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October 14, 2012
8:00:00 AM - 11:00:00 AM
Room Hall C-Area B

Generation of Electromyographic Evoked Response Curves Over a Range of Stimulating Currents

Sorin J. Brull, M.D., Jolanda A. Witteveen, M.Sc., David R. Hampton, Ph.D.
Mayo Clinic, Ponte Vedra Beach, Florida, United States

Background. The routine use of perioperative neuromuscular monitoring has been advocated as an important method of reducing the incidence of residual weakness (paresis or “recurarization”). In the clinical setting, clinicians most often use subjective criteria to evaluate the degree of neuromuscular block - either visual or tactile evaluation of “lack of fade” to train-of-four (TOF) peripheral nerve stimulation. Unfortunately, subjective evaluation is very poor at identifying residual paralysis. Objective evaluation is much more reliable and decreases the incidence of postoperative adverse events. The aim of this IRB-approved protocol is to describe the evoked neuromuscular response and the stimulus-response curves measured by a new electromyographic (EMG) device, the T4-EMG, over a range of stimulating currents.

Methods. In 10 consenting volunteers (8F/2M aged 26-44 yo, ASA 1-3, Wt. 122-215 lbs), single twitch (ST) and train-of-four (TOF) responses were recorded with the T4-EMG prototype. ST was delivered at varying currents, from threshold (Th) to maximal (Max) amplitude. Th current was defined as the lowest current able to produce a recorded action potential, and the Max current was 12 mA above Th. For all stimulations, the stimulus pulse width was constant at 200 µsec. Stimulating surface electrodes were placed along the ulnar and median nerves on the distal volar right and left forearms, and recording surface electrodes were placed on the thenar eminence to record responses of the adductor pollicis muscle (APM). ST stimulation was started at 1 mA, and was increased in 2 mA steps until a distinct and reproducible EMG threshold (Th) response was observed. Then, evoked responses were recorded while stimulus amplitude was increased from Th in four steps of 3 mA each. Monitoring of ST ended when the stimulus reached Th+12 mA, when amplitude of the evoked response generally reached a maximum (Max) (Fig 1).

Results. Recording of ST data revealed an average Th value of 14.2±4.7 mA (range, 6-27 mA), and an average Max value of 26.1±4.5 mA (range, 18-39 mA). Representative evoked ST response to increasing current amplitude T4-EMG tracing, from Th to Max, is shown in Fig 2.

Discussion. The intensity of neurostimulation (or charge, in µCoulombs, µQ) is the product of both current (in mA) and pulse duration (in µsec). As previously reported, ST evoked responses increased with increasing current amplitude (1). In our testing, pulse width was constant at 200 µsec, and the total charge of the ST stimuli varied between 1.2 µQ (6 mA Th current at 200 µsec) and 7.8 µQ (39 mA Max current at 200 µsec).

The Th values obtained with the T4-EMG prototype (1.2 µQ) were similar to those reported previously using EMG (1-3 µQ) (1). However, Max values recorded with the T4-EMG (7.8 µQ) are significantly lower than those reported previously (20-25 µQ) (1). Further studies should elucidate the relationship between stimulus charge, skin resistance, current density and patient characteristics.

References

1) Anesthesiology 1995;83: 702-9

Figure 1

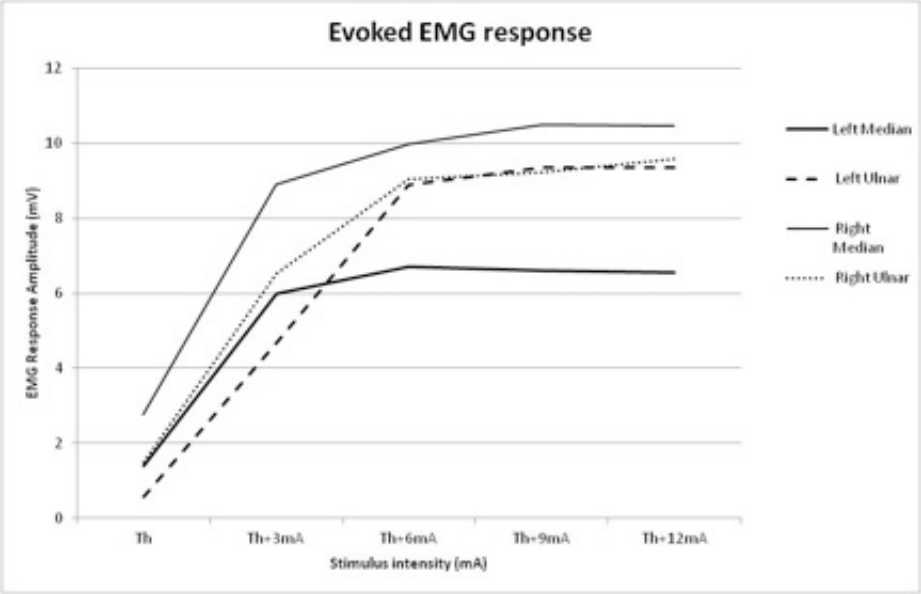

Figure 2