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Research report

Is postictal electrical silence a predictor of response to electroconvulsive therapy?

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Abstract

Electroconvulsive therapy (ECT) is an established effective treatment modality for patients with severe depression. Recent studies have focused on developing predictors of response. In this prospective study, using percent decrease in Hamilton Depression Scale (21 items) as the outcome measure, we blindly evaluated 33 inpatients with major depression to determine whether postictal suppression, the electrical silence following induced seizure, would predict treatment response to ECT. A significant relationship was observed between degree of postictal suppression and likelihood of clinical improvement. Postictal suppression should be explored in more controlled studies as a predictor of ECT response.

Keywords: Treatment response; Predictors; Affective illness; Major depression; Electroconvulsive therapy; Postictal suppression

1. Introduction

Sixty-years of research has established electroconvulsive therapy (ECT) as effective with patients suffering from severe depression (Potter and Rudorfer, 1993; Sackeim et al., 1993; Scott, 1989). Recent studies on ECT have focused on identifying predictors of response and to isolate specific EEG characteristics potentially critical to treatment response (Krystal et al., 1995; Nobler et al., 1993; Sackeim et al., 1987, 1991, 1993). These studies suggest that while seizure duration may not be a marker of therapeutic effectiveness (Nobler et al., 1993), other features of the EEG may estimate seizure efficacy (Sackeim et al., 1993; Krystal et al., 1995).

To better predict which patients with major depression would be responsive to ECT, this study examines a simple estimate of postictal suppression or electrical silence (ES), the period immediately following electrically-induced seizure. Since clinical improvement correlates with increased seizure threshold during ECT (Sackeim et al., 1987), we hypothesized that a greater degree of ES could indicate a more profound brain response. Therefore, the

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more significant the ES, the more likely it would be to observe a decrease in depressive symptoms. This hypothesis derives from neurological observations that seizures terminate with a period of postictal suppression. Many factors may cause this ES, including GABA-ergic (inhibitory) activity and ionic currents (e.g., potassium currents).

2. Methods

The list of patients referred for ECT at McLean Hospital between 1989 and 1991 was reviewed to identify individuals meeting DSM-III-R (APA, 1987) criteria for major depression (HP). The study was approved by the McLean Hospital Human Subjects Board, and informed consent given by all patients. Additional diagnostic confirmation was obtained from clinical evaluation by treating psychiatrists, medical records, a record review, and, in most cases, a brief structured interview with the patient (HP). Thirty-four consecutive patients met inclusion criteria and agreed to study participation. One patient did not receive at least five ECT treatments and is therefore not included in the analyses.

All remaining 33 patients had ES assessed at each of six ECT treatments. The type of ECT administered was unilateral, bilateral or, in a small number of cases, sine wave treatments. Because the primary aim was to see if a simple, readily obtained EEG characteristic (ES) could predict treatment response, the type of ECT given was not collected. ECT techniques followed McLean Hospital procedure which are reported elsewhere in some detail (Frankenberg et al., 1993). Briefly, the device used to administer most ECT treatments was a MECTA SR-1. When sine wave stimuli were used, the device was a MEDCRAFT B-24. Stimulus dosage was selected so that a seizure of 30–60 s could be achieved. The anesthetic agent was usually methohexital and succinylcholine. When unilateral ECT was used, the electrode was placed in the d'Elia position on the nondominant hemisphere. Seizure duration was determined by EEG monitoring and the cuff method.

Due to concern over accuracy of the MECTA electrodes (one recording electrode only) to record the quality of ES, a simultaneous 8 electrode array was done with three patients. Seizure characteristics and ES duration observed with the 8 electrode array were somewhat different compared to single electrode recordings, however the quality and time of ES onset were essentially equivalent. Importantly, within the time frame of evaluating the ES (2–5 s from onset) the two recording methods were virtually identical.

The degree of ES at five seconds was blindly rated on a 0–2 scoring scale, with 2 representing the most significant silence (essentially a flat line), 1 as intermediate from baseline (approx. 50% of frequency and amplitude), and 0 representing essentially no electrical change relative to pre-seizure baseline. The second rater (TS), blinded to the patient's identity, rated approximately 50% of the EEG strips to confirm electrical silence assessments. A high interclass correlation coefficient was found between the two raters ($r = 0.9$).

Clinical response to ECT treatment was measured by calculating percent improvement from baseline on the Hamilton Depression Scale (HDS) (21 items) (Hamilton, 1969). Of the 33 patients, the first 15 had Hamiltons administered before the 1st and following the 3rd and 6th ECT treatments, while the remaining 18 patients had Hamiltons only before the 1st and after the 6th treatment.

Correlation and linear regression analysis were used to investigate the potential relationship between HDS improvement and quality of ES. To make a very conservative statistical judgment statistical significance was determined using a Bonferroni corrected P-value ($P < 0.0083$). Because the degree of ES was rated on an ordinal (0–2) scale, the Spearman Rank Order Correlation coefficient is reported. All statistics were generated using Statistical Analysis System software, version 6.04 (SAS Institute Inc.).

3. Results

High correlation between degree of ES and likelihood of significant treatment response following six treatments was noted with the first 15 patients analyzed ($\Upsilon = 0.66$, $P < 0.008$; see Table 1). When all subjects ($n = 33$) were analyzed percent decrease in the HDS at six treatments showed a trend toward a significant correlation with ES ($\Upsilon = 0.39$, $P < 0.05$; see Table 1).

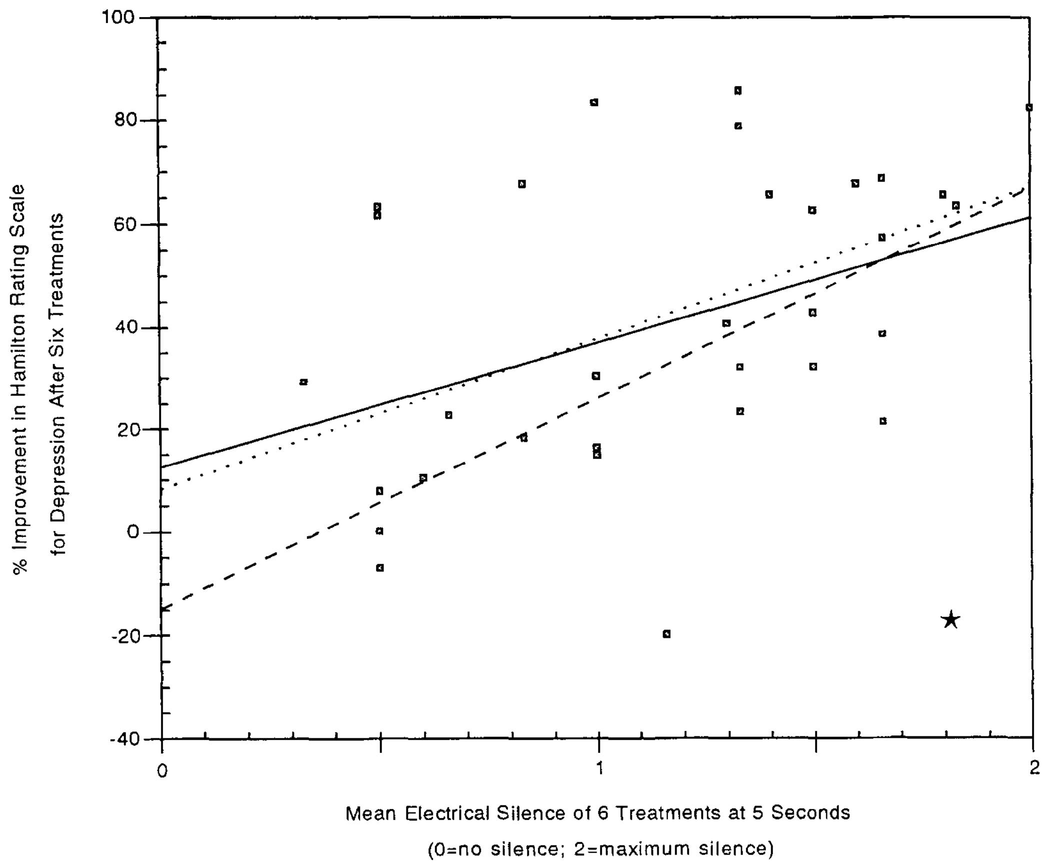

Fig. 1. Results of linear regression. Dashed line, $n = 15$; solid line, $n = 33$; dotted line, $n = 32$. ★ = outlier value, this patient's results excluded from analyses of group of $n = 32$ (see Table 1).

Table 1
Decrease in Hamilton depression rating with mean electrical silence at 5 s

ECT treatment	$n = 15$ [a]	$n = 33$ [b]	$n = 32$ [c]
1st–6th (mean)	$r = 0.66$	$r = 0.39$	$r = 0.50$
	$P < 0.008$	$P < 0.027$	$P < 0.005$
1st–5th (mean)	$r = 0.62$	$r = 0.37$	$r = 0.48$
	$P < 0.014$	$P < 0.033$	$P < 0.006$
1st–4th (mean)	$r = 0.45$	$r = 0.31$	$r = 0.40$
	$P < 0.096$	$P < 0.079$	$P < 0.025$
1st–3rd (mean)	$r = 0.49$	$r = 0.37$	$r = 0.44$
	$P < 0.063$	$P < 0.032$	$P < 0.012$
1st–2nd (mean)	$r = 0.46$	$r = 0.25$	$r = 0.34$
	$P < 0.083$	$P < 0.158$	$P < 0.062$
1st (mean)	$r = 0.53$	$r = 0.30$	$r = 0.38$
	$P < 0.044$	$P < 0.095$	$P < 0.037$

[a] First phase of study.
[b] Entire sample.
[c] Entire sample with one outlier dropped from data.

Since the goal in a pilot study is to identify population effects, a random regression analysis was conducted to determine whether any particular subject exerted undue influence. One patient was identified with more than twice the influence of any other subject (Cook's D). When this outlier was pulled from the analysis a significant correlation was observed ($\Upsilon = 0.50$, $P < 0.005$; see Table 1). Table 1 and Fig. 1 show results across the three groups; first 15, entire group of 33, and entire group with outlier value pulled ($n = 32$).

4. Discussion

This preliminary study found a significant relationship between degree of postical suppression or electrical silence and likelihood of improved depressive symptoms. This study is limited because multiple variables potentially influencing patient response were not evaluated. These variables include past history, comorbid conditions, gender and age. Given the limited nature of this pilot study, however, which supports an inexpensive and easy tool to evaluate treatment efficacy, the results are all the more striking.

Recent focus by experts in ECT has shifted to evaluate characteristics of ECT-EEG that may provide predictive value (Krystal et al., 1993, 1995; Nobler et al., 1993; Sackeim et al., 1987, 1993). This pilot suggests that while detailed analyses may be useful, they may not be necessary to predict treatment efficacy in day-to-day clinical practice. Postictal suppression should be explored further as a predictor of ECT response in a more controlled study.

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