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INCREASE OF SERUM LEVELS OF VITAMIN E DURING HUMAN AGING: IS IT A PROTECTIVE FACTOR AGAINST DEATH?

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SUMMARY

During the recent years, numerous reports have focused the attention on the role of vitamin E as a trophic factor in normal function of the nervous system and in protection against aging or other age related pathologies as tumors, Parkinson's disease and several spino-cerebellar syndromes. We have previously reported cases with severe neurological diseases, including peripheral and central pathology due to abnormality of primary symptoms after vitamin E supplementation. Here we report the results of our studies on the changes of serum concentration of vitamin E during development and aging. vitamin E has been measured in the serum of 479 normal subjects from the birth to the age of 106 years, groupped as follows: below 20; 20-40; 40-60; 60-80; 80-100 and above 100 years. The results, show a linear increase of serum vitamin E values (18 μmole/l in the youngest group to 33.2 μmole/l in the centenarians). The data may be related to higher vitamin E intake during aging or to higher adsorption, or to minor catabolism and utilization. In any case, the highest vitamin E availability during aging has been shown and its role in protection against death is discussed.

Keywords: vitamin E, tocopherol, tocopherol/cholesterol ratio, age-dependent increase of serum tocopherol content

INTRODUCTION

One of the supposed mechanisms of aging, is based on the hypothesis that free radical generating systems induce changes in energy-linked respiration and oxidative phosphorylation (Vanderwoude and Vanderwoude, 1987).

Changes in vitamin E serum levels during aging have been reported in several papers and a positive correlation between vitamin E and healthy population up to the sixth decade of life has been found (Lewis et al., 1973; Ito et al., 1990; Succari et al., 1991). In these reports the oldest investigated age was 80-90 years, and no centenarians have been analyzed. The present studies report the analysis of serum vitamin E in 479 normal subject from the birth to the age of 106 years.

SUBJECTS AND METHODS

Serum tocopherol and cholesterol levels were determined in 479 normal subjects divided in 6 groups of age (<20, 20-40, 40-60, 60-80, 80-100, >100 years).

Sampling and analytical methods. Tocopherol concentration was estimated "blindly" in non-fasting samples of serum, using a colorimetric method (Muller

et al., 1974). Serum cholesterol concentrations were measured enzymatically using standard commercially available clinical chemistry kits. The results are expressed as μmole/l.

RESULTS AND DISCUSSION

Serum vitamin E and cholesterol levels, as well as tocopherol/cholesterol ratios found in various age groups, are reported in Table I and Figure 1. A linear increase of serum vitamin E is evident during development and aging, reaching the highest values in the oldest subjects.

Table I

VITAMIN E AND CHOLESTEROL CONCENTRATIONS IN THE SERUM OF HUMANS OF VARIOUS AGES (μmole/l, mean ± S.D. of n subjects)

	AGE GROUPS (years)					
	<20	20-40	40-60	60-80	80-100	>100
n	165	130	120	47	14	3
Vitamin E	18.0 ± 5.3	21.8 ± 6.7	23.9 ± 6.2	25.6 ± 8.5	31.6 ± 2.5	33.2 ± 4.4
Cholesterol	42.2 ± 6.9	46.8 ± 9.4	54.3 ±11.1	52.7 ±13.0	50.4 ± 3.6	47.8 ± 5.4
Vitamin E/cholesterol ratio	0.42	0.46	0.44	0.48	0.62	0.69

Vitamin E serum levels in healthy population have been reported by several authors (Lewis et al., 1973; Vatassery et al., 1983; Vanderwoude and Vanderwoude, 1987; Ito et al., 1990; Succari et al., 1991). A significant increase with age of vitamin E serum level has been found if compared with younger subjects. However, the number of examined samples is generally lower than in our study which includes 479 healthy individuals.

Tocopherol is transported in the serum mainly by the HDL and LDL lipoprotein fractions (Traber et al., 1990). It is, therefore, justified to interpret tocopherol levels in relation to serum lipids. The tocopherol/cholesterol ratio appears to be the most convenient biochemical index.

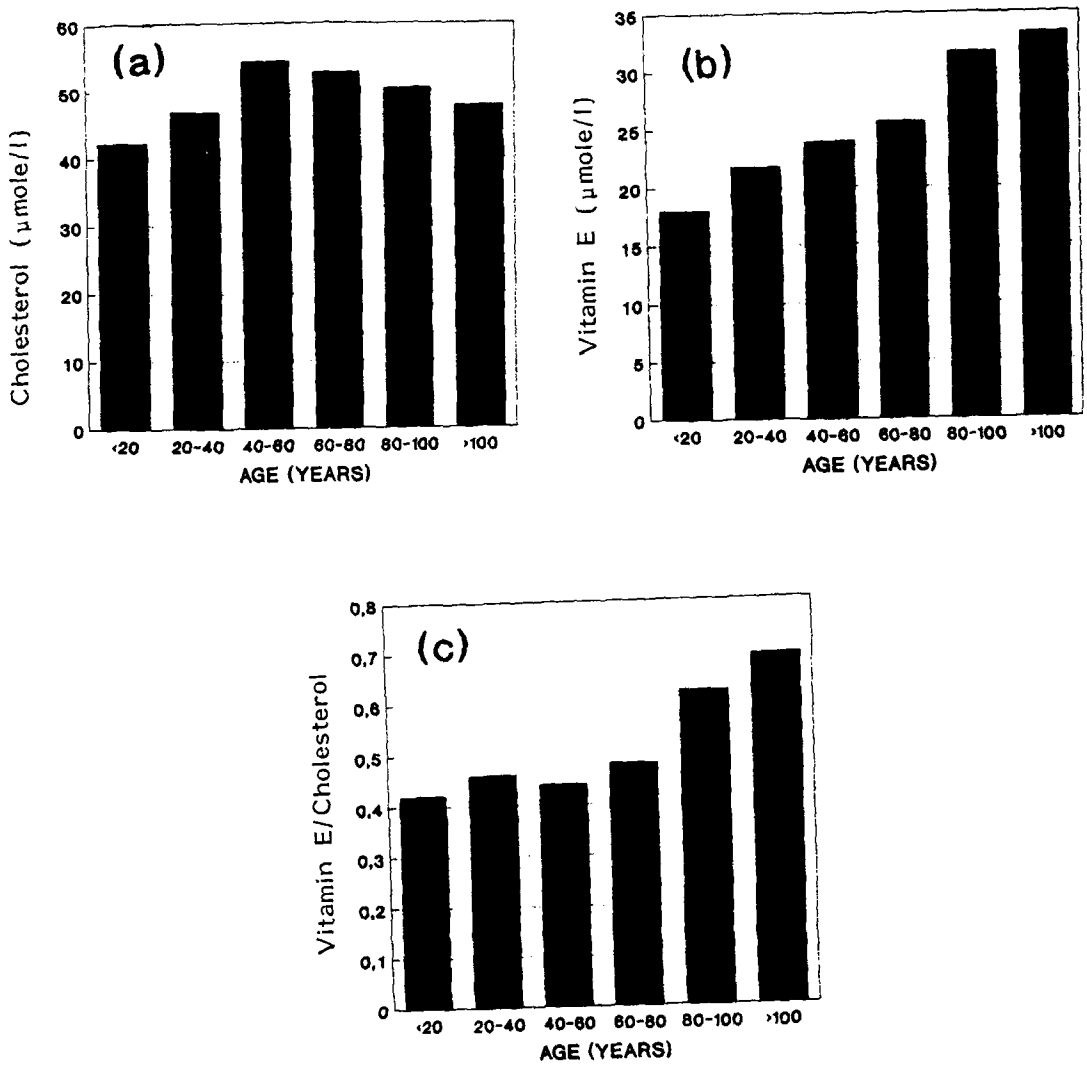

Figure 1. Graphic demonstration of the measured and calculated serum parameters during development and aging. (a) cholesterol levels; (b) vitamin E levels; (c) vitamin E/cholesterol ratio.

Serum levels of cholesterol increase with age, to reach a pick at the 40-80 years, thereafter decreasing. These data are similar to those reported by Vanderwoude and Vanderwoude in 1987.

The minor amount of cholesterol and the highest level of vitamin E cause a higher vitamin E/cholesterol ratio in the oldest group if compared with the other ages. In the other age groups (20-80 years) vitamin E/cholesterol ratio does not show any significant change.

These data confirm the recent reports of Ito et al. (1990) and Succari et al. (1991) who in a large population of healthy persons (7-86 years old age) reported a rise of vitamin E with age. Only one study in the literature did not show changes in serum vitamin E with age (Vatassery et al., 1983).

Our data showing in ultracentenarians a higher amount of serum vitamin E level than in the 80-100 years old group, is a further confirmation of a positive correlation between vitamin E and age. As a consequence of our results, we can assume that the increase of vitamin E serum level in the oldest population is real and it is not linked to an increase of serum lipids.

The highest vitamin E serum levels in very old persons may be a consequence of several physiological changes occurring during aging, such as altered nutritional habits and life style, higher vitamin E absorption and lower catabolism of it. These may result in an increase of vitamin E in the serum and in the tissues.

During the recent years, numerous reports have focussed the attention to the role of vitamin E in the protection of biomembranes against oxidative damage in various cell types (Packer, 1991) including platelets (Croset et al., 1990), lymphocytes (Meydani et al., 1990), human endothelial cells (Kaneko et al., 1991), and aging rat peripheral neurons (Koistinaho et al., 1990).

The role of vitamin E in the enhancement of cell mediated immunity (Meydani et al., 1990; Chandra et al., 1992), has been stressed mainly in elderly individuals. Its role in the inhibition of mutagenesis and cell transformation in vivo (Parola et al., 1992; Slack and Proulx, 1989), or in vitro (Barone et al., 1992; Longnecker et al., 1992; Benner et al., 1993) has also been shown. Among neurological disorders, cases with severe neurological symptoms including peripheral neuropathy, spinocerebellar degeneration (Eusebi et al., 1990; Harding et al., 1982; Federico et al., 1991), extrapyramidal disorders, like tardive dyskinesia (Egan et al., 1992), Parkinson disease (Parkinson Study Group, 1993) related to abnormality of vitamin E metabolism, have been reported.

All these data confirm the important role of vitamin E in preventing or minimizing free-radical damage associated with specific diseases. The highest serum vitamin E levels in individuals that were able to reach the oldest age, is a further in vivo confirmation that the highest vitamin E tissue availability may have a protective effect in the different cell systems against damage and death.

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