A Summary Look at CES Studies of Cognitive Function

By Ray B. Smith, Ph. D.

Executive Summary

Thirteen studies, in which a total of 648 patients with various types of cognitive dysfunction were treated with cranial electrotherapy stimulation (CES), were combined statistically in order to get a more confident look at the effectiveness of CES for treating this condition. While many of the studies were of the classic double blind protocol, others used either the single blind or open clinical trial. The result of the analysis showed that the overall effectiveness of CES was 44% improvement. When the 7 studies of patients with substance abuse and the 3 studies of fibromyalgia patients were analyzed separately it was found that the substance abuse patients averaged a 60% improvement, while the fibromyalgia patients gained a modest but significant 17%. The results indicate that a different etiology is most likely driving the cognitive dysfunction in the two. Perhaps in one group a more basic physiological change was at work due to the history of substance abuse, while the fibromyalgia patients may have simply been driven to cognitive distraction by their intractable pain. Elsewhere it was noted that the “permanent brain damage” that was said to be a condition of long term substance abuse patients as late as the 1980s, has now been seen to return to within normal functional limits following 3 weeks of daily CES treatment.

Introduction

Meta-analysis is a way of combining the results of many separate studies to see the effectiveness of a treatment when different types of patients are studied, under different study conditions, with different study protocols, and who came to the various studies with differing symptoms accompanying their cognition problem.

The goal of clinical studies is always to first test the effectiveness of a potential treatment and secondly to discover which patients the treatment may be most effective in treating. Meta-analysis has the effect of allowing us to essentially study a larger number of patients than can usually be assembled for a single study, and the larger the combined study sample, the greater is the confidence that can be placed in the study outcome: that the study findings are true and accurate. Also, the more diverse the study group is in the combined sample, the more confident can we be in generalizing the study outcome to larger groups of people outside the study. That is, it increases the range of potential types of cognitive dysfunction patients that we can predict will be effectively treated with CES.

In the table below is a summary of 13 studies that were combined into the meta-analysis reported on here.

Studies of Cognitive Function Completed Over the Past 31 Years

Study Design	Zr Score[a]	Presenting Group	No. Subjects	Measure Used[b]	Reference
Double Blind	.1.020	Substance Abuse	60	Profile of Mood States	1
Double Blind	.829	Substance Abuse	60	Psychological Tests	2
Double Blind	.151	Fibromyalgia	60	Profile of Mood States	3

Totals	**2.000**		**180**		
Average	**.667**				
Effect Size[c]	**r = .58**				
Single Blind	.604	Substance Abuse	72	Profile of Mood States	4
Single Blind	1.293	Substance Abuse	227	Psychological Tests	5
Single Blind	.388	Substance Abuse	24	Profile of Mood States	6
Single Blind	.234	Substance Abuse	100	Psychological Test	7
Totals	**2.519**		**423**		
Average	**.630**				
Effect Size	**r =.56**				
Open Clinical	.172	Graduate Students	54	Profile of Mood States	8
Open Clinical	.412	Post Traumatic Syndrome	2	Neuropsychiatric Texts	9
Open Clinical	.497	Substance Abuse	15	EEG	10
Open Clinical	.203	ADHD	23	Psychological Tests	11
Open Clinical	.182	Fibromyalgia	20	Profile of Mood States	12
Open Clinical	.182	Fibromyalgia	60	Profile of Mood States	13
Totals	**1.648**		**299**		
Average	**.275**				
Effect Size	**r =.27**				

SUMMARY, ALL COGNITION STUDIES REPORTED ABOVE

Grand Total	**6.167**	**648**
Average	**.474**	
Total Effect Size	**r =.44**	

SUMMARY OF SUBSTANCE ABUSE PATIENTS ONLY

Totals	**4.865**	**558**
Average	**.695**	
Effect Size	**.60**	

SUMMARY OF FIBROMYALGIA PATIENTS ONLY

Totals	**.515**	**140**
Average	**.172**	
Effect Size	**.17**	

a Since percent improvement scores can not legally be averaged, they are converted into Zr scores, averaged, and then converted back to percent improvement (effect size.)

b The Profile of Mood States is of published reliability and validity, as were each of the psychological tests used in the above studies.

c Effect size, here, is a statistician's basic estimate of the overall percentage improvement by the patients as a result of the treatment.

Discussion

In most of the studies, cognitive confusion was but one symptom within a larger syndrome. For example, in most of the studies, substance abuse was the presenting syndrome, while in three of the 13 studies, fibromyalgia was the presenting syndrome. And while all presented symptoms of cognitive confusion of some type, it is obvious from the above secondary analysis, that the cognitive dysfunction among the substance abuse patients was very likely of a different, physiological etiology than that of the fibromyalgia patients, who may have been experiencing cognitive distraction due to the stress of the unrelenting pain of their condition.

Researchers earlier received a strong impetus to study CES in substance abuse patients when in the 1970s it was found that the abstinence syndrome, including such features as depression, anxiety and insomnia, was seen to come under control very quickly with CES. Serendipitously it was also discovered that what had up until the 1980s been termed "permanent brain damage" in these patients responded to three weeks of CES treatment by bringing these patients back within the normal functioning range.

A word about the study types. In the open clinical study, the patients know they are being actively treated for their level of cognitive functioning, the clinicians know who is being treated, and the statistician who summarizes the study data also knows, since there is only one group of patients.

In the single blind study, the patients do not know which are getting treated and which are getting sham treatment, but the clinician providing the treatment knows which are the treated patients. In the single blind study, the clinician doing the post study evaluation of the patients is often blinded to treatment conditions when he completes his evaluation. The statistician is usually blinded also, so that he is given two sets of scores to compare, and doesn't know which group received the treatment. This study design was used earlier on before treatment blinding devices came on stream. In such studies, the treatment was administered sub sensation threshold, in which the clinician turned up the current intensity until the patient just felt it, then turned it back down until the patient said he could no longer feel the stimulation. At that point, the clinician either left the current at that level or turned the unit off (down to, but not including the final click). Because both the patients and the statistician are both blind to the study conditions, some authors have unwittingly published this design as a double blind experiment. But that term is generally reserved for the true double blind experimental design as described next.

The double blind study, the gold standard of science, is usually confined to studies in which neither the patient nor the clinician knows who is being studied. Those designs became available when a double blinding box could be inserted between the patient and the CES device. The double blinding box often had three, four or more settings in addition to a "0" setting in which current flowed freely between the CES unit and the patient. Among the other settings available, some passed current to the patient and some blocked it entirely. The clinician would begin the double blind treatment session by setting all double blinding boxes to the "0" position, would connect the patient to the CES electrodes, turn the current up slowly until the patient signaled he could just feel it, then reduce the

stimulus level until the patient signaled that he could no longer feel it. At that point, the clinician set the double blinding box to one of the other settings available and left the patient on the device for 30 minutes to an hour, not knowing who was receiving actual treatment..

Interestingly, in a good double blind experimental design, such as was the case in the majority of those reported in the table, the persons who were responsible for measuring or rating patient improvement were also blind as to whom was treated, as was the statistician who was given anonymous groups of data to analyze. Note that, in effect, that makes such studies quadruple blind, but that term is not used in science.

In the crossover design, half the patients get treated the first week or two of the study, while the other half receive sham treatment. In the second half of the study, the formerly treated patients now receive sham treatment while the formerly sham treated patients receive treatment. If the crossover does not involve a sham treatment condition, then the crossover study is treated as an open clinical trial where all patients and staff know who is being treated at each cross of the study. That design is often referred to as a study with “wait in line” controls, in that the patients waiting to begin treatment are tested before and at the end of the waiting period before going into treatment. That is thought to control for environmental factors such as unusual stressors on the 10 O’clock news, any local dramatic weather changes, and so forth.

Interestingly we learned early on in CES work to stay clear of the cross over design in CES studies, after we discovered that the improvement begun by a week or so of CES treatment can often continue after treatment is stopped. That is, the patients continue to get better as time goes on following treatment. One can imagine what that does to the statistical analysis when at the end of the study both groups have improved significantly, but the patients treated first are no longer behaving as good controls should, but are getting even better than the final treatment group is showing. Many otherwise good studies were lost early on due to that effect, and one can see in the table above that the crossover design was wisely avoided in all of the studies reported.

It is interesting to note that not one problem from negative side effects has ever been reported in any published CES study. None of the patients has raided the fridge during the night and gained weight. None has complained of grogginess the next day. None has complained of headaches or a foggy feeling following treatment. Nor has CES been associated with increased suicide rates. When asked, CES patients have reported instead feeling more rested, more alert, and less tired following treatment.

One interesting clinical detail we learned early on is that patients who have not been sleeping well when they enter a study – many of them, by definition – sometimes make up for lost REM sleep during CES treatment and have the most vivid, most colorful dreams they have ever had. We learned to warn study participants of this in advance, since some earlier patients associated this with incipient schizophrenia or some other serious mental condition. Once alerted to the possibility they have always looked forward to the effect with real anticipation.

References

1. Schmitt, R., T. Capo, H. Frazier, and D. Boren (1984) Cranial electrotherapy stimulation treatment of cognitive brain dysfunction in chemical dependence. Journal of Clinical Psychiatry. 45:60-063.

2. Schmitt, R., T. Capo, and E. Boyd (1986) Cranial electrotherapy stimulation as a treatment for anxiety in chemically dependent persons. Alcoholism: Clinical and Experimental Research. 10(2):158-160.

3. Lichtbroun, A.S., M.C. Raicer, and R.B. Smith (2001) The treatment of fibromyalgia with cranial electrotherapy stimulation. Journal of Clinical Rheumatology. 7(2):72-78.

4. Smith, R.B. and L. O'Neill (1975) Electrosleep in the management of alcoholism. Biological Psychiatry. 10:765-680.

5. Smith, R.B., and E. Day (1977) The effects of cerebral electrotherapy on short-term memory impairment in alcoholic patients. International Journal of the Addictions, 12:575- 562.

6. Weingarten, E. (1981) The effect of cerebral electrostimulation on the frontalis electromyogram. Biological Psychiatry. 16(1):61-63.

7. Smith, R.B. (1982) Confirming evidence of an effective treatment for brain dysfunction in alcoholic patients.Journal of Nervous and Mental Disease. 170:275-278.

8. Matteson, M.T., and J.M. Ivancevich (1986) An exploratory investigation of CES as an employee stress management technique. Journal of Health and Human Resource Administration. 9:93-109.

9. Childs, A., and M.L. Crismon (1988) The use of cranial electrotherapy stimulation in post-traumatic amnesia: a report of two cases. Brain Injury. 2:243-247.

10. Braverman, E., R.B. Smith, R. Smayda and K. Blum (1990) Modification of P300 amplitude and other electrophysiological parameters of drug abuse by cranial electrical stimulation. Current Therapeutic Research. 48(4):586-596.

11. Smith, R.B. (1999) Cranial electrotherapy stimulation in the treatment of stress related cognitive dysfunction, with an eighteen month follow up. Journal of Cognitive Rehabilitation 17(6):14-18.

12. Tyers. S., and R.B. Smith (2001) A comparison of cranial electrotherapy stimulation alone or with chiropractic therapies in the treatment of fibromyalgia. The American Chiropractor. 23(2):39-41.

13. Tyers, S. and R.B. Smith (2001) Treatment of fibromyalgia with cranial electrotherapy.