TITLE: CONSISTENCY OF ACCELOGRAPHIC TRAIN-OF-FOUR RATIOS AT VARYING CURRENTS

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Introduction. Assessment of fade to train-of-four (TOF) nerve stimulation at supramaximal current remains the most commonly employed means of assessing adequacy of neuromuscular blockade and its subsequent reversal. It recently has been reported that mechanographic determination of the TOF with the aid of a force transducer remains consistent at various stimulating currents.[1] However, monitoring with a force transducer is hampered by a somewhat elaborate setup and by the necessity of adjusting thumb preload in order to obtain optimal tracings. Recently, a new method of TOF monitoring, the Accelograph (Biometer, Denmark) was shown to correlate with TOF ratio obtained by mechanographic means.[2] The purpose of the present study was to determine whether the TOF by Accelograph is consistently maintained at varying stimulating currents.

Methods. Following institutional IRB approval, 31 consenting patients undergoing anesthesia and endotracheal intubation were investigated. Following induction with intravenous thiopental, 4 mg/kg, and fentanyl, 1-2 mcg/kg, anesthesia was maintained with isoflurane 0.75-1.00% end tidal concentration, and 70% N_2O in O_2. After accelographic determination of supramaximal current, a vecuronium infusion was adjusted to achieve a TOF ratio of 0.1-0.9. Accelographic measurement of TOF was continued at 15-second intervals, and the neuromuscular responses were continuously recorded on an interfaced calibrated printer. Once the TOF ratio remained constant for at least 5 minutes, the responses to randomly delivered TOF stimulations at 20, 30, 40, 50 and 60 mA were recorded. The consistency of the evoked TOF responses at the varying currents was analyzed with signed rank test; $p<0.05$ was considered statistically significant. In order to ascertain the relationship between the degree of blockade and current intensity, evoked responses also were subgrouped as to whether the TOF ratio was above 0.4 or below 0.4.

Results. The consistency of evoked TOF responses at the different currents is illustrated in the table. There were no statistically significant differences between the TOF ratios obtained at the various currents. This consistency was maintained for T_4/T_1 ratios above 0.4 as well as below 0.4, with less than 2% difference between TOF at 20 mA and TOF at 60 mA overall and within each subgroup.

Discussion. Our data confirm the consistency of evoked TOF ratios over a range of neuromuscular blockade and at varying currents with the use of the Accelograph. In light of a recent report which indicated that testing at lesser current decreases patient discomfort,[3] accelographic determinations of TOF ratios at low stimulating currents should prove to be a valuable and accurate means of assessment in awake patients as well as a practical intraoperative technique.

TOF RATIOS (n=31)

Current	Mean ± SD	Median	(Range)
20 mA	67.4±41.4	54.0	(15-122)
30 mA	64.8±37.7	50.0	(17-115)
40 mA	66.6±41.4	57.0	(18-133)
50 mA	65.2±38.4	63.0	(17-118)
60 mA	66.3±37.1	60.0	(18-116)

p=ns for 20 vs 60, 30 vs 60, 40 vs 60, 50 vs 60

References
1. Anesthesiology 72:629-632, 1990
2. Acta Anaesthesiol Scand 31:1-4, 1987
3. Anesth Analg 70:S68, 1990

TITLE: SUCCINYLCHOLINE-INDUCED FASCICULATIONS: CORRELATION TO LOSS OF TWITCH RESPONSE AT DIFFERENT STIMULATING FREQUENCIES

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Introduction. The present study was undertaken to determine the relationship between the time course of fasciculations and twitch height depression at two rates of neurostimulation (0.1 Hz and 1.0 Hz) following succinylcholine administration.

Methods. Following institutional IRB approval, 20 patients scheduled for general anesthesia were studied. Prior to induction, patients received midazolam .02-.04 mg/kg and fentanyl 1-2 mcg/kg. Induction was accomplished with IV thiopental 4 mg/kg and 70% N_2O in O_2. After airway patency was established, the stimulating electrodes were placed over the olecranon groove and volar aspect of the forearm, and the thumb was inserted in an adductor pollicis force transducer (APM, Lifetech, Houston, TX) interfaced to a monitor with a stripchart recorder. Patients then randomly received either supramaximal single twitch at 0.1 Hz (n=9) or at 1.0 Hz (n=11). Succinylcholine 1 mg/kg was then administered as a rapid bolus (time 0). The times to start and end of fasciculations (FASC START and FASC END) and times to 25%, 50%, 90% and 100% twitch height depression (T25, T50, T90 and T100, respectively) were recorded. Data were analyzed by independent t-test, and were expressed for each group as mean±SD, median and range; $p<0.05$ was considered statistically significant.

Results. One patient in each group did not exhibit fasciculations and was excluded from analysis. As expected, the FASC START and FASC END were similar in both groups. In contrast, the T25, T50, T90 and T100 were significantly longer in the 0.1 Hz group. Comparison of time course of fasciculations to twitch depression noted that the mean length of time between the FASC END and T90 was significantly shorter in the 1.0 Hz group than in the 0.1 Hz group (5 sec vs. 35 sec). Whereas the mean T100 was within 10 seconds of the FASC END in the 1.0 Hz group, it was 54 seconds later in those in the 0.1 Hz group ($p<0.05$ for difference between groups). Moreover, one of the eight patients in the 0.1 Hz group did not reach 100% depression, while all 10 patients in the 1 Hz group exhibited this twitch depression.

Discussion. It has long been appreciated that rapid stimulation may increase delivery of relaxant to the neuromuscular junction as well as promote fatigue.[1] The present data emphasize the importance of standardizing neurostimulating rate in evaluating the onset of succinylcholine. Furthermore, the data help explain why intubation immediately upon termination of fasciculations may be associated with inadequate relaxation. This may complicate intubation, allow diaphragmatic contraction and lead to an increase in intragastric pressure with possible regurgitation and aspiration.[2]

COMPARISON OF TIMES (seconds)

	0.1 Hz (n=8)		1.0 Hz (n=10)	
	Mean±SD	Median(Rng)	Mean±SD	Median(Rng)
FASC START	22.3±5	21.5(16-30)	16.8±5	17.0(8-24)
FASC END	45.9±8	45.5(35-56)	43.6±9	42.0(36-66)
T50	61.3±14	59.0(37-83)	38.3±3	38.0(34-43)
T90	81.3±17	79.0(57-109)	48.6±8	47.0(40-69)

References
1. Br J Anaesth 59:989-994, 1987
2. Br J Anaesth 58:498-501, 1986