

Title: THE EFFECTS OF ANESTHETIC AND SEDATIVE AGENTS ON MAGNETIC MOTOR EVOKED RESPONSES
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INTRODUCTION: There is considerable interest in developing a monitoring technique which would permit intra-operative assessment of motor pathways. It has been demonstrated that a pulsed magnetic field applied to peripheral nerves or the brain will evoke a motor response (1). As an initial examination of the feasibility of the intraoperative use of this technique, we have undertaken preliminary investigations of the effect of sedative agents (midazolam [M] and fentanyl [F]) and general anesthesia (pentothal, isoflurane, and N2O) on magnetic motor evoked responses.

METHODS: The protocol was approved by the local Human Subjects Committees. A Cadwell MES-10 was used to generate electro-magnetic stimuli. To date, 11 unpremedicated, consenting subjects (age 29-68) have been studied. The evoked EMG was recorded from gold disk electrodes (Grass) placed on the thenar eminence. The ground electrode was on the volar aspect of the mid-forearm. Stimuli were delivered at two locations: the ulnar nerve at the elbow and the brain over the contralateral parietal area. The scalp was marked at the location that evoked the maximum gross motor response. Baseline EMG recordings were obtained in quadruplicate in response to ulnar nerve stimulation (U), cranial stimulation (Cr), and cranial stimulation during facilitation of muscle activity (CrF). Facilitation was achieved by having the subject squeeze a rolled blood pressure cuff to a pressure of 20 mmHg with the hand from which recordings were made. Thereafter, subjects received either M, 2-6 mg (n=6), or F, 100-150 ug (n=2), intravenously over 60-120 seconds. EMG responses to U, Cr, and CrF stimulation were then recorded sequentially for 30-45 minutes. Recordings were performed over a similar period in 3 control subjects who received no medication. In 3 patients, recordings were repeated after induction (pentothal, 5-7 mg/kg) and during maintenance (N2O, isoflurane) of general anesthesia.

RESULTS: After administration of M or F, the amplitude of the EMG response to Cr and CrF stimulation decreased significantly (see Table). In some patients, there was evidence of recovery in the later recordings. There was no significant change in the amplitude of the EMG response to U stimulation after administration of M or F. The decrease in EMG amplitude was greater for Cr than for CrF stimulation after both M and F. There were no significant changes in EMG amplitude to U, Cr, or CrF stimulation in control subjects. The EMG changes in M and F treated subjects were similar and the these data have been combined for the graphic presentation in the Figure. During general anesthesia, responses were obtained to U but not to Cr stimulation.

DISCUSSION: M and F caused a decrease in the amplitude of the EMG response to Cr and CrF stimulation. It is probable that this is a central effect since the U response did not decrease after M or F. The lesser degree of amplitude decay observed for CrF stimulation suggests that drug effects are attenuated by muscle activity and/or subject arousal. This implies that the changes observed may be related to agent-specific effects and/or to nonspecific effects of decreased arousal. The absence of EMG response in anesthetized patients may represent greater degrees of either or both of these influences. Our results suggest that this monitoring modality may be difficult to employ during

administration of sedative or anesthetic agents but, pending further study, they should not be assumed to apply for stimulus parameters or combinations of agents other than those examined herein.

REFERENCES: 1. Barker AT, Jalinous R, Freeston IL: Noninvasive magnetic stimulation of human motor cortex. *Lancet* 2: 1106-1107, 1985.

EMG AMP	CTRL			MIDAZ			FENT		
	U	Cr	CrF	U	Cr	CrF	U	Cr	CrF
MAX Δ	23±7	17±9	13±7	6±13	-62±5*	-38±4*	38±9	-47±2*	-40±1*
FINAL	3±13	-5±6	11±8	10±11	-28±15	-20±11	2±2	-33±7	-33±7

Table. Percent change in thenar EMG amplitude after ulnar (U), cranial (Cr), and facilitated cranial (CrF) stimulation in control (CTRL), midazolam treated (MIDAZ), and fentanyl treated (FENT) subjects. Data are presented as maximum observed change (MAX Δ) and value at final pre-induction recording (FINAL). Values are mean ± S.E. *indicates significant difference from baseline recording.

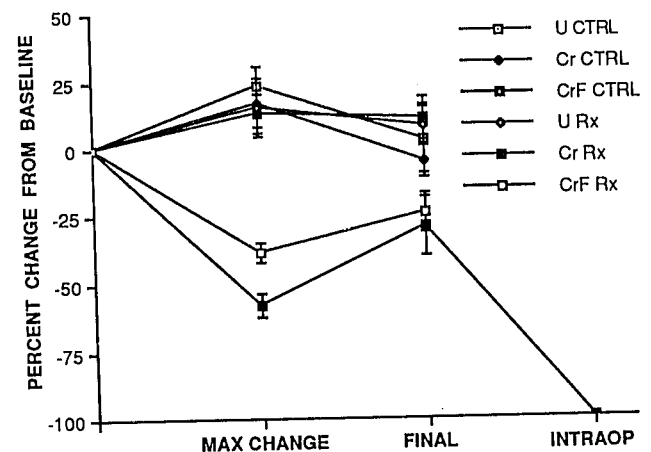


FIGURE. Changes in thenar EMG amplitude in response to ulnar (U), cranial (Cr) and facilitated cranial (CrF) stimulation. Values are expressed as percent change ± SE from baseline value prior to drug administration. Data are for untreated control (CTRL) subjects (n=3) and subjects who received either midazolam or fentanyl (Rx) (n=8). Responses to cranial stimulation were unrecordable after induction of general anesthesia (INTRAOP, n=3).