Anesthesiology
69:807, 1988

The Dose-effect Relationship of Metocurine: EMG *Versus* MMG

To the Editor:—I read with great interest the recent Clinical Report by Kopman,[1] who described how both the method used to quantify neuromuscular blockade and the data handling technique may affect the ED_{95} values calculated for metocurine. I would suggest that his report also illustrates the importance of identifying the muscle whose activity is being monitored (by either EMG or MMG). Thus, his ED_{95} values (pooled data) were 0.209 mg/kg by integrated EMG alone in group 1 (no preload), and 0.252 and 0.271 mg/kg by simultaneously evoked EMG (group 2, with preload) and MMG, respectively. Each of these three ED_{95} values was reported as being statistically significantly different ($P < 0.05$) from the other two.[1] Similar differences were found among the three mean ED_{95} values derived by averaging the calculated individual ED_{95} values for each patient.[1] Based on our current understanding of neuromuscular transmission, it seems unlikely that electrical stimulation of the ulnar nerve at the wrist could evoke a mechanical (MMG) response in the absence of an electrical (EMG) response in the same muscle. Harper *et al.*[2] recorded simultaneous EMG and MMG responses in the *same* muscle (adductor pollicis) during onset of neuromuscular blockade with atracurium and alcuronium. In no case did they observe an MMG response in the absence of an EMG response; indeed, when the MMG T1/TC was zero, the EMG T1/TC ratio was 0.2–0.3.[2] One must, therefore, also conclude from Dr. Kopman's study[1] that the first dorsal interosseous muscle whose EMG was being recorded is more sensitive to the effects of metocurine than is the adductor pollicis, whose MMG was being simultaneously recorded.

Another possible explanation for the observation that the ED_{95} by EMG was less than that by MMG is based upon the method described whereby the cumulative dose-MMG effect curves were constructed.[1] Thus, incremental doses of metocurine were given when the evoked T1/TC ratio *by EMG* was stable for three consecutive trains-of-four delivered at 20-s intervals (*i.e.*, EMG T1/TC was stable for 1 min), and the simultaneous MMG T1/TC ratio was recorded at this time. If the MMG T1/TC ratio had not yet reached a plateau and was still decreasing at this time, then this ratio would have been artificially increased, indicating relative resistance to metocurine at the cumulative dose-level given and in the ED_{95} values ultimately calculated.

The effect of preload on the sensitivity to metocurine as measured by EMG is also an interesting phenomenon. Dr. Kopman offers as one possible explanation that, in group 2, because the thumb was abducted under tension, the distance between recording electrode and muscle may have been reduced, resulting in a larger EMG signal. Since, during calibration, the Datex® 221 monitor prints the gain setting used, one wonders whether there were any differences in gain between the two groups. Such a difference, if present, might lend support to the explanation offered.

Finally, it is interesting to note that no significant differences were reported among the six ED_{50} values derived for metocurine.[1] The statistical description of the dose-effect curve is most powerful in its designation of the midpoint, *i.e.*, the ED_{50}.[3] This raises the question of the possibility of the introduction of artifact during the *calculation* of the ED_{95} values. In generating dose-effect curves, various data transformations, such as log-probit,[1] logit, or arc-sine, are often employed for the effect axis, while other studies[4] used no such data transformation. Differences among studies in their use of such transformations may also contribute to variations in the ED_{90} and ED_{95} values ultimately reported for the same relaxant. Differences in estimated potency arising from use of pooled data *versus* the mean values from individual patients have been demonstrated by Dr. Kopman.[1] Perhaps it is time to standardize the derivation of these indices of potency for neuromuscular blockers and thereby avoid the Humpty Dumpty practice of, "When *I* use a word, '. . . .' it means just what I choose it to mean—neither more nor less."*

* Lewis Carroll. Through the Looking-Glass, 1872.

JAMES B. EISENKRAFT, M.D.
Associate Professor of Anesthesiology
The Mount Sinai School of Medicine
New York, New York 10029-6574

REFERENCES

1. Kopman AF: The dose-effect relationship of metocurine: The integrated EMG of the first dorsal interosseous muscle and the mechanomyogram of the adductor pollicis compared. ANESTHESIOLOGY 68:604–607, 1988
2. Harper NJN, Bradshaw EG, Healy TEG: Evoked electromyographic and mechanical responses of the adductor pollicis compared during the onset of neuromuscular blockade by atracurium or alcuronium, and during antagonism by neostigmine. Br J Anaesth 58:1278–1284, 1986
3. Shanks CA: Design of therapeutic regimens. Clin Anesthesiol 3: 283–291, 1985
4. Fahey MR, Morris RB, Miller RD, Sohn YJ, Cronnelly R, Gencarelli P: Clinical pharmacology of ORG NC45 (Norcuron™): A new nondepolarizing muscle relaxant. ANESTHESIOLOGY 55: 6–11, 1981

(Accepted for publication July 26, 1988.)

Anesthesiology
69:807–808, 1988

In Reply:—Dr. Eisenkraft raises several important issues in his well-thought-out letter. Assuming that EMG and MMG instrumentation are equally sensitive, it is indeed difficult to see how evoked mechanical activity can exist in the absence of an electromyographic response. Although the small (7%) difference in the ED_{95} of metocurine that we calculated using these two methods was statistically significant ($P < 0.03$, Student's paired t test), I would not place too much importance on this disparity. If the series had been stopped at 19 patients, the respective EMG and MMG values for the ED_{95} would have been 0.237 and 0.250 mg/kg with a P value of >0.05. However, as Dr. Eisenkraft suggests, it may well be that the first dorsal interosseous (DI) muscle is slightly more sensitive to the action of nondepolarizing blockers than the ad-