Symposium on Clinical and Physicochemical Features of Aging*

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1. Assessment of Biological Aging Status

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There is considerable variation between individuals in the rate of aging process, which will be modified during an individual's lifetime by various factors such as diet, activity, smoking and so on. There are only a few studies which explore this area by statistical methods. In this study we defined biological aging status using multiple regression analysis, and tried to find out the factors which affected the rate of aging process.

SUBJECTS AND METHODS

The subjects for this study were 286 healthy male workers of an automobile assemble factory (16–59 years) and 53 males in an old people's home (60–85 years). For the assessment of physiological functions 16 parameters were tested; i.e., red blood cell count, hemoglobin concentration, serum uric acid, serum urea nitrogen, serum creatinine, serum total protein, serum alkaliphosphatase, fibrinogen, serum dehydroepi-

androsterone (DHEA), serum triglyceride, serum phospholipid, serum total cholesterol, serum high density lipoprotein cholesterol (HDL-cholesterol), blood pressure, vital capacity and ocular accommodation. For the assessment of physical strength 7 parameters were tested; i.e., grasping power, vertical jump, side running, push-up, one foot standing with closed eyes, anteflexion and 2 step test. For the assessment of the biological aging status of external appearance 5 parameters were tested; i.e., height, body weight, thickness of hair, percentage of white hair and number of omitted teeth. Moreover job status, habit for smoking and alcohol were also checked.

RESULTS AND DISCUSSION

Single correlation coefficients were calculated between calendar age and each of the parameters. Although a few parameters did not correlate with calendar age, most of the parameters had

*Presented at the 82nd Annual Scientific Session of the Japanese Society of Internal Medicine, April 4, 1985 in Nagoya.

significant correlation with calendar age. Parameters which did not show significant correlation with calendar age were excluded for further analysis. Multiple regression analysis was applied between calendar age and each of these parameters to calculate the estimated biological ages on external appearance, physiological functions and physical strength. Moreover, general biological age in which all parameters were included was also calculated. We got 4 equations from which age of external appearance, physiological functions, physical strength and general biological status could be estimated. Multiple regression coefficients of these equations were 0.873, 0.872, 0.919 and 0.962 respectively. All of these equations were significant statistically ($p < 0.0001$).

We defined aging grade of external appearance, physiological functions, physical strength and general biological status as the percentage of each estimated age to calendar age in order to exclude the effects of calendar age.

The effects of job status, smoking, alcohol on the individual's aging grade were examined in this study. 216 subjects on which all four aging grades could be calculated were divided into three groups: young age group (under 35 years), middle age group (35–59 years) and old age group (over 60 years). Most of the young age

group were ordinary workers and the effect of smoking or alcohol on the aging grade was considered to be minimum for the relatively short duration of the habits of smoking or drinking. All of the old age group were unemployed. Then the effect of job status was examined on the middle age group (Fig. 1). The aging grade of external appearance was lower in the managing

Fig. 1. Mean biological age score based on job status compared by Student's t-test. Calendar age of subjects was 35 through 59.

Fig. 2. Mean biological age score based on smoking compared by Student's t-test. Calendar age of subjects was 35 through 85.

Fig. 3. Mean biological age score based on alcohol consumption compared by Student's t-test. Calendar age of subjects was 35 through 85.

workers than ordinary workers, but there was no significant difference according to Student's t-test. The aging grade of physiological functions was lower in managing workers than ordinary workers ($p < 0.1$). The aging grade of physical strength was also lower in managing worker ($p < 0.01$). The aging grade of general biological status was lower in managing workers ($p < 0.01$). The effect of smoking was examined on the middle and old age groups (Fig. 2). The aging grade of external appearance was lower in nonsmokers than smokers ($p < 0.005$). The aging grade of general biological status was also lower in the nonsmokers than smokers ($p < 0.05$). The effect of alcohol was examined on the middle

and old age groups. The subjects of the middle and old age groups were divided into three groups: subjects who did not drink alcohol, subjects who drank a small amount of alcohol (less than 28 g/day) and subjects who drank a large amount of alcohol (more than 28 g/day). The aging grade of general biological status was lowest in subjects who drank a small amount of alcohol (Fig. 3). Although there was no significant difference between subjects who did not drink alcohol and those who drank a small amount of alcohol, the aging grade of general biological age was significantly lower in the subjects who drank a small amount of alcohol than those who drank a large amount of alcohol ($p = 0.05$).

2. Aging and Neurotransmitters

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Since neurons are postmitotic and nondividing cells, the aging in the nervous system proceeds progressively and irreversibly. The aging process also influences on neurotransmitters which regulate various nervous functions through synaptic transmission. Recently energetic attempts are undertaken to investigate abnormalities in neurotransmitters in age-related nervous diseases and to correct the abnormality through analogues or antagonists of neurotransmitters. The present paper describes age-related changes in neurotransmitters and abnormalities of neurotransmitters in demented patients in senescence.

Acetylcholine (Ach)

Ach has been known to participate in the consolidation of the memory. Ach is synthesized from acetyl-CoA and choline by choline acetyltransferase (CAT). Ach is converted to acetic acid and choline by acetylcholine esterase (ACE).

CAT seems to be related to a presynaptic function and ACE to a postsynaptic function.

The CAT activity has been reported to show an age-related decrease in the cerebral cortex of autopsied brain, especially in Brodmann area 21, 19 and 39.

The CAT activity was remarkably decreased in the cortex of autopsied brains from patients with Alzheimer's disease, compared with control subjects. The most prominent decrease was observed in the superior temporal gyrus (Brodmann area 22), CAT activity of which correlated well with that of nucleus basalis of Meynert.

The CAT activity in autopsied brains was slightly lower in patients with senile dementia (mean age of onset: 84 years old) than age-matched control subjects.

The degradative enzyme, ACE was measured in the cerebrospinal fluid (CSF). The ACE activity