

NEUROPSYCHOLOGICAL REHABILITATION OF ALCOHOLICS : A PRELIMINARY REPORT

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ABSTRACT

Alcoholism is associated with impairment of information processing attention, memory and concept formation, which hamper the patients response to psychotherapy aimed at treating alcoholism. We improved cognitive functioning in abstinent alcoholics through cognitive retraining. Eight detoxified male alcoholics, comparable on age, education, marital status, medication and years of alcohol consumption were assigned, four each to the treatment and control groups. Cognitive retraining given to the treatment group improved attention, information processing, memory, planning and reasoning. Daily, individual, one hour sessions were conducted for six weeks. Patients in the control groups were seen weekly once and counselled if necessary. In the treatment group, significant improvement of information processing, memory, and reduction of neuropsychological deficits resulted from retraining. Control group showed no changes in cognitive function. Family functioning and long term abstinence were not influenced by cognitive retraining. Neuropsychological rehabilitation is effective in improving cognitive deficits of abstinent alcoholics.

Key words : Cognitive retraining; neuropsychological rehabilitation, alcoholism, cognitive deficits, neuropsychological deficits, abstinence

The characteristic cognitive impairment in alcoholics are deficits of abstraction, visuospatial ability, verbal fluency, planning and organisation and shift of set and error utilisation (Gurling et al., 1991). Alcoholics with longer histories of drinking have greater deficits in abstracting abilities and conceptual shifting independent of age (Parker et al., 1977). Abstinence leads to recovery of function with the acute effects being mitigated after three weeks of abstinence (Goldman, 1983). Though cognitive deficits improve over time, the performance of alcoholics does not reach normal levels (Clarke & Haughton, 1975). Impairments of attention, memory and planning can reduce the effectiveness of psychotherapy aimed at preventing relapse (Goldman, 1983). Hence im-

provement of cognitive functioning is essential in rehabilitating the alcoholic patient.

Alcoholics were given cognitive retraining to improve attention, memory, spatial analysis and abstract reasoning. The patients improved in these functions, but due to lack of controls it could not be ascertained whether the retraining, abstinence or a combination of the two was responsible for the improvement (Hansen, 1977). We have retrained deficient cognitive functions in abstinent alcoholics and compared performance after the retraining with a control group of alcoholics who did not undergo the retraining. The control group controlled for effects of abstinence on cognitive functions.

MATERIAL AND METHOD

Sample : The sample consisted of eight literate males aged between 30 and 45 years with a diagnosis of alcohol dependence as per ICD-9 criteria selected from the deaddiction ward of the Department of Psychiatry, NIMHANS, Bangalore. Patients did not have history of multiple drug abuse, associated neurological deficits such as peripheral neuropathy, any other neurological or psychiatric disorder, except for depression or anxiety which did not qualify for an independent diagnosis. They were abstinent for three weeks and were not on any psychotropic drugs. All the patients included in the study continued to be abstinent for the duration of study. After obtaining informed consent, four patients were allocated at random to each of the treatment and control groups. Two patients each from the treatment and control groups were discharged after deaddiction and participated in the study as outpatients. Patients in the two groups were comparable in age, education, marital status, occupational status, medication status and years of alcohol consumption (Table 1).

Assessment : Pre/post assessments in both groups measured attention, information processing, memory and concept formation, the functions deficient in alcoholics and targeted in the cognitive retraining. *Focused attention* was tested by the digit symbol task of Wechsler Adult Intelligence Scale given with distraction (traffic noise) for two minutes, the score being the number of correctly entered symbols. The figure identification task of Weintraub & Mesulam (1986) measured *sustained attention*. Figures of similar sizes but different shapes were randomly placed on a sheet of paper. The patient circled a pre-designated target figure. Score was the time taken to complete the page. Divided attention or the ability to allocate attention simultaneously to two tasks was measured by combining the triads task with the rhythm detection task (Misra & Rao, 1994). In the triads task, 100 sets of triads of common 2-4 letter Kannada words were chosen. Each triad contained two

words which belonged to the same category while the third word did not. The word triads were printed in the centre of a card in three rows. Each of the 100 cards was presented for 4 seconds in a tachistoscope and the subjects called out the odd word. The inter trial interval was 2 seconds. The second task was auditory presentation of prerecorded rhythmic beats. The rhythms were composed by simple hand beats on a plane surface, with changes of rhythms occurring every 2 seconds. There was total of 124 rhythm changes. The patients pressed a tally counter with the left hand whenever the rhythm changed. The tasks were administered as single tasks with 100% resource allocation. Dual task performance was obtained with 75%-25%, 50%-50% and 25%-75% levels of resource allocation between the two tasks. Performance on each task at each of these four levels were plotted on the X and Y coordinates of a graph to obtain the Performance Operating Characteristic, with the scores of single task performance (100% resource allocation) being plotted on the X and Y axis. Efficiency index was calculated with the formula $EI = \sqrt{X^2 + Y^2}$, Wherein X and Y referred to the scores on the two tasks at the 50%-50% resource allocation level (Wickens, 1984). *Depth of memory encoding* was assessed using cued verbal recall under semantic (deep) and rhyme (shallow) encoding condition. Forty eight common concrete nouns of four to six letters were presented for 100 milliseconds each through a tachistoscope. A question presented prior to each word encoded the word at the shallow or deep level. e.g. -a) Does the word rhyme with (another word is given here)- shallow level. b) Does the word belong to a category (a name is given here)- deep or semantic level. The patient answered by pressing one of two buttons. After the presentation of all the stimulus words, cued recall was elicited. At each level of encoding half the cues were specific to that level, while the other half pertained to the other level. The patients recalled the stimulus words after each cue. The score was the total number of words correctly recalled, (Menon & Rao, 1997). *Concept for-*

formation was tested with the concept formation test (Rao, 1976). Colour, shape and number of figures were the parameters of the concepts. Each parameter varied at three levels. The levels of colour were blue, red and green; levels of shape were square, circle and triangle; levels of numbers were one figure, two figures or three figures. These three parameters at three levels yielded 27 combinations which were shown on 27 cards. The cards were presented simultaneously. A concept was made up of a combination of parameters and levels. The patients attained the concept by pointing to different cards which could be either positive or negative instances of the concept. The therapist indicated the same. Two different concepts were attained in the same manner. The total time taken to identify the two concepts and the number of trials (i.e. the number of cards pointed to) formed the score. Information processing tests measured simple and choice reaction time, serial and parallel processing in the visual modality wherein the patients responded with a button press for digits presented on a computer screen. The presentation of stimuli and recording of responses were computer controlled (Rao et al., 1985). In the simple reaction time task, the digit 2 was presented for 80 milliseconds. The patient pressed a button as soon as the digit appeared. In the choice reaction time task, the digit 2, 3, 5 and 6 were presented singly for 80 milliseconds. The patient pressed one of the four buttons at the appearance of each of the four stimuli. Reaction time was the score in each of the above two experiments. In the serial processing task, the same four digits appeared singly but at stimulus durations varying between 20 and 2560 milliseconds. Again the patient pressed one of four buttons after the appearance of the stimulus. The reaction time of correct responses at the 20, 40 and 80 millisecond stimulus duration formed the score. These stimulus duration were chosen because an earlier study had found that an organic group differed from normal at these stimulus duration (Rao et al., 1986). Parallel processing was

measured by the span of apprehension task. An array of digits 1-9 were presented on 80 trials for 200 milliseconds. The order of digits was randomized across the trials. In each trial the patient identified the digits seen. The NIMHANS neuropsychological battery was used for a global neuropsychological profile. Reduction of neuropsychological deficits would indicate generalisation of the cognitive improvement. The battery was developed by Mukundan et al. (1979) and is being routinely used for neuropsychological assessment in the neuropsychology unit of the Department of Clinical Psychology, NIMHANS. The battery assess deficits of frontal, parietal and temporal lobe functions and has been described elsewhere (Rao et al., 1997). Deficits in neuropsychological functioning is determined through a qualitative evaluation using the ideometric approach. Practice effects on the above tests would be taken into account by comparing the performance of the treatment group with that of the control group. *Improvement in the patients family functioning* was assessed by interviewing a close relative such as a spouse/sibling/offspring using a ten point scale with one indicating no disturbance and ten indicating maximum disturbance.

Cognitive retraining: Attention, memory, information processing and concept formation were improved in daily, individual, one hour sessions for six weeks. Symbol-symbol substitution task under auditory distraction improved *focused attention*. Task complexity increased with increase in the number and complexity of symbols, as well as familiarity of the distracting stimulus. The distracting stimulus ranged from traffic noise, recorded music unfamiliar to the patient and recorded music of the patients favourite song. *Sustained attention* was improved by the digit cancellation task. There was a gradual increase in the number of digits, reduction of size of digits and increased scatter of the digits to increase the difficulty level. *Divided attention* was improved with simultaneous performance on two tasks. Initially the task tapped different attention resource pools, i.e. different

hemispheres. Category fluency was combined with visual target detection. The targets were geometric forms (circle, hexagon, rectangle, square and diamond) presented in 8 colours (pink, green, blue, red, orange, brown black and yellow). In each session a form or colour was identified as the target. The patients had to note down the occurrence of the targets. Task difficulty increased with increasing overlap in the attention resource pools, i.e. same hemispheres. Figure fluency was combined with tactual recognition of form with the left hand, wherein both tasks tapped the right hemisphere attention resource pool. In the figure fluency task a basic figure was given and the patient drew as many figures as possible from it. The seguin form board was used for the tactual recognition of form. Memory was improved by improving elaborative processing through verbal and visual memory tasks. The patients produced four associations to the stimulus to start with, after which the original verbal/visual stimuli were recalled. Gradually the number of associations were reduced to increase the difficulty level. Starting with a baseline of 6 stimuli, the number of stimuli were gradually increased. The automatic encoding of frequency information was trained to improve the encoding of contextual information which would enhance recall (Hasher & Zacks, 1979). A list of words were presented in which some words were repeated. The patients recalled the words which were repeated and the number of times for which they were repeated. Recall of the total list was also required. Three trials were given. Gradually the number of words in the list increased and the frequency of repetitions decreased. Choice reaction time (pressing different buttons to different visually presented numbers), serial processing (recognition of single numbers briefly presented visually) and parallel processing (recognition of number arrays briefly presented visually) improved *information processing* (Rao et al., 1985a). Presentation of the stimuli and recording of responses were computer controlled in the information processing tasks. The patients performed the

tasks as described previously but with decreasing stimulus duration. The pattern drawing test of Bhatia's performance test of intelligence, Koh's block design test of WAIS and Porteus Mazes were used to improve *planning and organisation*. In each of the functions targeted for retraining the tasks were introduced in a graded manner. Each function was targeted at least once in three sessions, as all the functions could not be accommodated in every session. Patients differed in the level of complexity to which they could perform in different functions. Two patients could reach complex levels of the tasks in all areas, while the other two patients performed only at the simple levels of the tasks. These two patients could not apply the basic principles learnt at the simple levels to solving complex problems.

The control group did not undergo cognitive retraining. Three patients in the control group along with a family member were seen once a week. During these weekly sessions, the problems faced by the patient in maintaining abstinence if any, as well as problems in other areas were discussed. The fourth patient went to his native town after the pre-assessment and came only for the post assessment.

Counselling : The patients in both groups were counselled as required. Patients in the control group were counselled once a week, while patients in the treatment group were counselled more frequently. In the counselling sessions the problems faced by the patients in their occupational, family spheres were discussed. Problems faced by them in their endeavour to give up alcohol was also discussed. Strategies to solve their problems were discussed.

RESULTS

Mean scores on different functions in the pre and post assessments in the two groups are given in table 2.

The pre assessment mean scores on different functions were compared between the two groups. T test for independent means and

TABLE 1
SAMPLE CHARACTERISTICS

	Treatment Group	Control Group
	Mean \pm S.D.	Mean \pm S.D.
Age (in years)	39 \pm 5.4 t=0.58, N.S.	41 \pm 5.5
Education (in years)	12.5 \pm 2.9 T=15, N.S.	10 \pm 4.5
Married	3 patients	4 patients
Occupation Blue/White collar	2 Blue/2 white	1 Blue/3 White
Years of alcohol abuse	13.2 \pm 4.7 t=0.00, N.S.	13.2 \pm 4.7
Medication	1 patient on disulfiram	1 patient on disulfiram

T = Mann Whitney Rank Sum test

where necessary Mann Whitney rank sum tests were used. The two groups did not differ significantly in any of the functions (Table 2). The two groups are therefore comparable in terms of cognitive function as well as family functioning. They are also comparable on demographic characteristic and clinical parameters (Table 1).

Visual inspection of the pre post mean scores showed some exciting mean difference. The post assessment mean scores on most of the tests appeared to improve in the treatment group. Improvements were seen in simple and choice reaction time, serial and parallel processing, focused sustained and divided attention, memory encoding, concept formation, neuropsychological functioning and family functioning. There was no worsening of performance after cognitive retraining. In contrast in the control group the post assessment mean scores improved only on choice reaction time, parallel processing, focused sustained and divided attention and family functioning. Post assessment performance was worse on simple reaction time, serial processing, memory encoding, concept formation, neuropsychological functioning. The difference in the direction of

change between the two groups in the post assessment was interesting. Hence we carried out a repeated measures ANOVA even though the sample sizes were small. Interaction effect in the ANOVA would tell us whether the two groups differed in the direction of change between the pre and post assessments. In other words, the interaction effect would indicate whether the treatment effected a change and to what degree.

The interaction effects F ratios are given in table 2 for each test. The F ratios were significant for three tests. These were serial processing with the stimulus duration at 80 milliseconds, memory and neuropsychological deficits. A perusal of means indicate that at the stimulus duration of 80 milliseconds, in the post assessment reaction time became shorter in the treatment group, but became longer in the control groups. In the shorter stimulus duration there was no difference between the two groups as indicated by the insignificant F ratios. Cued recall was significantly better following cognitive retraining but there was no change in the control group. The significant interaction effect F ratio indicates that cognitive retraining improved memory significantly. In fact the amount of recall doubled from 7 to 13 words from pre to post assessment in the treatment group, while in the control group it hardly changed (6.25 and 6.5 respectively). The number of neuropsychological deficits has significantly reduced in the treatment group, from deficits in 6 functions in the pre assessment to deficit in only one function in the post assessment. In the control group there has been no change, with deficits in four functions in both assessments. These three significant interaction effects indicate that cognitive retraining has improved the speed of serial processing, improved memory and reduced neuropsychological deficits. Natural recovery from abstinence which was operating in the control group has not effected any change. In fact it has worsened the speed of serial information processing.

The treatment effects could be confounded by the number of counselling

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TABLE 2
RESULTS OF THE PRE POST ASSESSMENTS IN THE TREATMENT AND CONTROL GROUPS

	Treatment group		Control group		Pre vs pre difference	interaction effect F ratio
	Pre - assessment	Post assessment	Pre-assessment	Post assessment		
SRT	522.5 (11)	515 (6.3)	512 (13)	517 (21)	t=1.27	0.86
CRT	811 (53)	790 (20)	870 (14)	846 (19)	t= -2.16	0.01
SP 20ms	1219 (253)	917 (86)	1223 (285)	1102 (349)	t= -0.02	0.47
SP 40ms	1290 (204)	935 (32)	1090 (160)	1095 (247)	t= 1.54	4.00
SP 80ms	942 (17)	897 (32)	944 (27)	958 (14)	t= -0.14	6.29*
PP	86 (35)	113 (5)	59 (29)	75 (42)	t= 1.21	0.10
FA	52 (15)	69 (16)	43 (23)	55 (25)	t= 0.70	0.03
SA	264 (24)	232 (28)	363 (189)	330 (71)	t= 0.40	0.0005
DA	55 (21)	88 (15)	62 (21)	73 (28)	t= -0.47	1.09
M	7 (3.5)	13 (1.4)	6.3 (1.9)	6.5 (3.9)	T= 17	4.4*
CF NT	63 (28.3)	51(20.4)	68 (15)	81 (15)	t= -0.33	1.39
CF T	704 (278)	508 (278)	702 (227)	715 (290)	t= 0.01	0.60
NND	6.3 (1.5)	1 (0.8)	4.2 (2)	3.7 (2)	t= 1.57	7.90**
FFR	8.5 (6)	4.5 (3.7)	8.7 (1)	3.7 (2.7)	t= 0.44	0.19

Note : - Cell entries are mean scores. Standard deviations are given in brackets. t = t test for independent means. T=Mann whitney rank sum test. Interaction effect F ratio is obtained from a 2 way repeated measures ANOVA * =p<0.05; ** =P<0.01. SRT=Simple reaction time in milliseconds (ms); CRT=Choice reaction time in ms; SP SD=Serial processing stimulus duration and score in ms; PP=parallel processing score in ms; FA =Focused attention, score is number correct; SA=Sustained attention, score in seconds; DA=Divided attention, score is efficiency index; M=Memory, score is total recalled; CF NT=Concept formation - number of trials, score is the total number of trials; CF T = Concept formation- time, score is the total time in seconds; NND=Number of neuropsychological deficits; FFR=Family functioning rating, higher ratings indicate greater disturbance.

sessions which were significantly different between the two groups. The treatment group had a mean number of 16 sessions during the retraining program, while the control group had a mean of 4.5 sessions. The total number of counselling sessions differed significantly between the two groups, with a four fold increase in the treatment group. The issues raised in counselling sessions pertained to problems faced by the patient in various spheres such as occupation, family or maintaining abstinence. In spite of directly addressing these issues there has been no change in family functioning in either group. Hence the counselling does not appear to reduce stress significantly in either group at least in the area of family functioning. However abstinence has been maintained during the study period in both groups towards which the counselling sessions may have contributed. The counselling sessions might have affected cognitive functioning through reduction of stress.

It is well known that increased stress levels are associated with deterioration in cognitive functioning. However this is a generalised effect. Even if the greater number of counselling sessions reduced stress in the treatment group, it cannot explain the selective improvement in only two basic cognitive functions such as the speed of serial processing and memory. Stress reduction would be expected to have a generalised effect on all cognitive functions which were tested. Again the very fact of stress reduction is not certain as there is no improvement in family functioning which was one of the areas directly addressed in the counselling sessions in either group. Thus it may be concluded that the improvement of speed of serial processing, memory and reduction of neuropsychological deficits may be attributed to cognitive retraining and not to the reduction of stress consequent to a greater number of counselling sessions in the treatment group.

The treatment and control groups were comparable on the clinical parameters which can influence cognitive functions such as age, education, medication and years of alcohol consumption. They were also comparable on the clinical factors which would influence family functioning such as marital status. Hence the significant difference in the cognitive and neuropsychological functioning seen in the treatment group, but not in the control group may be attributed to the cognitive retraining.

DISCUSSION

Cognitive retraining is useful in improving some of the cognitive functions of detoxified, abstinent alcoholics. The cognitive retraining targeted focused, sustained, divided attention; information processing, planning and reasoning. Tasks to improve these functions were given to all the patients in the treatment group, though the patients differed in the level of complexity to which they reached in the tasks. Two of four patients could perform at complex levels in all tasks during retraining. Improvement occurred on each of the tasks retrained though the level of improvement varied among patients. Generalisation of this, on tasks improvement occurred only in the areas of speed of serial information processing and memory in the treatment group, as seen by the significant improvement in the mean scores during post assessment.

The reason for generalisation of improvement being restricted to only speed of serial information processing and memory might be because these are the basic components of cognition. Simple and choice reaction time, focused and sustained attention might not have improved because of a ceiling effect. On the other hand parallel information processing (span of apprehension test), divided attention and concept formation being complex functions might have needed a longer duration of retraining to improve significantly.

The generalisation of improvement to tests which indirectly measured the targeted function was obtained through neuropsychologi-

cal assessment. The individual cases indicate that the predominant neuropsychological deficits in both groups were in the areas of frontal and temporal lobe functions, i.e. predominantly in the areas of working memory and verbal as well as visual learning and memory functions. There has been a significant reduction in the number of neuropsychological deficits in the treatment group (Table 2) indicating an improvement in memory and learning function in both modalities as well as working memory. Memory and learning functions require a rapid processing of incoming information, capacity to sustain attention for the required length of time of process this information completely and encode the information to a deeper level in order to input it into long term memory. The improvements in the speed of serial information processing memory would have improved memory and learning functions which is reflected as a reduction in neuropsychological deficits. The absence of a significant reduction in the number of neuropsychological deficits in the control group supports the above hypothesis.

The improvements in cognitive functioning seen in the treatment group did not have an effect on the disturbances in family functioning reported by these patients and their relatives. In fact there was no change in either group. Neither cognitive retraining nor the frequent counselling sessions had a significant effect on family functioning in the treatment group. The reasons for the absence of improvement in both groups could be as follows. Alcoholics may not be able to benefit from counselling or psychotherapy due to impairment of attention and memory (Goldman, 1983). In fact patients in both groups had a deficient memory as they could recall only 7 out of 48 words in the memory task. Counselling was being given concurrently with cognitive retraining in the treatment group and not after the memory functioning had improved. Therefore the patients might not have remembered what had been discussed in the counselling sessions. In the control group the absence of cognitive

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retraining would have led to a similar situation. A significant improvement of memory did occur in the treatment group as evidenced by the significant improvement on memory tests during neuropsychological assessment. Possibly counselling sessions should have been held after improvement of memory functions.

Cognitive retraining does not have an effect on long term abstinence. Two of the patients in the treatment group were abstinent at one month follow up, while two had relapsed. Similarly in the control group two were abstinent, one had relapsed while one patient did not report for follow up. It appears that cognitive retraining does not help in maintaining long term abstinence.

The results underscore the importance of cognitive retraining in the management of alcoholic patients. Abstinence alone does not improve cognitive functions. However when abstinence is combined with cognitive retraining some of the fundamental cognitive functions improve. The improvement occurs in as brief a time as 6 weeks. This improvement of cognition would have wide ranging implications for the patient's life. The patient's functioning in vocational and family spheres would improve. Improvement of speed of information processing and memory would lead to a more efficient work performance. The patient would be able to remember the commitments made to the family and friends better. This would lead to a reduction in interpersonal conflicts and improve the quality of relationship at home and in the work place. Another major gain of improving the cognitive functioning is that alcoholic patients would become receptive to psychological modes of intervention such as psychotherapy and counselling. A better understanding and memory of what is happening in the therapy session would make the patient receptive to it and eventually benefit from it.

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