

Electrical Changes in Brain with Aging

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Changes in brain electrical activity with advancing age may form the basis of some important changes in other systems of the body. To analyze these electric changes, we included one hundred normal individuals in the study. No subject had history of epilepsy, stroke or dementia. No one had any psychoneurotic problem. Mini-mental state examination was done in all of them. Subjects included varied in age from 50 – 80 years EEG was done in each case. Both anterior brain (mainly frontal lobe) and posterior brain (mainly occipital and parietal lobe) regions showed changes in electric activity. In the age group of 50 – 60 years no theta waves were recorded but in relatively older age groups of 61 – 70 years and 71 – 80 years theta waves were recorded more frequently (10% and 20% respectively) Beta waves were dominant rhythm in age group of 50 -60 years but in age groups 61 – 70 years and 71 – 80 years it was present only in 40% and 30% subjects respectively. In these groups relatively larger and slow alpha waves become prominent. These normal electrical changes in human brain should be taken into account when physicians are dealing with old patients of dementia and neurodegenerative disorders.

Key words: EEG, alpha wave, beta waves theta waves, anterior brain region, posterior brain region.

Human body shows many physiological changes with advancing age. There is decrease in cardiac output, progressive decrease in BMR, decrease in maximum breathing capacity, muscle mass, average plasma concentration of growth hormone and sexual activity. There is decrease in number of functional nephrons with advancing age¹.

Among all the age related changes, those in nervous system are of paramount importance. There is decrease in size of pupil, presbyopia, insufficient convergence and decrease in dark adaptation. There is diminished sense of smell and taste. Changes in motor system include reduced speed and amount of motor activity, slow reaction time, reduced muscle power, impairment of fine co-ordination². There is impairment or loss of vibratory sense of toes and ankles and increased threshold for cutaneous stimuli. Changes are also observed in gait and posture. Walking become slower, movements become less graceful, more inelastic and handwriting tends to worsen. All hand and arm movements become clumsy³.

Urinary incontinence is a problem of old age⁴. There is severe degree of postural reflexes impairment in old age⁵. Cross-sectional studies of large samples of population showed decline in cognitive functions starting at 30 years of age. Most definite effect of age was on learning, memory and problem solving⁶.

Changes in electric activity of brain with advancing age may form basis of some important changes in nervous system with aging. Spontaneous electric activity generated in cerebral cortex is best recorded by electroencephalography⁷. This activity reflects the electric currents that flow in the extracellular spaces of brain and these in turn reflect the summated effect of innumerable excitatory and inhibitory synaptic neurons. This spontaneous activity of cortical neurons is much

influenced by sub-cortical structures such as thalamus and brain-stem reticular formation. Afferent impulses from these deep structures enter into cortical neurons to produce characteristic brain wave pattern such as alpha, beta, theta and delta waves⁷.

Aims and objects

Aging process has been studied for its physiological, morphological, immunological, biochemical and cellular aspects but no detailed work has yet been performed on its electrical aspects. In few studies⁷ it is claimed that with advancing age there is general tendency for EEG to show a slowing of alpha rhythm, increase in beta activity, decline in percentage of slow wave sleep and increasing intrusion of theta rhythm. The present study is unique enough as it has explored the detailed EEG changes in a large group of aged individuals for the first time. Significant neurological signs of aging can be correlated with underlying neuronal electric activity which may be the ultimate basis of these neurological signs. This study can be of much help for comparison in degenerative disorders as dementia and Alzheimer's disease where excessive neuronal degenerative process can also affect electrical activity.

Method and material

1. Population selection. A total of one hundred persons were included in this study they were all selected from a big sample of population after careful screening. No one had epilepsy. No person had suffered from stroke or psychosis. However, 20% were hypertensives, 30% had diabetes and about 25 % had ischemic heart disease. Their ages varied from 50 to 80 years.
2. Mini-mental state examination⁸. Mini mental state examination was done in each individual and all had

score above 24 showing the absence of dementia in them.

3. EEG. EEG was recorded by Neuro-travel Ates Medica Italy, machine by using standard protocols in each individual using sixteen electrodes. EEG waves were visualized on computer screen and were analyzed by a neurologist. Later they were printed by using laser printer. Following EEG waves were identified and defined.

Beta waves - they are of low amplitude (10 – 20 uV) and faster than 12 Hz per second. They are mainly recorded from frontal lobe.

Alpha waves -- they are of high amplitude 50 uV and slow wave having frequency 8 – 12 Hz per second. They are mainly recorded from occipital and parietal lobes.

Theta waves ---- these are of larger amplitude, more than 50 uV and have slow frequency of 4 – 7 Hz per second.

Delta waves --- they are the slowest waves having frequency of 1–3 Hz per second and are of large amplitude > 100 uV.

EEG was done by a trained technician and was supervised by a neurologist.

Grouping. ---- All the participants were classified into three groups depending upon age. Group I included 40 individuals ranging in age from 50 to 60 years.

Groups II consisted of persons aging from 61 – 70 years and had 30 individuals, while group III comprised of 30 persons varying in age from 71 to 80 years.

Results

EEG was done in one hundred persons varying in age from 50 to 80 years. These were 40 females and 60 males. No one had epilepsy, dementia and cerebro-vascular accident. Mean age was 68 years. 20% individuals were hypertensive, 30% were diabetics and 25% were having ischemic heart disease.

40 persons having age from 50 – 60 years were kept in group I. In this group dominant beta wave activity was noted in 80% subjects and dominant alpha wave activity in 20% subjects in the anterior brain regions (mainly frontal lobes) while posteriorly, (mainly occipital lobe and parietal lobe), brain exhibited dominant alpha wave activity in 90% and beta wave activity in 10% subjects (Table I).

In group II, which consisted of subjects of having ages between 61 to 70 years, anterior brain regions exhibited dominant beta activity in 45% subjects, dominant alpha waves in 40% individual, theta waves were present in 15% of the individuals, no delta wave activity was recorded. Posteriorly the brain exhibited dominant alpha waves in 90% of the subjects, no delta waves were recorded posteriorly in this group (Table II).

Group III included old persons of ages 71 – 80, these persons showed beta activity in 30%, dominant alpha activity in 60% and theta waves in 10% of subjects in the anterior brain regions. Posterior brain exhibited dominant

alpha waves in 80% and theta waves in 20% of the individuals (Table III).

Discussion

Results of the study indicate that both anterior and posterior brain regions show changes in electric activity with advancing age. There are no theta waves recorded in 1st group which comprised of individuals of ages 50 – 60 years. However persons of age group 61 – 70 years and 71 – 80 years exhibited theta wave activity in 10% and 20% of the subjects respectively. The results also indicate that with advancing age dominant Beta activity is replaced by dominant alpha waves in frontal lobes. Frontal regions of brain exhibited dominant beta rhythm in 80 % of the individuals of ages 50 – 60 years. In age groups 61 – 70 years and 71 – 80 years, beta rhythm was present only in 40 % and 30% of the individuals respectively. Beta rhythm is mainly replaced by relatively larger and slow alpha rhythm in these age groups. The dominant alpha wave activity was present only in 20% individuals of ages from 50 – 60 years but in age groups of 61 – 70 years and 71 – 80 years dominant alpha activity was present in 40% and 60% of the individuals respectively. Occipital lobe and parietal lobe did not show changes in basic electric brain rhythm.

Alpha pattern remained dominant in the age group of 50 – 60 years. However theta waves gradually become prominent in age group 61 – 70 years.

Various other neurologists have studied the neurology of aging. Tomlinson et al made observation on the brain of old people⁹. They have noticed that with advancing age there is general tendency of electroencephalogram for increasing intrusions of theta rhythm. Verhaaghem et al¹⁰ studied memory aging and have noted prominent Alpha waves with advancing age.

The electrical changes which occur in brain may be due to several age related changes in the brain. First, there are gross changes, such as decreased brain weight and decrease in level of proteins. Second, the human brain actually seems to lose neurons with advancing age¹¹. Third, there is reduction in the enzymes that synthesize dopamine and nor-epinephrine and less severe changes in cholinergic functions. These normal electrical changes in the human brain should be taken into account while clinicians are studying the patients of Alzheimer disease, dementia and other neurodegenerative disorders by the electroencephalo-graphy.

Table I. EEG changes in group I subjects with ages 51 – 70 years (n = 40)

Dominant EEG Pattern	Anterior Brain	Posterior Brain
Beta Rhythm	80%	10%
Alpha Rhythm	20%	90%
Theta Waves	---	---
Delta Waves	---	---

Table II. EEG changes in Group II subjects with ages 61 – 70 years (n=30)

Dominant EEG Pattern	Anterior Brain	Posterior Brain
Beta Rhythm	45%	----
Alpha Rhythm	40%	90%
Theta Waves	15%	10%
Delta Waves	----	----

Table III. EEG changes in Group III subjects with age 71 – 80 years. (n = 30)

Dominant EEG Pattern	Anterior Brain	Posterior Brain
Beta	30%	----
Alpha	60%	80%
Theta	10%	20%
Delta	----	----

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