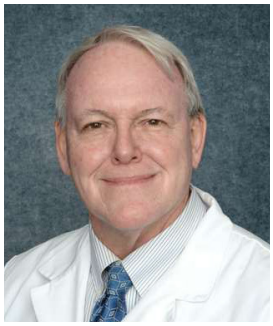
Improving Neuromuscular Monitoring: Key Role of Anesthesiology Technologists



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KEY POINTS SUMMARY

Quantitative EMG technology provides real-time information on key clinical indicators of neuromuscular function. It is highly accurate when key steps are taken during the initiation of monitoring, particularly the positioning of stimulating electrodes. EMG should be considered the clinical standard for informing the anesthetist of the appropriate time for tracheal intubation, the depth of neuromuscular block to facilitate drug dosing and the desired return of neuromuscular function (TOF ratio >0.90) for tracheal extubation.

INTRODUCTION

Anesthesia technicians provide an invaluable role in the anesthesia care team model (ACT) in the operating room (OR). Maintaining anesthesia machines and vaporizers in optimal function, assuring anesthesia equipment and pharmaceutical agents are readily available and in compliance with their date of use, assisting with patient transport and positioning in the OR, applying monitoring devices to patients, and often establishing arterial and venous access are integral roles that promote safe patient anesthesia care. The ACT model of care is an emphasis of the American Society of Anesthesiology (https://www.asahq.org/standards-and-practice-parameters/statement-on-the-anesthesia-care-

team). In this brief update, I wish to share evolving information on the critical nature of monitoring the neuromuscular function in anesthetic cases requiring the use of neuromuscular blockade.

QUANTITATIVE NEUROMUSCULAR MONITORING

Both the American Society of Anesthesiologists (ASA) and the European Society of Anaesthesiology and Intensive Care (ESAIC).1,2 recommend "quantitative" neuromuscular monitoring for patients receiving a paralytic drug during patient care under general anesthesia. "Quantitative" is a key adjective used to define monitoring. Qualitative monitoring is not encouraged and has been shown to put patients at risk from either the incorrect dosing of an additional paralytic drug or reversal drug or from postoperative residual muscle weakness. 3-7 What do we mean by the unwanted practice of qualitative monitoring? This would be visually observing or using tactile sensing of thumb motion/strength from a stimulus to the ulnar nerve (or other less ideal recording sites such as the facial nerve) or, even worse, not monitoring at all and trusting that neuromuscular strength has returned spontaneously or returned from a reversal drug such as sugammadex.

Quantitative monitoring means an accurate and meaningful output from ulnar nerve stimulation, either recorded from thumb movement detected by motion (such as acceleration from a sensor taped to the thumb, acceleromyography (AMG)) or recording the muscle action potential at the adductor pollicis muscle of the thumb from sensing electrodes placed at the base of the thumb (electromyography EMG)). While AMG monitoring requires the thumb to be free from obstruction, EMG devices work independently of thumb movement so that even with the arms tucked or wrapped, EMG signals are detected and reported on the monitoring device. EMG monitors are compact, have a user-friendly interface, and are programmed to report clinically significant EMG data in real time. They provide key measures of neuromuscular function, including train of four (TOF) ratio and TOF count, and will automatically, or by prompt, seek post-tetanic counts (PTC) during deep block to allow a complete understanding of the functionality of neuromuscular transmission.

Quantitative EMG monitors are now proving to be the most accurate devices for use in the operating room. They are essential for dosing neuromuscular blocking agents and reversal drugs and assuring sufficient return of patients' neuromuscular function at emergence from anesthesia. Challenges still exist with adopting routine neuromuscular monitoring in clinical practice.8,9,10 More importantly to the anesthesia technician community is the proper application of stimulating electrodes and initial activation of the EMG device before neuromuscular blocking drugs produce partial or full paralysis.

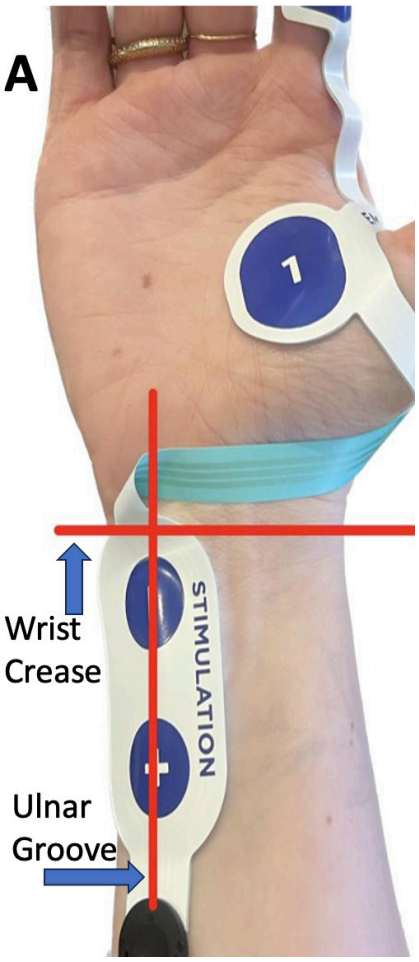

Figure 1. *Correct placement of the electrode array associated with the Blink, TwitchView system. It is essential to place the electrodes over and in alignment with the ulnar groove on the lateral part of the inner forearm. Placement near the wrist crease provides optimal signal transduction. Similar placement should be honored with the Senzime TetraGraph recording system.*

We are currently evaluating the relationship between the proper placement of the stimulating electrode array by anesthesia technologists that is required in EMG devices such as the TwitchView® monitor, Blink Device Co, Seattle, WA, and the TetraGraph® Senzime, Uppsala Sweden, and the end user (anesthesiologist) trust and satisfaction with the data on neuromuscular function. We have found that skin preparation and electrode placement are essential to reliable function. In this quality improvement project, the anesthesiology technologists initiated cleansing of the skin around the ulnar nerve area and with an education initiative, consistently placed the stimulating electrodes in the ulnar groove on the lateral side of the wrist and near the wrist crease (Figure 1), The end-user (anesthesiologists) trust in the data from the EMG devices used in each anesthetic case in the OR went from the 60% range to 90% with proper electrode positioning. Improper electrode

placement did not completely fail, but having EMG data that made sense to the anesthesiologist related to their dosing of paralytics and reversal of paralytics was best when the skin prep and the stimulating electrodes were placed properly. We assume that improving trust in the EMG systems promotes using quantitative EMG monitors and improves patient safety by avoiding the now well-described adverse effects associated with incomplete reversal of NM blockade, including postop respiratory challenges and increased hospital length of stay.3-7 Train of four ratios of 90% or greater is now the accepted value for the return of muscle strength such that patients can breathe well, cough, clear secretions, and avoid regional lung collapse (atelectasis) and postoperative pneumonia.

Guidelines on placement include removing skin oils, abrading the stimulation site, and allowing some curing time for the electrode-to-skin interface to become established. This is not always possible, and my sense is that proper anatomical placement is more important than the skin site preparation. The devices automatically determine the optimal stimulation intensity via their first activation sequence. I recommend that the guidelines that come with each device be reviewed, preferably in a group setting and possibly with the sales representative involved, to fully understand how the devices work in their optimal environment. It is also important to understand how the devices function when they are placed after the onset of paralysis when a baseline is not obtained. Most default to a common stimulus intensity as the maximum, but I do not want to mislead the reader in this regard. I have found nonsensical data often is displayed when our anesthesia care team has not placed the electrode array ahead of induction of anesthesia and has not performed the baseline calibration after the loss of consciousness and before the onset of paralysis. This might require communication with the anesthesia provider. If a rapid sequence induction is being performed, baseline data might not be possible. However, in a routine induction, you can ask the anesthesiologist to let you know if getting a baseline prior to or simultaneous to the administration of a paralytic is possible, thereby alerting the team to your role in activating the monitor for optimal measurements throughout the case. Recall that after IV bolus administration, rocuronium and vecuronium have an onset time of roughly 30 seconds, meaning a baseline can still be obtained when activating the NM monitor simultaneous to the administration of these paralytic drugs.

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Continuing Education Quiz

To test your knowledge on this issue's article, provide correct answers to the following questions on the form below. Follow the instructions carefully.

1. **What is the primary purpose of quantitative EMG technology in anesthesia?**
   A) Monitoring blood pressure
   B) Assessing heart rate variability
   C) Providing real-time information on neuromuscular function
   D) Analyzing respiratory parameters

2. **According to the text, what is considered the clinical standard for informing the anesthetist of the appropriate time for tracheal intubation?**
   A) Qualitative neuromuscular monitoring
   B) Quantitative neuromuscular monitoring
   C) Visual observation of thumb movement
   D) Tactile sensing of thumb strength

3. **What is a key aspect of anesthesia technicians' roles within the Anesthesia Care Team (ACT) model?**
   A) Performing surgical procedures
   B) Monitoring postoperative recovery
   C) Assisting with patient transport and positioning
   D) Administering anesthesia drugs

4. **Why is qualitative neuromuscular monitoring discouraged?**
   A) It provides real-time information
   B) It is highly accurate
   C) It increases the risk of incorrect dosing or inadequate reversal
   D) It requires less equipment

5. **Which adjective is used to define the recommended monitoring method for patients receiving paralytic drugs during general anesthesia?**
   A) Visual
   B) Quantitative
   C) Tactile
   D) Subjective

6. **According to the text, what value of TOF ratio is now accepted for the return of muscle strength before tracheal extubation?**
   A) 0.70
   B) 0.50
   C) 0.90
   D) 1.00

7. **What is the primary outcome of the quality improvement project mentioned in the text?**
   A) Increase in patient satisfaction scores
   B) Reduction in surgical site infections
   C) Improvement in trust in EMG data
   D) Decrease in anesthesia-related complications

8. **In what scenario might nonsensical data be displayed on the devices?**
   A) When the electrode array is placed after the onset of paralysis.
   B) When the devices are activated simultaneously with anesthesia induction.
   C) When the baseline calibration is performed before loss of consciousness.
   D) When the devices are used in routine inductions.

9. **What organization emphasizes the Anesthesia Care Team (ACT) model of care?**
   A) European Society of Anaesthesiology and Intensive Care (ESAIC)
   B) American Society of Anesthesiologists (ASA)
   C) World Health Organization (WHO)
   D) Centers for Disease Control and Prevention (CDC)

10. **How can a baseline still be obtained for the neuromuscular monitor during a rapid sequence induction?**
    A) By administering rocuronium or vecuronium after the baseline is obtained.
    B) By activating the monitor simultaneously with the administration of paralytic drugs.
    C) By delaying the administration of paralytic drugs until after obtaining the baseline.
    D) By consulting with the anesthesia provider.

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2.	A B C D	7.	A B C D
3.	A B C D	8.	A B C D
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