

SOME EEG FINDINGS IN OLD AGE AND THEIR RELATIONSHIP TO AFFECTIVE DISORDER

By

R. MAGGS, M.D., D.P.M.

*Consultant Psychiatrist
Hellingly Hospital, Hailsham, Sussex*

and

E. C. TURTON, M.D., M.Sc., M.R.C.P., D.P.M.

*Consultant Psychiatrist
Barrow Hospital, near Bristol*

INTRODUCTION

THE significance of the electro-encephalographic variations found in old age is not well defined and hence the value of this form of investigation as a prognostic measure is doubtful. Apart from a few papers such as Mengoli (1952), Mundy-Castle *et al.* (1954) and Obrist (1954), most of the published work contains no reference to findings obtained from a control series of persons of similar age and not suffering from a definite disability. This absence of definite criteria in respect of the EEG findings in records taken from apparently healthy elderly persons is important both as regards clear-cut abnormalities and also in reference to minor variations of doubtful significance.

The purpose of this paper is to evaluate the significance of the EEG findings in apparently healthy and normal persons aged 60 and over, and to compare these results with those obtained from a group of similarly aged patients suffering from a depressive illness. It was hoped that in this way these depressions of late onset might be differentiated from those arising earlier in life, with the possibility of determining in part the aetiological causation and clarifying the natural history of depressive illnesses. Interest in this subject has already been aroused by the work of Mayer-Gross (1945), Roth and Morrissey (1952) and recently Roth and Kay (1956), in which the importance of affective psychosis in old age is stressed.

A shift of the prominent components in the EEG towards the slow end of the frequency spectrum (Davis, 1941) and an increase in the amount of slow wave activity in persons over 70 years of age were the first changes to be noted. These findings were confirmed by Obrist (1951) in males aged over 75. A direct correlation between the severity of EEG abnormality and the degree of mental impairment in elderly patients has been found by some workers. Hoch and Kubis (1941) stated that if 1-5 c.p.s. slow waves were present so was mental impairment. Luce and Rothschild (1953) found only 12 per cent. abnormal records in those with functional psychiatric disorder, as opposed to 75 per cent. in those with an organic condition. Similarly, McAdam and McClatchley (1952) found very few abnormal records in psychiatric patients over 60 who were not clinically deteriorated, with a close correlation between the degree of marked deterioration and EEG abnormality.

However, the poor correlation between the EEG findings and the degree of organic mental impairment has also been frequently noted. For instance,

Liberson and Seguin (1945) found that one-third of definitely organic patients have a normal or borderline EEG record. Strauss and Greenstein (1948) found no direct relationship between the EEG normality or abnormality and the presence or absence of severe cerebral lesions. Silverman *et al.* (1953) found only 53 per cent. normal records in a group of elderly persons suffering from a variety of medical and surgical conditions but who had had no vascular accidents. Sheridan *et al.* (1955) stressed that records taken from persons in the senium often change in a few months, either for better or for worse, and that anyway good intellectual function is compatible with an abnormal tracing.

Bagchi *et al.* (1950) found that patients with very high blood pressure were more apt to have abnormal records, but most of these had either had a cerebrovascular accident or hypertensive encephalopathy. However, if these were omitted the correlation was poor and 42 per cent. had normal and 33 per cent. borderline with only 25 per cent. abnormals. Cohn (1949) noted predominantly high frequency activity and only rarely slow activity in patients with increased arterial blood pressure.

MATERIAL AND METHODS

Control Group

This consisted of 82 persons (63 females and 19 males). They were living independently of any sustained medical help and were drawn from all social strata. Each could be said to show "social integration".

The following examinations were carried out on all these individuals:

- (a) Psychiatric assessment, including general information and conceptual tests, so arranged as to reduce to the minimum the likelihood of fatigue.
- (b) Simple clinical memory test, comparing recall for recent and remote events.
- (c) Fundus and disc examinations.
- (d) Blood pressure estimation.
- (e) An EEG.

In addition to this the following information was obtained:

- (f) Full previous medical and where applicable psychiatric history.
- (g) An evaluation of social circumstances.
- (h) Present state of sight and hearing.

Fundus and disc gradings were attempted using the criteria of Wagener and Keith (1939). Two blood pressure readings were recorded, one before and the other after interview and the second reading was used for the purpose of our investigation. A rough estimate was made of the emotional state present, so that anyone with obvious evidence of psychiatric illness could be excluded. Our social workers confirmed and assessed the social state, as any individual showing evidence of social isolation and particularly any not living an active and independent type of life was excluded.

Group suffering from a Depressive Illness

Ninety-six cases of depression (65 females and 31 males) arising in patients aged 60 and over were examined. "Depression" in this investigation has been taken to mean a depressive symptom-complex sustained for a period of over three weeks. In view of the possibility of organic brain signs materially influencing our results, the following types of case were excluded:

- (a) Any with a possible history of cerebrovascular accident.
- (b) Mixed cases in which there was evidence of both depressive and organic symptoms.

- (c) Those cases of depression associated with damage to the C.N.S., e.g. an old hemiplegia or Parkinsonism.
- (d) Those cases of depression who had E.C.T. within three months of examination (for, say, a previous depression).
- (e) Those patients known to have made a suicidal attempt with carbon monoxide.

The present series has been subdivided into two main groups:

- (A) Those cases in which the first attack occurred before the age of 60 (the early onset group), total number 47;
- (B) A late onset group in which there was no evidence of depression before 60, total number 49.

This subdivision was decided upon to see if depressions of later onset, which might be considered to be of less good prognosis, showed EEG or other symptom differences as compared with the group of earlier onset.

EEG Interpretation

All the EEGs were evaluated by one of us (E.C.T.), who had no knowledge of the clinical group. Records were taken on an 8-channel Ediswan electroencephalograph, using standard electrode positions and a bipolar recording technique. Only those that were technically satisfactory were included. With regard to provocative procedures, results of overbreathing are not considered, as many subjects could only increase their respiratory exchange slightly. Photic stimulation was the only other technique routinely employed and the results are given separately.

The EEGs were all interpreted according to a fixed plan decided in advance. The records classed as normal were judged by ordinary adult standards and the alpha rhythm had a frequency of 8·5 c.p.s. or over. The borderline records were those showing an excess of fast or beta activity, with either a diminution or abolition of the alpha rhythm. The truly abnormal records all showed an excess of slow activity or epileptic features. Where these slow rhythms were generalized, the abnormality was graded as moderate or severe and in addition those tracings showing focal disturbances and epileptic features were separated.

RESULTS

Clinical Details of the Depressive Groups A and B

Social and environmental stress varied little in its incidence in the two groups. In approximately 21 per cent. of cases of Group A (10 out of 47) stress was present, whilst in Group B the figure was 17 out of 49 (35 per cent.). Physical disease seemed to play an important part in both groups either in precipitating or aggravating an attack of depression. Thus in 29 of the 96 cases (32 per cent.) the physical state was held to be an aetiological factor.

There was little difference in the end result of hospital treatment in the two groups. Thirty-nine out of 47 (87 per cent.) of Group A recovered, whilst the figure in Group B was 33 out of 49 (75 per cent.), the difference being well below the 5 per cent. level of significance. The recovery appeared to be spontaneous in 16 out of the whole series of 96. Further analysis of the individual clinical factors was considered to be beyond the scope of the present study, particularly in view of the exclusion of the categories described above and the distribution of the EEG abnormalities shown below.

EEG Findings

The normal EEG records (Table I) are evenly distributed between the control group and that of the depressives whose illness commenced before the age of 60. The percentage is rather lower in the groups of those with depression arising after 60, but the difference is not significant at the 5 per cent. level. The borderline records, i.e. those with an excess of fast activity, are noteworthy in their prominence and the evenness of their distribution. From this it can only be surmised that this is a general ageing phenomenon. The group of patients suffering from a depression arising after 60 showed the highest proportion of truly abnormal records (39 per cent.). However, this finding is not significant when compared with the abnormal records in the control group and only just significant at the 5 per cent. level when compared with the depressions of later onset. At the most this can only suggest a trend towards abnormality in the depressive Group B. Table II shows the different varieties of abnormal record encountered. Perhaps the most interesting finding is that in the control group, 4 showed severe generalized slow wave changes and the same number a definite slow wave or delta focus.

TABLE I
EEG Results Found in the Three Groups

EEG Type	Group			Totals
	C	A	B	
Normal	38	25	18	81
Borderline	23	13	12	48
Abnormal	21	9	19	49
Totals	82	47	49	178

Groups: C=Controls.
A=Depressives of early onset.
B=Depressives of late onset.

TABLE II
Analysis of the Abnormal Records Found in the Three Groups

EEG Type	Group		
	C	A	B
Diffuse slow changes:			
Moderate	13	5	11
Severe	4	1	6
Focal slow changes	4	1	2
Epileptic	0	2	0
Totals	21	9	19

The three groups were then compared as to age (Table III), being divided into two groups, 60–69 years and 70+. There is no indication at all that, within these limits, increasing age is a significant factor in the production of EEG abnormality.

The influence of blood pressure, both systolic and diastolic, was also considered, first on each of the three groups and also on the whole. Table IV shows

TABLE III

Effects of Age on EEG Results

EEG Type	Age 60-69 Years						Age 70+ Years			
	Group			Total	Group			Total		
	C	A	B		C	A	B			
Normal	21	21	12	54	17	4	6	27		
Borderline	9	11	11	31	14	2	1	17		
Abnormal	11	6	17	34	10	3	2	15		
Totals	41	38	40	119	41	9	9	59		

TABLE IV

Comparison of Systolic Blood-Pressure Levels in the Three Groups

EEG Type	B.P. Level—Systolic									Total C+A+B
	Under 170 mm./Hg			170-189 mm./Hg			190+ mm./Hg			
	C	A	B	C	A	B	C	A	B	
Normal	17	13	8	5	8	7	16	4	3	81
Borderline	8	7	10	6	1	1	9	5	1	48
Abnormal	8	4	13	6	3	3	7	2	3	49
Totals	33	24	31	17	12	11	32	11	7	178

the results for the systolic pressure. In none of the three groups, nor when the total findings were added together, was there any indication that a raised diastolic or systolic blood pressure could be related to EEG abnormality. In fact many patients with gross hypertension had perfectly normal records. Conversely a blood pressure within the normal range did not increase the likelihood of obtaining a normal tracing. We accepted the fact that in all three groups, despite the precautions taken, some part at any rate of the increased blood pressure may have been due to emotional factors.

It seemed to us important to consider the relationship between outcome of treatment and the type of EEG record. Accordingly a series of patients with abnormal records was compared with a group showing wholly normal records. An arbitrary group was used, taking each patient with an abnormal record and using the patient with a normal record next on the list alphabetically for the other group. In the abnormal group of 25 patients 8 (6) did not improve whilst 17 (19) did. There is no significant difference in the results obtained from patients with normal and abnormal EEGs, as the numbers in parentheses show. This suggests further evidence that the EEG abnormalities noted above are the changes of a genuine ageing process rather than characteristic of any individual disease.

Photic stimulation evoked abnormalities which could be considered epileptic in 7 cases (9 per cent.) in the control group and 11 (11 per cent.) in the depressive group, with the changes being especially marked and showing generalized seizure patterns in 6 and 4 cases respectively. These results probably do not indicate any increased likelihood to clinical epilepsy in either group but they do underline the questionable significance of this method of diagnosis unless substantiated by further abnormalities.

CONCLUSIONS AND COMMENTS

The results obtained emphasize the essential need for a carefully controlled experiment. All abnormalities in patients must be seen in the perspective of those found in the controls, e.g.—focal or generalized slow wave activity was present in no less than 21 cases (26 per cent.), a figure not markedly different from that found in the whole group of depressives, 26 (27 per cent.). These figures, however, differ widely when contrasted with the number of abnormal records found in younger persons suffering from a depressive illness. One of us (Turton, 1954) found that in a group of 125 persons suffering from an endogenous depression, only 9 (7 per cent.) showed any abnormality in their record of any kind, but in a group of a further 125 persons suffering from an involutional type of depression 14 (13 per cent.) showed a definite excess of slow activity.

Similarly, borderline records are few in the younger age groups but in the work cited, 39 (31 per cent.) of the involutional depressions showed a complex type of record with an excess of fast activity, very comparable to our findings of 24 such records (29 per cent.) in the control group and 25 (26 per cent.) in the total depressive group. Greenblatt (1944), Finley (1944) and Obrist and Bissell (1955) all found about the same percentage of persons with an excess of fast rhythms in this age group.

We postulate that these records represent a phenomenon of ageing and are not in fact causally related to either an involutional depression or an early organic dementia, and further that both the borderline records and those with an excess of slow activity should be largely neglected in assessing the prognosis of any individual case. Thus, although the EEG may be of value occasionally in determining the likelihood of clinical epilepsy supervening, as a general rule persons suffering from an affective disorder in the senium may or may not have an abnormal EEG, quite irrespective of the prognosis. Anyway, a considerable proportion of apparently socially well-adjusted elderly persons showing no definite organic deficit will have records of this kind.

Obrist and Bissell (1955) put forward the interesting hypothesis that the EEG abnormalities found in patients with cardiac and cerebrovascular disease could be related to poor cerebral circulation associated with anoxia and metabolic disturbance, with resulting slow or delta activity in the record. The process being reversible accounts for the fact that an abnormally slow record can, and fairly frequently does, return to normal. It seems to us probable that most of the EEG changes in old age are related to changes in cerebral circulation and are symptomatic, perhaps, of a disorder of function, often slight, rather than any irrevocable disruption of brain tissue.

SUMMARY

1. Persons over 60 years of age, who were leading a normal home existence, were examined clinically and electro-encephalographically.
2. The results obtained from these persons were compared with those from a group of depressive patients, these being divided into those whose initial illness started before the age of 60 years and those in whom the onset was at this age or later.
3. No definite difference in the record type was noted between these two groups and the control subjects, although there was a trend towards more abnormalities in the group arising at the age of 60 or over.
4. The blood-pressure level and the age of the patient when the record was taken, within the limits investigated, had no effect on the type of EEG or the percentage of abnormalities.
5. The considerable number of abnormal records and large number of borderline records found in all the three groups is probably an expression of a general ageing process and not limited to any one specific symptom complex or disorder.
6. Various clinical factors are discussed in relation to the two groups of persons suffering from a depressive illness and there was a trend for the early onset group to show a better response to treatment, although this was not significant statistically.

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