

Title: Monitoring of neuromuscular transmission in infants and children: A comparison between an acceleration responsive transducer and a force displacement transducer.

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Introduction: An acceleration responsive transducer intended for monitoring of neuromuscular transmission has recently been introduced (1). A close correlation between evoked acceleration and evoked force has been demonstrated in adults. Since the small size of the new transducer makes it suitable for pediatric purposes a study was undertaken to investigate stability (group 1,2) and precision (group 3,4) of the acceleration transducer in comparison with a force displacement transducer, in infants and children.

Methods: Twenty-four children (group 1-3), age (mean, range) 4.2 years (1-8 years), weight 18.2 kg (10-30 kg) and eight infants (group 4), age 7.7 months (6-10 months), weight 8.6 kg (7.0-8.9 kg), ASA I-II, undergoing elective surgery were studied. The protocol was institutionally approved and informed parental consent was obtained. Anesthesia was induced with thiopental and maintained with halothane in N_2O/O_2 . Group 1 (n=8) and 2 (n=8) did not receive any neuromuscular blocking drugs and were studied during spontaneous breathing. Group 3 (n=8) and 4 (n=8) were studied during mechanical ventilation following intubation with succinylcholine and maintenance of relaxation with vecuronium. Repeated supramaximal train-of-four (TOF) (2 Hz, 4 c.p.m.) stimuli were applied to the ulnar nerves by surface electrodes. The evoked isometric adductor pollicis tension response was measured by a Myograph 2000 (Biometer) (FDT) and the evoked acceleration response by an Accelograph (Biometer) (ACT). To assess the stability of the transducers FDT registrations (group 1) and ACT registrations (group 2) were started after 20 min of stabilization at inspiratory halothane levels of 0.5-0.75% and followed for at least 50 min. The time needed to achieve a stable control twitch (TO), defined as 16 consecutive TOF readings with a SD of TO values of less than 2%, was determined. The correlation, in regard to TOF-ratios (T_4/T_1) between the transducers, were studied in group 3 and 4 by simultaneous FDT and ACT measurements during spontaneous recovery from vecuronium induced block. In order to evaluate the precision of each transducer a logit transformation of TOF-ratios with subsequent temporal linear regression analysis (2) of transformed data was carried out. For statistical analysis simple linear regression analysis, two-way analysis of variance, t-tests and F-tests were used. $P < 0.05$ was considered statistically significant. Values are indicated as mean \pm SD.

Results: Supramaximal stimulation was obtained at 38 ± 12 mA and thenar skin temperatures were $34.5 \pm 0.9^\circ\text{C}$. Stable TO readings in group 1 were obtained after 11.4 ± 6.1 min and in group 2 after 10.8 ± 4.5 min ($p > 0.4$). TO values of the FDT and the ACT were 100.0 ± 1.5 and 100.0 ± 1.2 respectively. At 30 min TO readings in group 1 were 100.3

± 1.7 min and in group 2 100.1 ± 1.6 ($p > 0.2$). Regression data of TOF-ratios obtained by the two transducers in group 3 and 4 are illustrated (Table 1 and fig. 1). Complete recovery values of TO were 99.6 ± 9.9 for the FDT and 101.6 ± 8.1 for the ACT ($p > 0.3$). Linearity was achieved by logit transformation and demonstrated r^2 -values above 0.95. There was no difference in precision between the FDT and ACT (FDT/ACT variance ratio 0.9, $p > 0.4$).

Discussion: The fairly good correlation between results obtained by the two monitoring systems demonstrated in this study is consistent with our findings in adults. These observations indicate that the acceleration transducer based monitoring system fulfills the basic requirements of a pediatric neuromuscular transmission monitor.

References:

1. Viby-Mogensen J, Jensen E, Werner MU, Kirkegaard Nielsen H, Acta Anaesthesiol Scand 1988;32:45-48.
2. May O, Kirkegaard Nielsen H, Werner MU. Acta Anaesthesiol Scand 1988;32:239-243.

Table 1. Linear regression data on TOF-ratios (ACT=y, FDT=x)

Group	n°obs.	y-intercept	slope	SEE	r^2	p
3	339	-0.05	1.05	0.07	0.95	<0.0001
4	329	0.12	0.96	0.06	0.94	<0.0001

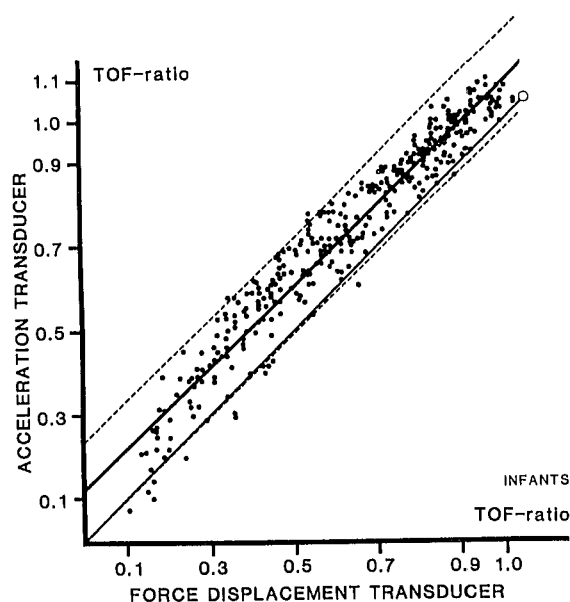


Fig. 1. Scatterdiagram of TOF-ratios in infants (group 4). Line of identity (-0) and the regression line with 95% confidence limits are illustrated.