Original Research Article

A retrospective analysis of stimulus characteristics, clinical profile and cognition of patients receiving maintenance electroconvulsive therapy

Hrishikesh B. Nachane[1], Jahnavi S. Kedare[2], Pankaj S. Patil[3], Romesh U. Bagde[4]

[1]Assistant Professor, Department of Psychiatry, TNMC & BYL Nair Ch Hospital, Mumbai
[2]Associate Professor, Department of Psychiatry, TNMC & BYL Nair Ch Hospital, Mumbai
[3]Senior Resident, Department of Psychiatry, Government Medical College & Hospital, Nagpur
[4]Resident, Department of Psychiatry, TNMC & BYL Nair Ch Hospital, Mumbai

Corresponding author: Hrishikesh Nachane
Email – hbnachane@gmail.com

ABSTRACT

Background: Maintenance electroconvulsive therapy (M-ECT) has been in use for a long time, yet there is dearth of literature regarding stimulus characteristics and cognitive changes with M-ECT, particularly in the Indian context. To assess stimulus characteristics, clinical profile and cognitive changes in patients receiving maintenance electroconvulsive therapy.
Methodology: Records of patients receiving M-ECT in one year were checked and their diagnosis, stimulus characteristics (duration of current, seizure duration, number of ECTs and total charge delivered) and serial MMSE scores (at baseline, after 1 month and final MMSE) were noted. Stimulus characteristics were correlated with sociodemographic details and cognitive changes. A comparison between psychotic and non-psychotic disorders was also made.
Results: In a total of 50 patients on M-ECT, total charge delivered was found to be significantly higher in females (P=0.02) and seizure duration was longer in males (P=0.04). Stimulus characteristics between psychotic and non-psychotic disorder did not differ (P > 0.05). MMSE score showed improvement with M-ECT (P = 0.01) and this was most significant between baseline and final MMSE (P < 0.05). Cognitive change negatively correlated with number of ECT (r = - 0.29, P = 0.04). Final MMSE score correlated only with baseline MMSE score (r = 0.47, P < 0.01).
Conclusion: Stimulus characteristics vary with gender, but not age and diagnosis. Cognition improves with M-ECT and depends upon number of ECT and pre-ECT cognition.

Keywords: maintenance ECT, stimulus, cognition, ECT.

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INTRODUCTION

Electroconvulsive therapy (ECT) has been around for more than 70 years and still remains one of the the most effective treatment in psychiatry, with unsurpassed efficacy and remarkable safety [1]. ECT is effective for various conditions and a viable option when other treatment modalities such as pharmacotherapy and psychotherapy have failed [1-2]. Many patients of mood disorder and schizophrenia who have a long and complicated course require ECT even after the acute phase. Continuation ECT or Maintenance ECT (M-ECT) is given after the acute phase of illness and remission and can last up to 6 months. Its main aim is to prevent relapse in the patient and is a good alternative to long term pharmacotherapy [3]. Even though the use of M-ECT has become sparse, there is modest evidence to its beneficial effects [4-5]. It has been seen

that M-ECT reduces the time to relapse in most patients [5]. Research has mainly been undertaken in patients suffering from depression and schizophrenia [6]. Most evidence is from individual cases reporting improvement on M-ECT. Whereas some studies have shown the greater efficacy of M-ECT in relapse prevention as compared to long-term psychotropic medications, others have shown equivocal response in both [7]. End points of such studies is usually reduction in number of hospitalization or time to relapse [6, 8]. The old notion that ECT stimulus characteristics are clinically irrelevant as long as seizure has been induced has now become redundant [9-10]. A lot of research has now shown that depending upon manipulations of ECT stimulus parameters, ECT-induced seizures can differ markedly in efficacy and side effects [11-12]. ECT stimulus parameters are key in discovering the mechanisms of the unparalleled efficacy of ECT as well as to the ability to optimize dosage to reduce side effects while preserving efficacy. However, the best metric(s) to describe the ECT dose and the optimal method of individualizing ECT dosage remain unresolved challenges. Characteristics such as electrode configuration, current amplitude and pulse amplitude have been shown to be potential targets for therapeutic benefits, while stimulus train frequency and the pulse width have not [13]. The ideal ECT stimulus came to be described as between 40 and 60 μsec in duration, applied at a frequency between 100 and 300 Hz [14]. Research has shown that seizure threshold correlates with age, but not sex [15]. However, such data particularly with respect to M-ECT is lacking.

One of the main issues limiting the use of ECT for prophylaxis and relapse prevention is cognitive impairment [15]. Cognitive impairment is the most common side effect of ECT and is the most common cause for its discontinuation [15]. Studies have highlighted that factors related to the stimulus such as electric charge, wave form, pulse width, frequency and total charge delivered have an impact on cognition [16]. However, there is research showing minimal – no cognitive impairment with patients receiving more than 100 ECT in a lifetime [17]. In fact, research has shown that cognitive impairment secondary to affective disorders may improve following ECT [18-19]. Vothknecht and others have shown that neurocognitive functioning improved over the course of ECT, but was not significant [20]. However, similar studies in M-ECT, particularly in the Indian context are lacking. The present analysis aims to study stimulus characteristics and cognitive changes in patients undergoing M-ECT at our centre.

METHODOLOGY

The following study was conducted in the department of psychiatry of a tertiary care center, after receiving clearance from the Institutional Ethics Committee. M-ECT records from the department for the year of 2017 were analyzed. M-ECT is defined arbitrarily as treatment extending beyond 6 months [21]. ECT was given via a brief pulse machine, in a bitemporal fashion to all patients. The frequency of M-ECT varied from once a week to once a month. None of these patients were still on M-ECT at the time of data collection and their treatments were terminated. A semi-structured pro forma was devised to obtain details regarding the patient's age, gender and diagnosis and stimulus characteristics such as: duration of current, seizure duration, number of ECT and total charge delivered. Cognitive assessment, which is done using the Mini Mental State Examination (MMSE) at our center, was noted for the first visit, after 1 month and the final ECT (these were available in the records). The Mini Mental State Examination (MMSE) is a quick and easy measure of cognitive functioning that has been widely used in clinical evaluation and research involving patients with dementia and those receiving ECT [22].

STATISTICAL ANALYSIS

Statistical analysis was carried out using SPSS 20.0 software. Comparative analysis was done using Mann Whitney test. Changes in cognition at the 3 stages was assessed using Freidman test with posttest Dunn's multiple comparison test. Correlation was done using Spearman's rank correlation. P value < 0.05 was considered statistically significant.

RESULTS

During the 1 year of study period, a total of 50 patients had received M-ECT at our center and these were subsequently recruited for data collection. Their stimulus characteristics, diagnoses and MMSE scores were noted. The mean duration of current was 2.48 ± 1.26 seconds and the charge delivered was 129.34 ± 330.42 J. The seizure on an average lasted for 33.48 ± 10.69 seconds and number of ECT required were 30.08 ± 25.62. When association of age and sex with ECT characteristics was assessed (Table 1), there was a significant association between sex of the patient and total charge delivered (p=0.02), which was higher in female patients and seizure duration and sex (p=0.04), which was higher in male patients.

Table 1: Association of ECT characteristics with age and sex

ECT characteristics	Distribution in the sample	Correlation with age	Variation with sex
Duration of current	2.48 ± 1.26	r = 0.22 P = 0.13	U = 227.00 P = 0.18
Charge	129.34 ± 330.42	r = 0.24 P = 0.10	U = 164.00 P = 0.02*
Seizure duration	33.48 ± 10.69	r = - 0.08 P = 0.54	U = 190.50 P = 0.04*
Number of ECT	30.08 ± 25.62	r = 0.06 P = 0.66	U = 242.00 P = 0.29

*indicates statistically significant

Table 2: ECT characteristics between psychotic versus non-psychotic disorder groups

Characteristic	Group A (n = 35)	Group B (n = 15)	Significance
Age (yrs)	34. 71 ± 13.03	35.73 ± 9.18	U = 233 P = 0.64
Sex	Males = 21 (60%) Females = 14 (40%)	Males = 10 (66.67%) Females = 5 (33.33%)	P = 0.76
Diagnosis	Schizoaffective disorder = 1 (2.86%) Schizo-obsessive disorder = 4 (11.43%) Schizophrenia = 30 (85.71%)	OCD = 2 (13.33%) Bipolar disorder = 1 (6.67%) Major depressive disorder = 12 (80%)	
Duration of current (sec)	2.54 ± 1.22	2.34 ± 1.38	U = 205.50 P = 0.23
Seizure duration (sec)	32.97 ± 10.85	34.67 ± 10.56	U = 224 P = 0.42
Number of ECTs	28.80 ± 19.45	24.08 ± 15.27	U = 206 P = 0.63
Total charge (J)	57.03 ± 38.87	41.98 ± 18.56	U = 146.50 P = 0.13
Baseline MMSE scores	24.26 ± 4.65	27.00 ± 2.36	U = 167.50 P = 0.06
MMSE scores at 6 weeks	25.54 ± 3.71	27.33 ± 1.59	U = 200.50 P = 0.19
Final MMSE scores	25.38 ± 4.49	27.73 ± 1.10	U = 196 P = 0.20

Table 3: MMSE scores at various intervals during the ECT course

Groups	Baseline MMSE scores	MMSE scores after 1 month	Final MMSE scores	Significance
Group A (n = 35)	24.26 ± 4.65	25.56 ± 3.77	25.38 ± 4.49	0.09
Group B (n = 15)	27.00 ± 2.36	27.33 ± 1.59	27.73 ± 1.10	0.37
Total sample (n = 50)	25.20 ± 4.27	26.08 ± 3.31	26.12 ± 3.90	**0.01***

*significant

Table 4: Association of ECT and demographic characteristics with change in cognition

ECT / demographic characteristic	r/U value	P value
Age	r = 0.05	0.75
Sex	U = 268.00	0.60
Duration of current	r = - 0.12	0.39
Charge	r = - 0.18	0.23
Seizure duration	r = - 0.13	0.38
Number of ECTs	r = - 0.29	**0.04***

Table 5: correlation of various factors with final MMSE scores

Characteristic	Correlation with final MMSE score
Age (yrs)	r = - 0.09, P = 0.56
Sex	U = 264, P = 0.55
Duration of current (sec)	r = 0.05, P = 0.71
Charge (J)	r = 0.09, P = 0.58
Seizure duration (sec)	r = - 0.01, P = 0.89
No of ECTs	r = 0.02, P = 0.91
Baseline MoCA score	r = 0.47, P < 0.01*

*indicates statistically significant

Based on their diagnoses, the patients were divided into two groups: those belonging to psychotic spectrum (Group A) and others (Group B). Overall, 35 patients were classified into the psychotic disorder group and 15 in the non-psychotic disorder group. The group with psychotic disorders consisted of patients with Schizophrenia (n = 30; 85.71%), Schizo-obsessive disorder (n = 4; 11.43%) and schizoaffective disorder (n = 1; 2.86%); whereas the non-psychotic disorder group consisted of Major depressive disorder (n = 12; 80%), obsessive compulsive disorder (n = 2; 13.33%) and Bipolar disorder (n = 1; 6.67%). Table 2 illustrates difference in these two groups with respect to demographic variables, stimulus characteristics and their MMSE scores. There was no statistical difference between the two groups ($p > 0.05$). Cognitive functioning was assessed by MMSE at baseline, after 1 month and then after completion of the ECT course. We found overall improvement in successive MMSE; however it was statistically significant only when the whole sample was assessed (table 3). Using Dunn's multiple comparison test, significant difference was seen only between baseline MMSE and final MMSE ($p < 0.05$). Table 4 illustrates correlation of change in cognition (MMSE difference at first and last visit) with ECT characteristics and demographic characteristics. We found that number of ECT had a negative correlation with change in cognition ($r = -0.29$, $p=0.04$). Correlation of the final MMSE value showed that it significantly correlated with baseline MMSE ($r = 0.47$, $p < 0.01$) and none of the stimulus characteristics (table 5).

DISCUSSION

M-ECT has proved to be a great modality of treatment to reduce relapses in various psychiatric disorders, such as depression, schizophrenia, OCD, etc. [8]. The present study analyzed 50 subjects who were on M-ECT in the year of 2017. The predominant diagnosis in this sample was schizophrenia (n = 30), followed by depression (n = 12). Even though older literature suggests that predominantly depressive illnesses receive M-ECT, the patient profile is changing as better antidepressants are now available [5]. Overall, the subjects received an average of 27.52 ECT. Case reports have shown patients receiving over 100 ECT, with a maximum reported number of 2400 [23]. The maximum number of ECT received by a single patient in our sample was 132. Among the two groups, the number of ECT did not vary significantly. It appears that the number of M-ECT required may not depend on the diagnosis. Other stimulus characteristics such as duration of seizure, duration of current and total charge also did not vary among the two groups. Though difference in charge and impedance has shown to vary with clinical outcome and profile, the present analysis shows that this may not be the case in M-ECT [24]. Previous studies associating gender with stimulus characteristics have generated varied results. Some show that gender does not influence the ECT dosage and some have shown that women have a higher seizure threshold [25-26]. The present analysis reveals that female patients require more charge to be delivered and male patients experience seizure for a longer duration. Both these findings support the hypothesis that females have a higher seizure threshold.

Cognitive impairment is a potential problem with ECT, limiting its use for prophylaxis [27]. Studies done hitherto have suggested that cognitive functioning may improve with M-ECT [27]. This appears to be more prevalent in those patients who have a lower cognitive status pre-ECT and with prior cognitive impairment secondary to psychopathology [16,28]. In the present analysis however, the average baseline MMSE scores of both the groups were above 24 indicating that there was no significant cognitive impairment prior to initiation of M-ECT. Yet serial MMSE showed significant improvement, implying that M-ECT leads to improvement in cognitive functioning even without prior cognitive impairment. This difference was however only significant when the whole sample were analysed together and not in the individual groups. This probably could be because of the difference in sample size. Post-test analysis showed that difference between baseline and final MMSE was significant, which implies that this improvement is gradual and mostly occurs later in the course of treatment. Similar findings have been documented by other researchers as well [16].

Looking at factors associated with change in cognition, it was seen that the patients receiving more number of ECT showed lesser changes in cognition. This could be due to ceiling effect of cognitive change beyond a certain number of ECT. Previous studies on ECT treatments have shown that there may be transient changes in memory and executive functions, but largely cognition remains unaffected [23]. Further analysis revealed that the final MMSE score positively correlates with initial MMSE score only and not with the number of ECT or other stimulus characteristics. However, studies have shown that ECT characteristics do correlate with cognitive impairment and this finding differed from our findings [16]. It could be due to small sample size. Pre-ECT cognition and post ictal confusion have been shown to be the strongest predictors of amnesia post ECT [16]. Our findings postulate that pre-ECT cognition may determine both cognitive improvement as well and more research in this area is warranted.

Our study was not without limitations. It was a retrospective analysis and the assessment of each patient was done by different physicians which might lead to inter-rater variability. Only cognitive changes were assessed and other variables of clinical improvement were not. It would be interesting to see how these differ with stimulus characteristics and cognitive profile. Also end point for each patient was not be available and hence it was difficult to determine whether M-ECT treatment was stopped due to improvement, non-response, side-effects or non-adherence; and hence this factor could not be evaluated.

CONCLUSIONS

The present study shows that cognition improves with M-ECT and as such M-ECT can be a good alternative to long term pharmacotherapy. Female patients on M-ECT have lesser seizure duration and require more charge. Change in cognition negatively correlates with number of ECT and final MMSE score only correlated with pre-ECT MMSE. Moreover, there seems to be little to no difference in the number of ECT

required or other stimulus characteristics such as duration of seizure or current between psychotic and non-psychotic disorders to achieve sustained remission.

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