

ELECTROSLEEP (ELECTRICAL TRANSCRANIAL STIMULATION) IN THE TREATMENT OF ANXIETY, DEPRESSION AND SLEEP DISTURBANCE IN CHRONIC ALCOHOLICS

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ABSTRACT

Internationally dispersed reviews of electrosleep (electrical transcranial stimulation) applications indicate this therapy has been demonstrated effective in a large number of psychiatric and psychosomatic conditions, especially those associated with anxiety, depression and insomnia. A double-blind design with treatment variables of current and suggestion, and outcome criteria of anxiety, depression and sleep disturbance was employed to test for effects of electrosleep in an alcoholic sample. Subjects were randomly assigned to one of four groups; two groups received current and two did not; one current and one non-current group received sensation, the other two did not. Current was standardized at 1 mA; peak-to-peak amplitude was manipulated to control for physical sensation. Five outcome criteria were employed: three depression indices, one index of anxiety, and one index of quality of sleep. Results were analyzed as to trend and suggested that electrosleep could have both a direct effect attributable to intracranial current flow, and an indirect effect attributable to the psychological influence of suggestion.

"Electrosleep" is a label for a method of external, transcranial, low-intensity, intermittent electrical stimulation of the brain. Electrical parameters define this

method and distinguish it from other methods of cranial stimulation. Electro-sleep utilizes intermittent current in a square wave form with a short rise time (less than 20 msec) and a pulse duration of 1 msec. Two parameters of the stimulating current are adjustable: Pulse frequency is variable in steps between 1.5 and 100 Hz; usually employed at 25 Hz; and pulse amplitude is variable from 0.5 to 2.0 mA. Current is transmitted by electrodes applied externally to the head for periods of 30-60 minutes per treatment. Electro-sleep is markedly different from electroconvulsive shock. Electroconvulsive shock employs high voltage (60-120V) and high intensity (200-800 mA DC) to effect convulsive seizure and unconsciousness. Electro-sleep employs low voltage (25V) and low intensity (0.5-2.0 mA DC), to effect a feeling of relaxation and tranquilization. The most popular electro-sleep machine is a portable, solid-state, flashlight-type battery operated device.

A. S. Cristovich was the first to make use of electro-sleep in the treatment of alcoholics [1]. He was particularly interested in the effectiveness of electro-sleep on alcoholic hallucinations. Other Russians evaluating the use of electro-sleep with alcoholics included Bolotova, Lapinskiy, Larionov, Slobodskiy, and Svininnikov. In these studies sleep was the first to return to normal, followed by the disappearance of vegetative disorders. They reported electro-sleep effective in eliminating withdrawal effects, and persistent "disorders of higher nervous activity due to chronic alcohol poisoning." They also believed that electro-sleep had a favorable influence on alcohol abstinence. Vish reported a study involving forty-four alcoholics where electro-sleep was combined with psychotherapy in treatment [2]. The subjects displayed persistent sleep disorders, headaches, and "astheno-depressive" states prior to treatment. The procedure was to begin with psychotherapy sessions, followed by 12-20 electro-sleep treatments, then more psychotherapy. Clinical recovery was reported for thirty-eight of the forty-four subjects. Three subjects maintained an alcohol abstinence for one year, eight for two years, eleven for three years, nine for seven years and seven other subjects were still "dry" for longer periods. This success was attributed in part to electro-sleep applications given these subjects twice a year as supportive therapy.

As with other addiction problems, alcoholism has proven refractory to a great many treatment methods. One of the chief reasons for this recurrent failure seems to be that the alcoholic reacts to dysphoric affective states such as anxiety or depression by resorting to drinking, while medications given to attempt to alleviate these symptoms tend to be abused in the same way as alcohol by the addiction prone personality. Electro-sleep should have advantages over many treatments of chronic alcoholism in that it does not require the ingestion of another potentially addictive substance, so that there are no liver, stomach, or other organic complications as happens so often with chemical treatments [3]. Further, it appears to be effective in cases of chronic tension states with anxiety, depression and sleep disturbance which have proven to be refractory to standard chemical or psychotherapeutic interventions [4]. Electro-sleep can be administered by trained, supervised paramedical personnel so that it can be used when

professional personnel is in short supply. Finally, side effects are minimal and transitory so that it appears to be a safe treatment technique [3].

The present research tested the effectiveness of electrosleep as an adjunct in the treatment of anxiety, depression and sleep disturbance in a sample of chronic alcoholics. It was reasoned that these symptoms were both cause and effect of excessive drinking and that if they could be modified, so might the excessive intake of alcohol.

Method

SUBJECTS

Subjects were twenty male alcoholic resident volunteers of the Alcoholic Rehabilitation Center (ARC) in San Antonio, Texas. Mean age was 51, range was 26-61. Mean educational level was tenth grade, range was third grade to college graduate. In terms of occupation, there were seven white-collar workers and eighteen blue-collar workers. Twenty-two were Caucasian, three were Mexican-American and one was Negro.

Prospective research subject volunteers were seen by a physician who examined them for contraindications to the proposed ETS treatments. To qualify, subjects must have been "dry" for at least two weeks and have no signs of organic brain syndrome. One subject was excluded due to gross organicity. The examining physician signed a "medical clearance" form for each subject who qualified. Research subjects were carefully informed by the project director that they might receive electrical transcranial stimulation treatments consisting of the passage of small electrical currents through electrodes placed at the rear of their head and on the forehead. They were made to understand that the current would be generated by small batteries (no wall connection) and that they would experience no electrical shock. They were told that they might experience a mild sensation at the electrode sites. The principal investigator made it clear to each subject that although there was no known physical or psychological danger associated with these treatments, they could withdraw from the procedure at any time. No beneficial effects were promised from the treatments. Pertinent information was printed on subject informed-consent forms which were signed by each subject-volunteer after the project had been fully explained and the subject's questions answered.

EXPERIMENTAL DESIGN

Subjects were randomly assigned to four groups with five subjects in each group. A random assignment table was prepared by throwing a die and recording numbers 1 through 4 as they appeared until a total of five of each number was recorded. Volunteers were assigned these numbers in order as they volunteered until all groups were filled.

The experimental design was planned to partial out the effects of two independent variables, (1) current and (2) suggestion.

Group 1 received Suggestion, Current (SC) – "Suggestion" meant that the machine was turned on and the subject felt the physical sensation of current briefly as he was titrated at the 1 mA level. The sensation of current was produced by the peak to peak amplitude of the intermittent current; the greater the amplitude, the greater the sensation. "Current" meant that the current flow was maintained at the 1 mA level throughout the treatment.

Group 2 received Suggestion, No Current (SNC) – After "Suggestion" as in Group 1, the machine was turned off for the remainder of the period. The subject was told that the machine was being adjusted so that he would not feel the physical sensation of current.

Group 3 received No Suggestion, Current (NSC) – "No Suggestion" meant that a DC bias control was manipulated which lowered peak to peak amplitude designed to eliminate the physical sensation of current. One mA of current flow was maintained throughout the treatment period.

Group 4 received No Suggestion, No Current (NSNC) – These subjects were prepared for treatment exactly as the others but turning on and adjusting the machine was simulated. The machine was not turned on.

MEASURES

The Clinical Analysis Questionnaire (CAQ) and Self Report Scale (SRS) were utilized to measure the effect of the independent variable. This psychological test battery was administered to subjects before and after treatment by two psychometricians in a blind, counterbalanced fashion. "Blind" since the psychometrists did not know to which treatment groups the subjects they tested had been assigned. "Counterbalanced" since the sex variable of the psychometrists (one male, one female) was eliminated by the systematic assignment of subjects within groups so that each psychometrist received half the total.

The CAQ produced by comprehensive factor analysis, a new diagnostic instrument intended for use in evaluating therapeutic progress and for basic research, consists of a shortened version of the "Sixteen Personality Factor Questionnaire" (16PF) and a twelve factor pathological supplement [5]. "Anxiety" is a second-order factor derived from primary source traits of the CAQ and was calculated utilizing a definition suggested by a factor analysis of the CAQ: $-C-E-H+L+O-Q_3+Q_4$. In this empirically derived formula, sten scores of four (C, E, H, Q_3) primary source traits were summed and subtracted from the sum of three others (L, O, Q_4). High positive scores reflected high

anxiety. Cattell, Eber and Tatsouka can be consulted for definition of component source traits [6]. Three indices of depression were utilized:

1. a second order factor derived by summing sten scores of four primaries, $D_1 + D_4 + D_5 + D_7$;
2. a second order factor consisting of sten score for D_2 ;
3. a second order factor consisting of sten score for D_6 .

Delhees and Cattell can be consulted for definition of component source traits [5]. As construct validity for these factors has not been consensually determined labels are offered only tentatively. Depression index 1 is consistent with hypochondriac concerns, bad dreams, tenseness, worrisome, lacks energy to cope, and irritable and seeks isolation from people. Depression index 2 has been termed "suicidal disgust" by Delhees and Cattell [5]. Depression index 3 has been termed "high guilt and resentment" by Delhees and Cattell [5].

The SRS is a twelve item questionnaire developed for this research. Each question provided five possible answers ranging from (1) "Very Poor" to (5) "Very Good." "Sleep" scores were compiled from six questions on the SRS:

1. How well do you presently sleep?
2. Describe your success in falling asleep at night.
3. How stable (free from toss and turn) is your sleep?
4. Rate the length of time you sleep at night.
5. Describe the content of your nighttime dreams.
6. How do you feel after a night's sleep?

METHOD OF TREATMENT

Two technicians administered treatments consisting of thirty minute sessions on five consecutive days. Treatments were performed in a blind counterbalanced fashion. "Blind" in that the technicians did not know which subjects would be assigned them. "Counterbalanced" in that the sex variable of the technicians (one male, one female) was accounted for by systematically assigning subjects within groups so that each technician received half the total.

The "Electrosone 50" ETS device was utilized according to a standard protocol. Two electrodes were placed on the forehead and two behind the mastoid processes using an electrode cream to facilitate current flow. All four of these electrodes were held in place by an electrode harness or "sleep mask" [7]. Subjects remained in their normal clothing and reclined on a comfortable bed.

Results

Figure 1 displays the pre-treatment and post-treatment scores for each group on the outcome measures of "Anxiety" and "Sleep." As each group consisted of only five subjects, statistical tests were not employed. Group means were plotted

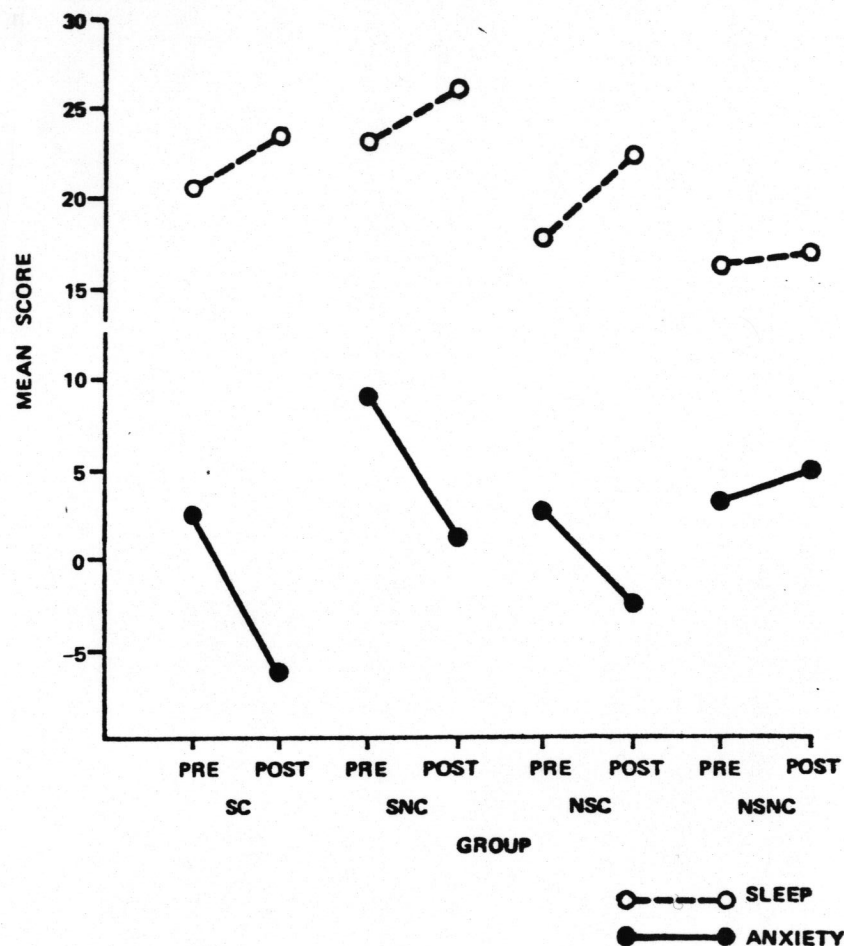


Figure 1. Pre-post scores for each group on "anxiety" and "sleep."

and the slope of the pre-post line was visually analyzed for trends. The NSNC group obviously performed in a manner opposite that of all other groups. All other groups reported that they "improved" with respect to both criteria over the one week period. The NSNC group indicated either no change or slight exacerbation of anxiety and sleep problems.

Figure 2 displays the pre-treatment and post-treatment scores for each group on the three outcome measures of "depression." Once again, on depression index 1, the NSNC group performed in a manner opposite that of all other groups. The other groups reported an improvement over the one week period, with the actual current groups (SC and NSC) improving slightly more so. Likewise, on depression index 3, the NSNC group showed a trend opposite that

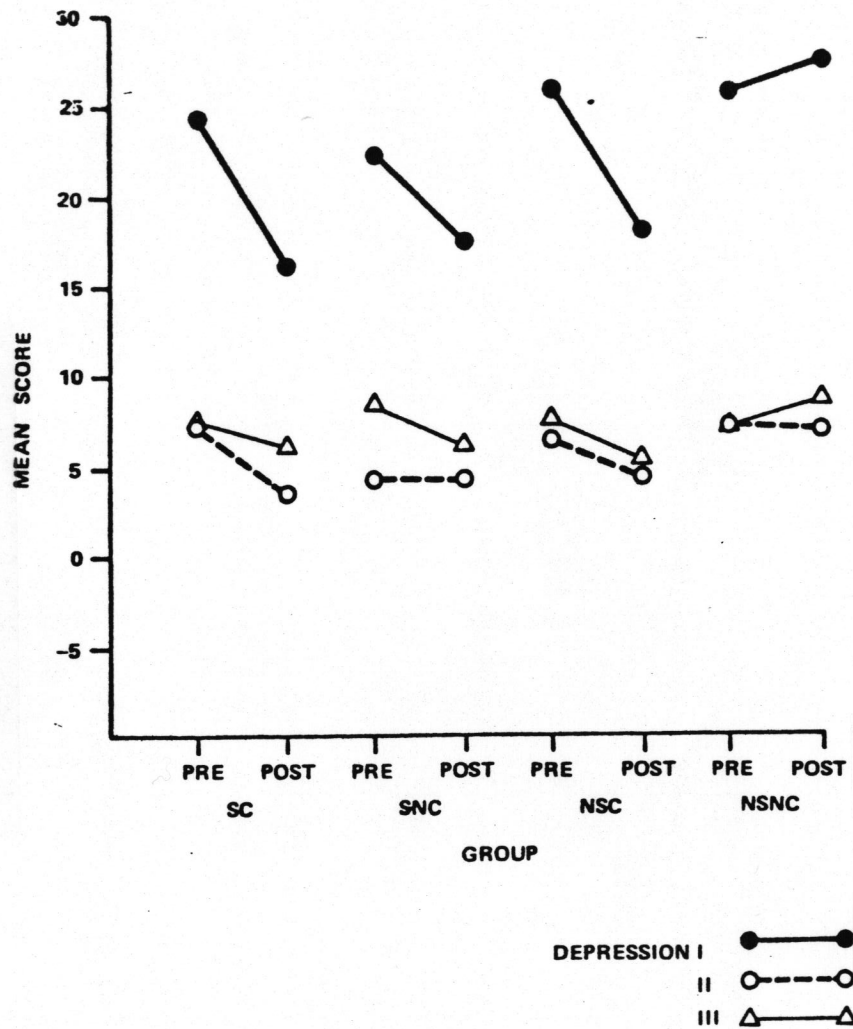


Figure 2. Pre-post scores for each group on three depression indices.

of the other groups and indicated no improvement. The other groups reported slight improvement. On depression index 2 the actual current groups (SC and NSC) reported improvement, and the SNC and NSNC groups reported essentially no change. Statistical tests would not demonstrate significance and there is also the possibility of artifact due to statistical regression. In this regard, the actual current groups are in a better position to show change in the desired direction as they are unequal at pretest from the SNC group.

Discussion

In this type of study with small n , conclusions must be offered tentatively. There is a growing body of literature which suggests that "electrosleep" does have a bonafide effect on the criterion measures employed here. The results garnered here certainly do not contradict this literature. On each measure the actual current groups reported improvement. On four of the five measures, however, the bogus treatment group (SNC) also reported improvement. On no measure did the control group (NSNC) report improvement.

If the trends noted here are accepted as reflecting the electrosleep effect the issue that is raised regards the mode of effect. The issue is represented on the one hand by those who believe that intracranial current flow occurs and is strong enough to effect actual organic changes of some sort within the brain which effect the changes in mood or subjective experiences (physiological or direct mode of effect), and on the other hand by those who believe that although intracranial flow might occur, any "organic" effects would not be sufficient to account for the electrosleep phenomena and that the effects are more appropriately ascribed to the effects of "suggestion," "expectancy" or experimenter bias (psychological or indirect mode of effect). Baker and Geddes have emphasized that the pathways taken by current applied externally are determined by the relative values of conductivity and orientation of brain tissues [8]. Lack of tissue homogeneity and the unavoidable modification of current distribution produced by electrodes renders measurement of current passage extremely difficult even when implantation is a possibility. When surface electrodes are involved, skull and scalp thickness and resistivity as well as brain tissue resistivity are important considerations. Driscoll and Rush reported that these variables directly affected current passage and the individual differences of scalp, skull and brain resistivity must be known for precise current measurement [9]. Yet the bulk of evidence from both Soviet and Western researchers has confirmed intracranial current flow. Glazov, Liventsev, and Robiner confirmed the flow of current in the skull cavity of rabbits and dogs from both extra-cranial and implanted electrodes [10-12]. Servit added corroborating evidence with experiments on white mice [13]. Robiner demonstrated direct action of a pulsed current on the brain and central nervous system [14]. The Graz research team demonstrated a "massive flow of electric current through the brain during electrosleep" by means of electrodes implanted in the "nucleus ventralis or oralis posterior thalmi" [15]. They demonstrated that the major flow of current, ten thousand times greater than normal thalamic potentials, passed through the brain stem. McKenzie, Rosenthal and Driessner concluded that electrosleep does produce electro-physiological changes in the brain as measured by EEG [16].

Woods, Tyce, and Bickford, however, on the basis of data from EEG monitors, stated that it was equivocal whether the small currents produced by the electrosleep devices could have a neurophysiological effect on the brain-stem or cortex as it was probable that the most significant part of this current

travels in the skin and does not penetrate the cranium [17]. Earlier, Belitskiy had come to a similar conclusion and stated that the action of the pulsed current was only "reflective" in nature and that electrosleep was the result of electrocutaneous stimulation with a considerable role attributed to the suggestive factor [18]. Robiner has emphasized that whether electrosleep has a "direct" or "indirect" effect on the central nervous system is very important and must be resolved [14]. As a result of this research, he has concluded that animals, and especially humans, appeared to adapt to electrosleep currents and that there is a conditioning phenomenon associated with electrosleep effects. He postulated that electrosleep has *both* a direct and an indirect effect on the brain.

The predominant Russian explanation for the effect of electrosleep is based on the Pavlovian theory of "protective inhibition" or "hindrance." This phenomenon called "parabiosis" resulted from the prolonged effect on the human organism of intermittent and uniform stimuli such as the sound of a metronome, the uniform noise of the wheels of a train, raindrops falling on glass or the rhythmic flashing of a bulb. Pavlov concluded that a very weak stimulus, a very strong stimulus or an unusual stimulus could produce this "protective inhibition" of the brain and that the duration of the stimulus controlled the depth of inhibition in the cerebral hemispheres. Proceeding from this, it was found that when a weak pulsed current is made to traverse the brain, a spread of protective inhibition takes place. Electrosleep is a therapeutic procedure based on this observation. Branshchikov, Vishnevskaya, and Kulilova compared the effects of local "electral analgesia," various other galvanic inputs, and electrosleep on thirty-one neurological patients and five healthy control subjects [19]. Light flicker rhythm assimilation response was evaluated on 163 EEG records. During electrosleep, the rhythm assimilation was suppressed within 10 to 20 minutes after current application. No such effect was evidenced by control subjects or subjects under other treatments. The researchers therefore claimed that *only* electrosleep had a direct effect on the CNS. Belitskiy and others have denied the type of cerebral effect assumed by Branshchikov, yet attributed the effectiveness of electrosleep to an "organic: reflex mechanism." Their hypothesis was that rhythmic, monotonous stimulation led to an inhibition of the neurons of the brain which facilitated sleep. This hypothesis differed from that of Branshchikov in that no physical modification of brain tissues was postulated.

Therapeutic effects of electrosleep can be attributed, at least in part, to psychological suggestion. Single- and double-blind studies have attempted to partial out this source of variance. Bulatov and Bul', in one of the few Soviet studies employing simulated treatments, reported that for certain of their subjects, the "sensation of current" was so explicit during the bogus treatments, that "disconnecting the current" had to be simulated [20]. This would imply a very strong indirect effect in this particular study. The effects obtained by electrosleep treatment in another study like the effects obtained through

methods involving suggestion in general, were deplorably short-lived and seemed to depend on the continuation of the treatment and the relationship of the subject to the technician [21]. Rosenthal conducted a double-blind clinical study with twenty-two patients [22]. Of the eleven patients who received *active* treatment, eight made a marked improvement, two made a partial improvement and one showed no improvement. Of eleven who received *inactive* treatment, one showed marked improvement, two showed partial improvement, and eight showed no improvement. This latter group was asked to return for the "opposite treatment" and eight returned. These received active electrosleep treatment and made improvement, but not as marked as the first group. Rosenthal speculated that in the second phase of the study, an "expectation of failure" was operative and this element of "negative suggestion" influenced the self-report of the clients as to degree of improvement.

Although it has been reliably documented that the low intensity pulsed current of electrosleep does pass through the brain, the physiological parameters of this passage have yet to be precisely determined. Likewise, an indirect effect due to suggestion has been demonstrated in electrosleep but this effect has yet to be accurately parcelled out. The indirect effect seems to be secondary to the physiological effect and a function of "expectancy," both on the part of the subject and the investigator.

In the current study it was apparent that an "effect" was being reported. This effect, however, was reported indiscriminately to the "actual" and the "suggested" current alike. Thus, both the direct effect model and the indirect effect model were supported. As this research involved "alcoholic" subjects the findings could suggest that this population is quite "suggestible" and that although this suggestivity is a source of experimental confounding it is also a source of therapeutic leverage. Anecdotal observations are enlightening in this regard. One subject in the NSNC group and one subject in the NSC group, each vigorously claimed sensation at the electrode site, when such sensation was either impossible, or extremely unlikely—clear evidence of potential experimental contamination and suggestibility. One subject in the SNC group kept a diary recording the positive changes he was experiencing, including improved memory, decreased irritability, and improved capacity for concentration and attention—clear evidence of client suggestibility and potential therapeutic leverage.

Other anecdotal evidence is available regarding the effects of electrosleep in this study. Technicians reported that seven of ten subjects who received current fell asleep one or more times during the treatment, while three of ten subjects in the non-current groups slept. As electrosleep current has been widely reported as producing sleep during treatment sessions, this possibility must be entertained as supported here.

Further, the baseline drop-out rate at this facility is .60. Two non-current subjects (.20) dropped out prior to completion of the regular rehabilitation program, and no current subjects (.00) dropped out. A beneficial influence might be suggested in this regard.

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