Analysis of Scalp EEG in Normal Controls

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Introduction

In the evaluation for fitness of Air Force personnel for flying duties the EEG is often relied upon as one of the parameters. While there is unanimity of opinion about the importance of spikes, sharp waves or paroxysmal slow waves, the significance of changes in the background, particularly if limited, is often a matter of doubt[1-3]. Hence we felt it worthwhile to record our observations on the scalp EEGs of 134 normal controls.

Materials and Methods

These subjects formed part of a larger study involving epileptics and normal controls[3-5]. The normality of the controls was established on the basis of absence of any symptoms or signs of organic neurological disorder. The detailed questionnaire as used for epileptic subjects was employed to ensure that the subjects were not epileptic. Since the individuals who come for evaluation before the Medical Board in the Air Force are over the age of 15 years, normal controls aged 15 years and above were chosen.

All EEGs were performed on a 16 channel Galileo EEG machine using the International 10-20 system of electrode placement. Both mono and bipolar montages were utilised. A time constant of 0.3 second was employed and use of muscle filter resorted to as and when necessary. The response to hyperventilation (H/V) was assessed in as many subjects as possible.

The EEGs were calssified as follows :

1. Normal .... No abnormalities in background; no paroxysmal discharges.
2. Nonspecific.... Abnormalities in background activity only.
3. Doubtful .... Semirhythmic slow waves, paroxysmal slow wave build ups and bursts, poorly defined spikes, sharp waves or spike and waves.
4. Definite .... Well defined spikes, sharp waves or spike and waves.

The EEG data at rest and after H/V in these 134 normal controls were compared with an age matched group of epileptics consisting of 365 individuals, 40% of whom had major seizures, another 40% temporal lobe epilepsy with or without generalisation and the remainder other focal seizures with or without generalisation.

Findings

Statical significance was assessed at the 5% level using the Chi Square type of analysis. The findings are indicated in Table No.1.

TABLE No. 1

Awake EEG including H/V

	Normal Controls	Epileptics	Stat. Sig
Normal	86 (64.2)	117 (32.1)	SIG
Nonspecific	6 (4.5)	30 (8.2)	NS
Doubtful	34 (25.3)	131 (35.9)	SIG
Definite	8 (6.0)	87 (23.8)	SIG
Total	134 (100)	365 (100)	—

It is interesting that 6 and 25% of the normal controls showed either definite spikes or sharp waves or paroxysmal slow wave disturbance respectively, though significantly less frequently than in epileptic subjects. None of the controls had a spike and wave activity. It is equally interesting

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that abnormalities in the background were not significantly less frequent in the control group compared to the epileptic subjects.

It is worth emphasising that the incidence of a family history of epilepsy or of past cerebral insult did not show any significant difference between the controls and the epileptics. Likewise there was no significant correlation between a definite EEG abnormality on the one hand and a family history of epilepsy or of past cerebral insult on the other in both the groups.

Evaluation of nonspecific abnormalities is always a vexatious problem. Out of the 134 controls only 6 (5%) showed such features in the record at rest even prior to H/V. These were seen only in those aged 26 years and above. In the epileptic group of 30 who showed, at rest, background abnormalities only, 17 (57%) were aged below 26 years and the rest 26 years and above. The degree of abnormality in the background in the controls and epileptics is indicated in table No. 2.

TABLE No. 2

Degree of EEG abnormality in the background in the controls and epileptics

Degree of EEG abnormality	Normal Controls	Epileptics	Total	Stat. Sig.
Mild	2 (33.3)	13 (43.3)	15	NS
Moderate to severe	4	17	21	
Total	6	30	36	

The type of background abnormality in the two groups is indicated in table No. 3.

TABLE No. 3

Type of EEG abnormality in the background in normal controls and epileptics

Type of EEG abnormality	Normal Controls	Epileptics	Total	Stat. Sig.
Excess theta	2 (33.3)	13 (43.3)	15	NS
Excess fast	4	17	21	
Total	6	30	36	

It can thus be seen that there was no correlation between the degree and the type of abnormality in the background alone in the record at rest in normal controls and epileptics.

All entrants to the Armed Forces Flying Services are now subjected to a routine scalp EEG including the response to H/V as part of their medical evaluation. A vast majority of these individuals are in the age group 15-20 years. It is well known that the response to H/V may be profound and yet be considered as normal till the age of around 25[4].

H/V cannot be standardised and the EEG response may well depend on the efficiency of its performance in this civilian population, unlike those in the Services who, when told to do something, will do it very well indeed[2]. In this study the degree of H/V was qualitatively assessed as follows:

Good — Deep and almost continuous

Fair — Fairly deep with more than slight intermittency

Poor — Other than above.

The degree of H/V was good in 36 (27.3%), fair in 69 (52.3%) and poor in 27 (20.4%). Though no significant correlation was found between the age of the patient and the degree of H/V, the responses to H/V in the two major age groups (15/26 years and 26 years and above) with reference to certain parameters in the EEG after H/V are discussed below. Two subjects in the normal control group failed to perform H/V and hence they have not been included in subsequent analyses.

Response to H/V was first considered in terms of bilateral slowing of the background rhythm. This was noted in only 9 out of 132 subjects (7%). There was a significant positive correlation between the degree of H/V and the presence of bilateral slowing of the background. Correlative data between age of the patient and the various parameters of bilateral slowing in the background consequent upon H/V are indicated in table No. 4.

TABLE No. 4

Correlative data between age of patient and bilateral slowing in the background after H/V

	Age in years 15 ∠ 26	26 +	Total	Stat.Sig*
1. Degree :				
Occasional	1	—	1	NS
Persistent	6	2	8	
2. Lowest frequency range :				
Theta	4	1	5	NS
Delta	3	1	4	
3. Earliest time of occurrence :				
∠ 90 secs	1	—	1	NS
90 secs +	6	2	8	
4. Latest time of disappearance :				
∠ 180 secs	—	—	—	NS
180 secs +	7	2	9	
5. Duration :				
∠ 120 secs	4	1	5	NS
120 secs +	3	1	4	

* Fisher's exact probability test.

Of the 9 subjects who showed bilateral slowing in background only this tended to be persistent in 8 (89%). The distribution between theta and delta ranges was more or less equal. The slowing appeared 90" after commencement of H/V in 8 subjects (89%). In no instance did the slowing in background disappear before the completion of H/V (180") and its total duration was almost equally divided on either side of an arbitrary time limit of 120". In general this bilateral slowing of the background was more frequent in the age group 15 ∠ 26 years than in those above, but this difference was statistically not significant. Comparative data in the epileptic group is under evaluation.

The presence of paroxysmal slow wave build ups or bursts without associated well defined spikes or sharp waves was then taken up for analysis. These occured in 21 out of 132 subjects (16%) only. There was a significant positive correlation between the degree of H/V and the presence of paroxysmal slow wave bursts. Correlative data between age of the patient and these paroxysmal slow wave bursts after H/V are indicated in table No.5.

TABLE No. 5

Correlative data between age of patient and paroxysmal slow wave bursts after H/V

	Age in years 15 ∠ 26	26 +	Total	Stat. Sig*
1. Incidence:				
Occasional	4	—	4	NS
Persistent	11	6	17	
2. Lowest frequency range:				
Theta	6	3	9	NS
Delta	9	3	12	
3. Earliest time of occurrence:				
∠ 90 secs	5	2	7	NS
90 secs +	10	4	14	
4. Latest time of disappearance:				
∠ 180 secs	6	2	8	NS
180 secs +	9	4	13	
5. Maximum duration of individual bursts:				
∠ 5 secs	12	5	17	NS
5 secs +	3	1	4	
6. Total duration of all bursts:				
∠ 20 secs	11	5	16	NS
20 secs +	4	1	5	
7. Total number of bursts:				
∠ 10	12	4	16	NS
10 +	3	2	5	

* Fisher's exact probability test.

It is interesting to note that when paroxysmal bursts appeared, by and large, they were persistent rather than occasional (81%) and more often in the delta range (57%). In nearly two-thirds of the group they tended to occur 90" after the commencement of H/V and disappear only after the cessation of H/V (180"). In nearly three quarters of the group the maximum duration of an individual burst was less than 5", the total duration of all bursts

less than 20" and the total number of burst less than 10. In general the various parameters described above were more frequent in the age group 15 < 26 years than in those above, but this difference was statistically not significant. Similar data in epileptics are not yet ready.

To summarise, in our experience amongst civilian population of normal controls aged 15 years and above, abnormalities in the background alone in the resting record were rather uncommon (5%) and did not show any significant difference in terms of degree or type from that in epileptics. Bilateral slowing of the background activity after H/V occurred in only 7% of the group. Though somewhat more frequent in the age group 15 < 26 years than in those above, the difference was statistically not significant. Similarly following H/V paroxysmal slow wave bursts occurred in only 16% of the entire group. As in the previous instance they were more frequent in the age group 15 < 26 years than in those above, the difference being statistically not significant. It must be emphasised that the number of cases in whom these changes were noted is rather small and if the numbers were much larger, the results of statistical evaluation could well be different.

The incidence and type of EEG changes in the normal population, especially as regards "non-specific" abnormalities and in younger individuals, the changes on H/V are of importance for their correct appraisal in—(*i*) entrants to the Air Force Flying Cadre, (*ii*) syncopal attacks and (*iii*) post-traumatic states. There is a unique opportunity for the Armed Forces Medical Services to gather their own data on such facets in a much larger group of normal individuals.

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BIBLIOGRAPHY :

1. Gloor, P: Contributions of the EEG towards diagnosis in adults with seizures in *Second Advanced Course in Electroencephalography*, Salzburg, Publ. Dept. Vienna Acad. of Med., Vienna, 1965. P. 59.
2. Jeavons, PM: Discussion on Aspects of Epilepsy in the Armed Forces and Aviation Medicine in Proc. Nat. Sem. on Epilepsy.

   Ind. Ep. Assn., Bangalore, 1975. P. 245.
3. Mani, KS: Inter-ictal EEC in Epilepsy: Possible Factors Associated with Definite Seizure Discharges. Neurology (India), 21: 51–62, 1973.
4. Mani, KS: Discussion on Aspects of Epilepsy in the Armed Forces and Aviation Medicine in Proc. Nat. Sem. on Epilepsy.

   Ind. Ep. Assn., Bangalore, 1975. P. 245.
5. Mani, KS and Geeta Rangan: 1976 — Unpublished Observations.