

EVALUATION OF UNILATERAL ELECTRO-CONVULSIVE THERAPY (A double blind study)

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ABSTRACT

A double blind study of one hundred twenty patients (ninety schizophrenics and thirty depressives) —who were divided equally into three groups, who received either (a) bilateral ECT or (b) unilateral application of electrodes on non-dominant hemisphere or (c) unilateral on dominant hemisphere was conducted. The three groups were compared regarding efficacy of the therapy, effects on memory, speed of recovery from each shock session and lastly changes in the electro-encephalogram.

It was found that all the three techniques were more or less equal in therapeutic efficacy. There was no significant difference between them in the speed of recovery, nor in the EEG changes. Only difference was that in the field of memory, unilateral non-dominant group showed significant improvement in the 'immediate verbal recall' component of memory in particular. Results have been discussed in view of the current literature on the subject.

Cerletti and Binni's introduction of ECT in 1938 amounts to one of the four epoch making contributions to Psychiatry during the last hundred years. Conventionally the treatment is administered by passing a standard current through bilateral electrodes placed on the temporo-frontal regions. The treatment ordinarily does not carry much risk to life by itself, though fatalities are known; but the concomitant loss of memory and a state of confusion often following the shock are its two well known sequelae. These disturbances are generally temporary but in some cases they may persist longer. Some observers have noted prolonged and severe disablement on account of these troubles (Brody 1944, Levy *et al.* 1942 and Freeman 1979). Because of these disturbances ECT has lost some of its original popularity. Both the sequelae are known to be due to the passage of current and not the convulsion itself (Otto 1960). Considering the efficacy of the treatment, there have been various attempts to modify it. Unilateral ECT is one such modification, which is supposed to reduce the impact of the current. Because both the electrodes are placed on one side (preferably non-dominant) one hemi-

sphere is kept rather free from impact, thus speech memory areas in one fronto-temporal lobe is spared. This way the modification seems to be an improvement over the conventional bilateral method. Beneficial effects of this technique were demonstrated by Fredman as early as in 1942, but it was not followed up till Thenon (1956) and Lancaster *et al.* (1958) had made the observations that by placing the electrodes on the non-dominant side, the complications became less.

All the studies made so far on evaluation of unilateral ECT can be grouped under three heads: (a) Studies which have shown that this method produces less complications (Lancaster *et al.* 1958, Cannicott 1962, Martin *et al.* 1965, Zamora and Kaelbing 1965, Halliday 1968, Valentine *et al.* 1968, Zinki and Birtchell, 1968, Fleminger 1969, Sutherland *et al.* 1969, Costello *et al.* 1970 and Doongaji *et al.* 1973). (b) Works denying any advantage to this method (McAndrew *et al.* 1967, Levy 1968, Bidder *et al.* 1970 and Fakhr el Islam *et al.* 1970). (c) Studies which are equivocal (Impastato *et al.* 1952, Strain *et al.* 1968 and others). It was also seen that practically all the studies reviewed, suffer from one or more

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handicaps, either in methodology or in planning. The important lapses were 1. Sampling: Only depression cases were included in the majority, thus omitting a major indication of ECT, viz. schizophrenia. Samples were usually small. 2. Cerebral dominance was not objectively determined. 3. Treatment schedule of ECT, viz. dosage of current and the number of treatment sessions were not kept constant. 4. Effects of past ECT were not excluded. 5. Blind condition did not prevail. 6. EEG studies not done in most of them. 7. Memory testing, though a major parameter, was not done in most of them and they relied mainly on patient's complaint.

Keeping in view the limitations of earlier works and the conflicting reports, this project was planned to study the subject in depth after obviating the lapses. Comparison was made between all the three treatment techniques, viz. (a) Conventional bilateral method, (b) Unilateral non-dominant placings, (c) Unilateral dominant method. For the purpose of comparison four parameters were chosen on the basis of the current literature. They were:

- (1) Therapeutic efficacy,
- (2) Memory loss,
- (3) Speed of recovery from each shock,
- (4) Variation in EEG.

MATERIAL AND METHOD

All patients of depression and schizophrenia treated at the Armed Forces Medical College and Command Hospital, Poona, during one year who had fulfilled the criteria of selection were included. The criteria were: a) Disease was not more than one year's duration, b) Age range from 16 to 50, c) No history of receiving ECT in the past six months. There were 138 patients studied in all, but a number of them had to be excluded for different reasons. 14 patients did not complete the schedule, 2 patients were found to be ambidextrous and in another 2, there was no unanimity in diagnosis. Thus a total of 120 patients were included in the project.

The task of assignment of the patients to a particular method of treatment was given to the post-graduate trainees, so that the authors were blind about it. The trainees were advised to assign equal number of schizophrenics and depressives to each group. Thus there were thirty schizophrenics and ten depressives in each of the three groups. Age, sex and duration of illness of the patients in each group is tabulated in Table 1.

TABLE I—*Characteristics of the Sample*

Method	Mean Age	Sex		Duration of illness (mean)
		M	F	
Bilateral	28.83	31	9	162 days
Uni-N. D.	29.00	34	6	153 „
Uni Dom	28.50	33	7	120 „

No statistical significant difference between three groups ($p > 0.5$) was observed implying that the groups were matching.

Every patient when included in the study, went through three phases of investigations, viz. Initial, Treatment and Post-treatment. In the initial phase the investigations done were: Laterality study: a well tried test containing questionnaire as well as performance (Zamora 1965) was given to each subject for determining the dominant side. (b) Clinical rating: was done by two experienced psychiatrists independently (one rater was the first author himself). The rating was done from the constellation of symptom (a total of eighteen) from Chatterjee and Golechha (1975) in the schizophrenics and from the Beck's rating scale (1961) in the case of depressives. Each symptom when present was rated in a four point scale (1-4) according to the intensity of the symptom. c) Rorachach rating: Nine pathogenomic features of schizophrenia and seven of depression after

Klopfers and Kelly (1946) given in appendix, were rated on a four point scale *d*) Memory test : Seven subtests were chosen from the Indian version of Boston memory scale (NIMHANS) on the consideration of easy administration and of taping different aspects of memory. (subtests are given in appendix). *e*) EEG study : due to stringency of the EEG papers, it was decided to take EEG of every third patient. Interpretation was done with the help of Adviser in Neurosurgery. Five common features were chosen for the sake of comparison, viz. synchronisation and alpha activity, frequency of spikes, beta activity, frequency of theta and delta waves and lastly any evidence of asymmetry. In the treatment phase investigations were *a*) Observations during the fit which included any unilateral fit if present, any local burn at the site of electrodes and any other unusual feature. *b*) Time for recovery from shock : this was time from moving of the switch of the machine to patient's recovery to be able to answer his personal as well as occupation particulars. Both the studies in this phase were done by the resident and the clinical psychologist, the latter (second author) staying at recovery room, unaware of the technique of treatment involved. ECT was given by the Reiter's machine, model SOS, voltage output 150 volts, 50 cycles and the current supplied is unidirectional, range 0.50/m.a. Every shock was modified with pentothal and scoline by an anaesthetist. Schedule of treatment sessions were kept constant, the schizophrenics receiving eleven and the depressives five shocks. For the unilateral treatments, electrodes were placed at a distance of 7.5 c.m. on the points as per Gotlieb and Welson (1965). In the post-treatment phase, studies were conducted three weeks after the treatment schedule was over. Clinical rating, Rorschach rating and the memory tests were done in the same way as in the initial phase. EEG was repeated on only those who had an EEG done in the initial phase.

OBSERVATIONS & RESULTS

All the 120 patients had generalised convulsion of grand mal type and there was no case of sub-shock or delayed shock. The unilateral cases, as reported by the resident, started the tonic phase on the opposite side first indicated by stiffness of limbs of that side. Duration of unilateral seizure was momentary (4-6 seconds) in all the cases. There were three cases of local burn at the site of electrodes,—two amongst the Uni-N.D. and one in the Uni-Dom. group. Treatment had to be deferred for three days in each case for reasonable recovery of the burn.

For the purpose of evaluation and comparison of the three groups over the objectives of four parameters, all the results are tabulated. Summary of results and statistical evaluation of individual methods are given first and then the comparative tables. (Tables 2 to 10).

DISCUSSION

Present study on 120 patients, given a total of 1170 ECT shocks is possibly a work done with maximum number of patients on the subject to date. The authors have come across only two papers (Doongaji *et al.* 1973 and Fakr el Islam 1970) who had worked on schizophrenic patients as well, others were those of depression. Considering the fact that the incidence of schizophrenia is about 3-4 times more than depression, frequency of administration of ECT is also much more in this disease. This is particularly true in our country where for reasons of economy and quick manageability, ECT remains a common treatment modality unlike the western. Hence both the diagnostic categories were taken in the ratio of 3 : 1; In the present project, the three treatment methods have been evaluated from multiple dimensions, rather than one or two, as had been done in most of the studies. This was attempted to arrive at a reasonably certain conclusion regarding the utility of the unilateral methods

TABLE 2—Observations in Bilateral Method

Parameter	Diagnostic groups	Initial mean score	Final mean	Difference & (std. error)	t value	Significance
Clinical recovery	.. Schiz.	.. 21.27	4.75	16.52 (4.85)	18.66	@@@
	.. Dep.	.. 23.75	5.30	18.45 (2.88)	20.26	@@
Rorschach recovery	.. Schiz.	.. 31.03	10.43	20.60 (7.81)	14.45	@@
	.. Dep.	.. 23.00	6.10	16.90 (2.60)	20.56	@@
Memory changes	.. Schiz.	.. 37.23	41.03	3.80 (11.65)	1.59	N.S.
	.. Dep.	.. 44.00	47.00	3.00 (6.46)	1.47	N.S.
Recovery time	.. Schiz.	.. 11.66	S.D.	3.62		
	.. Dep.	.. 11.21	S.D.	5.02		

@@@ highly significant ($p < 0.01$), @@ significant ($p < 0.05$) N.S. : not significant.

TABLE 3—Observation in Unilateral—N.D. Method

Parameter	Diagnostic group	Initial mean score	Final mean	Difference & (std. error)	t value	Significance
Clinical recovery	.. Schiz.	.. 18.67	2.72	15.95 (7.12)	12.27	@@
	.. Dep.	.. 27.35	6.55	20.80 (8.21)	8.01	@@
Rorschach Recovery	.. Schiz.	.. 27.30	8.43	18.87 (7.83)	13.20	@@
	.. Dep.	.. 23.20	5.60	17.60 (5.08)	10.66	@@
Memory changes	.. Schiz.	.. 42.90	48.60	6.57 (13.44)	2.32	@
	.. Dep.	.. 44.00	48.50	4.50 (5.66)	2.51	@
Recovery time	.. Schiz.	.. 11.63	S.D.	5.14		
	.. Dep.	.. 1.40	S.D.	3.27		

@@Highly significant ($P < 0.01$) @significant ($p < 0.05$)

TABLE 4—Observations in Unilateral—D. Method

Parameter	Diagnostic groups	Initial mean score	Final mean	Difference & (std. error)	t value	Significance
Clinical recovery	.. Schiz.	.. 21.10	3.87	17.23 (6.2)	13.64	@@
	.. Dep.	.. 26.10	3.40	22.70 (7.61)	.43	@@
Rorschach recovery	.. Schiz.	.. 28.10	10.77	17.33 (5.16)	18.40	@@
	.. Dep.	.. 26.80	9.40	17.40 (7.89)	6.97	@@
Memory changes	.. Schiz.	.. 42.30	43.70	1.40 (9.86)	0.78	N.S.
	.. Dep.	.. 42.30	6.60	4.30 (10.83)	1.26	N.S.
Recovery time	.. Schiz.	.. 10.68	S.D.	3.07		
	.. Dep.	.. 11.43	S.D.	3.70		

@@highly significant ($p < 0.01$), N.S.—not significant ($p > 0.5$)

TABLE 5—*Comparison of therapeutic efficacy—Clinical*

Groups	Mean		Rating		Difference		Remission	
	Initial		Final				in per cent	
	Schiz.	Dep.	Schiz.	Dep.	Schiz.	Dep.	Schiz.	Dep.
Bilateral ..	21.27	23.75	4.75	5.30	16.52	18.45	74.47	78.32
Unilat. N. D. ..	18.67	27.35	2.72	6.55	15.95	20.80	84.94	75.28
Unilat. Dom. ..	21.10	26.10	3.87	3.40	17.23	22.70	79.57	83.15

TABLE 6—*Comparison of therapeutic efficacy—Rorschach rating*

Group	Mean rating				Difference		Remission	
	Initial		Final				in per cent	
	Schiz.	Dep.	Schiz.	Dep.	Schiz.	Dep.	Schiz.	Dep.
Bilateral ..	31.03	23.00	10.43	6.10	20.60	16.90	66.72	74.77
Unilat. N. D. ..	27.30	23.20	8.43	5.60	18.87	17.60	70.11	75.54
Unilat. Dom. ..	28.10	26.80	10.77	9.40	17.33	17.40	61.48	62.02

TABLE 7—*Comparison of effects on memory*

Group	Initial		Final		Difference		Loss		Gain	
	Schiz.	Dep.	Schiz.	Dep.	Schiz.	Dep.	Schiz.	Dep.	Schiz.	Dep.
	Bilateral ..	37.23	44.0	41.03	47.0	3.80	3.00	10	3	17	6
Unilat. N. D. ..	42.0	44.00	48.00	48.5	5.70	4.50	9	2	16	8
Unilat. Dom. ..	43.30	42.3	43.70	46.6	1.40	4.30	11	5	16	4

TABLE 8—*Comparison of speed of recovery*

Method	Mean recovery time	
	Schiz.	Dep.
Bilateral ..	11.66 mts.	11.21 mts.
Unilat. N. D. ..	11.63 "	10.40 "
Unilat. Dom. ..	10.68 "	11.43 "

TABLE 9—Comparison of changes in EEG
(N=40, schiz. 27, Dep. 13)

Features	Bilateral	Unilat. N.D.	Unilat. Dom.
<i>Synchronisation</i>			
(a) Better	4	6	8
(b) No change/Worse	..	..	..
(c) Alpha, well formed	8	6	..
<i>Spikes and Seizures</i>			
(a) Appears	..	8	4
(b) No change	12	..	..
<i>Fast activity</i>			
(a) Disappears	12	15	13
(b) Increases/No change	..	..	..
<i>Slow activity</i>			
(a) Appears	7	3	13
(b) Disappears	..	..	..
<i>Asymmetry</i>			
(a) Increases	4	10	13
(b) Decreases	6	5	..

TABLE 10—Statistical Evaluation between different methods *t* values

Parameters	Diagnostic groups	I vs II	I vs III	II vs III
Clinical recovery	Schiz.	<1 (N.S.)	<1 (N.S.)	<1 (N.S.)
	Dep.	<1 (N.S.)	1.55 (N.S.)	<1 (N.S.)
Rorschach recovery	Schiz.	<1 (N.S.)	1.41 (N.S.)	<1 (N.S.)
	Dep.	<1 (N.S.)	<1 (N.S.)	<1 (N.S.)
Memory changes	Schiz.	<1 (N.S.)	<1 (N.S.)	1.41 (N.S.)
	Dep.	<1 (N.S.)	<1 (N.S.)	<1 (N.S.)
Recovery time	Schiz.	<1 (N.S.)	<1.13 (N.S.)	<1 (N.S.)
	Dep.	<1 (N.S.)	<1 (N.S.)	<1 (N.S.)

I—Bilateral II—Unilateral N.D. III—Unilateral Dom. N.S.=Not significant (p>0.5)

since presently both extreme as well as moderate views are prevalent regarding its effectivity and utility (d'Elia 1976).

Analysis of the differences between pre and post treatment rating scores (clinical and psychological)—Table 10, shows that there is no significant difference in the three groups regarding efficiency. It is also seen that all the three treatment modalities are quite effective individually regarding amelioration of symptoms—Tables 2, 3 and 4. This finding is in line with most of the earlier works. As the number of ECT was kept constant, there is no scope for presuming that any group would need more ECT for recovery, as had been thought by Bidder *et al.* (1970), Cannicot (1962) and Strain *et al.* (1968). Since both the authors were kept blind regarding the method of treatment, the element of prejudice was totally excluded. Though none so far has been able to show any difference in the efficacy in the three treatment methods, some workers have commented that bilateral method is perhaps the most effective and that lesser number of shocks are required by this method. Present work clearly rules out this prejudice.

Unilateral ECT was introduced with the idea that memory disturbances known to occur with ECT would be minimised and this was also demonstrated by Lancaster *et al.* 1958. But their findings have been confirmed as well as challenged equally by other workers. Logically ECT should have both the effects viz. impairment due to direct effect of the current and improvement

due to amelioration of the disease process, thereby leading to better concentration, attention and initiative. An element of learning also adds perhaps to the apparent picture of improvement. In the present study many patients had shown improvement of memory under all the three treatment groups, but in Unilateral non-dominant method this effect was statistically significant (Table 3). When a comparative study is made, no significant difference is seen between them (Table 10). In the absence of any significant difference between the three groups regarding changes in memory, further analysis was done. The seven items of memory test were grouped as A (1 and 2), B (3 and 4) and C (5, 6 and 7); 'A' items denoting immediate auditory verbal recall, 'B' for short and long term memory and 'C' for memory dependent on learning and intelligence. These analyses results are shown in Table II. (Schizophrenia and depression cases combined).

It will be seen that in set 'A' (immediate recall), the improvement was highly significant in only Unilateral N. D. group; while in set 'C' also the improvement was significant. In the other two methods there was no significant change in any of the areas. Thus it is evident that as far as immediate recall, Unilateral N. D. has clear advantage over the other two. This advantage has also been reported by Annet *et al.* (1974).

Speed of recovery from the effects of shock in all the three groups did not show any significant difference in this study.

TABLE 11—Analysis of memory scores

Sets	Bilateral				Uni. N. D.				Uni. Dom.			
	Mean	S.D.	't'	Sig.	Mean	S.D.	't'	Sig.	Mean	S.D.	't'	Sig.
A ..	+0.24	2.05	<1	N.S.	+0.88	1.88	2.38@@		-0.04	2.26	1	N.S.
B ..	-0.24	3.69	<1	N.S.	+0.65	3.16	<1.05	N.S.	+0.08	2.91	1	N.S.
C ..	+2.04	6.13	<1.66	N.S.	+2.19	5.46	<2.05@		+1.64	5.27	1.5	N.S.

Sig. —Significance N.S.—not significant. @—significant @@ —highly significant.

The results are contrary to what was observed by Lancaster *et al.* 1958, Cannicot 1962, Halliday *et al.* 1968 and Sutherland *et al.* 1969. There had been good amount of individual variation, but this was true for all the groups.

General pattern of changes in EEG were more or less the same in all the three groups, viz. better formation of alpha waves, reduction or disappearance of fast activity and accentuation of theta activity. Contrary to expectation, features pointing to asymmetry were not significant, and the Uni. Dom. group did not show any change at all in this regard. Our findings are at variance with those of Martin *et al.* (1965) and Zamora *et al.* (1965), who found evidences of theta activity on the same side as the electrode placement. The number of cases in each group being small, statistical evaluation was not possible, but the changes being universal, it may be safely presumed that there is no EEG evidence to support or deny any advantage to any particular group.

From comparison of the results of all the parameters studied, it is apparent that all the treatment groups produce significant improvement in clinical condition and that there is no statistically significant difference between them as regards effects on memory, speed of recovery and the changes reflected in EEG. Only significant difference is that the Unilateral Non-dominant (N.D.) group has a distinct advantage as far as immediate auditory verbal recall part of memory function is concerned. This is probably accounted for by the relative sparing of the dominant hemisphere. It would appear that generalised convulsions resulting from each of the treatment groups, affecting all the brain structures equally, neutralise the local effects of the electrodes on the temporal lobes, if any.

Local burn at the site of electrodes in two cases in Uni. N. D. group and one in Uni. Dom. do not reflect any significant disadvantage.

CONCLUSION

Thus this study has established that unilateral non-dominant method should be the method of choice since the therapeutic efficacy is definitely not inferior to the bilateral method and at the same time, the improvement of memory, of the immediate verbal recall component in particular, is also significant when compared to other two methods. Quite a good number of institutions in the west have already switched over to this technique and it appears that there are good reasons for that.

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Appendix 'A'**Rorschach rating scale**

(Klopfer & Kelly)

Schizophrenia	Depression
1. Manner of approach (confused)	1. Less number of responses
2. Preservation	2. Long reaction time
3. Description of cards	3. Rejections
4. Blocking (Rejection)	4. High A %
5. Low P %	5. Decreased M and C responses
6. Low F %	6. Side remarks depicting depression
7. Confabulator D W	7. High F + responses
8. Abstract and personal references	
9. Variability in quality (F- to F+)	

Appendix 'B'**Memory tests (Sub-tests from Boston memory scale)**

(Indian version by NIMHANS)

1. Digit forward	5. Common knowledge
2. Digit backward	6. Counting 20 to 1.
3. Personal data (remote)	7. Paired associates.
4. Personal data (recent)	