

TITLE: OPTIMAL ELECTRODE SITE ON THE HAND FOR EVOKED EMG MONITORING
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The characteristics of an evoked compound muscle action potential depend on the positioning of the recording electrodes.¹ To define surface electrode sites suitable for clinical monitoring of the neuromuscular blockade, a comparison of various sites was carried out under standardized isoflurane anesthesia.

After approval of the Hospital Ethics Committee, twenty ASA 1-2 patients (age 36-50 yrs) undergoing elective operations gave their informed consent. Anesthesia was induced with thiopental, fentanyl and succinylcholine 1 mg kg⁻¹. Isoflurane end-tidal concentration of 0.5% (O₂ / N₂O 1:2) was obtained in five minutes and was kept constant thereafter. Peripheral temperature was maintained and continuously measured. A stabilization period of thirty minutes was allowed for complete recovery of neuromuscular blockade and for the disposable surface electrodes to warm up. The position of the stimulation electrodes on the ulnar nerve was selected according to the best response with the neuromuscular relaxation monitor (Relaxograph®, Datex, Finland). This device was used for stimulation and pre-amplification in the comparison. Responses filtered from 60 to 330 Hz were analyzed with a memory recorder. Analysis of variance and t-test were statistical methods, p < 0.05 was regarded statistically significant.

During the second thirty-minute period the following surface recording electrode pairs were compared:

1. Adductor pollicis muscle	vs. second finger
2. First dorsal interosseus m.	vs. second finger
3. Abductor digiti minimi m.	vs. fifth finger
4. Adductor pollicis m.	vs. abductor digiti minimi m.

Supramaximal response was always obtained. Steady biphasic curves were recorded with electrode pairs 1-3.

Pair	Amplitude (mV)	Onset latency (msec)
1.	8.5 (2.0)	4.5 (0.3)
2.	12.5 (3.7)	4.8 (0.4)
3.	9.4 (2.0)	4.0 (0.1)

MEAN (SD)

The Interosseus muscle vs. 2nd finger response (pair 2) appeared sharp and steep compared with the others. Pair 4, an example of improper placement, resulted in a multiphasic low amplitude response. In all electrode positions, a close correlation (r=0.9, p<0.001) between the amplitude and the integrated area of the curve was found.

The first dorsal interosseus muscle response was optimal; this site may be recommended for clinical monitoring of the neuromuscular blockade.

Reference

1. British Journal of Anaesthesia 62: 188-193, 1989

Title: A METHODS-COMPARISON STUDY OF ACCELERATION, EMG AND FORCE RESPONSES DURING RECOVERY FROM A NON-DEPOLARIZING BLOCK IN CHILDREN
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The dose-response relationship of non-depolarizing relaxants is influenced by the monitoring method. This study intended to evaluate the correlation and technical error of two mechanomyographic monitors and one EMG monitor - the Accelograph® (ACC, Biometer), the Myograph® (FORCE, Biometer) and the Relaxograph® (EMG, Datex).

Following institutional approval and informed consent from the parents 18 children (ASA physical class I-II, 5.4±2.4 years, 18.9±4.5 years) (mean±1SD) were studied during elective surgery. Anesthesia was induced with thiopental and succinylcholine and maintained with isoflurane (1-1.5% insp.) in N₂O/O₂. The neuromuscular responses were measured at the left thenar region using train-of-four (TOF) stimulation of the ulnar nerve at the wrist. After stable FORCE and EMG responses had been obtained atracurium (0.2-0.4 mg/kg, n=9) or vecuronium (0.04-0.06 mg/kg, n=9) was administered. Simultaneous EMG and FORCE responses were recorded during spontaneous recovery. After the TOF-ratio had recovered to ≥0.90 increments of atracurium (0.05 mg/kg) or vecuronium (0.01 mg/kg) were given. Alternating measurements of ACC and FORCE responses were made during the second spontaneous recovery period. TOF recovery data were analyzed for each individual and for each method by best fit polynomial regression analysis (r² > 0.97). The standard error of the estimate (see) for each regression line was taken as a measure of the technical error. Corresponding data-points from the

calculated regression lines were analyzed by linear regression analysis and compared by analysis of variance and by a paired Student's t-test. A P-value < 0.05 was considered statistically significant.

A linear relationship was observed between the methods (table 1). The TOF-ratio for the ACC responses was significantly higher than for corresponding FORCE responses (P<0.0001). EMG TOF-ratio was significantly higher than corresponding FORCE responses in the atracurium group (P=0.03) at FORCE TOF-ratios of less than 0.60. The technical error of the ACC, the EMG and the FORCE monitors was 2.0%, 3.4% and 2.4% respectively. The technical error of the EMG differed significantly from the FORCE monitor (P=0.01), and from the ACC monitor (P=0.001).

These data indicate that although there is a fairly good linear correlation between the methods there are significant differences in the TOF recovery measured by acceleration, EMG and force in children. The data also suggest that mechanomyographic measurements may have a higher degree of precision than electromyographic measurements in clinical research.

Method	observ./patient	y-intcpt	slope	r ²	see
EMG _{atra}	8.7 ± 0.8	.18**	.80**	.92	.06
EMG _{vcc}	8.9 ± 0.3	.12*	.86*	.85	.09
ACC _{atra+vcc}	9.7 ± 0.7	.09*	.99	.94	.06

Table 1 illustrates linear regression data of TOF-ratio recovery for EMG in the atracurium group (EMG_{atra}=y, 78 observations) and for the EMG in the vecuronium group (EMG_{vcc}=y, 80 observations) and for the ACC (ACC_{atra+vcc}=y, 175 observations) compared to corresponding FORCE (x) measurements (mean±1SD). Significant differences from the line of identity are indicated by * P<0.05 and ** P<0.01.