

Seizure Duration Decreases Over a Course of Bifrontal and Not Bitemporal Electroconvulsive Therapy

Hulegar A. Abhishekh, Jagadisha Thirthalli¹, Anusha Hegde, Vivek H. Phutane², Channaveerachari N. Kumar¹, Kesavan Muralidharan¹, Bangalore N. Gangadhar¹

ABSTRACT


Context: Mechanism of action of electroconvulsive therapy (ECT) is unclear. Anticonvulsant action of ECT has also been one among the hypothesized mechanisms. Anticonvulsant effect may manifest during ECT in at least two ways (a) increased seizure threshold (b) decrease in seizure duration. In depression, increased seizure threshold has been shown to be associated with better antidepressant response. However, relationship between seizure duration and antidepressant activity has been inconsistent. These issues are not investigated in conditions other than depression. **Aims:** We examined seizure duration over the course of ECT in schizophrenia patients. **Settings and Design:** Material for this analysis was obtained from a clinical trial examining the differential efficacy of bifrontal ECT (BFECT) versus bitemporal ECT (BTECT) in schizophrenia patients. As a part of study 122 schizophrenia patients who were prescribed ECT were randomized to receive either BFECT or BTECT. **Subjects and Methods:** Final analysis was conducted on data from 70 patients, as the rest of the data either had artifact or there was a significant change in medication status. Electroencephalogram seizure duration was noted in each session for these patients. **Results:** Seizure duration declined significantly from second ECT to 6th ECT (repeated measures analysis of variance $F = 4.255$; $P = 0.006$). When separate analysis was conducted for BTECT and BFECT patients the decline in seizure duration from 2nd to 6th ECT was significant only with BFECT ($F = 3.94$; $P = 0.014$) and not with BTECT ($F = 0.966$; $P = 0.424$). **Conclusions:** Better anticonvulsant effects with BFECT may explain the better therapeutic observed with BFECT in schizophrenia as well as mania in our earlier studies.

Key words: Bifrontal, bitemporal, electroconvulsive therapy, seizure duration

INTRODUCTION

Many hypotheses have been proposed to explain the mechanism of action of electroconvulsive therapy (ECT). Anticonvulsant action of ECT is one among

them.^[1] This effect is manifest in at least two ways over the course of ECTs: (a) Progressive increase in seizure threshold and (b) a progressive decrease in seizure duration.^[2] Progressive increase in seizure threshold is associated with better antidepressant response.^[2] However, the relationship between seizure duration and antidepressant response has been inconsistent.^[3-5] These issues have not been investigated in any other psychiatric disorders. In this study, we have examined the relationship between the increase in seizure threshold during the course of ECT and clinical response in patients with schizophrenia referred for ECT.

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Medical Student, Bangalore Medical College and Research Institute, ¹Department of Psychiatry, National Institute of Mental Health and Neurosciences, Bangalore, Karnataka, India, ²Department of Psychiatry, Royal Melbourne Hospital, Melbourne, Victoria, Australia

Address for correspondence: Dr. Jagadisha Thirthalli
Department of Psychiatry, National Institute of Mental Health and Neurosciences, Hosur Road, Bangalore - 560 029, Karnataka, India.
E-mail: jagatth@yahoo.com

SUBJECTS AND METHODS

Data for this study was obtained from an earlier larger study examining the differential efficacy of bifrontal ECT (BFECT) versus bitemporal ECT (BTECT) in patients with schizophrenia.^[6] 122 in-patients, who were referred for ECT by their respective treating clinicians, were randomized to receive either BFECT or BTECT. Details of the patient recruitment is described elsewhere.^[6] The study protocol was approved by the Institute's Ethics Committee.

Electroencephalogram (EEG)-monitored ECTs were administered using the NIVIQURE machine (Technonivilac, Bangalore, India). Brief-pulse stimulation with constant current at 800 mA and 125 pulses/s with pulse width of 1.5 ms was used; duration of the train was altered to adjust the charge. ECTs were administered under anesthetic modification (thiopentone 2-4 mg/kg and succinylcholine 0.5-1 mg/kg). During the first ECT session, threshold was determined by titration method.^[7-9] From the second session onward, the patients received ECTs with 1.5 times the threshold stimuli.

EEG was recorded with the NIVIQURE ECT-EEG machine using left and right frontal pole leads (FP1 and FP2), referenced to ipsilateral mastoid processes. EEG was recorded from the start of the stimulus, through the ictal phase until after 5 s following the cessation of EEG seizures.

Artifact-free EEG recording was available in 94 patients. Only those who had received at least 6 ECTs were included in the analysis. Out of the 81 who had received at least 6 ECTs, 11 patients were on benzodiazepines. As this could influence the duration of seizures over the course, these were also excluded from the analysis. Analysis of EEG-seizure duration was thus conducted on 70 patients.

RESULTS

Mean age of patients was 28.31 (standard deviation (SD) = 7.4) years. There were 32 (45.7%) female patients. Thirty-seven (52.9%) patients received BFECT and 33 (47.1%) received BTECT. There was no significant difference between patients who received BFECT and BTECT in age (mean \pm SD = 28.32 \pm 7.6 vs. 28.30 \pm 7.4 years; $t = 0.01$; $P = 0.9$) and sex (16 females in each group; $\chi^2 = 0.8$; $P = 0.8$). Seizure threshold was comparable between the two electrode placements (mean \pm SD seizure threshold for BFECT and BTECT were 101.7 \pm 50.5 and 84.6 \pm 48.9 mC respectively; $t = 1.44$; $P = 0.16$).

Repeated measures analysis of variance was used to analyze change of seizure duration between 2nd and 6th ECT. Data from first ECT session was not considered for analysis, as during the session patients would have received sub-convulsive stimuli before receiving threshold stimulus. Moreover, electrical stimulus for the second ECT onward was set at 1.5 times the threshold.

Overall, seizure duration declined significantly from baseline (mean \pm SD = 66.2 \pm 29.4 s) to the end (mean \pm SD = 54 \pm 18.4 s; $F = 4.255$; $P = 0.006$). When BTECT and BFECT patients were compared with each other, the decline in seizure duration was significant only with BFECT (mean \pm SD = 73.7 \pm 33.2 s for the 2nd ECT; 57.2 \pm 18.2 s for the 6th ECT; $F = 3.94$; $P = 0.014$) and not with BTECT (mean \pm SD = 57.8 \pm 22.1 s for the 2nd ECT; 50.5 \pm 18.2 s for the 6th ECT; $F = 0.966$; $P = 0.424$).

DISCUSSION

The most important finding of this study on patients with schizophrenia is that the seizure duration significantly reduced only with BFECT and not BTECT over the course of treatment. This issue could have contributed to the greater and better improvement of BFECT patients. To the best of our knowledge, this is first such report in schizophrenia.

Patients in both groups were comparable in age, sex and seizure threshold. Patients in neither group had received any anticonvulsant medications. Hence, the difference cannot be attributed to these potential confounds. In the background of BFECT being having better therapeutic efficacy in schizophrenia,^[6] this preliminary finding provides indirect support to possible anticonvulsant mechanism of action of ECT, similar to that shown in depression.^[1] However, these results need replication.

The significant decrease in seizure duration over the course of ECT is consistent with the theory that ECTs potentiate GABAergic tone, thus producing anticonvulsant effect. GABAergic tone is known to be impaired in patients with schizophrenia.^[10] In support of this mechanism, recent report suggests significant decline in cortical excitability indirectly suggesting the increase in GABAergic tone with ECT.^[11] The difference in the change in seizure duration between BFECT and BTECT is consistent with the finding of faster action of BFECT in schizophrenia than BTECT.^[6]

Some earlier studies have reported a drop in seizure duration over the course of BTECT.^[12-14] However,

these studies have examined the drop in duration from 1st ECT through the course of ECT. In the current day practice where the recommendation is to administer stimulus 1.5 times threshold,^[15] seizure duration is expected to drop substantially from 1st to 2nd ECT, as higher electrical dose is known to be associated with shorter seizure duration.^[9,16] Hence, ECT data on seizure duration during 1st ECT becomes redundant. Further Rasimas *et al.*^[17] reported that seizure duration does not drop after the second ECT. Lack of a significant drop of seizure duration in BTECT is consistent with this observation. However, significant drop in BFECT group beyond second ECT is a novel finding.

In summary, this study shows that seizure duration declines significantly over the course ECT in patients with schizophrenia and this decline occurs with BFECT and not with BTECT. These preliminary observations, if confirmed by replication, may throw useful light on the possible differential neurobiological effects of different electrode placements in ECT.

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