

THE STUDY OF CORTICAL ELECTROGENESIS IN AGED HUMANS

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Summary. In order to obtain data of comparative value regarding the difference between a healthy normal adult and a subject included in any of the age decades above the adult age, useful in estimating the evolution of a normal process of nervous system ageing, sixty nine subjects were grouped according to age decade into 4 lots: lot I 15 subjects as control (aged 22-44 years), lot II 22 subjects (aged 71-80 years), lot III 27 subjects (aged 81-90 years) and lot IV 5 subjects (aged 91-100 years).

EEG was carried out under the basal condition required for recording the alpha rhythm. The mean amplitude and mean frequency values of the EEG tracings were computed, noting as positive the tracings whose response to intermittent light stimulation coincided to the value of the mean frequency of the EEG tracings. Whenever the subjects' age allowed it, EEG alterations were also studied using the hyperpnea activation test for 3 minutes.

The evolution of the normal process of ageing presupposes:

1. A decrease in the mean frequency value of the EEG tracing, from 10.5 c/s to 8.5 c/s.
 2. A dichotomic process of the mean amplitude evolution of the EEG tracings from 50 microV either towards hypovoltage, as in most cases, or towards slightly higher values than the adult mean (over 50 microV) as encountered in some of the cases.
 3. A more or less marked decrease of the response to intermittent light stimulus and to the hyperpnea test.
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In earlier works carried out on a relatively large number of subjects we reported the fact that the alpha rhythm in the healthy adult individual shows variations in its most important parameters, such as frequency and amplitude [3]. In the same works we were also reporting that the variations in frequency come within the range of a Gauss type of curve with a maximum of 10-11 c/s and 8-9 c/s and respectively 12-13 c/s the lower limits.

From a statistical standpoint the large number of normal cases (over 60%) are situated at the top of the slope, the frequencies corroborated by the amplitude of the EEG traces showing, in most cases, the presence of normovoltage within the range of 40 to 70 microvolts (mean amplitude 50 microvolts) [3].

In order to obtain data of comparative value regarding the difference between a healthy normal adult and a subject included in any of the age decades above the adult age, useful in estimating the evolution of a normal process of senescence, we also undertook a number of studies demonstrating from a statistical view the distributions of the mean values of the alpha rhythm frequencies in relation to age. This enabled us to notice that most of the alpha rhythm frequencies at advanced ages (80-90 years) come within the range of 8-9 c/s which gives a different curve than the one plotted for the adult. This made us subdivide the alpha rhythm into several compartments: (i) slow rhythm (8-9 c/s), (ii) fast rhythm (12-13 c/s) and, (iii) in-between these two extremes a medium rhythm (around 10.5 c/s). As a

result of this subdivisioning we were able to notice that the highest incidence of slow frequencies occurs in advanced age decades, a fact that entitled us to consider it as a normal feature of the senescence process.

Using hyperpnea as a test for alpha rhythm reactivity we found that unlike the normal adult values where the amplitude increased up to 20% of its initial values, the evolution of the senescence process leads, as a rule, to the attenuation of this reactivity.

The present work attempts to explore on a group of subjects believed to undergo a normal senescence process, the cognitive value of the response to intermittent light stimulation (ILS) in order to enrich the picture of the physiological modifications due to the senescence process.

MATERIAL AND METHOD

Sixty nine subjects were grouped according to age decades into 4 lots as follows:

- Lot I 15 subjects intended as controls (aged 22—44 years)
- Lot II 22 subjects (aged 71—80 years)
- Lot III 27 subjects (aged 81—90 years), and
- Lot IV 5 subjects (aged 91—100 years).

Electroencephalography was carried out with the aid of an 8-channelled Mingograf Junior Siemens Elema, the subjects being placed in a dim lighted chamber and under the basal conditions requested for recording the alpha rhythm. ILS was performed with the aid of a stroboscope placed at 1.5 m in front of the subject and provided with a photostimulator of the type Officine Galileo R 79 C.

The electrodes were placed on the scalp according to Jasper's method (1958) using the 10—20 international system. The electrodes were connected to two standard programs.

The mean amplitude and mean frequency values of the EEG tracings were computed according to Goldstein and Beck's method [1] as modified by Racotta [2] noting as positive the tracing whose response to ILS coincided to the value of the mean frequency of the EEG tracing. Whenever the subject's age allowed it, EEG alterations were also studied using the hyperpnea activation test for 3 minutes.

RESULTS

The results are set forth in Fig. 1 showing the EEG mean frequencies of the 3 age-groups as against the control lot. Inspection of the panels reveal a graded decrease in values from 87% in controls having a fast alpha rhythm down to 20% reached by subjects aged 91—100 years.

As concerns the slow alpha rhythm compartment (8—9 c/s), it was noticed an ascending distribution in the aged lots with values ranging from 27% to 60% as against the 0% in the control lot.

Figure 2 displays the evolution of the mean amplitude of the EEG tracings in the age groups. The evolution of the values in the groups with mediovolted and hypovolted amplitude within each lot seems to us of significance. Thus, the group with middle voltage amplitude representing 53.4% in the controls evolves to-

wards values of only 20% in lot IV whereas the group with hypovolted amplitude representing 26% in the controls, evolves towards 60% in lot IV.

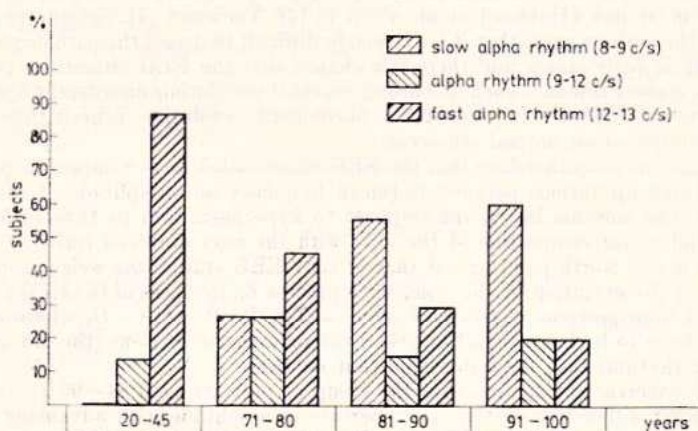


Fig. 1. — Evolution of the mean frequency of the EEG tracings in various age-groups.

At this point it is worth mentioning (see later comments) that the group of normovolted amplitude of the EEG tracings has an ascending evolution of 13.4% in lot I and reaches 22.2% in lot III.

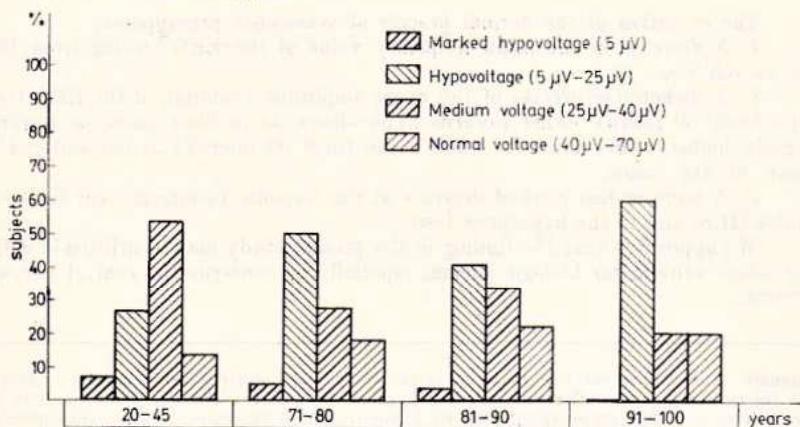


Fig. 2. — Evolution of the mean amplitude of the EEG tracings in various age-groups.

As concerns reactivity to ILS we noticed a tendency towards progressively diminished responses in relation to age, down to complete disappearance. This was objectivized both for the potential amplitude and for the response within frequency band adequate to the alpha rhythm.

DISCUSSIONS

The normal EEG changes in the ageing process have been objectivized in a number of studies (Hubbard et al., cited in [4], Verdeaux [4], Sacerdoteanu [3]). Most of the authors agree that it is extremely difficult to detect the pathologic event occurring in early stages and there is a chance that the EEG alterations encountered in various diseases, such as chronic cerebral circulation disorders, respiratory disorders with subsequent hypotoxic phenomena, evolutive neuropathies, etc., be superimposed on normal senescence.

It is necessary therefore that the EEG examination be as complex as possible by following up various parameters (mean frequency and amplitude of the EEG tracings, the morpheic index, the response to hyperpnea, and to ILS) in longitudinal studies, for comparison of the data with the ones obtained earlier.

It is also worth pointing out that in later EEG studies the weight should be placed on the evolution of the senescence process on the basis of the EEG tracings obtained from posterior derivations, such as T_p-P; P-O; C-O, whose modifications seem to be more significant than the rolandic derivations (the Mu and the rolandic rhythm) that show nonsignificant changes.

As concerns the finding that the group of patients aged 81-90 years show a somewhat different evolution, i. e. increase in amplitude with advancing age, a possible explanation would be the intervention of a natural selection process which helped those individuals who enjoyed better health (including the nervous system) to become long-livers.

CONCLUSIONS

The evolution of the normal process of senescence presupposes:

1. A decrease in the mean frequency value of the EEG tracing from 10.5 c/s to 8.5 c/s.
2. A dichotomic process of the mean amplitude evolution of the EEG tracings from 50 microV either towards hypovoltage, as in most cases, or towards slightly higher values than the adult mean (over 50 microV) as encountered in some of the cases.
3. A more or less marked decrease of the response to intermittent light stimulus (ILS) and to the hyperpnea test.

We appreciate that the finding of the present study may be utilized in defining some criteria for biologic ageing, especially as concerns the central nervous system.

Résumé. Afin d'effectuer une étude à valeur comparative entre l'adulte normal et sain et les sujets encadrés en différentes décades d'âge supérieures à l'âge de l'adulte, dans le but de déceler des différences spécifiques de l'évolution d'un processus de sénescence normale, 69 sujets furent divisés en plusieurs groupes comme il suit: I^{er} groupe 15 sujets témoins (22-44 ans), II^e groupe 22 sujets (71-80 ans), III^e groupe 27 sujets (81-90 ans) et IV^e groupe 5 sujets (91-100 ans).

Les électro-encéphalogrammes ont été effectués en respectant les normes de base pour enregistrer le système alpha. Nous avons calculé la valeur de l'amplitude moyenne et de la fréquence moyenne des tracés électro-encéphalographiques, considérant comme positif le tracé électro-encéphalographique dont la réponse aux signaux lumineux intermittents a coïncidé avec la valeur de la fréquence moyenne du tracé. Dans le cas où l'âge du sujet nous

l'a permis, nous avons étudié aussi les modifications électro-encéphalographiques dues au test d'activation à l'hyperpnée pendant 3 minutes.

L'évolution des processus normaux de sénescence suppose:

1. La baisse de la valeur de la fréquence moyenne du tracé de 10,5 cycles/seconde à 8,5 cycles/seconde.

2. Un processus dichotomique d'évolution de l'amplitude moyenne des tracés de 50 V, soit vers un hypovoltage, situation rencontrée dans la majorité des cas, soit vers des valeurs légèrement supérieures à la moyenne de l'adulte (plus de 50 V), situation plus rarement rencontrée.

3. Une diminution plus ou moins accentuée de la réponse aux signaux lumineux intermittents et du test à l'hyperpnée.

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