



STEARIC FATTY ACID IN ADIPOSE TISSUE IN SOME PATHOLOGIC CONDITIONS UNITED WITH PRETERM ATHEROSCLEROSIS

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Summary. In the paper the findings of investigations of the percentage of content of stearic fatty acids in adipose tissue from 250 persons are presented, containing different disturbances and having very often as consequence a preterm development of atherosclerosis. The results are compared with a control group ($n = 93$) of metabolic healthy and normally nourished persons. The method of gas-liquid chromatography is used. Except for persons with an phenotype picture of hyperlipoproteinemia type IIa, in all persons (obese, NIDDM, sudden death from myocardial infarction, other types of hyperlipoproteinemia) significant lower values of stearic fatty acids compared to the control group ($p < 0.005-0.001$) are determined and a significant connection of its decrease with the degree of nourishedness. ($r = 0.662$, $p < 0.001$) in obese persons is also discovered. In opposition to that, undernourished persons had some higher value of stearic fat acids statistically insignificant. The results are completely in accordance with our earlier findings in separate lipid fractions in serum and in serum in general.

The fact that some other authors who investigated the problem have come to identical results points to the conclusion that our investigations represent the confirmation of a new knowledge about the antiatherogenic effect of the fatty acids in contrast with other long chain saturated fatty acids. No doubt, these findings have certain implications on treatment of patients as well.

Key words: Fatty acid composition of adipose tissue, stearic acid, atherosclerosis, coronary heart disease

Introduction

In our earlier investigations the decrease of stearic fat acids (SFA) was discovered in total serum as well in some isolated serum lipid fractions (free fatty acids, cholesterol esters, triglycerides, high density lipoproteins) in a number of diseases often together with atherosclerosis (sudden death due to myocardial infarction, extremely obese persons, patients with hypothyroidism, persons with an phenotype picture of hyperlipoproteinaemia type IIb and IV) (1-7). At those times long chain saturated SFA was considered as particularly atherogenic making those results paradoxical at first view. It is a well known fact that the fatty acids composition of blood is changing rapidly in the course of a few weeks in contrast to adipose tissue where those changes are extremely slow so that the first differences could be observed only after half a year, depending on food composition (8). That led us to farther investigations of fatty acids composition in healthy persons in different pathologic conditions.

The aim of the investigation has been to determine the percentage of content of SFA in adipose tissue of

persons suffering from some illnesses in conjunction with preterm development of atherosclerosis and its complications.

Subjects and Methods

The investigated group was formed of 250 persons divided in 4 groups and 8 subgroups and the control group was made of 93 metabolic completely healthy and normally nourished persons (BMI = 20-24.9). In the group of persons with altered body mass ($n = 137$), 16 of them were undernourished (BMI under 20), 83 were moderately obese (BMI = 30-39.9) and 38 extremely obese (BMI = over 40), than 23 patients with sudden death from myocardial infarction (CHD patients), 20 with type 2 of diabetes (NIDDM) and 70 persons with different phenotypes of hyperlipoproteinaemias (type IIa - 17, type IIb - 15 and the most numerous type IV - 38 persons).

All investigated persons, exclusively with diabetes, as well as persons of the control group, were of different age and sex using the usual food characteristic for the

population in the Province of Voivodina, for at least a couple of years.

Starting from the known fact the fatty acids content of the adipose tissue can be different in various parts of the human body, the samples were taken always using the anterior abdominal wall, close under right costal arc (because in most patients the samples were taken during cholecystectomias). The samples were taken from the same place during autopsy from persons with sudden death.

The qualitative and quantitative analyses of the fat acids, methylesters, after recent esterification with borontrifluoride (BF₃) were carried out using the method of gas-liquid chromatography. HEWLETT PACKARD Model 7650 A Chromatograph ON-line assisted with 3352 B computer HEWLETT PACKARD system was used. The columns were 3m and 68 cm long, 1/8 inch in diameter, packed with 10% SP-222-PS from SUPELCO, Inc. The carried gas was helium, the flow rate 25 ml/min, the column temperature 196° isothermally. Quantitative identification of the fat acid methylesters was performed by comparing their retention times with the internal standard relation times (SUPELCO, Inc., Bellefonte, Pennsylvania).

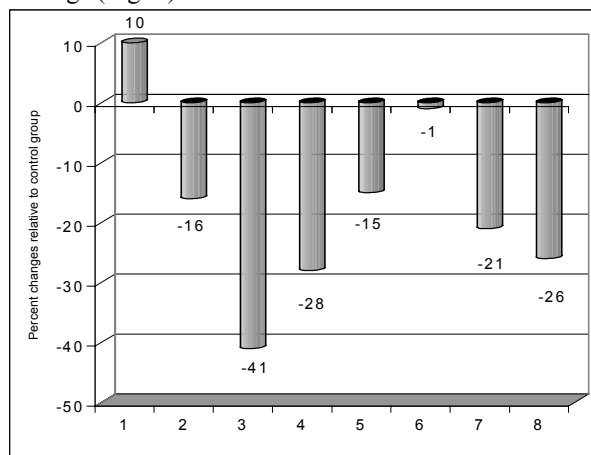
By that treatment over 20 different saturated, mono- and polyunsaturated fatty acids could be separated but in the study the values of SFA, besides myristic and palmitic long chain fatty acids were elaborated only.

The data were analysed by the variation-statistical method using Student t-test and the regression method.

Results

The obtained results are presented in table 1, where it could be clearly seen in all persons with some investigated pathologic conditions, often unified with preterm atherosclerosis, as compared to the control group, statistically significant lower per cent of content of SFA in the adipose tissue of the anterior abdominal wall has been recorded. The exception is the subgroup of persons with phenotype picture of hyperlipopro-

teinaemia type IIa and, what is easy to be understood, undernourished persons having SFA values even higher (for 10 per cent) as compared to the control group, but not statistically significant. The differences as stated are still clearly looking at the graphic presentation of the findings (Fig. 1).



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|---------------------------|---------|
| 1. Undernourished persons | n. s. |
| 2. Moderately obese | p<0.001 |
| 3. Extremely obese | p<0.001 |
| 4. CHD subjects | p<0.001 |
| 5. Diabetic patients | p<0.005 |
| 6. HLP type IIa | n. s. |
| 7. HLP type IIb | p<0.005 |
| 8. HLP type IV | p<0.001 |

Fig 1. Changes of stearic acids in some pathologic conditions with preterm atherosclerosis in relation to control group (taken as 100 %).

As compared to other two long chain saturated fatty acids - the myristic and the palmitic fatty acids - those findings are not so homogenous but in a number of investigated groups (especially myristic fatty acid) they are statistically higher as compared to healthy persons of the control group.

Table 1. Mean values of the percentage of content (percent of total fatty acids) of the long chain saturated fatty acids in adipose tissue patients compared to normally nourished metabolically and healthy persons – control group.

Investigated group	n	C 14:0			C 16:0			C 18:0		
		$\bar{x} \pm SD$	%	p<	$\bar{x} \pm SD$	%	p<	$\bar{x} \pm SD$	%	p<
Control group	93	1.88 (0.45)	–	–	20.73 (1.44)	–	–	5.40 (1.21)	–	–
Undernourished persons	16	2.16 (0.45)	+15	0.025	20.55 (1.39)	-1	n. s.	5.94 (0.83)	+10	n. s.
Moderately obese	83	1.66 (0.36)	-12	0.001	21.35 (1.42)	+3	0.005	4.56 (1.03)	-16	0.001
Extremely obese	38	1.54 (0.40)	-18	0.001	20.50 (1.39)	-1	n. s.	3.21 (0.97)	-41	0.001
CHD patients	23	1.70 (0.40)	-10	n. s.	19.85 (1.83)	-4	0.02	3.87 (0.91)	-28	0.001
Diabetic patients	20	1.92 (0.59)	+2	n. s.	21.94 (2.21)	+6	0.005	4.57 (0.93)	-15	0.005
HLP type IIa	17	1.71 (0.40)	-9	n. s.	21.24 (1.67)	+2	n. s.	5.39 (0.92)	-1	n. s.
HLP type IIb	15	1.74 (0.36)	-7	n. s.	20.52 (1.66)	-1	n. s.	4.29 (1.25)	-21	0.005
HLP type IV	38	1.53 (0.30)	-19	0.001	20.67 (1.70)	0	n. s.	3.97 (1.42)	-26	0.001

% = percent changes relative to metabolically normal group.

HLP = hiperlipoproteinaemia

Discussion

Physical, chemical and biological characteristics of different sorts of lipids in an organism are highly dependent of the type of fatty acids, present in every lipid fraction with ester-bound. Experimental works and numerous investigations on humans have shown an altered serum level of determined fatty acids, as well as an altered fatty acids content of adipose and other tissues (f. e. platelets, more exactly their membrane part) could represent a serious risk factor in the evolution of coronary disease, tromboembolic incidents and atherosclerosis in general (9-17). It has been already found out that serum and other fluids in persons suffering from atherosclerosis contain significantly lower concentrations of polyunsaturated (essential, before all) and significantly higher concentrations of long chain saturated fatty acids (11,13, 18-21).

In view of those findings, our earlier results with decreased concentrations of SFA in different lipid fractions in serum, in serum in general and adipose tissue in pathologic conditions following preterm atherosclerosis, were unexpected and inexplicable (1-7). It should be stressed from the report of Hirsch et al. from 1965 (8), separate information about a decreased SFA in patients with coronary disease and myocardial infarction could be found, but no explanation or interpretation of the significance of such findings were presented (9,22-26).

Back in 1988 Bonanome and Grundy (27) for the first time pointed to the fact that SFA is acting exactly in the opposite direction having an antiatherogenic effect in contrast to other long chain saturated fatty acids. These data were confirmed later by a number of investigators (9,14,28-31) and the mechanism of its action was partly clarified too. (32,33).

The significant decrease of SFA in the adipose tissue which was confirmed in this investigation, including a number of pathologic conditions unified with a preterm atherosclerosis and the development of myocardial infarction, is completely in accord with our earlier investigations in serum and its separate lipid fractions (1,2,5,6). Moreover, the correlation between the percentage of content of SFA in the adipose tissue and the degree of obesity is confirmed by a correlation analysis. Thus the existence of a significant connection between its content and the degree of obesity has been confirmed. ($r=0.662$, $p<0.001$; Fig. 2). Concerning the subgroup of persons with the phenotype picture of hyperlipoproteinemia type IIa, showing no deviation from the control group, we support the opinion that such

a result should be explained by the fact that in cholesterol esters the most frequent constituent is the linoleic acid, whereas SFA is present in traces only (5).

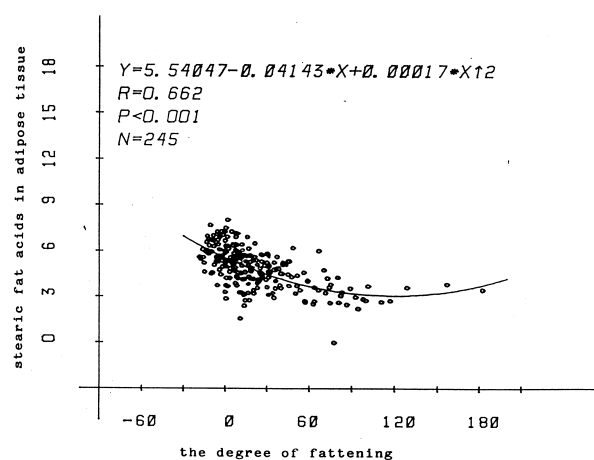


Fig 2. Correlation between the per cent content of stearic fat acids in the adipose tissue and the degree of fattening.

Similar findings concerning the percentage of content of SFA in adipose tissue of persons with developing atherosclerosis and coronary disease (8,19,22,24-26,34) could be found in literature, as well as for patients suffering from chronic renal failure (35). It should be stressed even more that Insull et al. (23) have observed the same decrease of SFA concentration in adipose tissue of persons who died suddenly of coronary disease. Their findings are identical with the findings in our investigation. Finally, in the study of population with differences in prevalence of coronary disease, Lee et al. (36) noted, many years ago, lower values of SFA in the population with its increased prevalence.

Disregarding present numerous controversies it could be concluded that the data of our investigations of SFA in adipose tissue represent perhaps a new confirmation of today's concepts that of all saturated long chain fatty acids SFA is not acting atherogenically. That is because that fatty acids should be regarded completely separated from other long chain saturated fatty acids (C12:0-C16:0). From that point of view the original formula of the American authors Connor et al. (37) for the calculation of atherogenic potential of food has been modified excluding the stearic fatty acid from the group of atherogenic long chain saturated fatty acids (38).

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STEARINSKA MASNA KISELINA U MASNOM TKIVU OSOBA S NEKIM PATOLOŠKIM STANJIMA UDRUŽENIM S PRERANOM ATEROSKLEROZOM

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Kratak sadržaj: U radu se iznose rezultati istraživanja procentnog sadržaja stearinske masne kiseline u masnom tkivu ispitanika (n=250) s različitim poremećajima u kojih vrlo često dolazi do preranog razvitka ateroskleroze. Nalazi su upoređeni s kontrolnom grupom (n=93) metabolički zdravih i normalno uhranjenih osoba. Korišćena je metoda gasnotečne hromatografije. S izuzetkom osoba s fenotipskom slikom hiperlipoproteinemije tipa IIa, u svih ispitanika (gojazni, NIDDM, iznenada umrli od infarkta miokarda, drugi tipovi hiperlipoproteinemija) konstatovane su signifikantno niže vrednosti stearinske masne kiseline nego u kontrolnoj grupi ($p < 0,005-0,001$), a u gojaznih i signifikantna povezanost njenog smanjenja sa stepenom uhranjenosti ($r=0,662$; $p < 0,001$). Suprotno ovome, pothranjene osobe imaju čak nešto više vrednosti stearinske masne kiseline, ali to povećanje nije statistički značajno. Ovi nalazi potpuno su u skladu s rezultatima naših ranijih ispitivanja u pojedinim lipidskim frakcijama seruma i u serumu kao celini. Činjenica da su do identičnih rezultata došli i drugi retki autori koji su proučavali ovaj problem, upućuju na zaključak da naša istraživanja predstavljaju potvrdu novih saznanja o antiaterogenom efektu ove masne kiseline za razliku od drugih zasićenih masnih kiselina dugog lanca. Nesumnjivo da ova saznanja imaju određene implikacije i na terapijskom planu.

Ključne reči: Masnokiselinski sastav masnog tkiva, stearinska kiselina, ateroskleroza, koronarna bolest

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