Zealand intensive care practice

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Abstract

***Introduction*: The optimal role of neuromuscular blocking agents (NMBA) in the management of ventilated ICU patients remains controversial. Guidelines suggest they should be reserved as rescue therapy, although more recent evidence suggests judicious NMBA use may reduce inflammation and mortality. NMBA use in New Zealand intensive care practice remains unmeasured.**

***Aim*: To describe the current NMBA use by NZ intensive care medical practitioners.**

***Method*: A representative from every NZ ICU was contacted to encourage ICU medical practitioners to complete an online multiple-choice survey over a period of two weeks. Low return rates were followed up with emails.**

***Results*:**

Who: 70 responses, 77% consultants, 43% intensive care specialists.

How: 68% never or hardly ever used NMBA in ICU ventilation. Of those using NMBA, 88% used it mainly or exclusively as a bolus, while none used only infusions. When using NMBA 64% used a pressure mode for ventilation, 27% used a volume mode, 27% preferred a form of SIMV. Neuromuscular monitoring was used rarely or never by 50% of respondents while 25% always used it.

Which: Practitioners most frequently used rocuronium, vecuronium and pancuronium.

For whom: NMBA use in ARDS, sepsis, post cardiac arrest, advanced gestation or morbidly obese patients were infrequent. Its use in head injury was moderate, while a high frequency of use was reported if there was a high FiO2/PEEP and the dyssynchronous mechanical ventilation occurred.

***Conclusion*: While the frequency of NMBA prescribing in NZ ICU is relatively low, there is considerable variation in the indications, monitoring, medication used, and end points targeted.**

Introduction

Positive pressure ventilation is an essential component in the current standard management of patients with severe reversible respiratory failure. The role of neuromuscular junction blocking agents (NMBA) in facilitating positive pressure ventilation in intensive care remains controversial and ill defined. (1-4) NMBA have been variously advocated to decrease oxygen consumption through reduction of the work of breathing, ablation of shivering and reduction of metabolic rates, as well as to increase oxygen delivery through improved ventilation. (1,2,4) Additional attributed benefits include the reduced potential for barotrauma, enhanced ventilator-patient synchrony, and an ability to reduce the inspired fraction of oxygen. Despite all of these putative benefits, there remains scant high-grade evidence to guide rationale use of NMBA in the critically ill patient.

Guidelines recommend that NMBA should be avoided due to the associated risk of prolonged neuromuscular weakness. (3,5) Other increased risks associated with NMBA use include the consequences of undetected disconnection

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for the respiratory circuit, inability to elicit important neurological signs, risk of patient awareness and recall in inadequately sedated patients, increased post-traumatic stress disorder, and reduction in supported spontaneous breathing and coughing. (1,6,7) Consensus guidelines suggest they should be reserved as rescue therapy, although more recent evidence suggests judicious NMBA use may reduce inflammation and mortality. (3,5-8) Previous unit surveys and point prevalence studies in Australia and New Zealand have suggested that NMBA use is probably not common. (9) The clinical circumstances when clinician would prescribe NMBA, the current prescription frequency and clinical targets aimed for in New Zealand intensive care practice use of NMBA is unknown.

The aim of our survey is to assess the current practice of using NMBA in the mechanically-ventilated patients among medical practitioners throughout the intensive care units (ICUs) of New Zealand. We hope to identify the preferred commonly-used agents, the indications, the mode of use, the mode of monitoring, the tendency for use in some clinical settings (like ARDS, head-injury), the expected targets of NMBA use and the potential side effects encountered.

Method

We designed 23 online questions with multiple-choice answers. The survey was pilot tested on a small group of independent intensive care physicians before circulating the online invitation. We approached a dedicated representative from each ICU in New Zealand to assist us circulating the invitation among all ICU practitioners of that department. Two weeks were allowed. Units with low or absent responses were re-approached through its Head of Department or other known medical members in an attempt to further circulate. Respondents were requested to participate only once. The results were subsequently filtered to ensure logic and accuracy (for example, those who answered they never used NMBA had their subsequent answers excluded as no more applicable, and those who never monitor NMBA usage were no more expected to choose means of monitoring).

The adjusted responses were subsequently tabulated as described in the results below using the software provided by the same website that hosted the survey (www.kwiksurveys.com).

Results

Demographics

The survey was first circulated on the 10th of January 2010. At the cutoff date of 1st February 2010 70 responses were completed, all of which belonged to medical practitioners who provided care to mechanically-ventilated patients in the setting of an ICU. Of these, 55 were consultant specialists, 15 were resident medical officers, 9 were non consultant senior medical officers and 1 an intensive care medicine fellow (**Figure 1**). Of these respondents, 43% were vocationally-registered in intensive care medicine (specialists) and 57% were not.

Of our respondents, 60% had 0-20 years of experience since their graduation (Bachelor's Degree). 6% had more than 40 years of experience (**Figure 2**).

Response to specific questions

When asked "What best described the (overall) frequency of their using NMBA (other than for airway procedures)" "Never", "Hardly ever", or only "Occasionally", with 3% replied "Often", 0% for the "Almost always" and "Always" options (**Figure 3a**).

This data was further analysed as per the respondents' years of experience. **Figure 3b** describes the results of the respondents with less than twenty years of experience and **Figure 3c** describes those from respondents with twenty or more years of experience.

There was no significant difference between the two groups ($p=0.99$).

Of those who indicated they used NMBA, none selected "Always infusion", 9% used it mainly as an infusion and occasionally in boluses, 3% used it in infusions and boluses in equal amounts, 50% used it mainly as a bolus and 38% indicated that they always used it in a bolus only (**Figure 4**).

Of those who do use it in a continuous infusion, 64% often, almost always or always interrupted on daily basis the continuous infusion of NMBA (**Figure 5**).

Of the responders, 27% of the NMBA users preferred some form of volume ventilation, rising to 38% if a volume

targeted pressure controlled were included, with 53% preferring other forms of pressure control. Other responses included BiLevel (x3 responses) and "No strict preference but always patient-context-sensitive". The data were further analyzed as per the years of experience (**Figures 6a-c**).

There was no significant difference in ventilation mode choices between the group below and above the median age bracket (p=0.65)

On a scale of 1-10, when asked to indicate the frequency of usage of NMBA as per each specific agent (apart from the purposes of routine airway procedures), where 1 indicated "NEVER" and 10 indicated "ALWAYS", the data were obtained as shown in **Table 1**.

There was no significant difference in choice of NMBA between the group below and above the median age bracket (p=0.74).

Faced with a mechanically-ventilated patient with ARDS 86% of respondents indicated they would never "Hardly ever" or only "Occasionally" use NMBA. No one opted for the "Always" option. Similar results seen through the different age bands of the respondents (**Figure 7**).

Apart from during routine airway and other procedures all clinicians would "Never" ,"Hardly ever" or only "Occasionally" use NMBA to manage a mechanicall-ventilated patient with sepsis. Similar results seen through the different age bands of the respondents (**Figure 8**).

When managing head injury, 74% "Never", "Hardly ever", or only "Occasionally", used NMBA. Similar results seen through the different age bands of the respondents (**Figure 9**).

Looking at the usage of NMBA within the context of a mechanically-ventilated patient post cardiac arrest and apart from routine airway and other procedures, 5% replied "Never", 38% replied "Hardly ever", 25% replied "Occasionally", 16% replied "Often", 9% replied "Almost always" and 8% replied "Always". Similar results were found through the different age bands of the respondents (**Figure 10**).

Looking at the usage of NMBA within the context of a morbidly-obese mechanically-ventilated patient and apart from routine airway and other procedures, 11% replied "Never", 64% replied "Hardly ever", 23% replied "Occasionally", 2% replied "Often", 0% replied "Almost always" and 0% replied "Always". Similar results were found through the different age bands of the respondents (**Figure 11**).

The usage of NMBA in the management of a mechanically-ventilated patient in an advanced stage of pregnancy only 2% replied "Often" and none replied "Almost always" or "Always". Similar results are seen through the different age bands of the respondents (**Figure 12**).

When asked about NMBA prescription in the management of a mechanically-ventilated patient who continues to be hypoxic despite high FiO2 and high PEEP, 54% hardly ever or occasionally used muscle relaxants, while 55% used it often or more frequently (**Figure 13**). Similar results were seen through the different age bands of the respondents.

Prescription of NMBA within the context of an adequately sedated, mechanically-ventilated patient who continues to be in dys-synchrony with the ventilator- (apart from routine airway and other procedures), 48% used NMBA "often" or more frequently (**Figure 14**).

When asked about their expectation regarding the association between NMBA usage and sustained muscle weakness (critical-illness neuropathy or myopathy), 2% of the respondents replied "Never", 33% replied "Hardly ever", 36% replied "Occasionally", 8% replied "Often", 2% replied "Almost always", Zero% replied "Always" and 20% were unable to ascertain to that association (**Figure 15**).

When asked about how often they think NMBA usage is associated with patient awareness, all clinicians responded that they were unable to assess or that NMBA use was never, hardly ever or only occasionally with patient awareness (**Figure 16**).

When asked about neuro-stimulation use to monitor patients on NMBA, the response were suggested that half never or hardly ever used monitoring during blockade (**Figure 17**).

Of those who do use neuro-stimulation for monitoring purposes, 0% preferred the single twitch, 80% preferred the train of four, 6% preferred post tetanic count, 10% preferred the double burst stimulation, 0% preferred muscle

relaxographs and 4% preferred a mixture of the above.

When asked about targets/end-points when using NMBA, the most frequent was synchrony, with just over a quarter respondents (**Figure 18**).

Lastly, when asked about the availability of set guidelines for the use of NMBA in their departments, 20% replied "Yes", 69% replied "No" and 11% replied "I don't know".

Discussion

The use of neuromuscular blockade in New Zealand intensive care is largely unmeasured and is the focus of this brief survey of intensive care medical practitioners in New Zealand ICUs. Intensive care services are provided in 24 public hospital units using a closed or semi closed model. Medical care of these patients is provided by the consultant and resident staff, who were surveyed in this study. Historically the consultant medical care was provided by a combination of anesthetists and physicians with a few emergency medicine physicians. The majority of intensive care consultants had formal anesthetic training. Of the 70 respondents in total, 30 of these were from Vocationally Registered (specialists) in Intensive Care Medicine (VR-ICM). This represents over half of thoseVR-ICM practicing medicine in New Zealand in early 2010. There were a further 25 consultant responders without VR-ICM. Overall this represents slightly under half those providing consultant services intensive care services to critically ill ventilated patients in New Zealand.

The Clinical Practice Guidelines for Sustained Neuromuscular Blockade in the Adult Critically Ill Patient produced by the task force of SCCM, and the latest Sepsis Guidelines have a similar overall message: it is recommended that NMBA be avoided where possible due to the risk of prolonged neuromuscular weakness following discontinuation. (3,5)

The latest Sepsis Guidelines recommendation have rated NMBA use at Grade 1B evidence, which is quite remarkable as the reviewers having noted that there is limited published evidence to support NMBA use in septic patients. (5) The Task Force recommendations provide a more conservative grading, acknowledging both the weaknesses. (3)

Pharmacological paralysis using NMBA migrated to the ICU from anesthetic practice. (10) Concern about disuse atrophy and neuro-myopathy have caused concern, and lack of improvement in short term surrogate markers of improvement although associated with use have not yet been shown to be causative in the critically ill. The available evidence suggested that prudent use of NMBA does not prolong weaning or produce other problems. In small trials maintenance of spontaneous breathing while using APRV is associated with improved outcomes, although its role in routine management of severe ARDS remains unclear. Use of small tidal volume, and protective lung ventilation would also likely to influence clinicians choices towards a more controlling NMBA regime, which will also continue to influence our practice. In the clinical scenarios tested most clinicians appear reluctant to use prescribe NMBA, with never more less than half the respondents would use the NMBA more than "occasionally'.

Clinicians faced with patients with resistant hypoxemia despite high inspired fraction of oxygen and elevated PEEP, such as in ARDS, appear more likely to utilize NMBA. Recent studies, published in full after this survey was completed, demonstrated a survival benefit from the systematic use of 48 hours of NMBA in patients with severe ARDS, without evidence of long term harm. (6) The mechanism of how this occurs is still unclear, although reduction in alveoli over-distension has been postulated. (10) Consensus committees updating neuromuscular blockade guidelines have yet to evaluate this new evidence, but this data may well influence future practice, especially in those with severe respiratory failure. If this option is to be used, clinicians need to consider improved outcome of longer term use (2 days) rather than identifying improvement in oxygenation and lung mechanics using short term changes.

Choice of mode of ventilation suggests a wide variation in practice. More respondent expressed a preference to the "pressure" modes of ventilation over "Volume" modes. "Standard" pressure control was the single most popular, although many chose one of the two forms of available SIMV. Of interest is that the years since graduation appeared to have minimal effect on the mode used.

Total dose and duration of neuromuscular blockade action were not investigated in this study. While many practitioners would have a view on the duration of use in reality NZ practice the registered nurse at the bedside would be the

clinician administering the majority of the medication. As most clinicians indicated their ignorance of or the absence of a NMBA protocol in their units, further enquiry into this is unlikely to produce meaningful results.

Rocuronium, vecuronium and pancuronium were the most commonly preferred. Choice of the agent may of course be controlled by the "impress" pharmaceuticals in the ICU, or the availability within the hospital. The agent cis-atracurium, used in the recent French studies and thought to be associated with reduced inflammatory response in ARDS, is not available in New Zealand. (3,6,8) However, atracurium was never used by 33%, and always used by only 5% of respondents. It is not clear whether any of the newer agents has any pharmacological advantages over any of the others.

Clinical circumstances like sepsis, post cardiac arrest, advanced gestation and morbid obesity seem not to be specific drivers for the use of NMBA. Head injury seems to be a moderate prompt. Although patients on high FiO2/PEEP and the dyssynchronous mechanical ventilation are more likely to precipitate the prescription of NMBA than other patients, its use even in these patients is still not common. The use of NMBA appears to be significantly lower than the use previously reported in other countries. (11,12) Whether this difference is due to temporal or geographical factors is not clear.

The limitations of this survey are many. Firstly, the survey did not result in returns from all practitioners, although encouragingly the sample taken reflected more than half of the VR-ICM, and nearly half of all intensive care practitioners. Secondly, the reported usage may differ from that of actual usage, because of some subtle reporting bias. Thirdly, the brief vignettes used for the clinical scenarios may not provide sufficient detail for clinicians to decide whether NMBA would be used. Nevertheless, the survey provides some insight into the current practice in New Zealand ICUs. Overall, this study suggests that the current prescription of NMBA in intensive care in New Zealand is low, is mainly prescribed as a bolus, monitored solely by clinical signs in the majority of cases, and the prescription of NMBA is not frequently controlled by an established unit protocol.

Summary

Who responded: 70 respondents, majority consultants in critical care in New Zealand, with greatest representation to the 10-20 years post graduation group.

How used: Bolus, rather than infusion.

Which agents: Rocuronium, vecuronium and pancuronium seem to be preferred.

For which patients: "Pressure" modes of ventilation were preferred over "volume" modes. The reported use of NMBA in clinical circumstances like ARDS, sepsis, post cardiac arrest, advanced gestation and morbid obesity were relatively low. Use in head injury was more common. Patients on high FiO2/PEEP and with dyssynchronus mechanical ventilation (despite adequate sedation) were more likely to receive NMBA than other patients, but its use was still not common.

Side effects: Expected moderate association with critical-illness muscle weakness and a lesser association with patient awareness.

Monitoring: Routine use of neuro-stimulation to monitor the NMBA effect was low, but when it was used, the practitioners utilized a Train of Four.

End-points: Synchrony seems to be a popular aim, followed by reducing the plateau pressures and/or reducing the FiO2 requirements.

Guidelines: Use of unit guidelines for the use of NMBA in our ICUs is not common.

Table 1. Frequency of usage of individual NMBA on a 1-10 scale (1=never used, 10=always used)

	1	2	3	4	5	6	7	8	9	10
Rocuronium	19%	22%	8%	5%	8%	6%	11%	6%	9%	6%
Atracurium	33%	22%	17%	5%	5%	6%	5%	0%	3%	5%
Vecuronium	42%	9%	8%	5%	5%	8%	3%	11%	2%	8%
Mivacurium	95%	5%	0%	0%	0%	0%	0%	0%	0%	0%
Pancuronium	42%	19%	5%	8%	3%	6%	3%	9%	3%	2%
Cisatracurium	97%	0%	2%	0%	2%	0%	0%	0%	0%	0%
Suxamethonium	69%	14%	5%	2%	2%	0%	2%	3%	3%	2%
Other	98%	0%	0%	2%	0%	0%	0%	0%	0%	0%

Figure 1. Distribution pattern as per the level of employment

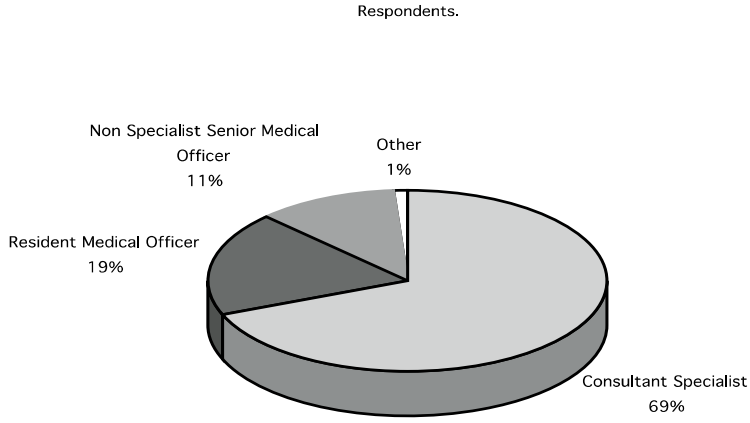


Figure 2. Distribution pattern as per the years of experience

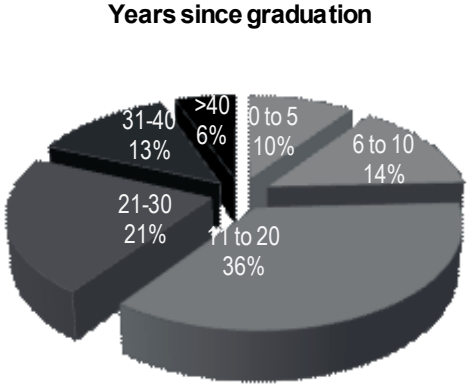


Figure 3a. Overall usage of NMBA among (all) respondents

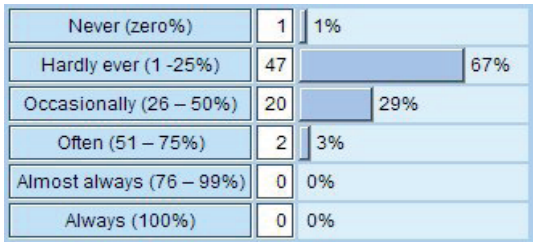


Figure 3b. Overall usage of NMBA among respondents with less than twenty years of experience

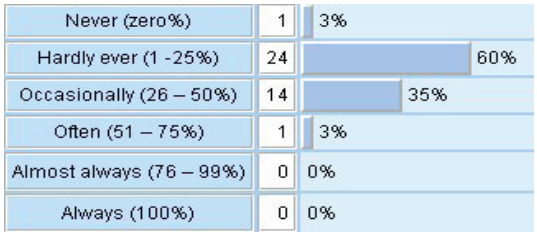


Figure 3c. Overall usage of NMBA among respondents with twenty or more years of experience

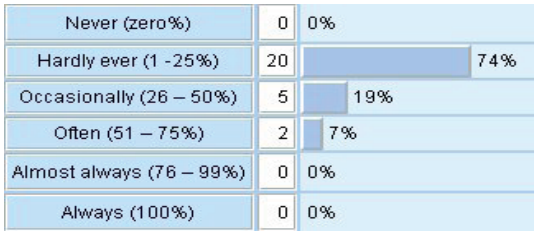


Figure 4. Mode of usage, bolus vs infusion

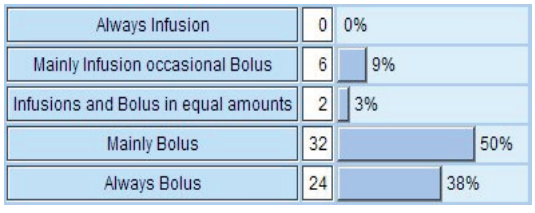


Figure 5. Tendency to interrupt continuous infusions on daily basis

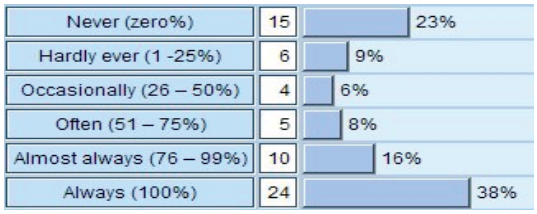


Figure 6a. Preferred mode of ventilation in combination with NMBA usage among all respondents

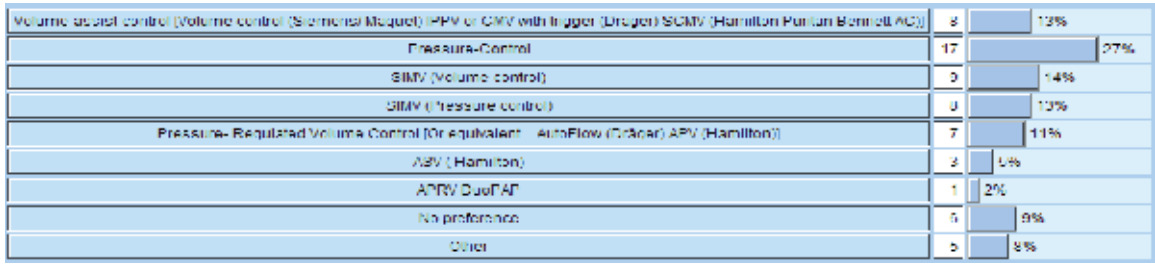


Figure 6b. Preferred mode of ventilation in combination with NMBA usage among respondents with less than 20 years of experience

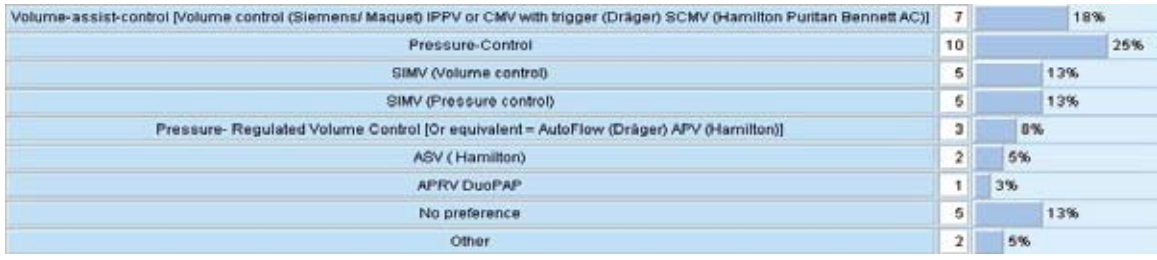


Figure 6c. Preferred mode of ventilation in combination with NMBA usage among respondents with 20 years or more of experience

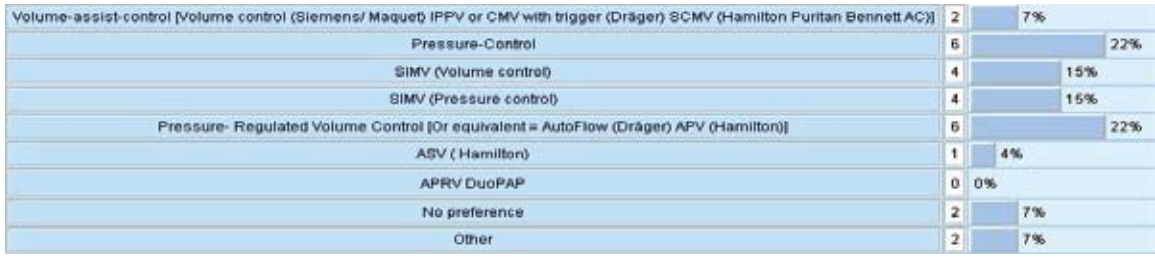


Figure 7. Tendency for use of NMBA in ARDS patients

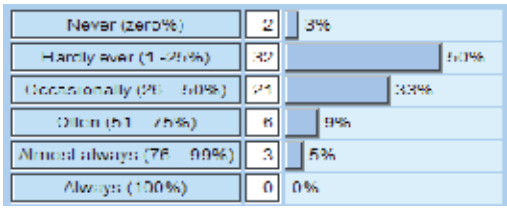


Figure 8. Tendency for use of NMBA in mechanically-ventilated sepsis patients

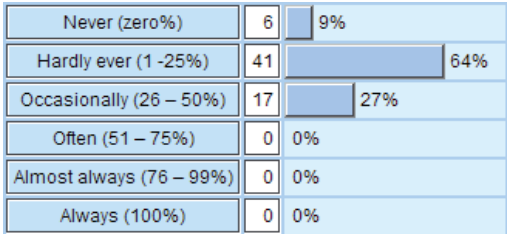


Figure 9. Tendency for use of NMBA in mechanically-ventilated head injury patients

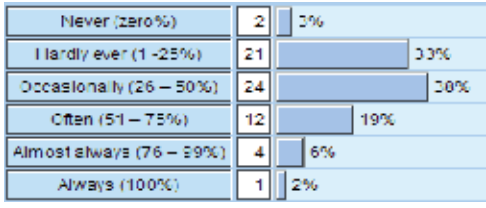


Figure 10. Tendency for use of NMBA in mechanically-ventilated patients post cardiac arrest

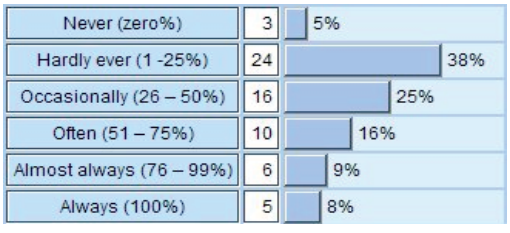


Figure 11. Tendency for use of NMBA in mechanically-ventilated morbidly-obese patients.

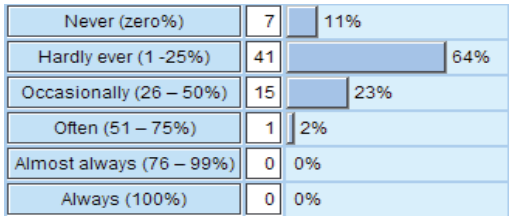


Figure 12. Tendency for use of NMBA in mechanically-ventilated patients at advanced stages of pregnancy

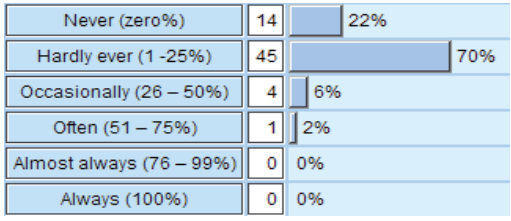


Figure 13. Tendency for use of NMBA in hypoxic mechanically-ventilated patients on high Fi02 and PEEP

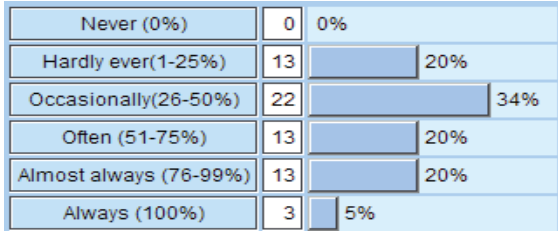


Figure 14. Tendency for use of NMBA in adequately-sedated, mechanically-ventilated patients in dyssynchrony with the ventilator

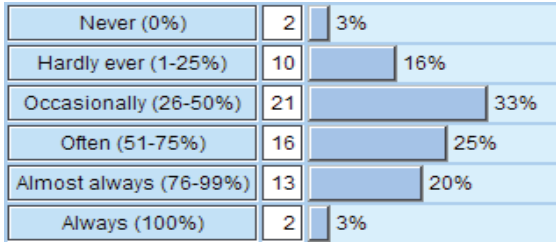


Figure 15. Expected association between NMBA usage and sustained muscle weakness

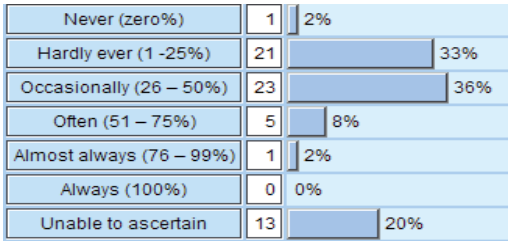


Figure 16. Expected incidence of awareness in association with NMBA usage

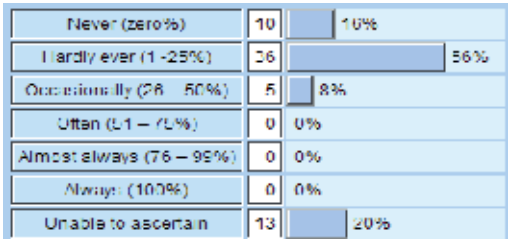


Figure 17. Use of neuro-stimulation to monitor NMBA

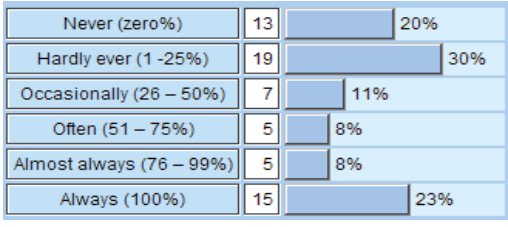
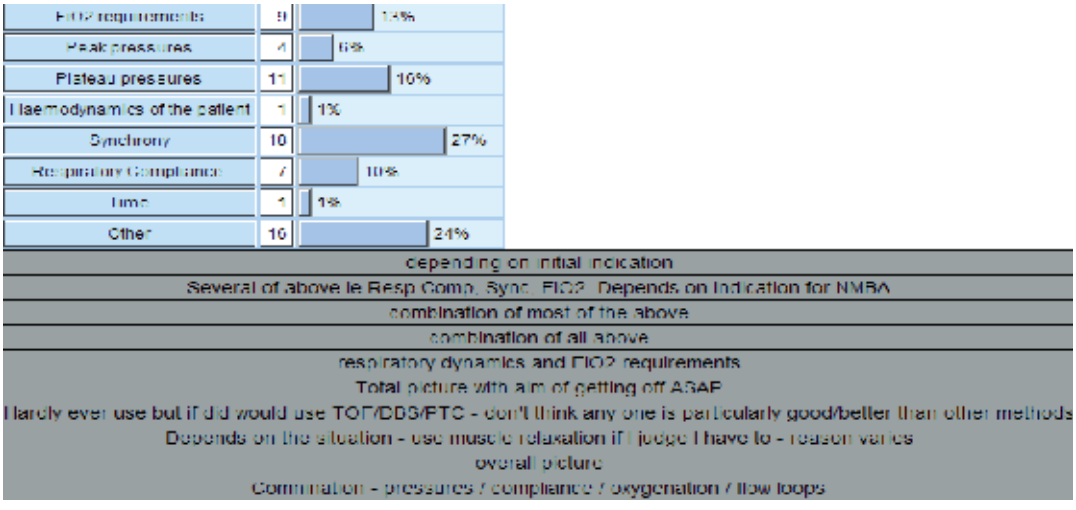


Figure 18. Targets/end-points to achieve when using NMBA



References

1. Freebairn RC, Derrick J, Gomersall CD, Young RJ, Joynt GM. Oxygen delivery, oxygen consumption and gastric intramucosal pH are not improved by a computer-controlled, closed-loop, vecuronium infusion in severe sepsis and septic shock. Crit Care Med 1997;25:72-7.
2. Murray MJ, Cowen J, DeBlock H, Erstad B, Gray AW Jr, Tescher AN, et al. Clinical practice guidelines for sustained neuromuscular blockade in the adult critically ill patient. Crit Care Med 2002;30:142-56.
3. Gainnier M, Roch A, Forel JM, Thirion X, Arnal JM, Donati S, et al. Effect of neuromuscular blocking agents on gas exchange in patients presenting with acute respiratory distress syndrome. Crit Care Med 2004;32:113-9.
4. Freebairn RC, McHugh G. Neuromuscular blockade in the optimal management of mechanical ventilation patients with respiratory distress. Curr Respir Med Rev 2010;6:223-8.
5. Surviving sepsis campaign guidelines. Pocket guide 2008. [Online] 2008 [cited 2009 Dec]; Available from: URL:http://www.survivingsepsis.org/GUIDELINES/Pages/default.aspx
6. Papazian L, Forel JM, Gacouin A, Penot-Ragon C, Perrin G, Loundou A, et al. Neuromuscular blockers in early acute respiratory distress syndrome. N Engl J Med 2010;363:1107-16.
7. Lemson J, Driessen JJ, van der Hoeven JG. The effect of neuromuscular blockade on oxygen consumption in sedated and mechanically ventilated pediatric patients after cardiac surgery. Intensive Care Med 2008;34:2268-72.
8. Forel JM, Roch A, Marin V, Michelet P, Demory D, Blache JL, et al. Neuromuscular blocking agents decrease inflammatory response in patients presenting with acute respiratory distress syndrome. Crit Care Med 2006;34:2749-57.
9. Shehabi Y, Botha JA, Boyle MS, Ernest D, Freebairn RC, Jenkins IR, et al. Sedation and delirium in the intensive care unit: an Australian and New Zealand perspective. Anaesth Intensive Care 2008;36:570-8.
10. Freebairn R. How relaxed should we be with acute respiratory distress syndrome? Crit Care Med 2004;32:296-8.
11. Hansen-Flaschen JH, Brazinsky S, Basile C, Lanken PN. Use of sedating drugs and neuromuscular blocking agents in patients requiring mechanical ventilation for respiratory failure. A national survey. JAMA 1991;266:2870-5.
12. Klessig HT, Geiger HJ, Murray MJ, Coursin DB. A national survey on the practice patterns of anesthesiologist intensivists in the use of muscle relaxants. Crit Care Med 1992;20:1341-5.

Appendix 1

Questionnaire

1. Are you a senior medical officer, and currently practicing in New Zealand?
□ Yes
□ No

2. Do you provide cares for ventilated patients in the setting of an Intensive Care Unit?
□ Yes
□ No

3. Are you Vocationally-Registered in Intensive Care Medicine?
□ Yes
□ No

4. Does your department have set guidelines for the use of NMBA?
□ Yes
□ No

5. What best describes the (overall) frequency of your using NMBA? (other than for airway procedures)
□ Never (zero%)
□ Hardly ever (1-25%)
□ Occasionally (26-50%)
□ Often (51-75%)
□ Almost always (76-99%)
□ Always (100%)

6. When it comes to the mode of usage -continuous infusion vs boluses- you would use NMBA in a continuous infusion?
□ Never used
□ Always infusion
□ Mainly infusion, occasional bolus
□ Infusions and bolus in equal amounts
□ Mainly bolus
□ Always bolus

7. If in a continuous infusion, do you routinely interrupt the infusion on daily basis?
□ Never (zero%)
□ Hardly ever (1-25%)
□ Occasionally (26-50%)
□ Often (51-75%)
□ Almost always (76-99%)
□ Always (100%)

8. If NMBA are used in ventilation, what mode of ventilation is used?
□ Volume-assist-control [Volume control (Siemens/ Maquet), IPPV or CMV with trigger (Dräger), SCMV (Hamilton, Puritan Bennett AC)]
□ Pressure-Control
□ SIMV (Volume control)
□ SIMV (Pressure control)
□ Pressure-Regulated Volume Control [Or equivalent=AutoFlow (Dräger), APV (Hamilton)]
□ ASV (Hamilton)
□ APRV DuoPAP
□ Other
□ No preference

9. Still within the setting of a ventilated patient, and apart from the purposes of routine airway procedures, what are the agents of choice you frequently use?
[Please record an estimate percentage of your usage to each agent below, up to a total of 100%)
□ Rocuronium (___%)
□ Atracurium (___%)
□ Vecuronium (___%)
□ Mivacurium (___%)
□ Pancuronium (___%)
□ Cistracurium (___%)
□ Other (___%)

10. Special considerations:
In a ventilated patient with **ARDS**, you would use NMBA:
□ Never (zero%)
□ Hardly ever (1-25%)
□ Occasionally (26-50%)
□ Often (51-75%)
□ Almost always (76-99%)
□ Always (100%)

11. Special considerations:
In a ventilated patient with **Sepsis**, you would use NMBA:
□ Never (zero%)
□ Hardly ever (1-25%)
□ Occasionally (26-50%)
□ Often (51-75%)
□ Almost always (76-99%)

□ Always (100%)

12. Special considerations:
In a ventilated patient with **head injury**, you would use NMBA:
□ Never (zero%)
□ Hardly ever (1-25%)
□ Occasionally (26-50%)
□ Often (51-75%)
□ Almost always (76-99%)
□ Always (100%)

13. Special considerations:
In a ventilated patient **post cardiac arrest**, you would use NMBA:
□ Never (zero%)
□ Hardly ever (1-25%)
□ Occasionally (26-50%)
□ Often (51-75%)
□ Almost always (76-99%)
□ Always (100%)

14. Special considerations:
In a ventilated patient **with morbid obesity**, you would use NMBA:
□ Never (zero%)
□ Hardly ever (1-25%)
□ Occasionally (26-50%)
□ Often (51-75%)
□ Almost always (76-99%)
□ Always (100%)

15. Special considerations:
In a ventilated patient **at an advanced stage of pregnancy**, you would use NMBA:
□ Never (zero%)
□ Hardly ever (1-25%)
□ Occasionally (26-50%)
□ Often (51-75%)
□ Almost always (76-99%)
□ Always (100%)

16. Side effects:
In your practice/experience, the NMBA usage is associated with sustained muscle weakness (critical-illness neuropathy or myopathy)
□ Never (zero%)
□ Hardly ever (1-25%)
□ Occasionally (26-50%)
□ Often (51-75%)
□ Almost always (76-99%)
□ Always (100%)
□ Unable to ascertain

17. Side effects:
In your practice/experience, how often is usage of NMBA associated with awareness?
□ Never (zero%)
□ Hardly ever (1-25%)
□ Occasionally (26-50%)
□ Often (51-75%)
□ Almost always (76-99%)
□ Always (100%)
□ Unable to ascertain

18. Monitoring:
In the setting of NMBA continuous infusions, do you monitor the patients with neuro-stimulation?
□ Never (zero%)
□ Hardly ever (1-25%)
□ Occasionally (26-50%)
□ Often (51-75%)
□ Almost always (76-99%)
□ Always (100%)

19. If you do use neuro-stimulation, which method do you often use?
□ Single Twitch
□ Train of Four
□ Post Tetanic Count
□ Double Burst Stimulation
□ Muscle Relaxaograph
□ Other

20. Targets and end-points - What applies best: You gauge the effect of and the on-going need for NMBA for ventilation through the:
□ FiO2 requirements,
□ Peak pressures,
□ Plateau pressures,
□ Haemodynamics of the patient
□ Synchrony
□ Respiratory compliance
□ Time
□ Other: _____