AGE-RELATED METABOLIC DISTURBANCES IN ADULT PATIENTS WITH ACUTE ISCHEMIC STROKE

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ABSTRACT

INTRODUCTION: There is rising evidence of the role of hyperglycemia, hyperlipidemia and dyslipidemia in the etiopathogenesis of acute ischemic stroke (AIS). There is a considerable risk for AIS in adult individuals in advanced and senile age with these abnormalities. Our purpose was to reveal the incidence rate of the disorders of glucose and lipid metabolism in adult patients with AIS.

MATERIAL AND METHODS: We examined 129 male and 129 female AIS patients at a mean age of 71 years hospitalized in the First Clinic of Neurology, St. Marina University Hospital of Varna, in 2007-2013. The levels of blood glucose and of serum total cholesterol, triglycerides, HDL- and LDL-cholesterol at admission were examined. Statistical data processing was performed by variation (ANOVA as a *t*-criterion was considered significant if p<0.05) and correlation (Pearson's coefficient) analyses.

RESULTS: Males aged ≤65 years and females aged 71-75 years presented with the highest mean blood glucose values. There were much more males with higher blood glucose concentrations than females aged ≤70 and 76-80 years. Both mean and maximal concentrations of total cholesterol were highest at the age of 71-75 years, those of HDL-cholesterol - in males aged 66-70 years and those of LDL-cholesterol - in females aged 71-75 years. The differences between the mean levels of total cholesterol in males and females aged ≤65 years as well as those of LDL-cholesterol in males and females aged ≥81 years were statistically significant (p<0.01).

CONCLUSION: A regular control of the parameters of glucose and lipid metabolism in adults is necessary. Keeping-up the individual's healthy life-style could ensure a more effective AIS prevention.

Keywords: *acute ischemic stroke, age dependence, blood glucose, serum lipids*

INTRODUCTION

In the recent two years, numerous publications are dealing with the role of hyperglycemia (1-3), hyperlipidemia and dyslipidemia in the pathogenesis (4-6) and prognosis (7-9) of acute ischemic stroke (AIS). AIS is one of the leading causes of death in the industrialized countries for people older than 65 (10). A reduction of the preconditioning endogenous mechanisms against AIS characterized by a brief episode of ischemia rendering the brain more resistant against subsequent longer ischemic events could explain this phenomenon in the elderly.

The objective of the present study was to reveal the incidence rate of the disorders of glucose and lipid metabolism in relation to age in adult and elderly AIS patients.

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MATERIAL AND METHODS

We examined 129 male and 129 female AIS patients at a mean age of 71 years hospitalized in the First Clinic of Neurology, St. Marina University Hospital of Varna, in 2007-2013. The levels of blood glucose and of serum total cholesterol, triglycerides, HDL- and LDL-cholesterol at admission were examined. Reference values of these parameters provided by the Clinical Laboratory, St. Marina University Hospital of Varna, were used to distinguish AIS patients with normal, reduced, or elevated laboratory values. Statistical data processing was performed by variation (ANOVA as a *t*-criterion was considered significant if $p<0.05$) analysis and correlation (Pearson's coefficient) analysis as well. SPSS, version 13.0 software was applied.

RESULTS

The distribution of mean blood glucose values according to age and gender is demonstrated on Table 1.

Table 1. Mean blood glucose values at admission in adult males and females of various age

Age groups (years)	Blood glucose (mmol/L)	
	males	females
≤65	7.78±3.20	6.30±1.78
66-70	7.04±2.48	7.21±2.97
71-75	7.46±3.45	7.63±3.16
76-80	7.58±2.61	6.52±2.08
≥81	6.35±2.61	6.70±2.21

Males at the age of ≤65 years and females at the age of 71-75 years present with the highest mean

Table 2. AIS patients' distribution according to age and blood glucose values at admission

Blood glucose	Age groups (years)										total	
	≤65		66-70		71-75		76-80		≥81			
	m.	f.	m.	f.	m.	f.	m.	f.	m.	f.	m.	f.
reduced	2	0	1	1	0	1	1	1	1	0	5	3
normal	14	13	14	10	10	13	4	12	5	7	47	55
elevated	25	14	21	16	12	22	14	14	5	5	77	71
total	41	27	36	27	22	36	19	27	11	12	129	129
	68		63		58		46		23		258	

Table 3. Mean values of four lipid parameters at admission in adult males and females of various age

Lipid parameters	Age groups (years)				
	≤65	66-70	71-75	76-80	≥81
			Total cholesterol (mmol/L)		
males	4.50±1.29	5.12±1.43	5.42±2.41	5.32±1.43	4.24±0.84
females	5.42±1.31	5.56±1.27	5.82±1.30	5.38±1.53	5.01±0.94
			Triglycerides (mmol/L)		
males	2.00±1.41	2.18±1.32	1.72±1,20	1.68±0,98	1.04±0.49
females	1.81±0.76	2.16±0.91	2.08±1.00	1.63±1.02	2.56±3.64
			HDL-cholesterol (mmol/L)		
males	1.29±0.44	1.41±0,66	1.38±0.42	1.34±0.46	1.18±0.22
females	1.29±0.25	1.39±0.45	1.29±0.31	1.40±0.77	1.29±0.35
			LDL-cholesterol (mmol/L)		
males	2.56±1.22	2.35±0.90	2.84±1.76	2.44±1.26	1.73±0.77
females	2.78±0.90	2.84±1.19	2.80±1.56	2.79±1.10	2.88±1.16

blood glucose values. The mean glucose concentration in these male patients is statistically significantly higher than that of the females of the same age (t=2.44; p<0.01). The distribution of the numbers of AIS patients according to age and gender with normal, reduced or elevated blood glucose values is presented in Table 2.

The patients with abnormally high blood glucose concentrations considerably prevail, especially in males in the age groups of up to 70 years and 76-80 years as well as in females in the age groups of 66-75 years.

The mean values of the four parameters of lipid metabolism in AIS patients according to age and gender are indicated in Table 3.

Both mean and maximal total cholesterol values are highest in males and females in the age group between 71 and 75 years while those of HDL-cholesterol are highest in males aged 66-70 years and in females aged 76-80 years. There is a statistically significant difference of the mean total cholesterol values between both genders in the age group ≤65 years (t=2.85; p<0.01). Both mean and maximal LDL-cholesterol values are highest in males aged 71 and 75 years. There is a statistically significant difference of the mean LDL-cholesterol values between both gen-

Table 4. AIS patients' distribution according to age and total cholesterol values at admission

Total cholesterol	Age groups (years)										total	
	≤65		66-70		71-75		76-80		≥81			
	m.	f.	m.	f.	m.	f.	m.	f.	m.	f.	m.	f.
reduced	2	0	1	0	0	0	0	1	0	0	3	1
normal	23	13	22	11	13	9	11	12	10	8	79	53
elevated	16	14	13	16	9	27	8	14	1	4	49	75
total	41	27	36	27	22	36	19	27	11	12	129	129
	68		63		58		46		23		258	

Table 5. AIS patients' distribution according to age and triglyceride values at admission

Triglycerides	Age groups (years)										total	
	≤65		66-70		71-75		76-80		≥81			
	m.	f.	m.	f.	m.	f.	m.	f.	m.	f.	m.	f.
reduced	31	22	27	20	18	25	16	23	10	10	102	100
normal	3	0	1	0	2	3	0	2	1	1	7	6
elevated	7	5	8	7	2	8	3	2	0	1	20	23
total	41	27	36	27	22	36	19	27	11	12	129	129
	68		63		58		46		23		258	

Table 6. AIS patients' distribution according to age and HDL-cholesterol values at admission

HDL- cholesterol	Age groups (years)										total	
	≤65		66-70		71-75		76-80		≥81			
	m.	f.	m.	f.	m.	f.	m.	f.	m.	f.	m.	f.
reduced	11	3	6	4	3	4	6	3	1	2	27	16
normal	20	22	23	26	14	26	8	21	10	8	75	93
elevated	10	2	7	7	5	6	5	3	0	2	27	20
total	41	27	36	27	22	36	19	27	11	12	129	129
	68		63		58		46		23		258	

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Table 7. AIS patients' distribution according to age and LDL-cholesterol values at admission

LDL- cholesterol	Age groups (years)										total	
	≤65		66-70		71-75		76-80		≥81			
	m.	f.	m.	f.	m.	f.	m.	f.	m.	f.	m.	f.
normal	23	13	21	14	13	20	12	17	10	8	79	72
elevated	18	14	15	13	9	16	7	10	1	4	50	57
total	41	27	36	27	22	36	19	27	11	12	129	129
	68		63		58		46		23		258	

ders in the age group ≥81 years (t=2.82; p<0.01). In males, the mean triglyceride value is highest in the age group between 71 and 75 years but the maximum one is highest in the age group ≤65 years. In females, the mean triglyceride value is highest in the age group ≥81 years but the maximum one is highest in the age group between 71 and 75 years.

The distribution of the numbers of AIS patients according to age and gender with normal, reduced or elevated values of these lipid parameters is presented in Tables 4 through 7. The number patients with abnormally high total cholesterol concentrations considerably prevail over that of the patients with reduced concentrations. In regard to the reduced triglyceride values, the number of the males aged up to 70 years slightly prevails over that of the females of the same age while that of the females aged between 71 and 80 years does over that of the males of the same age. There are much more males than females with increased and decreased HDL-cholesterol values in the age group ≤65 years as well as much more females than males with increased LDL-cholesterol values in the age group between 71 and 75 years.

It should be added that the Pearson's coefficient is highest between the values of total cholesterol and LDL-cholesterol (r=0,797) but considerable between these of total cholesterol and triglycerides (r=0,565).

DISCUSSION

Our results and the literature data available convincingly prove the diagnostic and prognostic importance of the permanent examinations of the metabolic parameters and their regular control in females and males aged over 60 years in the outpatient practice.

In a sample of 1196 patients with four AIS subtypes (noncerebral artery stenosis, intracranial stenosis, extracranial stenosis and combined intracranial and extracranial stenosis), the following risk factors and lipid profiles are identified: diabetes mellitus (p=0.01) and LDL of ≥2.6 mmol/L at admission (p<0.01) - for intracranial stenosis; LDL of ≥2.6 mmol/L - for extracranial stenosis (p=0.02) and for combined intracranial and extracranial stenosis (p=0.01); male gender (p<0.01) - for combined intracranial and extracranial stenosis (p=0.02) as well as older age - for extracranial stenosis (p=0.02) and for combined intracranial and extracranial stenosis (p=0.01) (11).

Out of a total of 1004 AIS patients, 137 (13.65% of the cases) are aged ≤45 years (12). These younger patients are more commonly female (57% versus 34%; p<0.0001) and present more rarely with diabetes mellitus (1% versus 15%; p<0.0001), hypercholesterolemia (26% versus 56%; p<0.0001), arterial hypertension (19% versus 65%; p<0.0001) and coronary heart disease (14% versus 40%; p<0.0001) than the older patients aged >45 years. The investigation of lipids and other risk factors such as blood glucose, uric acid, arterial hypertension, diabetes mellitus and atrial fibrillation for AIS by logistic regression analysis demonstrates that low HDL-cholesterol correlates to the AIS with diabetes mellitus. The relative risk of AIS in low HDL-cholesterol is 2.113 (95% CI = 1.191-3.749; p=0.011), especially in the population aged ≤70 years (13).

The comparison between 300 AIS patients and 300 controls in Barcelona, Spain reveals different dietary habits (14). AIS patients report a higher caloric intake (p=0.001), higher intake of proteins (p<0.001), total cholesterol (p=0.001) and breaded foods (p=0.001) and lower consumption of probiotic yogurt (p=0.002). Control participants indicate greater intention to eat vegetables (p=0.002) and whole

foods (p=0.000). These people reduce their intake of salt (p=0.002), fat (p=0.001) and sweets (p=0.004).

AIS has been diagnosed in 73 out of 2620 Iranians aged ≥50 years. Only among females, total cholesterol, LDL-cholesterol and non-HDL-cholesterol are independently associated with increased risk of AIS (15).

Among 3939 AIS veterans of a national sample admitted to 129 Veterans Affairs medical centers for IS at a mean age of 67.8±11.5 years, the youngest patients are more likely to receive smoking cessation counseling while the oldest ones should more likely to receive lipid management (16).

The investigation of 141 consecutive AIS patients reveals an interaction between gender and age (17). The median percentage mismatch lost is 7% (0% to 12%) in women and 18% (1% to 35%) in men younger than the population median (71 years, p=0.061). It is not different between men and women ≥71 years old (25% in both groups). The linear regression model shows that gender (p=0.027) and the interaction between age and gender (p=0.023) are independent predictors of this percentage mismatch lost.

The analysis of 502036 AIS admissions from 1256 hospitals in the Get With the Guidelines-Stroke program in the USA from 2003 to 2009 by age groups (<50, 50-59, 60-69, 70-79, 80-89, and ≥90 years) establishes that older patients differ in clinical characteristics and experience higher in-hospital mortality than younger ones (18).

Low total cholesterol (<4.6 mmol/L) is associated with older age, lower blood pressure, presence of angina pectoris, and a higher risk of death in AIS patients (19). Three-month, one-year and five-year survival rates are 100%, 98% and 84% in high total cholesterol patients as compared with 92%, 87% and 57% in low total cholesterol ones (p=0.0001).

The examination of 235 AIS patients aged 40-64 years and 316 ones aged >65 years during a mean follow-up of 26.4 months shows recurrences in 49 patients (in 8.89% of the cases) (20). Other vascular events occur more often in the older than in the younger patients (in 12.7 versus 3.8% of the cases). The hazard ratio direction for triglycerides is significantly different between both age groups. Differential effects of triglycerides on long-term outcomes after AIS are hazardous at middle age only.

CONCLUSION

Our investigation demonstrates that a regular control of the parameters of glucose and lipid metabolism in people at advanced and senile age in Bulgaria is obligatory. Keeping-up individual's healthy life-style could ensure a more effective prevention of AIS.

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