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Neuropsychological Correlates of the Electroencephalogram in Epileptics: III. Generalized Nonepileptiform Abnormalities

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INTRODUCTION

In an earlier study of the psychological correlates of EEG abnormalities, Vislie and Henriksen (1958) found lowered intelligence and clinical signs of dementia among individuals exhibiting "diffuse dysrhythmia." The worst patients had both dysrhythmia and generalized epileptiform discharges; the best had only focal discharges without dysrhythmia. Lennox and Lennox (1960) produced similar findings with various measures of intelligence and concluded, "Slow waves often match slow wits" (p. 673). Jenkins (1962) grouped the EEGs of a variety of neurological patients according to degree of generalized slowing and used primarily the Wechsler Adult Intelligence Scale (WAIS) to assess abilities. He demonstrated a consistent relationship between slowing and performance, but found statistically significant differences only with respect to nonverbal measures of abilities. In a somewhat parallel study of mildly retarded individuals, Matthews and Manning (1964) found a number of trends but few statistically significant differences. Kløve and White (1963) classified the EEGs of a spectrum of neurological patients as Normal, Mildly Abnormal, Moderately Abnormal, and Severely Abnormal and evaluated performance with the Wechsler-Bellevue Intelligence Scale. Only the Normal and Severely Abnormal groups had consistent differences in performance identified by this scale.

In previous research (Wilkus and Dodrill, 1976), we studied the neuropsychological correlates of presence and absence, topographic distribution, and average rate of occurrence of EEG epileptiform discharges in epileptics. In general, topographic distribution was the most potent EEG variable in differentiating performances, such that patients having generalized discharges performed worse than those having focal discharges or no such patterns. A second investigation (Dodrill and Wilkus, 1976) identified neuropsychological correlates of the waking EEG dominant posterior rhythm frequency (DPRF) in a parallel fashion. Relatively fewer correlates of neuropsychological functions were found, but there was generally lowered performance among individu-

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als having a DPRF of less than approximately 8 Hz.

From the studies cited, it is apparent that there is a tendency for individuals with more severe EEG abnormalities to have lower levels of performance. It is also apparent, however, that this relationship has not been shown to be consistent, but that it varies depending on the types of patients under evaluation, the particular tests employed, and the criteria used for establishing the various groups. Furthermore, most investigators have used only measures of general intelligence to relate to EEG findings, and the limitations inherent in such an approach have already been stressed (Reitan, 1956; Dongier et al., 1976). The study reported here utilized a broad neuropsychological battery to evaluate groups of adult epileptics established on the basis of extent of generalized nonepileptiform EEG abnormalities. In turn, the correlates of this EEG variable were compared to those of other EEG parameters, complementing our previous studies and bearing directly on some of the issues raised by earlier work.

MATERIAL AND METHODS

The 111 adults (aged 16 and over) used in this investigation were epileptics with uncontrolled seizure disorders evaluated at the Epilepsy Center of the University of Washington Hospitals. These 60 males and 51 females averaged 27.29 years of age (SD = 8.40) and 11.88 years of formal education (SD = 2.14). Information available on 108 subjects revealed that they had been experiencing seizures since a mean age of 12.92 years (SD = 8.70) for an average duration of 14.34 years (SD = 8.97). Clinically, 12 patients had generalized tonic–clonic convulsions as their primary diagnoses, 16 had generalized seizures other than tonic–clonic (absence, akinetic, tonic or clonic), 14 had elementary partial seizures, 63 had complex partial attacks, and 6 had various combinations of these. Seventy-six persons were on phenytoin alone at the time of their evaluations, 22 were on combinations of phenytoin and other drugs, and 11 were taking other antiepileptic drugs but not phenytoin. In those patients taking phenytoin, the average serum level of this drug was 26.67 μg/ml.

The complete neuropsychological battery originated by Halstead and developed by Reitan was administered, including the Wechsler Adult Intelligence Scale. This battery has been well described elsewhere (Halstead, 1947; Reitan and Davison, 1974), and its relationships with brain functioning have been well established. For uniformity, the 15 neuropsychological variables used in our earlier studies (Dodrill and Wilkus, 1976; Wilkus and Dodrill, 1976) were again selected for this research.

EEGs were performed during wakefulness on 16-channel electroencephalographs (Beckman Accutrace) utilizing the international 10–20 system of electrode placement (Jasper, 1958). All EEGs were interpreted by the same electroencephalographer who was unaware of the results of the neuropsychological studies. The EEGs and neuropsychological tests were completed within a median of 2.5 days of each other and were never more than 30 days apart. No subject underwent studies while in an obviously postictal state.

Criteria were established to classify diffuse nonepileptiform abnormalities in representative alert but resting sections of waking EEGs taken under eyes-closed conditions. The results of hyperventilation and stroboscopic stimulation were not considered. Patients whose EEGs were sufficiently asymmetric to preclude identification of abnormalities as "generalized" were excluded from the study. Diffuse EEG changes were graded according to a scheme of visual assessment of the relative preservation or distortion of physiological rhythms and the abundance of diffuse, slow wave patterns. Disregarded were strictly regional slow waves, epileptiform discharges regardless of their distribution or pominence, and fast activity within the beta frequency band. Recordings were assigned to one of three categories according to the following characteristics:

1. *None (No abnormalities)/Mild*: This included EEGs which were normal, or, if abnormal, had readily identifiable physiological rhythms within the alpha frequency band (8–13 Hz) and diffuse theta patterns (4 to just under 8 Hz) for no more than one-fourth of the representative segments.

2. *Moderate*: EEGs included here had physiological rhythms within the alpha frequency band and diffuse theta waves for no more than one-half of the waking, resting recording time. Delta waves (0.5 to just under 4 Hz) could be present but would not be a preponderant feature of these tracings.

3. *Marked*: This included abnormal EEGs with more than one-half of the representative recording time having diffuse theta and/or delta waves. The remainder of these sections could include waves of alpha frequency, although in nearly all cases the posterior waking rhythm was slower than 8 Hz. Delta waves, when present, appeared randomly or in diffuse bursts.

The above classification scheme is similar to that used to derive the routine EEG reports at our facility. Having only three categories, however, forced the assignment of intermediate recordings to one or the other adjacent categories. The difficulty of these decisions was demonstrated by a subsequent check of the reliability of the EEG ratings. Twenty EEGs, randomly chosen, were reclassified by the same electroencephalographer without knowledge of the original categories several months following their initial interpretations. Of these 20 tracings, 17 were classified in the same category as previously, but the remaining 3 tracings were rerated in the most closely applicable adjacent category. These three all involved a choice between "None/Mild" and "Moderate" ratings.

With respect to epileptiform discharges, the criteria used for their identification were those delineated by Zivin and Ajmone Marsan (1968). Insofar as topographic distribution of these patterns was previously found to be the most potent in differentiating neuropsychological performances (Wilkus and Dodrill, 1976), this parameter was compared to the generalized abnormalities variable. Table 1 displays the topographic distributions of the epileptiform abnormalities found in our patients. Focal and generalized discharges coexisted in only 1 case, and this subject was classified as having generalized atypical spike-and-wave discharges. The 5 subjects who manifested "small sharp spikes" (Gibbs and Gibbs, 1952) were excluded from the analysis involving topographic distribution of discharges because such patterns are apparently of no localizing or lateralizing significance (Reiher and Klass, 1968).

Two analyses of data were conducted. In the first, neuropsychological correlates of generalized nonepileptiform EEG abnormalities alone were evaluated without concern for epileptiform discharges which might have been present in the same recordings. EEG slow wave abnormalities were rated as None/Mild in 35 persons, Moderate in 63, and Marked in 13. One-way analysis of variance was applied across these groups for each neuropsychological variable, and where significant F statistics appeared, the Neuman-Keuls procedure for unequal Ns (Winer, 1971) was used to assess differences among the groups. In order to facilitate analyses and comparisons, all data

TABLE 1. *Topographic distribution of EEG epileptiform patterns in patients undergoing neuropsychological tests*

Generalized atypical spike and wave	13
Generalized typical spike and wave	1
Generalized, other	14
Right temporal	17
Left temporal	8
Bitemporal independent	4
Right frontal	2
Bifrontal independent	3
Right parietal	1
"Small sharp spikes"	5
None	43
Total	111

were converted into normalized T scores having a mean of 50 and a standard deviation of 10 prior to analysis of variance. There were no statistically significant differences across the groups with respect to age, years of education, total number of attacks in the month preceding the evaluations, phenytoin serum levels, total number of anticonvulsants administered, ratings for the presence of anticonvulsant side effects (Troupin et al., 1977), and duration of seizure disorders. There was, however, a significant difference in age of onset of epilepsy with the None/Mild abnormalities group having a mean age at onset of 17.00 years (SD = 10.39) as compared with 11.29 years (SD = 7.36) and 9.42 years (SD = 5.28) for the Moderate and Marked abnormalities groups, respectively ($F = 6.51, p < 0.002$).

The second analysis permitted the simultaneous comparison of generalized EEG abnormalities with topographic distribution of epileptiform discharges relative to the results of the neuropsychological testing. Each of the three categories of patients classified on the basis of generalized EEG abnormalities was divided into three groups on the basis of epileptiform EEG activity (No Discharges, Focal Discharges, Generalized Discharges), and the data were assembled into a 3×3 design. In the generalized abnormalities None/Mild classification, the numbers of patients with No Discharges, Focal Discharges, and Generalized Discharges were 21, 6, and 5, respectively. Parallel figures for the Moderate abnormalities classification were 21, 23, and 17, whereas those for the group with Marked abnormalities were 3, 4, and 6. With the patients distributed in this fashion, the results on each neuropsychological variable were subjected to two-way analysis of variance.

RESULTS

Table 2 presents the raw score results of the neuropsychological testing in relation to the degree of nonepileptiform generalized EEG abnormalities. For visual comparison of differences, the corresponding standard score data are presented in Fig. 1, with higher scores indicating better performances. Statistically significant differences were observed across the groups on 13 of 15 neuropsychological variables. There was an orderly decrease in performance with increasing EEG abnormalities. Furthermore, the performances of the Moderate group were generally somewhat closer to those of the None/Mild group than to those of the Marked group, as is revealed by the numerical superscripts of Table 2.

Table 3 presents results of simultaneous consideration of generalized EEG nonepileptiform abnormalities and topographic distribution of epileptiform discharges. It can be seen that, in comparison to the 13 neuropsychological variables having statistically significant differences relative to generalized slow wave EEG abnormalities, the epileptiform discharge variable was associated with only seven significant differences. Thus, the most potent epileptiform discharge variable identified in our previous study (Wilkus and Dodrill, 1976) was not as effective as the generalized nonepileptiform abnormalities parameter in differentiating neuropsychological performances. However, simultaneous use of both EEG variables maximized the dispersion of neuropsychological test scores (Table 3). In particular, the group having marked generalized slow wave abnormalities accompanied by generalized epileptiform discharges had conspicuously the worst neuropsychological performance except on the dynamometer. Also, we observed that several statistically significant interaction effects existed, suggesting once again that simultaneous consideration of the two EEG variables is worthwhile.

DISCUSSION

The most striking finding in this study is the remarkable relationship between differences in neuropsychological performance and degrees of generalized EEG nonepilep-

TABLE 2. *Means, standard deviations, and* F *statistics of neuropsychological test results on patients grouped according to generalized EEG abnormalities*

	Groups						
	None/Mild		Moderate		Marked		
Test variable	Mean	SD	Mean	SD	Mean	SD	*F* statistics
Category Test	$51.09^{\underline{1}}$	29.27	65.49	33.40	$82.54^{\underline{1}}$	34.70	5.08^{b}
TPT Total Time	$18.33^{\underline{1}}$	10.52	$25.49^{\underline{2}}$	15.06	$37.99^{\underline{1,2}}$	19.01	9.06^{c}
TPT Memory	$7.89^{1,2}$	1.34	6.81^{1}	1.87	6.08^{2}	3.01	4.94^{b}
TPT Localization	$4.40^{\underline{1},2}$	2.49	2.83^{2}	2.12	$1.92^{\underline{1}}$	1.60	8.04^{c}
Seashore Rhythm	$24.69^{\underline{1}}$	2.75	22.84	4.91	$18.08^{\underline{1}}$	9.73	4.12^{a}
Speech Perception	7.57	4.44	8.51	5.04	14.15	11.87	2.72
Finger Tapping	$47.63^{\underline{1}}$	7.03	44.52	6.64	$36.69^{\underline{1}}$	11.54	5.52^{b}
Impairment Index	$0.47^{\underline{1}}$	0.29	0.62^{2}	0.27	$0.78^{\underline{1},2}$	0.24	7.79^{c}
Trail Making, Part A	$33.17^{\underline{1}}$	14.74	46.19^{2}	39.21	$72.77^{\underline{1},2}$	49.32	6.43^{b}
Trail Making, Part B	$102.83^{\underline{1}}$	64.96	$124.51^{\underline{2}}$	79.35	$192.85^{\underline{1,2}}$	107.03	5.45^{b}
WAIS Verbal IQ	$100.91^{\underline{1}}$	14.64	98.31^{2}	14.87	$83.85^{\underline{1,2}}$	16.13	6.46^{b}
WAIS Performance IQ	$98.14^{\underline{1},2}$	12.99	$86.67^{2,3}$	12.85	$80.85^{\underline{1},3}$	14.59	9.62^{c}
WAIS Full-Scale IQ	$99.71^{\underline{1}}$	13.77	$94.35^{\underline{2}}$	13.37	$81.69^{\underline{1,2}}$	15.10	8.14^{c}
Perceptual Errors	$7.74^{\underline{1}}$	10.06	12.84^{2}	15.98	$25.54^{\underline{1},2}$	24.69	5.40^{b}
Dynamometer	43.94	12.22	39.11	13.41	40.31	13.92	1.38

^{a} $p < 0.05$, $F \geqslant 3.09$.
^{b} $p < 0.01$, $F \geqslant 4.83$.
^{c} $p < 0.001$, $F \geqslant 7.41$.
All F statistics were calculated on the basis of data in T score form. Identical single numerical superscripts across groups within each test variable indicate significant difference of $p < 0.05$; if superscripts are underlined, $p < 0.01$.

tiform abnormalities. Performance on all but two neuropsychological tests chosen for this research systematically decreased as nonepileptiform abnormalities increased. Actually, it should be noted that the results on the two remaining neuropsychological variables were not entirely unexpected. The Speech Perception Test has been known for some time to be one of the weaker Halstead measures (Reitan, 1955); in fact, it failed to meet the basic criteria for inclusion in the "Neuropsychological Battery for Epilepsy" (Dodrill, *in press*). Similarly, performances on the dynamometer might have been expected to bear little, if any, relationship to diffuse EEG abnormalities. The test measures differentiated by the EEG findings covered a broad range of functions including simple sensory-perceptual abilities, simple and complex motor skills, memory abilities, problem solving skills, language skills, and visual-spatial abilities. Thus, the generalized nonepileptiform EEG abnormality variable had many correlates with performance.

Also of interest was the finding that generalized EEG abnormalities are much more potent than epileptiform discharges in differentiating neuropsychological performances. Table 3 reveals that within each neuropsychological variable, the F statistic for the discharges was always smaller than that for the generalized nonepileptiform abnormalities with only a single exception (Tapping Test). Furthermore, it should be recalled that in an earlier study (Dodrill and Wilkus, 1976), epileptiform discharge parameters were more potent than the DPRF in correlating with performance levels. Although we have not taken space to report a comparison of the correlates of generalized EEG slow wave abnormalities with those of the DPRF, the former was far more potent than the latter in differentiating

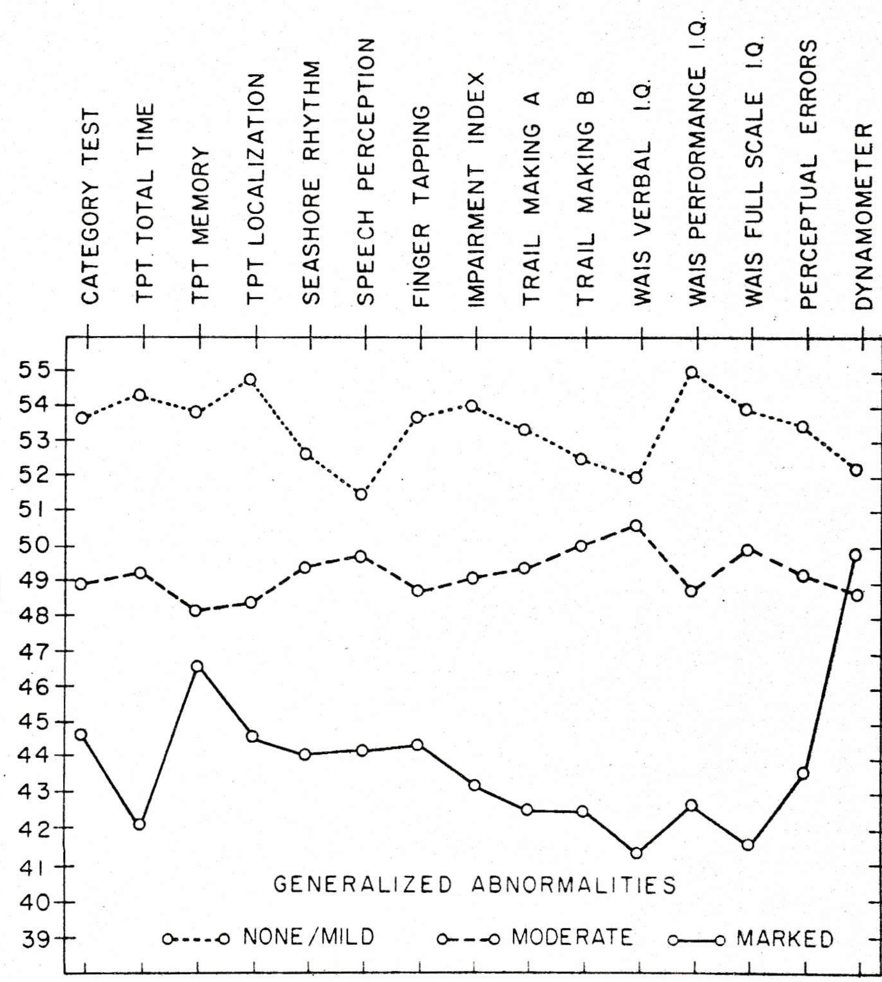

FIG. 1. Neuropsychological performances of patients grouped according to generalized nonepileptiform EEG abnormalities.

neuropsychological performances. Thus, in summary of our work, generalized abnormalities are strongest, epileptiform discharges are intermediate, and DPRF is the weakest of the three in differentiating levels of neuropsychological performance.

The clarity of our findings stands in contrast to the less conclusive observations of previous investigators. Several factors are likely to be responsible for this difference. One, of course, relates to the reliability and/or reproducibility of the EEG ratings. In only one study (Jenkins, 1962) was an effort made to evaluate the consistency of the EEG classifications. More important, however, might be the design of the classification scheme itself. In light of our own research, it appears that earlier studies may have overemphasized the importance of certain EEG phenomena but underemphasized others. As an example, in one investigation (Matthews and Manning, 1964), the finding of a single EEG spike pattern was sufficient to assign a patient to the worst possible category along with other subjects showing almost continuous generalized epileptiform discharges superimposed on pervasive delta patterns. In addition, our previous work (Wilkus and Dodrill, 1976) and the present research

TABLE 3. *Means, (standard deviations), and* F *statistics of neuropsychological test results on patients grouped according to generalized EEG abnormalities and epileptiform discharges*

	Groups									*F* statistics		
	Gen. Abnorm. None/Mild			Gen. Abnorm. Moderate			Gen. Abnorm. Marked			Main effects		Interaction effect
Test variable	No disch.	Focal disch.	Gen. disch.	No disch.	Focal disch.	Gen. disch.	No disch.	Focal disch.	Gen. disch.	Gen. abnorm.	Discharges	
Category Test	51.24 (32.05)	41.50 (17.94)	54.60 (36.54)	60.29 (30.88)	66.39 (34.17)	70.12 (35.73)	61.67 (41.62)	64.75 (37.02)	104.83 (16.25)	3.65[a]	1.45	0.94
TPT Total Time	18.83 (12.36)	14.07 (5.42)	19.88 (9.36)	21.32 (11.70)	24.92 (14.03)	31.91 (18.76)	25.37 (12.55)	22.72 (4.72)	54.48 (13.51)	6.51[b]	4.78[b]	0.88
TPT Memory	7.81 (1.47)	8.00 (1.26)	8.40 (1.14)	7.71 (1.49)	6.39 (1.80)	6.24 (2.11)	7.67 (1.53)	8.25 (1.50)	3.83 (2.86)	3.27[a]	3.22[a]	3.94[b]
TPT Localization	4.67 (2.37)	4.33 (3.14)	4.60 (2.51)	3.76 (2.51)	2.44 (1.88)	2.24 (1.64)	2.00 (1.73)	3.75 (0.50)	0.67 (0.52)	6.51[b]	2.62	1.91
Seashore Rhythm	24.71 (2.78)	24.50 (2.26)	24.60 (1.67)	22.86 (3.53)	23.26 (4.50)	22.18 (7.02)	23.67 (6.11)	23.25 (3.78)	11.83 (10.82)	3.35[a]	1.03	1.50
Speech Perception	7.62 (4.61)	6.33 (2.66)	6.80 (2.68)	8.90 (4.94)	8.17 (3.37)	8.65 (7.18)	7.67 (4.73)	7.00 (3.56)	22.17 (13.35)	2.72	.36	2.61[a]
Finger Tapping	47.43 (6.59)	50.17 (6.40)	44.40 (11.10)	46.19 (5.50)	45.87 (5.68)	40.82 (8.21)	41.33 (2.31)	47.75 (3.86)	33.50 (14.45)	3.44[a]	5.15[b]	0.64
Impairment Index	0.48 (0.30)	0.32 (0.22)	0.48 (0.34)	0.56 (0.26)	0.63 (0.24)	0.66 (0.32)	0.63 (0.25)	0.60 (0.20)	0.98 (0.04)	6.62[b]	1.39	1.64
Trail Making, Part A	30.14 (10.86)	36.00 (17.94)	40.40 (25.99)	34.00 (14.31)	48.04 (40.67)	58.94 (55.26)	60.33 (29.87)	28.00 (1.63)	108.83 (47.13)	4.26[a]	3.16[a]	1.47
Trail Making, Part B	93.29 (56.82)	80.83 (24.38)	157.40 (101.98)	92.67 (54.36)	141.70 (84.65)	141.10 (93.80)	163.00 (118.82)	94.25 (50.25)	273.50 (64.91)	3.64[a]	2.44	2.12
WAIS Verbal IQ	102.67 (12.77)	98.33 (16.43)	98.90 (19.73)	101.81 (12.44)	98.61 (17.35)	93.53 (14.35)	96.33 (13.05)	90.75 (11.47)	73.00 (14.31)	4.84[b]	3.30[a]	0.91
WAIS Performance IQ	97.57 (12.25)	103.50 (12.63)	93.00 (15.17)	95.90 (10.36)	87.44 (11.03)	85.24 (16.06)	85.33 (11.72)	94.00 (7.79)	69.83 (11.11)	6.14[b]	4.33[a]	2.54[a]
WAIS Full-Scale IQ	100.43 (12.56)	100.83 (13.23)	96.20 (18.46)	99.43 (10.48)	93.44 (14.27)	89.35 (14.56)	91.33 (11.02)	91.75 (8.73)	70.17 (12.51)	5.40[b]	4.89[b]	1.25
Perceptual Errors	9.19 (12.01)	3.17 (3.31)	6.60 (3.51)	7.76 (6.88)	16.17 (21.50)	14.94 (15.40)	28.00 (35.16)	5.25 (3.86)	37.83 (21.11)	3.92[a]	1.96	2.97[a]
Dynamometer	44.62 (12.53)	44.83 (10.99)	47.00 (10.77)	40.69 (14.86)	39.70 (11.42)	35.03 (13.45)	45.50 (16.45)	41.12 (13.74)	37.17 (14.65)	1.96	0.88	0.42

[a] $p < 0.05$.
[b] $p < 0.01$.
All F statistics were calculated on the basis of data in T score form.

suggest that other investigators have overlooked important factors such as average rate of occurrence and topographic distribution of EEG epileptiform discharges. Some studies (e.g., Jenkins, 1962) placed an emphasis on the "alpha" rhythm, which seems unwarranted in view of another of our studies (Dodrill and Wilkus, 1976). Perhaps most important of all, other authors failed to consider that various EEG phenomena might have differential impacts on performance. Our studies benefited from individual consideration of EEG patterns and from the grading of each in a systematic and relatively objective fashion. Furthermore, we have dealt solely with epileptics rather than with subjects having diverse diseases. Finally, the employment of tests of a broad range of neuropsychological functions, rather than just tests of intelligence, widened the spectrum of our findings.

The question of whether or not antiepileptic agents have significantly influenced the results of our study is worth considering. In answer, it should be recalled that the vast majority of our subjects were taking phenytoin, with or without other seizure medications, and that there were no differences in phenytoin levels across our three principal EEG groups (None/Mild, Moderate, Marked). Likewise, there were no differences in clinical ratings of side effects of medications. In addition, the previously recognized pattern that neuropsychological impairments primarily involve motor tasks when patients take large doses of phenytoin (Dodrill, 1975) is different from that observed in this study. Here, nearly every task was affected, regardless of the presence or absence of a motor component. Thus, we feel reasonably confident that anticonvulsants are not responsible for our results. Similarly, it seems unlikely that the effects of seizures accounted for our findings, since there were no differences across the groups in rate of attacks and we did not study postictal patients.

One should recall, however, that there was a relationship between increased degree of generalized EEG nonepileptiform abnormalities and earlier age of onset of seizures and, possibly, the more severe forms of epilepsy (Tarter, 1972). Also, our subjects were examined for fixed neurological deficits including hemiparesis, spastic diplegia, adventitious movement, and/or other major problems which could have affected performances on the psychological tests. In the None/Mild group, 3 patients (9%) had these findings while in the Moderate group there were 8 (13%) and in the Marked group 3 (23%) such subjects. Thus, a trend was apparent although it was not statistically significant ($X^2 = 1.80$, $df = 2$).

Finally, a statistical note should be offered. Whereas the numbers of individuals in the groups of the analysis shown in Table 2 were adequate, the cell sizes of the other analysis (Table 3) were much smaller and, in fact, five cells had fewer than 10 patients apiece. With analysis of variance procedures, such small groups may reduce the statistical significance. Thus, it is possible that with larger groups, additional areas of statistical significance might have been identified or higher levels of statistical significance obtained. However, this factor should not have affected one EEG variable more than another, and our findings were quite prominent even with some small cell sizes.

Overall, we have identified a rather large array of neuropsychological correlates of generalized nonepileptiform EEG abnormalities spanning many types of clinically important brain functions. This study has reaffirmed the importance of assessing certain stationary patterns in the EEG of epileptic patients. It is hoped that refinements in the objective assessment of such patterns, presumably through the use of computer techniques, will even increase the usefulness of the EEG in this regard.

SUMMARY

A broad battery of neuropsychological tests was given to 111 adult epileptics

treated primarily with phenytoin. The patients were grouped according to degree of generalized nonepileptiform EEG abnormalities in waking EEGs. In patients classified as None/Mild, Moderate, or Marked in terms of these EEG abnormalities, performances on 15 neuropsychological measures were contrasted. Statistically significant differences across the groups were found on 13 of the 15 neuropsychological variables. An orderly decrease in performance occurred as a correlate of an increase in EEG abnormalities. These results were compared to a similar analysis of the correlates of topographic distribution of epileptiform discharges (Absent, Focal, Generalized). It was discovered that degrees of generalized slow wave EEG abnormalities were more potent in differentiating levels of neuropsychological performance than epileptiform discharges. Nevertheless, when discharges and degree of nonepileptiform abnormalities were simultaneously considered, a maximal level of correlation was reached.

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RÉSUMÉ

Une large batterie de tests neuropsychologiques a été appliquée à 111 épileptiques adultes traités par la phénytoine. Les patients furent groupés suivant l'importance des anomalies EEG "nonépileptiformes" sur les tracés de veille. Il fut ainsi distingué 3 groupes suivant que les anomalies étaient nulles ou légères, modérées ou accusées. Les performances de chaque groupe pour 15 tests neuropsychologiques furent appréciées. Des différences statistiquement significatives concernant 13 des 15 variables neuropsychologiques furent constatées suivant les groupes; c'est-à-dire qu'une diminution des performances fut trouvée en corrélation avec une augmentation des anomalies EEG. Ces résultats furent comparés à ceux d'une analyse similaire tenant compte de l'absence ou de l'existence de décharges "épileptiformes" focales ou généralisées. La comparaison des deux analyses fit ressortir que l'importance des ondes lentes généralisées sur l'EEG est plus grande que celle des décharges "épileptiformes" pour différencier des niveaux de performance neuropsychologique. Toutefois le niveau de corrélation le plus élevé est obtenu lorsque l'on prend en considération à la fois l'importance des décharges "épileptiformes" et des anomalies "nonépileptiformes" de l'EEG.

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RESUMEN

Con una amplia bateria de test neuropsicológicos se han estudiado 111 epilépticos adultos tratados fundamentalmente con fenitoina. Los enfermos se agruparon de acuerdo con el grado de anormalidades generalizadas no epileptiformes del EEG registrado en vigilia. Los resultados de 15 tests neuropsicológicos fueron contrastados en los enfermos clasificados como Ninguna/Ligera/ Moderada y Marcada según las anormalidades del EEG. En 13 de las 15 variables neuropsicológicas se encontraron diferencias estadísticamente significativas en los grupos. Se observó un descenso ordenado de las performances en correlación con el aumento de las anormalidades del EEG. Estos resultados se compararon con un análisis similar de las correlaciones de la distribución topográfica de las descargas epileptiformes (ausentes, focales, generalizadas). Se descubrió que diversos grados de anormalidades del EEG en forma de ondas lentas generalizadas eran más importantes para diferenciar los niveles de las performances neuropsicológicas que las descargas epileptiformes. A pesar de todo, cuando se consideraron simultáneamente las descargas y el grado de las anormalidades no epileptiformes, se consiguió una correlación máxima.

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ZUSAMMENFASSUNG

Mit einer breiten Batterie neuropsychologischer Tests wurden 111 erwachsene Anfallskranke untersucht, die primär mit Phenytoin behandelt wurden. Die Patienten wurden nach dem Grad der generalisierten, nicht epileptiformen Abnormität im Wach-EEG eingeteilt: Patienten ohne/mit geringen, mäßigen, ausgeprägten EEG-Abnormitäten; die Ergebnisse von 15 neuropsychologischen Maßen wurden verglichen. Statistisch signifikante Unterschiede zwischen den Gruppen wurden bei 13 der 15 neuropsychologischen Variablen gefunden. Eine deutliche Verschlechterung der Testdurchführung korrelierte mit einer Zunahme der EEG-Abnormitäten. Diese Ergebnisse wurden mit einer ähnlichen Analyse der Korrelation mit der topographischen Verteilung der epileptiformen Entladungen verglichen (fehlend, fokal, generalisiert). Es wurde festgestellt, daß das Ausmaß der generalisierten langsamen Wellen im EEG stärker die neuropsychologischen Ergebnisse beeinflusste als epileptiforme Entladung. Wenn Entladungen und das Ausmaß der nicht-epileptiformen Abnormität gleichzeitig berücksichtigt wurden, fand sich allerdings die höchste Korrelation.

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