

Intraoperative Neuromuscular Monitoring: Electromyography Monitor Versus Peripheral Nerve Stimulator - Does the Face Lie?

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Introduction

- Quantitative train-of-four (TOF) monitoring with an electromyography (EMG)-based monitor provides a reliable method to evaluate the depth and recovery of neuromuscular block.
- However, subjective assessment using peripheral nerve stimulation (PNS) remains a common practice despite the well-known limitations of subjective (visual and tactile) evaluation.
- As an operator-dependent technique, the use of a PNS is not sufficiently sensitive to detect clinically significant TOF fade and increases the risk of postoperative residual neuromuscular block.

Objectives

Identify different sensitivities between respiratory and peripheral muscles to neuromuscular blocking agents and ascertain the difference between subjective evaluation and quantitative monitoring.

References

- Murphy GS. Neuromuscular monitoring in the perioperative period. *Anesth Analg*. 2018;126(2):464-468.
- Thilen SR et al. 2023 American Society of Anesthesiologists Practice Guidelines for Monitoring and Antagonism of Neuromuscular Blockade: A Report by the American Society of Anesthesiologists Task Force on Neuromuscular Blockade. *Anesthesiology*. 2023;138(1):13-41.

Case description

- An 8-year-old, 22.9-kg female with extrahepatic portal vein thrombosis, portal hypertension, splenomegaly, and pancytopenia returned to the operating room for revision of a distal splenorenal shunt.
- General anesthesia was initiated with midazolam, dexmedetomidine, and ketamine. Neuromuscular block was achieved with a rocuronium bolus (0.6 mg/kg) followed by an infusion (0.3-0.4 mg/kg/hr), titrated to maintain 1 TOF twitch using a TetraGraph™ (Senzime AB, Uppsala, Sweden) EMG monitor.
- Despite neuromuscular block, spontaneous respiratory efforts (curare cleft on the ETCO₂ waveform) and 4/4 TOF twitches were observed via facial nerve peripheral nerve stimulation (PNS). No other muscle movement was noted.
- A rocuronium bolus dose was given, and the infusion rate was increased to 0.48 mg/kg/hr.
- Toward the end of the procedure, the rocuronium infusion was stopped. Six minutes later, the TetraGraph™ showed 0/4 twitches, while facial nerve PNS showed 2/4 twitches with respiratory efforts. Another rocuronium bolus was administered.
- After 43 minutes, the TOF count (TOFC) was 1/4, and sugammadex (5 mg/kg) was given for reversal.
- Neuromuscular recovery was uneventful. The patient's trachea was extubated after confirming a TOF ratio ≥ 0.9 , and she was admitted to the PACU for postoperative care.

Conclusion

The sensitivity of various muscles to NMBAs is widely variable and muscle-dependent. While the diaphragm exhibits the lowest sensitivity (it is most resistant to total block), the pharyngeal muscles demonstrate the greatest sensitivity (they are blocked first and recover last).

This should remind us that an evoked response to a particular monitored muscle may not reflect recovery of other muscles.

At the same time, the proximity of the facial nerve to the corrugator supercilii and orbicularis oculi muscles represents a call for caution to avoid direct muscle stimulation, which is particularly likely when stimulating the facial nerve.

This limitation is addressed in the recent ASA Guidelines, which specifically discourage the use of the face as a site of neuromuscular monitoring. Importantly, these Guidelines also discourage the use of subjective evaluation with a PNS. We conclude that "the face lies."

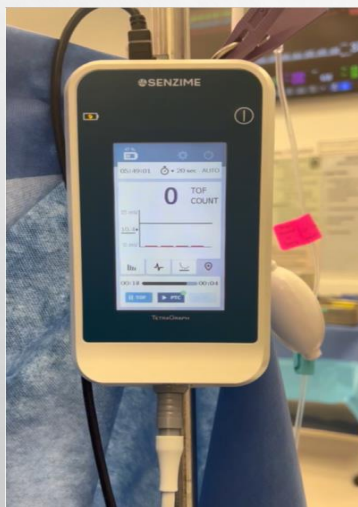


Figure 1: TetraGraph™ NMT EMG-based monitor (TOFC 0/4 measured every two minutes)

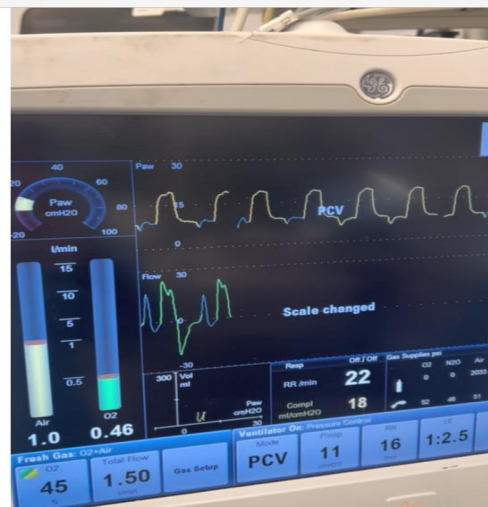


Figure 2: Pressure-controlled ventilation (PCV) mode with evidence of patient respiratory effort



Figure 3: Recording electrodes (palmar surface) and stimulating electrodes (forearm) from pediatric sized sensor (TetraSens™)