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A Survey on Current Practice on Management of Neuromuscular Blockade Monitoring in The State of Karnataka-A Questionnaire Based Study

Abstract
Introduction:
Neuromuscular blockade (NMB) is essential in modern anesthesia, enabling effective muscle relaxation during surgical procedures. However, inadequate monitoring can lead to serious complications, including residual paralysis and respiratory issues. Despite advancements in monitoring technology and increased awareness of the importance of NMB management, practices can vary significantly based on regional and institutional protocols. In Karnataka, where diverse healthcare settings exist—from advanced tertiary care centers to smaller district hospitals, the approach to NMB monitoring may differ widely.
Aim:
This survey evaluated current NMB monitoring practices among anesthesiologists in Karnataka, concentrating on neuromuscular monitoring, reversal of residual neuromuscular block, and the incidence of adverse events.
Methodology:
This cross-sectional survey used a structured questionnaire to assess NMB monitoring practices among anesthesiologists in Karnataka medical colleges from August to October 2024. An online Google form based survey was sent to anaesthesiologists practising in Karnataka medical institutions via email and whatsapp link, featuring questions on their observations and attitudes toward NMB monitoring techniques, residual neuromuscular blockade, the availability and use of monitoring equipment, the use of antagonists, and safe tracheal extubation criteria. Each anesthesiologist reported based on their practice of administering NMB agents during surgery. Quantitative data were analyzed using statistical software.
Results:
A total of 45.6% of respondents used both quantitative and clinical monitoring methods, while 54.4% reported no formal monitoring. Residual NMB was rarely encountered by 52.2% of participants. Notably, 60.9% frequently repeated muscle relaxants, indicating a potential risk for complications. Additionally, 32.6% noted incidents of residual paralysis, emphasizing the need for enhanced monitoring protocols.
Conclusion:
The findings reveal critical gaps in NMB management, highlighting the need for improved education and standardized protocols. Enhancing monitoring practices is essential for improving patient safety and outcomes in anesthetic care.

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I. Introduction

Neuromuscular blockade (NMB) is a critical aspect of anesthesia practice, facilitating surgical procedures by providing muscle relaxation and enabling intubation. However, the management of NMB must be approached with caution, as inadequate monitoring can lead to significant complications, such as residual neuromuscular blockade, which can result in postoperative respiratory issues and prolonged recovery times (1, 2). These risks highlight the necessity for effective monitoring techniques to ensure patient safety during and after anesthesia.

Quantitative neuromuscular monitoring, particularly using devices that measure the Train-of-Four (TOF) ratio, is recognized as the gold standard for assessing neuromuscular function. Studies demonstrate that reliance solely on clinical signs for recovery can be misleading, as up to 30% of patients may experience residual weakness despite appearing clinically ready for extubation (3). Implementing objective monitoring can significantly reduce the incidence of such complications, thereby enhancing patient outcomes (4).

Despite the known benefits, adherence to recommended monitoring practices remains inconsistent among anesthesiologists. Factors influencing this variability include the availability of monitoring technology, the level of training received, and institutional protocols (5). A survey conducted in different regions of India

revealed disparities in the use of neuromuscular monitoring techniques, suggesting that many practitioners may not be following best practices due to lack of awareness or resources (6).

In Karnataka, the landscape of anesthesia practices is diverse, influenced by a mixture of public and private healthcare settings, each with differing access to technology and training opportunities. Understanding current practices in this state is crucial for identifying gaps in knowledge and application of monitoring techniques (7). The lack of a unified approach can lead to regional variations in patient care, making it essential to gather data on how neuromuscular blockade is currently managed across various institutions.

This study aims to assess the current practices of neuromuscular blockade monitoring among anesthesiologists in Karnataka through a structured questionnaire. By collecting and analyzing this data, we hope to identify barriers to effective monitoring and areas in need of improvement. The findings will provide insights that can inform educational initiatives and enhance patient safety standards throughout the region.

II. Methodology

A cross-sectional survey was designed to assess the current practices and attitudes regarding neuromuscular blockade (NMB) monitoring among anesthesiologists in medical colleges across Karnataka. The survey was conducted over a three-month period from July to September 2024.

The target population for this survey included anesthesiologists working in medical institutions throughout Karnataka. Inclusion criteria were set to encompass all practicing anesthesiologists, regardless of their level of experience. Anesthesiologists who were not currently practicing or who worked outside medical colleges were excluded from the study.

A structured questionnaire was developed to capture a comprehensive range of information regarding NMB monitoring practices. The questionnaire included:

1. **Demographics**: Information on the anesthesiologist's age, years of experience, and OTs in hospital.
2. **Observations and Attitudes**: Questions assessing participants' views on the importance and frequency of NMB monitoring.
3. **Monitoring Techniques**: Inquiries about the specific monitoring techniques used (e.g., TOF monitoring, EMG) and their frequency of application during surgical procedures.
4. **Residual Neuromuscular Blockade**: Questions related to the anesthesiologists' experiences with residual neuromuscular blockade and their assessment methods for recovery.
5. **Equipment Availability**: Information regarding the availability and utilization of neuromuscular monitoring equipment in their institutions.
6. **Use of Antagonists**: Questions concerning the types of neuromuscular blockers used and the prevalence of antagonists (e.g., neostigmine) in practice.
7. **Extubation Criteria**: An assessment of the criteria used for safe tracheal extubation following NMB.

The questionnaire was piloted with a small group of anesthesiologists to ensure clarity, relevance, and comprehensiveness. The finalized questionnaire was distributed using an online Google Forms platform. A link to the survey was shared via email and WhatsApp with anesthesiologists practicing in various medical institutions across Karnataka. The invitation to participate included a brief description of the study's purpose and assurance of confidentiality regarding the responses.

Quantitative data collected from the survey responses were analyzed using appropriate statistical software. Descriptive statistics were calculated to summarize participant demographics and responses to the various questions. Results were reported as frequencies, percentages, and means as applicable. Ethical approval for the study was obtained from the Institutional Review Board (IRB). Informed consent was obtained from all participants prior to their participation in the survey. Participants were assured that their responses would remain confidential and used solely for research purposes.

III. Results:

Table 1: Demographics of Respondents

Demographic Variable	Category	Frequency (n)	Percentage (%)
Age	<30 years	9	19.6%
	30-40 years	12	26.1%
	41-50 years	15	10.9%
	>50 years	10	21.7%
Years of Experience	<5 years	11	23.9%
	5-10 years	12	26.1%
	>10 years	23	50.0%

Number of OTs including NORA	1-5	14	30.4%
	6-10	22	47.8%
	10-15	6	13.1%
	>15	4	8.7%

The age group 30-40 years has the highest representation at 26.1%, while those aged 41-50 years constitute the smallest proportion at 10.9%. Regarding experience, a significant majority (50.0%) have over 10 years, indicating a seasoned workforce. In terms of OTs, the 6-10 range is the most common, comprising 47.8% of respondents.

Table 2: NMB Monitoring Practices Among Participants

NMB Monitoring Criteria	Frequency (n)	Percentage (%)
For all cases	3	6.5%
High-risk patients only	15	32.6%
Geriatric patients only	2	4.3%
Critical condition patients only	3	6.5%
ASA 3 and above	10	21.7%
Patients with pre-existing conditions	11	23.9%
Patients on anti-seizure medications	2	4.3%

The majority of respondents (32.6%) monitor NMB for high-risk patients only, while monitoring for ASA 3 and above accounts for 21.7%. Notably, only a small percentage monitors all cases (6.5%) or focuses on geriatric (4.3%) and critical condition patients (6.5%). Patients with pre-existing conditions also represent a significant group for monitoring (23.9%).

Table 3: Methods Used for NMB Monitoring

Monitoring Method	Frequency (n)	Percentage (%)
Clinical method only	20	43.5%
Both quantitative and clinical methods	21	45.6%
Qualitative method only	5	10.9%

A slight majority (45.6%) employ both quantitative and clinical methods, indicating a preference for a comprehensive approach. The clinical method alone is used by 43.5%, reflecting a strong reliance on clinical assessment. In contrast, qualitative methods are the least utilized, with only 10.9% of respondents using this approach.

Table 4: Complications Encountered by Participants

Complication	Frequency (n)	Percentage (%)
Repeating muscle relaxants	28	60.9%
Residual paralysis	15	32.6%
Recurarization	0	0%
Failure to differentiate between cholinergic crisis and NMB paralysis	1	2.2%
Repeating reversal after 20 minutes, shifting patient to ICU, re-intubation	1	2.2%
No complications reported	1	2.2%

The most common issue reported is the repetition of muscle relaxants, affecting 60.9% of respondents. Residual paralysis is also significant, impacting 32.6% of cases. Notably, there were no reports of recurization, suggesting that this complication is not prevalent in this sample. Other complications, such as the difficulty in differentiating between cholinergic crisis and NMB paralysis, as well as the need for re-intubation or ICU transfer, were minimal, each reported by only 2.2% of respondents.

Table 5: Criteria for repeating Muscle Relaxants

Administration Criteria	Frequency (n)	Percentage (%)
Time-based administration	5	10.9%
Patient's breathing efforts	9	19.6%
Input from surgeons	0	0%
Visible patient movements	1	2.2%
Changes in vital parameters	1	2.2%
Capnography monitoring	2	4.3%
All of the above parameters	28	60.9%

A significant majority (60.9%) use all the listed parameters for administration, indicating a comprehensive approach. Patient's breathing efforts are considered by 19.6%, while time-based administration accounts for 10.9%. Minimal emphasis is placed on other criteria, such as capnography monitoring (4.3%) and changes in vital parameters (2.2%). Notably, there is no reliance on input from surgeons, suggesting that administration decisions are primarily clinician-driven.

Table 6: Monitoring Techniques Used

Monitoring Technique	Frequency (n)	Percentage (%)
Electromyography (EMG)	16	34.8%
Acceleromyography	2	4.3%
Kinemyography	2	4.3%
Phonomyography	1	2.2%
None	25	54.4%

A notable portion of respondents (34.8%) utilizes electromyography (EMG) as their primary method. However, a significant 54.4% reported using no monitoring technique at all, indicating a reliance on clinical judgment rather than objective measures for many practitioners. Other methods, such as acceleromyography and kinemyography, are infrequently employed (4.3% each), and phonomyography is used by only 2.2%.

Table 7: Agreement of anesthesiologists

	Never	Rarely	Sometime	Often	Always
How often have you encountered residual NMB in your PACU?	5 (10.9%)	24 (52.2%)	9 (19.6%)	4 (8.7%)	4 (8.7%)
How often do you use quantitative/ qualitative neuromuscular monitoring in your patients receiving muscle relaxant?	5 (10.9%)	13 (28.3%)	21 (45.6%)	5 (10.9%)	2 (4.3%)

A majority of respondents (52.2%) report rarely encountering residual NMB, while 19.6% and 8.7% say they sometimes and often experience it, respectively. In terms of monitoring, 45.6% use quantitative or qualitative methods sometimes, with 28.3% doing so rarely. Only a small percentage consistently utilize these monitoring techniques, indicating that while residual NMB is a recognized issue, the adoption of systematic monitoring practices remains limited among practitioners.

IV. Discussion

The findings from our survey on the current practices of neuromuscular blockade (NMB) management in Karnataka reveal significant insights into the monitoring and administration criteria employed by practitioners. A predominant theme across the results is the reliance on a combination of both quantitative and clinical methods for monitoring NMB, with 45.6% of respondents adopting this multifaceted approach. This suggests a recognition of the importance of objective measures alongside clinical judgment in ensuring patient safety during anesthesia (8, 9).

Notably, the data indicates a considerable gap in the use of advanced monitoring techniques, with a majority (54.4%) of respondents reporting no utilization of any formal monitoring method. This finding is concerning, given the established risks associated with residual NMB, particularly in the post-anesthesia care unit (PACU) (10). While the survey highlights that 52.2% of respondents rarely encounter residual NMB, the presence of this complication, even at low frequencies, underscores the necessity for improved monitoring practices to mitigate potential risks (11, 12).

The criteria for NMB administration predominantly involve comprehensive assessments, as indicated by the 60.9% of respondents who consider multiple parameters before administering neuromuscular blockers. However, the limited emphasis on time-based administration and the minimal involvement of surgeons suggest that decision-making may be primarily clinician-centric, which may overlook collaborative aspects of patient care (13). This finding aligns with previous studies that emphasize the importance of multidisciplinary approaches in enhancing patient outcomes (14).

Complications related to NMB management, particularly the frequent repetition of muscle relaxants (60.9%), highlight a critical area for further training and awareness among practitioners (15). The identification of residual paralysis in 32.6% of cases reflects a need for enhanced monitoring protocols, especially for high-risk populations (16). It has been documented that residual paralysis can lead to severe postoperative complications, thereby necessitating vigilant monitoring strategies (17).

The current practices identified in this survey underscore a significant opportunity for the implementation of standardized protocols for NMB monitoring and administration. Previous literature has shown that the adoption of such protocols can lead to improved patient safety and reduced complications associated with NMB (18, 19). Moreover, the integration of educational initiatives focused on the importance of neuromuscular monitoring could further enhance the knowledge and skills of anesthesiology practitioners in Karnataka (20, 21).

In conclusion, our study reveals both strengths and areas for improvement in the management of NMB in Karnataka. While there is a clear awareness of the complexities involved in NMB monitoring, the low utilization of advanced monitoring techniques and the frequent repetition of muscle relaxants signal a need for educational initiatives aimed at promoting best practices. Future research could explore the barriers to adopting such monitoring technologies and the potential benefits of training programs to enhance patient outcomes in anesthetic care (22).

V. Conclusion:

Our survey highlights significant gaps in neuromuscular blockade management in Karnataka, particularly regarding the low adoption of advanced monitoring techniques and the frequent repetition of muscle relaxants. These findings underscore the urgent need for enhanced education and standardized protocols to improve patient safety and reduce complications. Addressing these issues is vital for fostering safer anesthetic practices and better patient outcomes.

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