Title : DETECTING MILD SEDATION WITH THE EEG

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Introduction. The EEG can determine the presence, type, and concentration of many anesthetic agents (1); can it also detect mild sedation? We examined this by using aperiodic analysis of the EEG to try to detect sedation from diphenhydramine (D). Methods. We used a double-blind parallel design. Ten subjects received placebo (P) on days 1-7 and D 50 mg on day 8; 10 received D on day 1 and P on days 2-8; and 20 received a new ostensibly nonsedating antihistaminic, astemizole (A) 60 mg on days 1, 2, and 3; 30 mg on day 4; and 10 mg on days 5-8. We used FP1-O1, FP2-O2, T3-C3, and T4-C4 EEG leads, filtered at 1-70 Hz bandpass and calibrated with a 100 mcv, 10 Hz sine wave available for strip chart, tape recorder, and an EEG analyzer. We recorded during a resting control period and 1 and 2 hours after administration of the pill on days 1 and 8. The tapes were played back into a prototype Neurometrics EEG monitor. The Neurometrics uses aperiodic analysis (2) which instead of averaging wave forms over a given epoch, as do most EEG analysis techniques, maps individual waves in relation to their frequency, amplitude, and time of occurrence. We set up on a Cromemco Z-2 Computer a matrix of 5 measurements vs. 30 1-Hz frequency bins, computed over 210 sec, and selected 21 variables for this study: Total power at 2, 3, 9, 10 and 11 Hz; waves in bins 2, 3, 9, and 10 Hz, average power at 1, 2, 3, 9, 10 and 11 Hz; per cent power at 2 and 9 Hz; total waves in bins 1 and 2, 1 and 3, and 9 and 10; and cumulative per cent power at 3 Hz. A profile-of-mood-state (POMS) test subjectively evaluated sedation for comparison with the EEG results. We used analysis of variance and the Bonferroni inequality, accepting a P value of 0.05 as significant.

Results. We could detect no differences between the control EEG's of subjects on day 1 compared with day 8, nor in any control values among the three groups. We did observe several changes following P (2/21 and 5/21 changed significantly after 1 and 2 hours, respectively), presumably related to time or to the volunteers' becoming adjusted to the experimental conditions. A produced no changes either at 1 or 2 hours or at one week. D produced several significant changes, particularly after 2 hours (3/21,7/21) (See Fig. 1 for an example of the results). In comparing the groups among themselves, we observed that A was significantly different from D (3/21,12/21). In paired comparisons of the EEG changes, we noted differences between P and D (3/21,7/21), as well as A and D (0/21,11/21), but not between A and P (Fig. 2). The POMS evaluation confirmed the EEG analysis; there was greater fatigue and less vigor with D vs. P or D vs. A.

Discussion. We concluded that our EEG methods were consistent from day to day and subject to subject, that they can distinguish 50 mg D from P and from A, and that A, even in large doses, does not produce detectable sedation. The EEG aperiodic method is sensitive enough to detect sedation that produces only slight drowsiness.

References.
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2. Demetrescu M, Kavan E, Smith N Ty: Monitoring the brain condition by advanced EEG (Abs) Anesthesiology 55:A130, 1981.

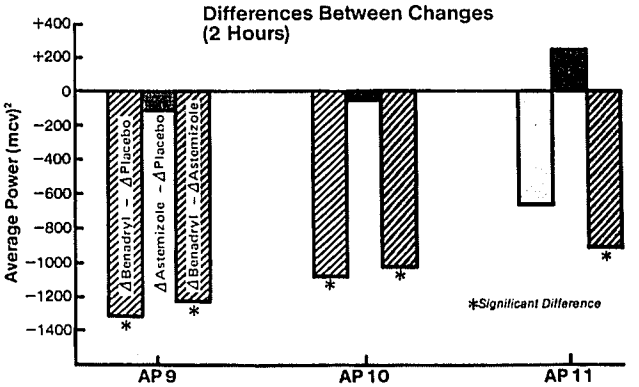

Fig. 1. Absolute values 2 hours after P, D, and A. Average power (AP) = power per wave in each of the named frequency bins.

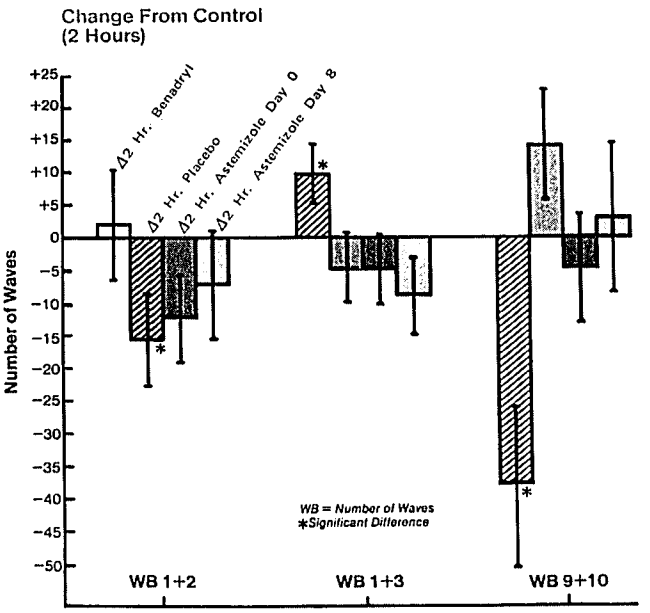

Fig. 2. A paired comparison of the EEG changes produced by D, P, and A, using the number of EEG waves in an epoch as the variable.