Age-Related Changes in the Content of Proteins and Protein Fractions in Blood Serum

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Abstract. The article describes the results of the study of changes in the concentration of total protein and its fractions in the age range from 16 to 60 years. Concentrations of total protein and its fractions were studied in several age groups formed according to age periodization. Blood donors were the subjects. Biochemical blood analysis was performed using an automatic analyzer. Total protein, albumin and globulin fractions in blood serum were studied. According to the results of the study, it was found that there were age-related differences in some of the studied biochemical components. Mainly age differences were noted in the transition from adolescence to adulthood, the first period. There were no statistically significant differences between the subjects of adolescence and adulthood, the second period. Thus, age-related changes in total protein and its fractions in blood serum were largely absent in the age interval from 16 to 60 years.

1 Introduction

Age is one of the key factors having a significant influence on the quantitative indices of biochemical components [4, 8].

Total serum protein is a complex mixture of different proteins that can be separated by different methods. Plasma albumin, globulin fractions, fibrinogen, prothrombin and other clotting factors are mainly synthesized in the liver and enter the blood. Gamma globulin is produced by plasma cells. Special requirements are imposed on the biochemical composition of donor blood [3, 4]. Donor blood plasma must contain not less than 60 g/l of total protein to obtain raw blood plasma.

Modern automatic blood analyzers allow the study of a large number of biochemical parameters. Moreover, blood biochemical parameters can vary greatly depending on the type of analyzer, the reagents used and the methods of determination [2].

It has become necessary to identify the reference limits taking into account these factors. It is also important to take into account regional and ethnic peculiarities, which can influence human biochemical parameters.

The aim of the present work was to study the total protein and protein fractions in Grozny residents depending on age.

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2 Research Methodology

The study was conducted in three age groups: adolescence, adulthood, first period, mature age, and second period. In each age group blood tests were examined in ten male and female subjects. All examined were residents of Grozny and active blood donors.

Biochemical analysis was performed using a Helena analyzer (Helena, USA). Subjects' blood serum was obtained for analysis and biochemical parameters were determined in it. Reagents of Roche company (Roesh, France) were used as reagents. The analyzer allows us to determine the total protein content and concentration of its fractions (albumin, globulins). The analyzer gives values of protein fractions both in g/l and in percentage of total protein.

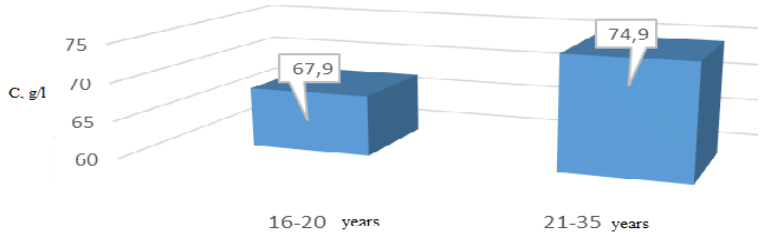
To process the quantitative values of protein fractions and total protein we used "Biostatistics" program. We used Student's test as the criterion.

3 Results and Discussions

There were statistically significant differences in the content of total protein in the blood serum in the donors of the two groups - 16-20 and 21-35 years old (Table 1, Figure 1).

Table 1. Total serum protein in donors at different ages: 16-20 and 21-35.

Groups	Total protein, g/l
16-20 years	67,9±2,14
21-35 years	74, 9±3,12
p	<0,05*



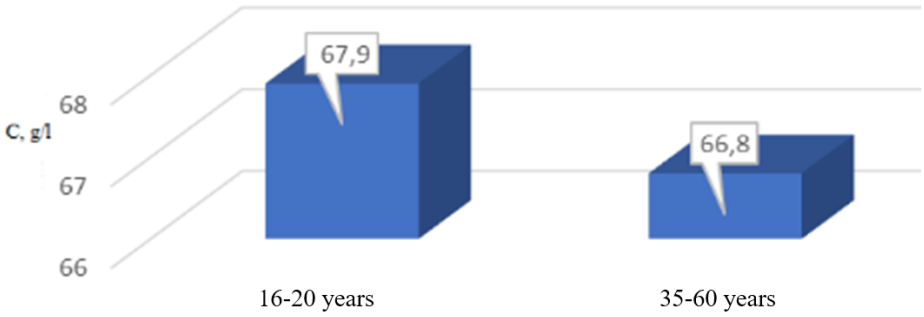
a) total blood protein content in donors of two age groups

Fig. 1. Peripheral blood total protein content in donors aged 16-20 and 21-35.

When comparing the parameters of donors in the age groups of 16-20 and 35-60 years old, reliable differences in the concentration of protein in blood serum were not revealed (Table 2, Figure 2).

Table 2. Total serum protein in donors in age groups: 16-20 and 35-60.

Groups	Total protein, g/l
16-20 years	67,9±2,14
35-60 years	66,8±1,96
p	>0,05



a) concentration of total blood protein in donors aged 16-20 and 35-60

Fig. 2. Concentration of total protein in peripheral blood in adolescent and mature donors.

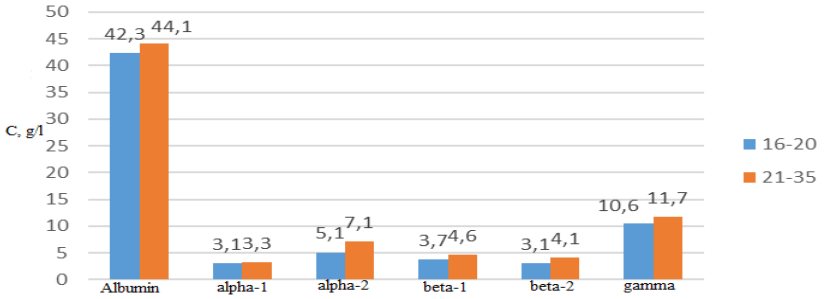
Thus, the concentration of total protein significantly increased during the transition from adolescence to adulthood of the first period. When comparing with the second period of adulthood, the differences blurred, as the subjects had a slight decrease in total protein compared with the previous period of adulthood.

The study of albumin concentration revealed that its content slightly increased in the second age group (mature age, first period) compared to that in the adolescent age group (16-20 years old) (Table 3, Figure 3).

Age-related changes in protein fractions. A total of five globulin fractions were examined using the analyzer in individuals aged 16-20 and 21-35 years. Age-related differences were detected in some of the globulins (Table 3, Figure 3). Thus, the concentration of alpha-1, beta-1, and beta-2 fractions of globulins increased. In principle, in the first period the concentration of total protein, albumin increased. Perhaps, this explains the increase of these fractions involved mainly in the transport of substances (hormones, salts, lipoproteins). There are indications in the literature that blood protein content is little affected by age, particularly in the interval from 16 to 60 years [6]. However, according to our data, age-related changes in total protein and some protein fractions are noted if we compare the adolescent period (16-20 years) with the mature age - 21-35 years.

Table 3. Protein fractions in blood donors in age groups: 16-20 years and 21-35 years.

Age group	Albumin, g/l	Globulins, g/l				
		α1	α1	β1	β2	γ
16-20	42,3±1,62	3,1±0,23	5,1±0,36	3,7±0,21	3,1±0,23	10,6±0,47
21-35	44,1±2,02	3,3±0,25	7,1±0,29	4,6±0,20	4,1±0,17	11,7±0,52
p	>0,05	>0,05	<0,01**	<0,01**	<0,05*	>0,05



a) albumin and globulins in the blood of donors in the age groups 16-20 and 21-35

Fig. 3. Comparison of albumin and protein fractions in the two age groups.

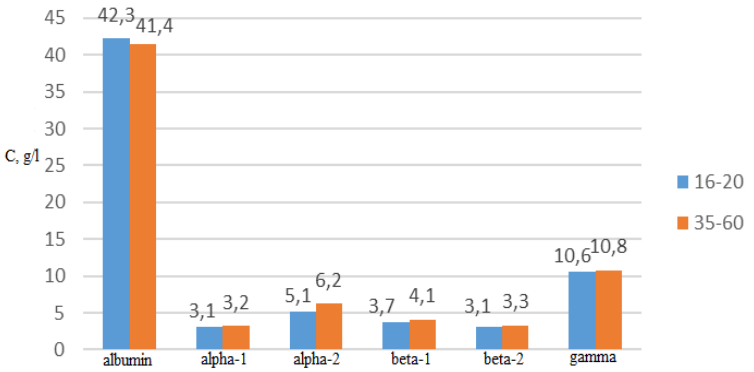
A study of protein and albumin fractions in the two periods of adulthood shows that they change little with age (Table 4, Figure 4). Although an increase in one of the fractions, alpha-2, is noted in our study.

The data on age-related changes in the literature are quite contradictory. Thus, according to [9], a noticeable drop in the level of total protein begins after 60 years of age. Moreover, the curve of total blood protein decrease is different in female and male individuals. Women have a more pronounced decrease in protein concentration compared to men. The increase in protein content from 11 years of age to adulthood, the first period (21-35 years) according to [7] gradually increases, and then begins a slight decrease in the second period of adulthood. This pattern is observed in both sexes. As noted by many authors [1, 7], changes in protein metabolism are associated with growth changes in humans, with alterations in endocrine metabolic regulation. In mature (after 50 years old) and old (after 60 years old) senile (after 75 years old) the decrease of protein level is conditioned by the decrease of activity of hormonal regulation of metabolism.

Table 4. Concentrations of individual protein fractions in serum from adolescent and mature second period blood donors.

Age period	Albumin, g/l	Globulins, g/l				
		α1	α2	β1	β2	γ
16-20	42,3±1,42	3,1±0,23	5,1±0,36	3,7±0,21	3,1±0,23	10,6±0,47
35-60	41,4±1.63	3,2±0,31	6,2±0,41*	4,1±0,26	3,3±0,25	10.8±0,54

*- p<0,05



b) albumin and globulins in the blood of donors in the age groups 16-20 and 35-60

Fig. 4. Peripheral blood globulin content in adolescent and mature, second period donors.

It is interesting to note the dynamics of changes in the concentration of total protein in males and females at different age periods of life. According to [7], the content of total protein and albumin is higher in mature males than in females, and according to [9], total protein after 60 years of age was higher in females up to 80.5 years, and then becomes lower than in males. In men, the total protein after 80.5 years of age changes little, while in women there is a strong decrease. In our similar work [5], there is little change in the total protein content in men, and a slight decrease in women. In women, age-related endocrine shifts seem to play an important role in the regulation of protein and its fractions [2]. It is possible that age-related changes in the neuroendocrine system may influence the level of metabolism, the concentration of biochemical substances in the human body [6]. Biochemical parameters are little affected by age-related changes after adolescence up to 50-60 years of age [1, 2, 6]. The stability of some blood biochemical constants is explained by the fact that they should be within the strict limits of the norm [2]. Among the strictly regulated biochemical constants, apparently, are some proteins. For example, maintaining albumin concentration is important for the regulation of blood oncotic pressure and ensuring substance transport [2]. According to our data, insignificant age-related changes in the concentration of total protein and fractions were noted in the age interval from 16 to 60 years old.

When comparing the values of fractions and total protein of our work with the reference [2] given in the literature, it was found that they were within the normal range.

It should be noted that with the constant improvement of automatic analyzers, the use of reagents from different manufacturers, biochemical studies remain relevant. It is also important to consider in what liquid media (blood, plasma, serum) determine biochemical substances [2].

4 Conclusions

1. The concentration of total protein varies with age. A significant increase in the concentration of total protein is noted between the age groups 16-20 and 21-35 years old;

2. The concentration of albumin increases in the transition from adolescence to the first period of adulthood, and then it decreases. At the same time, the increase in albumin concentration was not significant;

Concentration of some protein fractions also changes with age. An increase in fractions-alpha-2, beta-1, and beta-2-was noted in the transition from adolescence to first-period adulthood.

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