Original Research Article

A comparative study of effects on working and logical memory in psychiatry patients receiving combined electroconvulsive therapy with pharmacotherapy and pharmacotherapy only

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Abstract

Background: Electroconvulsive therapy, psychotropic drugs have their own effects on cognition. It is necessary to know how much of the cognitive impairment is due to the psychiatric disability, psychotropic drugs and how much of it is due topassage of electricity. **Aim:** To compare the effects of ECT-psychotropic drug combination therapy and pharmacotherapy only on working and logical memory. **Material and Methods:** All the cases were diagnosed as per ICD10 Diagnostic criteria6 for Research by experienced psychiatrists. Study group consisted of 50 patients prescribed psychopharmacological agents and ECT. Control group consisted of 50 patients undergoing treatment with drugs only. Evaluation was carried out by psychological tests. Pre-treatment evaluation was carried out oneday before ECT treatment and post-treatment evaluation was carried out at week 3 and 7. **Results:** All patients with severe psychiatric disorders have significant impairment in working memory which appear to be a state marker of symptomatic status. Working memory improved with pharmacotherapy. ECT didn't confer any additional advantage or disadvantage. ECT contributed to impaired short anterograde memory impairment which resolves by week 7 post-treatment.36% of patients of ECT group had subjective impairment of memory, while none in the control group had this type of memory impairment.
Conclusion: ECT does impose short lasting impairment of subjective impairment of memory. Working memory and new learning improve with combined ECT and pharmacotherapy.
Key Word: Severe psychiatric disorders, Electroconvulsive therapy, psychotropic drugs, working memory, logical memory

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INTRODUCTION

Electroconvulsive Therapy (ECT) is a biological therapy where seizures are Induced under medical supervision by passing electric current across the scalp.[1]Like all medical procedures ECT also may have certain unwanted effects. The potential adverse effects from ECT range from mild complications like myalgias to serious events such as fractured bones, cardiovascular catastrophes and death. Advances in ECT machines and methods along with better monitoring and management have brought down physical morbidity to a remarkably great extent so much so at present The issue of cognitive side effects of ECT, continues to generate much debate in the professional

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circles. During acute treatment both anterograde and retrograde memory are reported to be impaired however their persistence varies from 0 to 100%.[2] Further, psychotropic drugs like heterocyclic antidepressants and typical antipsychotic drugs (still widely used in our country) have their own effects on cognition. Benzodiazepines, which are prescribed for comorbid anxiety and agitation have also significant effects on memory. Newer antipsychotic drugs are noted to produce variable effects on cognition.[3] As most patients in our country get concurrent pharmacotherapy and electro-convulsive therapy, the issue of cognitive side effects of psychotropic drugs becomes relevant. It is necessary to know how much of the cognitive impairment is due to the psychiatric disability, psychotropic drugs and how much of it is due topassage of electricity. Controlled trials in this area are sparse.[4] In India it is common practice to give ECT in combination with disability appropriate psychotropic medications right from the outset in an emergency or as an augmentation strategy later on for resistant cases.[5] The present study was designed as a preliminary excursion into the area to compare the effects of ECT-psychotropic drug combination therapy and pharmacotherapy only on working and logical memory.

MATERIAL AND METHODS

The study was conducted over a period of two years at a teaching hospital in the Department of Psychiatry having indoor facility, daily outpatient facility and round the clock emergency services with fully equipped Electroconvulsive Therapy unit consisting ofCardiac monitor, pulse oxymeter and Boyl's Apparatus, suction apparatus and oxygen in cylinders.

Sample: Study group: 50 patients who have been prescribed psychopharmacological agents and ECT formed the study group. Control group: 50 patients undergoing treatment with drugs only formed the control group; only those diagnostic categories for which ECT were prescribed were selected for control. Both groups were matched for sex, age and education.

METHODOLOGY

All the cases were diagnosed as per ICD10 Diagnostic criteria[6] for Research by experienced psychiatrists. The investigator had no role in deciding mode of treatment, dosage requirements nor termination of either treatment. Persons who had ECT within the past one year and those having neurological deficits, serious physical illnesses, mental retardation or dementia were excluded from the study. Informed consent as per guidelines given by Gada *et al*[7] to take ECT was obtained prior to every treatment. A separate informed consent was obtained to participate in the research study.

ECT: ECT was administered by means of a Medica Model BPE-2000 of Medicaid Systems which gave bidirectional square wave pulses at a frequency of 20-90 Hertz. Pulse width could be adjusted from 0.1milli sec to 2 milli sec. while the stimulus duration could vary from 0.1sec to 4.9 sec. At 220 Ohm impedance the machine could give a minimum power of 2.7J and maximum of power of 160J. Electrical seizure could be monitored in real time by means of inbuilt EEG leads and Hewlett-Packard laptop computer. The entire procedure was carried out as per guidelines of Gangadhar *et al*.[1] At our centre, it was found that a charge of 100 mc approximates to a level just above the seizure threshold at a pulse width of 1 milli Second, frequency of 60 Hz and a constant current of 0.7 amperes with a 1 second stimulus train. This generally produces a seizure of 20 seconds minimum duration. As a rule of thumb 50% increment in the charge was made at every subsequent procedure. This is in accordance with Bealle *et al*[8] and Coffey *et al*.[9]As bitemporal electrode placement found to be more effective all patients were given ECT's with bilateral temporal electrode placement. Oxygen 100% administered via face mask. A minimum 95% saturation is maintained on pulseoxymeter monitor. Patients CVS state was constantly monitored by Cardiac monitor and frequent Blood Pressure measurements manually. No adverse cardiological events occurred during the entire study.There was no need to augment the ECT procedure. Pulse width stimulus duration and other electrical parameters were decided as per the directions of attending Psychiatrist.

Evaluation: Detailed evaluation was carried out clinically and by means of psychological tests. Pre-treatment evaluation was carried out oneday before ECT treatment and post-treatment evaluation was carried out at week 3 and 7. All the findings were recorded on a specially designed proforma.

Statistical Analysis: Repeat Analysis of variance with post-hoc Bonferroni correction carried out for within group comparison across time span. Chi square and students t-test, paired and unpaired were, used to compare categorical and continuous variables respectively.

PSYCHOLOGICAL TESTS

Verbal Working Memory N Back Test[10]

This test is a sub test of NIMHANS Neuropsychological Test Battery.[10] Thirty randomly ordered consonants common to multiple Indian languages were presented auditorily at the rate of one per second. Nine of the consonants are repeated. The subject was asked to responds whenever a consonant was repeated consecutively. The total Number of omissions and commissions formed the error score. Scoring and norms were given in the NIMHANS Battery.

1. Verbal Retention for Dissimilar Pairs[11]

This is a sub test of PGI Memory Scale.[11] 5 pairs of items were read out to the person at the rate 2 seconds for each pair with a gap of 5 seconds between each pair. At the end of the presentation individual was expected to give the name of the pair when the first name of the pair was given by the tester. Three trials were given totally. Scoring and norms are given in the manual. The test was administered only once at each point of assessment.

2. Logical Memory Test[10]

This is a sub test of NIMHANS Neuropsychological Battery.[10] The test consists of a short passage with 24 facts. The passage is read out slowly and clearly once. Only immediate recall was tested. The total number of facts recalled formed the score.

RESULTS

The mean age of control and study group was 31.2 and 30.3 years respectively. The pharmacotherapy and pharmacotherapy + ECT group evenly matched for age, sex, educational status (Table 1:)

Table 1: Characteristics of the study population

Patient characteristics	Control group (n=50)	Study group (n=50)	P value
Age			
Mean	31.2	30.3	>0.05
SD	13.29	9.56	(Not significant)
Sex			
Male	22	26	>0.05
Female	28	24	(Not significant)
Education			
Primary	07	05	
Secondary	23	26	
Undergraduate	10	11	>0.05
Graduate	07	08	(Not significant)

In control group, 17 patients were diagnosed as schizophrenia, 32 with depression and one with mania whereas, among study group, 13 patients were diagnosed with schizophrenia, 28 with depression and 9 with mania (X^2=7.2;DF=2;p< 0.05).

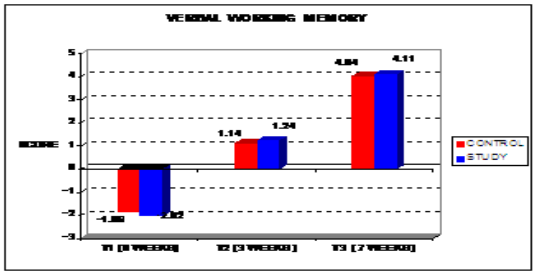

Figure 1: Comparison of Verbal Working Memory between two groups

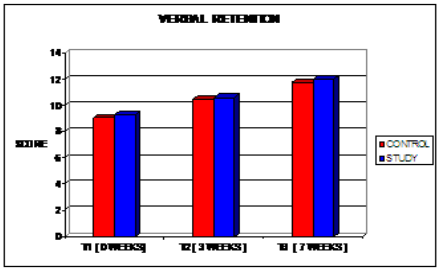

Figure 2: Comparison of verbal retention between two groups

Verbal working memory as tested by 'N back' Test, improved significantly within both control and study groups at 3 weeks (T2) and 7 weeks (T3) after treatment (p<0.001). However, there was no statistically significant difference (p>0.05) between the groups which indicates that improvement in working memory has been same in each group. Hits minus errors was taken as an index of memory in the present study. The mean hit rate found to be 4.25 (SD 1.48) and the mean error rate found to be 6.36 (SD 1.6) for the entire sample. The difference between the sample subject and norms was highly significant (p< 0.001) (Graph 1).

The verbal retention has improved at 3 weeks (T2) 7 weeks post-treatment (T3) from base line (T1). Within both groups (p<0.01) (Bonferroni significance p< 0.017). There was no statistically significant difference between the groups at assessment point T1 and T3. However, verbal retention had improved highly significantly (p< 0.002) in the study group at 3 weeks post treatment (T2) (Graph 2).

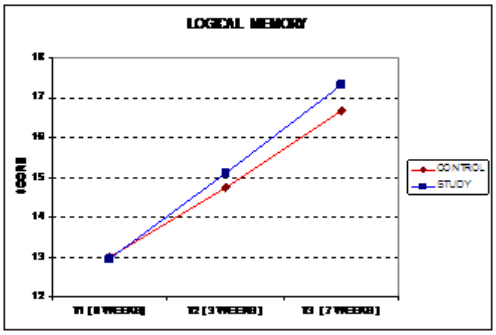

Figure 3: Comparison of logical memory between two groups

The logical memory of the patients of both groups improved consistently at point T2 and T3. ($p< 0.01$ and 0.001 respectively). However, there was no statistically significant difference between the groups pre and post treatment indicating the fact that ECT does not bring any additional advantage in improving short term memory. There was a highly significant increase in the side effects within each group (Repeat ANOVA $p<0.001$). The increase was highly significant at point T2 and T3 within each group.There was no statistically significant difference in the side effects between the control and study groups, which indicates that ECT confers no further burden of side effects. Mean scores range from 7.06 to 17 in control and 7.06 to 16.7 in study group.

DISCUSSION

There has been a surprisingly little information about the short term and long term consequences of combined pharmacotherapy and electroconvulsive therapydespite the fairly common practice of combining the two treatment modalities in the management of serious mental disorders in India. The present investigation was a prospective observational study designed to ascertain if the independent variable ECT has any positive or negative effect on the memory functions of the patients. In the present study, the pharmacotherapy and pharmacotherapy + ECT group evenly matched for age, sex and educational status. The mean age of control and study group was 31.2 and 30.3 years respectively. Patients of the study were much younger than other studies[12,13] which may be due to the fact their sample consisted exclusively of cases of depression. The cognitive process of maintaining the information of the primary task "*in mind"*while conducting the secondary task is the core of working memory functioning.[14]It can beconceptulized as a dynamic short term memory where the "*central executive*" of the working memory allocates attentional resources to the primary and such secondary tasks that a particular situation or event imposes only the verbal aspect of working memory, called the "*phonological loop*" by the originators, has been investigated in the present study. The "*N back test*" requires the subject to "*keep in mind*" the previous consonant while comparing the incoming steady stream of consonants for similarity. The logical memory test as well as the verbal retention test have an obvious working memory element. Working memory as tested by 'N back test' found to be grossly impaired in both groups at the baseline ($p<0.001$), when compared with norms given in the NIMHANS neuropsychology battery manual.[10] Obviously it is a state marker of severe psychiatric disorders. The notable point here is that ECT has no adverse effect on working memory. Working memory impairment is a known phenomenon in schizophrenia.[15,16]Though cognitive impairments in mood disorders is known,[17]specific defects in working memory, though understandable, has not been mentioned in standard text books. Significantly diminished hit rates and raised error scores contributed to the working memory impairment seen in the entire sample. The impact of drugs and ECT on working memory has not been investigated by any worker so far. Both the study and control group registered impressive improvement in working memory after treatment. As between the group comparison did not reveal any significant difference in working memory index between the control and study group it appears that ECT does not confer any advantage in improving working memory. Though labeled as verbal retention by the originators, the administered test actually measures new learning and working memory. Paller[18]makes a distinction between retention and new learning, retention is tested by delayed recall. Hence, this test is a measure of antrograde memory. Both the study and control groups record highly significant improvement at 3 and 7 weeks post treatment compared to baseline, indicating this measure as an indicator of clinical recovery. Between the group comparison reveal interesting findings. There was no significant difference between the control and study groups at baseline and at 7 weeks post treatment. However, at 3 weeks mark the study group made some remarkable progress in anterograde memory ($p< 0.002$). This improvement in new learning appears to reflect faster recovery from symptoms in the study group. ECT is known to bring faster relief from symptoms.[19]Retention has not been tested in the present study. Logical memory for a given passage is a measure of working memory and organizing ability. The subject need to relate the sentences logically while holding the material ***"in mind".*** As only immediate recall is tested in the present study no comment can be made about the retention aspect of anterograde memory. The highly significant improvement in logical memory that both groups have shown at point T2 and T3 indicates again that it is state marker for severe psychiatric disorders and drugs are effective in reversing this aspect of memory as there is no difference in scores in between the group comparison it can be inferred that ECT does not confer any further advantage or disadvantage in reversing new learning deficits. A further factor of relevance is that new learning is highly improved by week 3 in the study group. It is a well-established fact that ECT reverses new learning defects of psychiatric patients. So, it can be reasonably inferred that the improved quality life by week 3 in the study group is due to rapid and effective clinical response to a combination of ECT and pharmacotherapy. This could one of the reason for psychiatrists in India

preferring this method of treatment. This could also be the cause of Abhayankars[20] observation that in clinical practice patients and relatives readily agree to ECT and in fact many patients demand it. Anecdotal reports of many experienced psychiatrists do corroborate the above observation.

CONCLUSION

In conclusion, it can be said that ECT does impose short lasting impairment of subjective impairment of memory. Working memory and new learning improve with combined ECT and pharmacotherapy.

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