A neurobehavioral treatment for unilateral complex partial seizure disorders: A comparison of right- and left-hemisphere patients

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This study looked at the efficacy of a multi-disciplinary neurobehavioral approach for treating patients with complex partial seizure disorders. Patients with a seizure focus in either the left or right hemisphere were compared for overall effectiveness of this approach in achieving control of complex partial seizures. Patients in this study received short-term treatment based on a model of self-control developed by the Andrews/Reiter Epilepsy Research Program.

This research selected all patients who met the lateralization criterion from among cases receiving short-term treatment between 1992 and 1996. Forty-four patients were identified, a group of 21 right-hemisphere subjects and a second group of 23 left-hemisphere subjects. These patients were treated in a short-term (5 consecutive days) treatment protocol and then released, with weekly phone contact for 6 months following treatment. They were then followed for an additional 19 months through the continued submission of their seizure logs and journals. Subjects in both groups kept seizure records throughout the study starting with a two-month baseline period. Other data collected allowed study of the interaction of emotional states with seizure occurrence.

This project produced valuable and relevant information regarding neurobehavioral management interventions as an effective adjunctive or alternative treatment for obtaining seizure control in epilepsy patients. Overall, 79% of patients treated achieved seizure control. More than 64% identified a recognizable emotional state that triggered seizures. The emotional trigger was specific for either the right or left hemisphere.

Key words: complex partial seizures; right- or left-hemisphere seizure foci; seizure triggers; pre-seizure warning; emotional triggers.

INTRODUCTION

The purpose of this study is to test the efficacy of a short-term multi-disciplinary neurobehavioral approach for treatment for patients with a unilateral seizure focus who had uncontrolled complex partial seizures (CPS). The treatment is based on a model of self-control developed by the Andrews/Reiter Epilepsy Research Program. The results from two previous studies utilizing this approach are encouraging, in that they show more than 70% of the patients are able to control seizures after treatment[1, 2]. This study used a multi-group time series design with a temporary single-treatment phase. In addition to information on seizure frequency, data were collected regarding severity of seizures, presence of a pre-seizure warning, and emotional state prior to a seizure. This additional information allowed investigations on how specific hemispheric lesions affect patients and their response to treatment. The treatment model is described in the workbook: *Taking Control of Your Epilepsy: A Workbook for Patients and Professionals*[3]. It has been a successful adjunctive approach for helping individuals who continue to experience seizures despite therapeutic levels of anticonvulsant medication.

This study has three major goals. Goal one has two components: (1) to measure the effectiveness of a neurobehavioral approach in treating of right- and left- hemisphere CPS patients; and (2) to determine if there is a predictable increase in the frequency of seizure potentials (i.e. auras only; these are listed as aborted seizures) following the first aborted seizure. The second goal is to measure the impact of having a pre-seizure warning on ability to achieve control. The third goal is to examine whether patients in the two groups have a predictable emotional state that precedes the seizure. If so, do the two groups differ in what that emotional state is?

The consequences of having epilepsy are numerous, complex, and varied. According to psychological studies this is especially true in the case of CPS[4–8]. Physicians have long known that the quality of life for many epilepsy patients is less than optimal. This effect is due to both the occurrence of seizures and the drugs used to treat them. For the individual the combined effects of both seizures and anticonvulsant drugs have an altering and often debilitating effect on personality, intellectual performance, self-image, self-confidence, and self-acceptance[7, 9–11]. The seizures can distort or inhibit any brain function[8]. There can be changes in sensation, perception, cognition, speech output and analysis, arousal, affect, memory storage and retrieval, motor activity, and behavior[5]. Not only can seizures cause strong emotional affects, but strong emotions generated by external events can precipitate seizures, often serving to reduce the social interactions of these patients[12]. Finally, studies show that the effects of anticonvulsants further impair cognitive functioning[10, 11]. The proportion of patients experiencing adverse reactions to anticonvulsants increases to 50% for patients who are on three or more anticonvulsant drugs[11–13] . A more recent double blind crossover study, of 15 newly diagnosed patients on mono-drug therapy, has shown that some cognitive impairment is observed even at low serum levels of phenytoin, phenobarbital and carbamazepine[10]. Therefore a treatment that both reduces seizures and the need for anticonvulsant medications could play a significant role in improving the quality of life for people with epilepsy.

Aura phenomenon in epilepsy

The relationship between anxiety and the occurrence of seizures has been observed with interest by clinicians throughout time[14] and has been the subject of special study looking at the influence of emotion on the occurrence of convulsions, primarily a state of anxiety[15]. It was theorized that some other event preceded this anxiety and that this precursor led to the anxiety reaction[16]. The term that identified this precursor to seizures is the ‘aura’ and refers to a symptom or group of symptoms, which precede a seizure[17].

The aura may consist of an unusual sensation, a body movement or a feeling state. Examples of common auras are flashing lights, tingling in an area of the body, an abrupt change in mood, sudden fear, an unpleasant smell, dizziness, and twitching of the extremities[1]. What determines the type of aura is the area of the brain from which the seizure originates[18]. The aura experience itself is thought to be the result of a discharge of electrical energy in a particular area of the brain, which reflects the function whose characteristics are inherent in the sensation[19].

Most people with epilepsy who have been able to identify their ‘pre-seizure aura’ also note that their aura experience does not always result in a seizure[19] . This poses the question of what determining factors sometimes cause an electrical discharge in the brain to lead to a seizure and other times result only in an aura. It appears that consciousness exists in a range between the variations in brain excitation and inhibition that are possible. These two processes are equally important for coordinating brain cell function[3]. In people with CPS, there is a disturbance of the neuronal network in one area of the brain. Within this area, the process of inhibition at times does not function effectively, resulting in too much excitation. When the energy in the neurons reaches a state of extreme excitation,

a sudden electrical discharge is released. This is what causes the aura and its associated sensation[5] . The sensation itself is followed by anxiety to some degree or another and this reaction might be more aptly called the 'fight–flight response'[20] , which calls up a predetermined and complex group of physiological reactions. The first of these appears to be the cessation of breathing[21] . If one just concentrated on this aspect of the primal response pattern, one would quickly come to an understanding of how this primal response might lead to a seizure. For the brain to maintain normal levels of functioning, a regular and steady supply of oxygen must be delivered for use. When this supply is cut off, even for short periods of time, it is likely to alter normal functioning. An individual might begin to feel light-headed or dizzy. In the case of a person experiencing an aura, the breath holding creates a crisis, which can quickly provoke a seizure[3].

Triggering mechanism for seizures

There are a multitude of potential triggers for CPS. These mechanisms can be isolated, multiple, or inter- active depending on the complexity and mass of the brain tissue involved. Triggers can be physical (stress), internal (emotionally charged or chemical imbalance), or external (pressures). It has long been known that physical and environmental stimuli have been responsible for triggering seizures (e.g. breathing rate, psychological and physical stress, music, reading, and photic stimuli)[22].

Medical approaches relying on medications alone tend to ignore the emotional life of the patient. In so doing, they overlook important information, which could promote seizure control if appropriately used[3]. It has been argued that the episodic nature of this chronic disorder carries with it a predictable pattern of fears and concerns that impact all individuals with epilepsy to some degree. This impact on the individual life has been found to be related to behavioral and emotional adjustment seizure state problems regard- less of the severity of the seizures[23] .

Situations or life issues that contributed to the onset of the seizure, which might have been solved early in treatment, tend to become elusive. These same unresolved issues and the patient's emotional response to them tend to be a stimulus for overloading a patient's coping mechanism[2] . It is the overload on this coping mechanism that is thought to be the stressor that triggers (causes) the seizure state[2, 3, 24] .

Hypersensitivity to heat, the blare of sirens, and the sound of vacuum cleaners or low-flying jets are not uncommon triggers encountered in the clinical setting[5]. An unusual and infrequent triggering phenomenon is found in the well-publicized case, reported by Ramani, (1989) of a 45-year-old woman who was triggered into a seizure every time she heard the voice of Mary Hart, the female host of 'Entertainment Tonight'. Among the more common triggers are sleep deprivation, missing meals or medication, and strong emotional reactions of all types, both positive and negative[3] .

In the self-control paradigm for treating seizures, the discovery of the triggering mechanism(s) is paramount in the goal to take control[3]. A commonly held belief concerning the trigger mechanism is that it is connected with high arousal states (i.e. fear, stress, affect or overexertion). Dahl's (1987) study of 18 subjects (11–14 years of age), observed that low-arousal in children was also a trigger for seizures as well. It would follow that we are seeking a balance in brain functioning that does not exceed a parameter on either end of a range of a potential spectrum or threshold of consciousness.

MATERIALS AND METHODS

Sample

This study compares right- and left-hemisphere foci patients with respect to their response to the A/R short- term treatment model. In particular, the study investigates: (1) to what degree both groups achieve success with seizure control, (2) to what degree having a pre-seizures warning affect success with treatment, (3) whether the seizure potentials increase for a time following the first aborted seizure, and (4) whether there is a predictable lateralized emotional precursor involved in the triggering mechanism for seizures. The study examines 44 patients with lateralized foci who have been treated in the short-term treatment protocol. A description of the study groups and eligibility criteria is outlined below under subject selection.

Measures

As part of their treatment protocol, baseline seizure data were collected as well as a complete medical history on each patient. Each subject was provided treatment for 5 days and data in the form of seizure logs and journal entries were collected weekly for at least 2 years following the treatment period. In addition, participants had weekly phone contact with the epilepsy counselor during a post-treatment period for 6 months.

Procedures

A protocol for short-term treatment was developed in 1992, as a response to a demand by individuals who lived outside our clinic's usual service area. The subjects were informed that this approach had not been tested and its potential for reduction of their seizures was unknown. Appropriate procedures for informed consent, protection of human subjects, and data collection were developed, and each patient or guardian signed an authorization on the intake form giving their permission to collect and use their information for research.

Subject's selection

(a) Sample size. A total of 44 patients with a lateralized lesion in either the right (n = 21) or left (n = 23) hemisphere requested and received treatment in the intensive program between 1992 and 1996. This group of 44 patients represents all of those who had a specific diagnosis of either right- or left-hemisphere foci complex partial epilepsy (established by positive EEG recordings and/or positive MRI results) and therefore meet the lateralization criteria for this study. All of these subjects were still experiencing seizures even though they were on medication at therapeutic levels. All of these patients had experienced at least three medication trials and many were on combinations of medications when they entered treatment.

(b) Subject eligibility criteria. To be eligible for participation in this study, patients met following criteria:

(1) Subjects must have CPS, with positive medical findings to support the diagnosis of the disorder (i.e. with a right or left focus). Rationale: This type of seizure is one of the most difficult to control with present medical approaches and is the type for which this approach was developed.

(2) The frequency of seizure episodes must be at least one per month, as verified by baseline records provided by the parents or subjects prior to treatment. Rationale: Frequencies below this level would make the measurement of improvement more difficult.

(3) Subjects must have an I.Q. of 80 or above determined by assessment. Rationale: It is probable that individuals in this I.Q. range can rapidly learn the A/R procedures, given the short time frame.

(4) Subjects had to be nine years of age at the time of recruitment into the study. Rationale: It is felt that this is the youngest age that could benefit from this short-term treatment protocol.

(5) Subjects must be highly motivated to participate in this protocol. Rationale: It is felt that without this commitment the A/R methods could not be fairly assessed.

TREATMENT OF DATA

Baseline data collection

Baseline data were collected before subjects entered treatment. The patient's records were reviewed by a medical neurologist to determine that these participants met the patient characteristics required for this study.

The following information was collected: (1) information on patient characteristics, including demographic and medical data; (2) counts of the number of seizures experienced, collected by means of seizure logs beginning 2 months prior to treatment; (3) measures of severity of the seizures, collected by charting; (4) patient noted seizure-warnings prior to their seizures. It is obviously important to determine the number of seizures experienced at baseline, before the treatment period begins, so that comparisons can be made with the numbers reported after treatment. Although a change in the number of seizures is the primary clinical outcome to be measured, additional variables include assessment of changes in the pattern of seizure activity, evaluation of the effects of having a pre-seizure warning on seizure control, and determination of emotional states, which precede seizures. As described in later sections on data analysis, similarities and differences in patient characteristics between the two treatment groups were examined.

(a) Seizure charting. During the two-month baseline period, all 44 subjects in the study kept a daily record of seizure activity by means of a seizure log. The purpose of the seizure log is to maintain an accurate count of how often seizures occur. Each seizure log form provides space to record one week of seizure activity, and subjects were provided with sufficient logs for the entire baseline period.

(b) Patient characteristics. Demographic information about age, sex, occupational, and marital status was obtained. Specific information about subjects' adjustment to seizures, social and intellectual functioning and quality of life was obtained in the intake interview from both the subjects and the parent's point of view.

(c) Patient treatment phase. The treatment period lasted for 5 days. Following treatment a 10-minute follow-up contact by phone once per week for 6 months was made post-treatment. Subjects received a copy of the workbook and were required to read it and do assignments in each chapter as part of their treatment in the A/R program. This served to standardize the approach for the short-term treatment participants. The areas covered in treatment are described in *Taking Control of Your Epilepsy*[3] and other documentation[1] outlined under A/R treatment below.

Subjects all received the same treatment, which consisted of relaxation training, which includes, daily relaxation (home practice for 30 minutes with relaxation tapes), guided relaxation training, two exposures to biofeedback alpha training, and counseling during the 4 days of treatment. The biofeedback training was done with an Autogen

Systems Instrument (ASI-120 EEG unit). The ASI-120 is a research grade single- or multi-channel biofeedback unit.

The goal of this training was to introduce the patient to the concept that they have some control over the functioning of their brain activity. Tapes were used to facilitate an experience of relaxation while being monitored. The relaxation tapes used were developed by Inner Health[26]. These were used for daily reinforcement and practice for relaxation training at home following treatment as well.

Subjects in the treatment groups were taught a diaphragmatic breathing technique and were instructed to take such breaths when they anticipate a seizure[21].

In addition, these subjects used the comprehensive seizure log. These subjects were asked to record not only their seizures but any awareness of their aura and pre-seizure emotional state. They were asked to make

Table 1: Summary statistics for left- and right-hemisphere group variables.

Variable	Range		Group total	Mean	SD
	from	to			
Number of seizures during baseline months	Left 1	265	754	31.0	55.65
	Right 1	72	324	15.4	19.66
Number of seizures during final 2 months	Left 0	9	15	0.6	1.89
	Right 0	3	5	0.23	0.61
Age of onset	Left 1	37		13.1	10.21
	Right 4	50		20.0	12.25
Years uncontrolled	Left 1	48		11.5	12.65
	Right 1	37		13.1	10.21

a note in their journal to record the information about the severity of the seizure, their aura and specific information about their emotional state (i.e. what event or circumstance was responsible for the emotional state).

It is important, in therapy with epilepsy patients, to promote a reality-based therapy that strengthens the boundary between subjective and objective reality[27]. Such an approach is necessary because people with epilepsy experience a wider range of phenomena that is directly associated with over-excitation in dysfunctional networks of brain neurons that create sensory experiences that are not based in reality, but instead are the effect of the over-excitation[3]. Patients benefit from therapies that are directed at helping them to identify and respond appropriately to these stimuli[2]. It may be detrimental to approach this population with the nor- mal focus of traditional psychotherapeutic attention to transference issues, because the presenting problems are not related to interpersonal relationships[12]. A cognitive approach to therapy, which presents in a systematic way the adaptive difficulties and the psychological stresses that have resulted from the seizure disorder, is likely to be most effective[7].

Treatment was utilized to accomplish

When patients entered the program on more than one medication an attempt was made to reduce the medication to just one. Generally, this medication was pre- scribed at the lowest possible therapeutic dosage to minimize iatogenic effects. This practice helped the subjects to distinguish between seizure symptoms and their normal state of functioning.

Seizure logs and the journal helped the patient and the therapist to: (1) discover a dependable warning for seizures; (2) discover the elements of the triggering mechanism; (3) identify problematic life issues; and (4) determine the effectiveness of the treatment.

Following the five-day intensive treatment and the 6 months of follow-up phone contacts, subjects continued data collection using the seizure logs for a period of 19 months.

Initial data analysis

Using data collected during the baseline period, both groups were compared in terms of patient characteristics and seizure frequency at the start of the study. Seizure frequency was defined as the total number of seizures recorded during the two-month baseline period. This procedure will serve to assess similarities and differences between the groups before treatment began. Univariate statistical tests were used for this purpose. In particular, independent sample *t* -tests were used to compare the groups for seizure frequency and other quantitative variables. For categorical variables, a chi-squared test of homogeneity was used.

Final data analysis

Seizure frequency was examined from the baseline period through the post-treatment period. A line graph showing the mean number of seizures each month was used to present the information visually, with separate graphs for each patient group. The primary outcome measure, proportional reduction in seizure frequency, was defined as, the difference between the number of seizures during the baseline period and the number of seizures during the last two months of follow-up. Analysis of covariance (ANCOVA) was used to determine whether there are significant differences (in this proportional reduction) between (1) the two patient groups; and (2) patients who have a pre-seizure warning and those who do not.

A comparison of the number of seizures during the 2 months following the first aborted seizure to the number of seizures at baseline helped to determine whether a predictable pattern for improvement existed. The distribution of seizures following the month when the first seizure was aborted was described using a frequency distribution. The number of seizures reported by both groups that were preceded by an emotional state was identified from the seizure log. To test whether the groups differ in the type of emotional state reported, an independent sample chi-squared test was used.

RESULTS

Effect on seizure control

Total seizure control was achieved by 18 of the 23 patients in the left-hemisphere group, or 78.2% of this sample and by 17 of the 21 patients in the right-hemisphere group, or 80.9% of this sample. Seizure control was achieved by 35 out of 44 patients in the two groups, or 79.5% for the total population treated in the brief therapy model. Those patients identified as having achieved control had been seizure-free for 6 months or longer.

Summary of variables: multivariate

The range, mean and standard deviation (SD) of each of the study variables is shown in Table 1 for both study groups left (n = 23) and right (n = 21). All of the variables had distributions that were positively skewed.

Both groups showed a significant reduction in seizure frequency following treatment. The proportional reduction in seizures was calculated for each patient, this proportion was converted to a percentage, and then computed as the mean percent for each group of patients. The mean percent of reduction of seizures in both groups is greater than 90%. The mean for the left-hemisphere group is 95.7% and the mean of the right-hemisphere group is 93.7%. The confidence interval for the proportion of reduction in seizures achieved by treatment in both groups is as follows:

- Left-hemisphere group was 92–99%
- Right-hemisphere group was 87–99%.

See Figs 1 and 2 for actual month-by-month charting of the groups seizure frequency.

The ANCOVA showed no significant differences between the left and right groups or between those with and without pre-seizure warnings, in proportional reduction in seizure frequency. None of the patient's characteristics used as co-variables in this analysis (i.e. age, sex, and years seizures were uncontrolled) were significantly related to the proportional reduction. Fisher's exact test also showed no significant difference in the attainment of seizure control between the left and right groups (see Table 2).

Table 2: Fisher's exact test.

	Complete control	Not complete control	Total
Left	18	5	23
Right	17	4	21

P value D 0:562 Indicates that there is no significant difference.

Table 3: Analysis of seizure potential following first aborted seizure.

Seizure potentials	Left hemisphere	Right hemisphere	Total
Increased	10	5	15
Same	1	2	3
Less	8	11	19
Not aborted	4	3	7
Total	23	21	44

Relationship of pre-seizure warnings to seizure control

It was expected that subjects who have a pre-seizure warning when they enter treatment or discover one during treatment would have a better response to treatment.

The number of patients in this patient population who did not have a pre-seizure warning was small, only 12 out of the 44. In the group of $n = 12$ the mean proportional reduction was lower than those who did have a pre-seizure warning, 0.909 versus 0.958. How- ever, the difference was not statistically significant. Also Fisher's exact test showed no significant difference in the attainment of seizure control between those with and without pre-seizure warnings, although the *P* value of 0.101 approached borderline significance.

Data were analyzed to determine if subjects experienced a pattern of change that showed an increase in the number of seizure potentials (pre-seizure warnings) following the first aborted seizure. The analysis of the 2 months following the first aborted seizure compared with the baseline did not identify a typical pattern of increase in seizure potentials. This pattern of increase does happen for some patients. Table 3 shows patients that experienced an increase, stayed the same, or decreased their seizures following the first aborted seizure and those who never aborted a seizure are listed.

Emotional states preceding seizures

The number of seizures reported by both groups that were preceded by an emotional state were identified using the seizure logs. To test whether the groups differ in the type of emotional state reported, an independent sample chi-squared test was used to deter- mine whether a significant difference exists between the groups. Table 4 shows the results of the nonparametric test for emotional triggers per seizure.

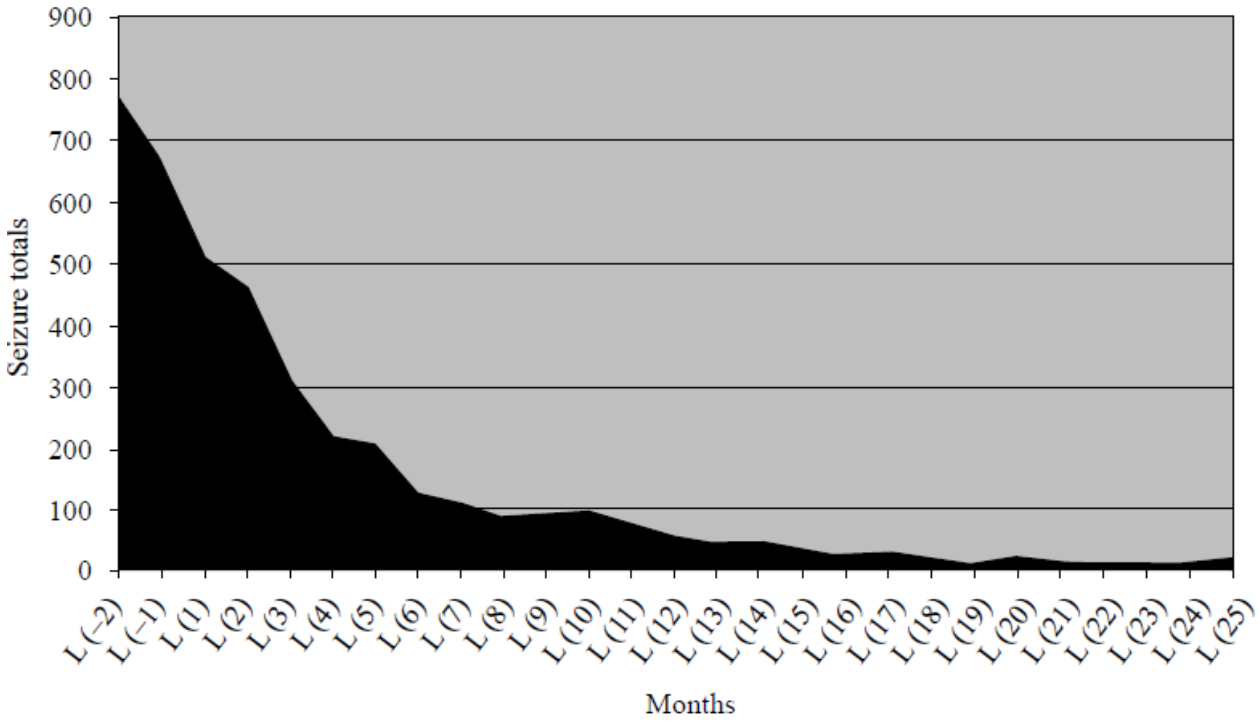

Fig. 1: Left-hemisphere patients seizures by month.

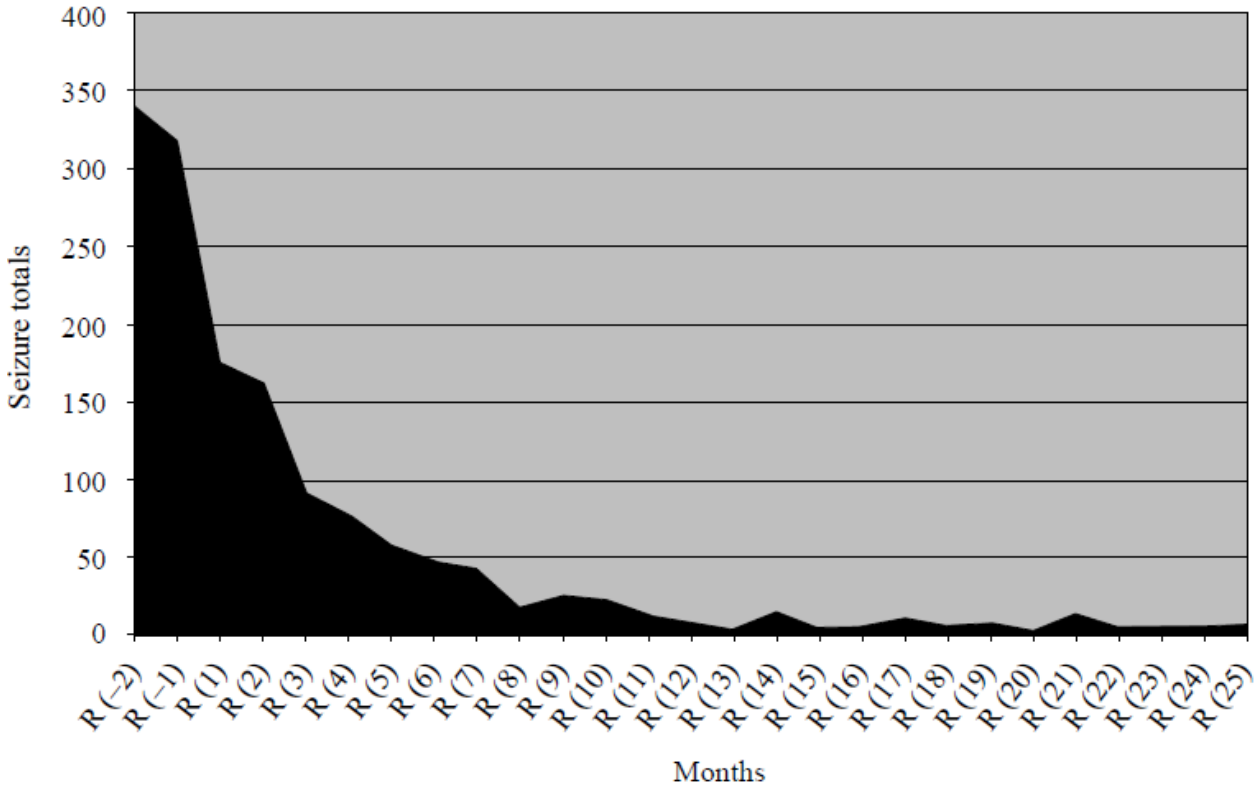

Fig. 2: Right-hemisphere patients seizures by month.

A second test focused on the number of patients reporting emotional triggers and the type of triggers that they reported. The chi-squared statistic has a value of 43.98 with 3df. The *P* -value =< 0.0001 which leads to the conclusion that the types of triggers are significantly different for the two groups. See Table 5 for the patients reporting emotional triggers.

DISCUSSION

Both groups showed a significant reduction in seizure frequency. The reduction in overall seizure activity in the left-hemisphere group had a mean of 95.7% and the right-hemisphere group mean was a 93.7% reduction In addition, complete control was achieved by 18 of the 23 subjects in the left-hemisphere group and 17 of the 21 subjects in the right-hemisphere group and this improvement was maintained for period of 6 months or longer. Figures 1 and 2, which plot the progress of each group of patients, demonstrate that the improvement in seizure control had a pattern of steady decline that was maintained throughout the follow-up period. Therefore, the assumption is that the brief therapy treatment used with these patients is responsible for the improvement noted among the individuals in the two groups.

The analysis of covariance showed that none of the co-variables in the study significantly related to the proportional reduction in seizures. The Fisher's exact test showed no significant difference in the attainment of seizure control between the two groups.

Table 4: Seizures reported with and without emotional triggers.

	Observed values					
	Anger	**Fear**	**Excited**	**Worry**	**No emotion trigger**	**Total**
Left	2242	0	223	187	1444	4096
Right	10	444	1	492	501	1448
Total	2252	444	224	679	1945	5544

(*P* value > 0:0001).

Table 5: Number of patients reporting emotional triggers.

	Worry only	**Anger (w/o fear)**	**Fear w/ anger**	**Fear w/o anger**	**Total**
Left	0	23[a]	0	0	23
Right	5	0	3	13[b]	21

P value < 0:0001.
[a] Excited was never reported by itself, but 16 patient reported excitement with anger on at least one occasion.
[b] Excited was reported by one person on one occasion with fear.

It did not appear that a pre-seizure warning is significantly related to achieving control. While it is true that the proportional reduction of seizures in the group $n = 12$ who did not have a pre-seizure warning was lower, 0.909 versus 0.958 it was not a statistically significant difference. One reason for this finding may be that the group that did not have a pre-seizure warning was too small to test the significance of this variable. Another reason why statistical significance was not found may be that one of the goals of the treatment, to achieve a 'relaxation response', by itself may have resolved the seizures in some of these patients.

The subjects in both groups were studied to discover the pattern of change in their seizure potentials to determine if, in fact, they get worse before they get better. This question was studied because of the observation that some individuals appear to have more seizure potentials, for a short period-of-time, after they abort their first seizure. The use of the word potential here means pre-seizure warnings that did not result in seizures, but typically would have and these are referred to as aborted seizures. The combined count of actual seizures and aborted seizures were analyzed to identify the pattern for seizures. The analysis of this variable did not identify a typical pattern of increase. In those that do experience an increase, it is short-lived (lasting less that 2 months) and is then followed by a significant decrease.

This study looked at the possibility that damage in a specific hemisphere was vulnerable to being triggered into seizures by specific emotions. The seizure logs used for the study identified specific emotions that were suspected as potential seizure triggers. The independent sample chi-squared test determined that a significant difference does exist between the two groups.

To answer the question of the importance that emotions play in the trigger for seizures, two tests were run: (1) on the number of seizures reported that were preceded by an emotional response (showed a significance level at *P* value =< 0.0001) and (2) the number of subjects reporting emotional triggers (showed a significance level at the *P* value =< 0.0001).

The analysis of seizures showed that an emotional trigger was reported 64% of the time in the left-hemisphere group and 65% of the time in the right-hemisphere group. Further, the types of emotion reported in the left-

hemisphere group was predominantly anger and excitement and for the right-hemisphere group was fear. Worry was mentioned by both groups with some regularity and presents as a possible global trigger. This was not a complete list and therefore much more study is necessary to uncover the full extent of this parameter in limbic system function. The second test showed that all of the subjects in this study reported emotional triggers for some percentage of their seizures. This suggests that patients with complex partial seizures are vulnerable to emotional reactions and that these reactions are involved in triggering seizures.

CONCLUSION

The efficacy of this treatment approach was 79.5% achieving control. There was no statistically significant difference between subjects with right- and left- hemisphere seizure foci.

Having a pre-seizure aura was not statistically significant in the goal to achieve control. This was an unexpected finding and clearly demands that a more rigorous study with a larger number of subjects be launched to determine whether this is an accurate finding. One explanation that may account for this outcome, is that the brain has learnt a relaxation response and can evoke it without the conscious awareness of the individual. It is also possible that these individuals engaged in the skills acquired in this program without consciously thinking about it.

What has been identified here is that the ability to interpret specific emotions is localized to a specific hemisphere. This is significant and demands that more research be conducted to understand the full picture of emotional lateralization. In view of complex partial seizures, it is clear from these findings that damage in a specific hemisphere predisposes the individual to an overload from the limbic system for specific emotions that can be traced as the cause for over 64% of their seizures. Therefore, learning better ways to deal with the impact of the target emotion holds the possibility of significantly reducing a patient's seizure frequency, as the figures on the two groups' response to treatment indicate.

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