Examining Awake Volunteer Pain Scores and Operator Ease of Use of a Novel Neuromuscular Blockade Monitor

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Introduction

Postoperative residual neuromuscular blockade is a significant problem that exposes patients to unnecessary risks (hypoxemia, airway obstruction, unpleasant subjective symptoms, longer recovery, delays in extubation, increased risk of postoperative pulmonary complications and cost).[1] The use of peripheral nerve stimulators is common to guide management of neuromuscular blocking agents (NMBA). However, this technique relies on clinicians to subjectively determine the degree of fade in response to train-of-four (TOF) stimulation. This subjective assessment fails when TOF ratio is between 0.4 and 0.9, as sufficient recovery of block is defined as a TOF ratio ≥ 0.9.[2] Quantitative monitors are therefore preferred to help guide intraoperative management of neuromuscular blockade and accurately demonstrate complete recovery. Unfortunately, many of these quantitative monitoring techniques such as acceleromyography (AMG) and kinemyography rely upon freely moving muscles to determine the level of block. Surgical positioning with arms tucked to the side can often impede such movements, limit access to the hands, and preclude the use of these monitors. Electromyography (EMG) does not depend on freely moving muscles as the sensing electrodes measure electrical activity of the muscle that results from depolarization.[3] The authors describe their experience with a new EMG-based neuromuscular monitor, Tetragraph™ (Senzime, Uppsala, Sweden) and the specially-designed electrodes, and compare the level of discomfort associated with neurostimulation in comparison with an existing monitor, AMG-based TOF-Watch (Organon, Dublin, Ireland).

Methods

After IRB approval, 10 adult volunteers gave written informed consent. The skin overlying the ulnar nerve on the distal volar forearm was cleansed with alcohol and the Tetragraph™ stimulating electrodes were placed over this area. One sensing electrode was placed on the hypothenar eminence, and the other over the base of the 5th finger to record the response of the abductor digiti minimi to ulnar nerve stimulation. An anchor visual analog score (VAS) was obtained after single twitch stimulation at 30 mA to obtain a reference VAS for the volunteer. TOF stimulation at 20 mA, 30 mA, 40 mA, and 50 mA was delivered in random order, with the volunteer blinded to the intensity. VAS scores were obtained for each of these intensities, with each stimulation performed in triplicate. The TOF-Watch was then applied to the other arm with stimulating electrodes placed over the ulnar nerve. The accelerometer was taped to the thumb and the preload device was applied, as per manufacturer recommendations. VAS scores were then obtained in triplicate as for TetraGraph™.

Results

VAS scores obtained with Tetragraph™ were significantly lower than those obtained with TOF-Watch at intensities greater than 30 mA (Table 1). Furthermore, the device interface was intuitive and provided a TOF ratio that would be expected in healthy, awake adults.

Table 1. VAS Scores

Amplitude	TOF-Watch			TetraGraph			Correlation	*P*-value
	M	SD	CI	M	SD	CI		
20 mA	1.56	1.25	1.05-1.95	1.52	1.40	0.97-2.07	0.86	0.96
30 mA	3.11	1.58	2.72-3.95	2.89	1.93	2.13-3.65	0.50	0.35
40 mA	4.25	2.40	3.95-5.85	2.88	1.15	2.39-3.36	0.75	<.0001
50 mA	4.75	2.23	4.54-6.40	4.08	2.38	3.08-5.09	0.89	0.04
Overall	3.35	2.24	3.34-4.26	2.80	1.97	2.42-3.19	0.76	0.001

M= Mean; SD= standard deviation; CI = Confidence interval with range 5-95%

Conclusions

The Tetragraph™ monitor is a hand-held EMG device that produces less painful stimulation than the TOF-Watch device in awake healthy volunteers. The lower discomfort may be due to the larger stimulating area of the TetraGraph™ electrodes that decreases stimulating current density. The investigators found the monitor easy to use, required less than a minute for set-up and will begin exploring intraoperative applications.

References

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For disclosures:

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