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pressed patients nificant numbers lly treated with 1981). Clinical r effectiveness of dequate doses of asons (e.g., the c disease), and nal or catatonic cidal or cachetic ase (APA, 1978; ea requiring in- eation and the tors or historical s antidepressant atment for en-

nown that many te episode of ma- l with ECT or ironic course of n, 1981). Thus, red to and com- eventing relapse

or recurrences of new depressive episodes, requires investigation. Hopefully, the recent availability of potential biological markers of endogenous depression (e.g., dexamethasone suppression test, sleep electroencephalography (EEG) abnormalities) and techniques reassessing the adequacy of therapy (e.g., tricyclic antidepressant plasma levels, seizure time, and EEG changes with ECT) will facilitate the performance of definitive studies in these important areas.

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Evaluation of the Central Nervous System Risks of ECT

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Introduction

Electroconvulsive therapy (ECT) is currently used as a treatment modality for severely ill psychiatric patients, particularly for major depressive disorders (Weiner, 1979). There continues to be controversy, however, with respect to ECT's risk/benefit considerations, a situation which is confounded by the widely varying types of ECT in use today, particularly in terms of electrode placement and stimulus waveform.

To help resolve this matter, a controlled prospective clinical study has been set up to investigate the acute and long-term effects of ECT upon memory, the electroencephalogram (EEG), and clinical status. In particular, this study considers the differential effects of stimulus electrode placement and stimulus waveform. As this is an ongoing study now in its third year, data collection and analysis have not been completed and only salient features of the data regarding the acute effects of ECT upon certain memory and EEG parameters will be presented here. Preliminary data regarding therapeutic response are reported elsewhere (Welch, Weiner, Weir, Cahill, Rogers, Davidson, Miller, & Mandel, 1981).

Methods

Experimental subjects have been referred for voluntary ECT treatment by their psychiatrists. All of those who meet Research Diagnostic Criteria (Spitzer, Endicott, & Robins, 1978) for major depressive disorder and have no evidence of preexisting central nervous system (CNS) impairment are subjected to a full series of test measures (memory, EEG, and clinical). ECT subjects who do not meet these criteria are tested only in terms of EEG. Control subjects meet all study criteria except for not being referred for ECT. Memory data will be presented on 33 experimental and 8 control subjects, while EEG data is presented on 40 experimental and 4 control subjects.

All experimental (ECT) subjects are randomly assigned to either unilateral nondominant or bilateral electrode placement and either sine wave or bipolar pulse stimuli. Standard modified ECT procedures are otherwise carried out, with the addition of EEG and stimulus energy monitoring.

The number of ECT treatments is determined by the subject's psychiatrist on a clinical basis. No significant difference in age, sex, education, I.Q., or socioeconomic status among the various treatment groups was noted.

All testing is done prior to ECT, 2-3 days post completion of the treatments, and 6 months later (only the acute data will be presented here). Clinical measures have been discussed in part elsewhere (Welch et al., 1981). Memory measures include a variety of tests of anterograde and retrograde memory performance (for both dominant and nondominant hemispheric function). The personal, or autobiographic memory questionnaire focuses upon specific events relating to the subject's own life, particularly over the past year. A time frame which appears to be especially sensitive (Squire, Slater, & Miller, 1981) will serve as the memory measure presented below. In terms of physiologic abnormalities (Small, Small, & Milstein, 1978), both visual rating of EEG slowing and computer spectral analysis are utilized, with data from the latter being presented here. Testing is done blind with respect to subject group assignment, as indicated.

Results

The fraction of baseline personal memory items not remembered at the second testing session (2-3 days post completion for ECT experimental subjects) is shown in Figure 1. Analysis of variance shows control subjects to be *less* amnestic than ECT subjects ($p \leq .001$), and unilaterally treated subjects to be *less* amnestic than those receiving bilateral treatment ($p \leq .01$). A small trend for sine wave-treated subjects to be more impaired than those treated with pulse stimuli did not reach clinical significance ($p \leq .08$). Further statistical investigations revealed that the degree of apparent amnesia was *not* correlated with mean seizure length or total seizure duration, but *was* positively correlated with number of treatments ($p \leq .03$).

The difference in EEG slowing between the second testing session (2-3 days post completion of ECT for the experimental subjects) and the baseline measurements is shown in Figure 2. Analysis of variance shows control subjects to exhibit *less* slowing than ECT subjects ($p \leq .05$). Also, unilaterally treated subjects show *less* slowing than bilaterally treated subjects ($p \leq .02$). An additional finding, different from the memory results, is that subjects receiving pulse ECT show significantly *less* slowing than subjects receiving sine wave administration ($p \leq .01$).

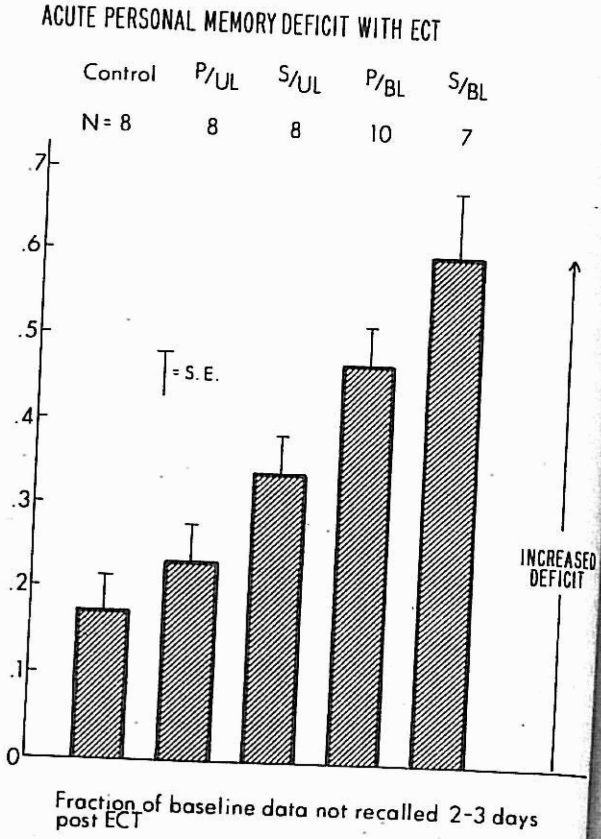

FIGURE 1

Discussion and Conclusion

The above findings indicate that the use of personal memory questionnaires and computerized EEG spectral analytic techniques can be used to extend the sensitivity of the assessment of CNS impairment following ECT. Acute personal memory impairment is less with unilateral nondominant electrode placement, as reported by

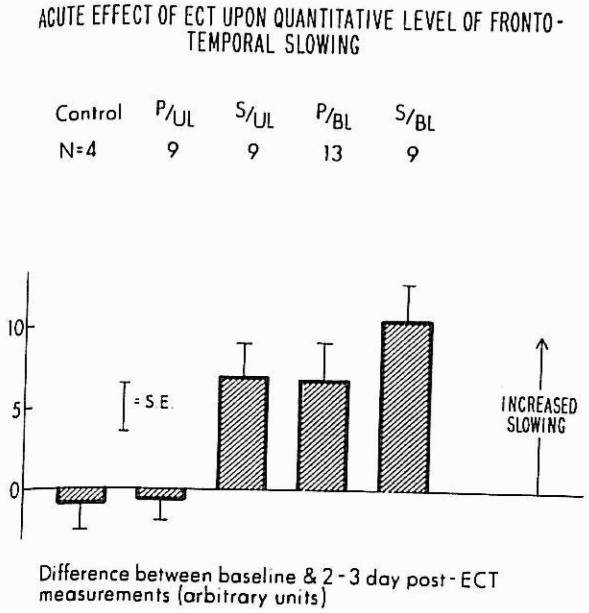

FIGURE 2

many others (e.g., Squire, 1977). No clear effect of stimulus waveform upon acute memory deficits is apparent, though a possible mild dysmnestic effect of sine wave stimuli requires further evaluation. In addition, the number of treatments, but not seizure duration, was found to exert a cumulative effect upon acute memory impairment, suggesting that, in general, brief electrically induced seizures appear to exert discrete effects upon memory performance.

In terms of acute EEG changes, unilateral nondominant ECT results in less slowing than bilateral ECT, while pulse ECT results in less slowing than sine wave ECT. This indicates that EEG slowing, which appears more sensitive to stimulus waveform than does amnesia, may represent a somewhat different phenomenon than amnesia, with the former being a nonspecific encephalopathic change, perhaps related to confusion, and the latter being a more specific effect of ECT, perhaps mediated through temporal lobe mechanisms.

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Efficacy of ECT in the Treatment of Depression: Wave Form and Electrode Placement Considerations

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There is wide variation in electroconvulsive therapy (ECT) technique and little data to indicate which technique, if any, is must efficacious. The two most important variables are the position of the treatment electrodes on the head, and the shape of the electrical wave form. Many clinicians have strong opinions about the effect of these variables on efficacy, but studies to date have been inconclusive.

Bilateral fronto-temporal electrode placement is still the standard technique in this country, in spite of an increasing body of evidence that unilateral nondominant placement has less side effects (d'Elia, 1970; Squire, 1977) and that it may be equally efficacious (d'Elia & Raotma, 1975). Although existing studies vary widely in methodology, more rigorously designed studies tend to show equal efficacy, while those lacking control

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