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Increased pre-diabetic blood glucose levels as a risk factor of elevated systolic, but not diastolic, arterial pressure

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Increased pre-diabetic blood glucose levels as a risk factor of elevated systolic, but not diastolic, arterial pressure

Introduction. The Finnish Diabetes Risk Score (FINDRISC) assesses the 10-year type 2 diabetes risk in adults by identifying individuals with overweight or obesity, inadequate physical activity, poor nutrition, or a family or personal history of hyperglycemia.

Aim. The objective of the study was to analyze the effect of personal history of increased (pre-diabetic) venous blood glucose on body weight, waist circumference, the magnitude of arterial pressure, and the total FINDRISC score of randomly selected individuals.

Materials and methods. The study was conducted in years 2015/2016 on 190 individuals – 96 women and 94 men. We determined FINDRISC score and measured blood pressure twice. The results were analyzed in STATISTICA 10 at $p < 0.05$.

Results. Interestingly, subjects with personal history of increased blood glucose had significantly higher systolic blood pressure ($p=0.03$), but not diastolic blood pressure, than subjects with history of normoglycemia. Both waist circumference ($p=0.01$) and total FINDRISC scores ($p<0.001$) were significantly elevated in the first group. Subjects with personal history of increased venous blood glucose showed a strong tendency ($p = 0.055$) towards higher body mass index (BMI) values than subjects with history of normoglycemia.

Discussion. Cardiovascular autonomic dysfunction(CAD) seems to be a main reason for hypertension in early stages of glucose dysmetabolism.

Conclusion. Increased pre-diabetic blood glucose level is an important risk factor of elevated systolic pressure, whereas diastolic pressure seems to be not affected by this factor.

Key words FINDRISC, pre-diabetic blood glucose level, arterial hypertension

Introduction

FINDRISC scale (Finnish Diabetes Risk Score) was developed in Finland enabling to assess the risk of developing diabetes. FINDRISC consists of eight questions about following risk factors of diabetes: the age, overweight or obesity, a low level of physical activity, poor nutrition, a family or personal history of hyperglycaemia, regular taking of anti-hypertensive medication. The scale is available in almost all European languages, allows to determine the risk of developing type 2 diabetes within 10 years - including asymptomatic diabetes and abnormal glucose tolerance with an accuracy of about 85% [1,2]. It is particularly

recommended for overweight, obese people, with a family history of diabetes and with suspected metabolic disorders. It can be easily performed in the family physician's office, allows to estimate the risk of developing diabetes, enables early implementation of prophylactics or diagnosis and treatment [3].

In Poland over 3 million people suffer from diabetes, whereas 800 000 people are still undiagnosed. A number of people with prediabetes is similar to or higher than the number of people with diabetes [4]. Unfortunately, in the period of prediabetes the serious complications may develop: early forms of nephropathy, chronic kidney disease, small fibre neuropathy, diabetic retinopathy, and cardiovascular diseases [5].

Hyperinsulinemia may contribute to hypertension by increasing sympathetic activity and vascular resistance. Experiments in animals demonstrated that insulin can increase sympathetic neural outflow by altering glucose metabolism in ventromedial hypothalamic neurons [6]. In addition, chronic trophic actions of insulin could promote structural vascular changes that contribute to hypertension. Epidemiological data indicate an association between obesity, insulin resistance, hyperinsulinemia, and hypertension [7]. Interestingly, in healthy, young people, acute increase in plasma insulin within the physiologic range and with constant blood glucose increase sympathetic neural outflow, but reduce forearm vascular resistance and do not cause the increase of arterial pressure. In the elderly people with impaired endothelial function, hyperinsulinemia leads to increased peripheral vascular resistance [8]. Another data support the hypothesis that an age-associated decline in mitochondrial function is a reason of insulin resistance development in the elderly [9]. Chronic hyperinsulinemia has been shown to cause mild sodium retention [10]. Since the FINDRISC score includes personal history of hyperglycaemia, an interesting question arises as to how increased pre-diabetic blood glucose levels may affect systolic and diastolic arterial hypertension.

Aim

The objective of the study was to analyze the effect of personal history of increased (pre-diabetic) venous blood glucose on body weight, waist circumference, the magnitude of arterial pressure, and the total FINDRISC score of randomly selected individuals.

Material and methods

The study was conducted in 2015/2016 during the 12th and 13th Lublin Science Festivals on a group of 190 individuals – 96 women (F) and 94 men (M). Participation in the study was voluntary and anonymous. The participants were selected randomly. The FINDRISC score was determined for the subjects and their blood pressure (BP) was measured twice, after 15 minutes of rest.

The individuals were shared into 2 groups according to venous blood glucose history. The values for the parameters analysed were presented as arithmetic mean, standard deviation, minimum and maximum values, lower and upper quartiles, and median. Mann-Whitney U Test was followed to determine whether there was a significant difference between parameters in studied groups. A p value of less than 0.05 was considered statistically significant. The data were analysed using STATISTICA 10.0 software (StatSoft, USA). All procedures involving participants were approved by the local Research Ethics Committee (KE-0254/71/2011).

Results

High blood glucose levels in the past had been found in 26 subjects (14 F, 12 M), whereas 164 subjects (82F, 82M) have no increased blood glucose history. Individuals with pre-diabetic blood glucose levels were statistically significantly older (the Mann-Whitney U Test, $p < 0.001$) (Fig. 1).

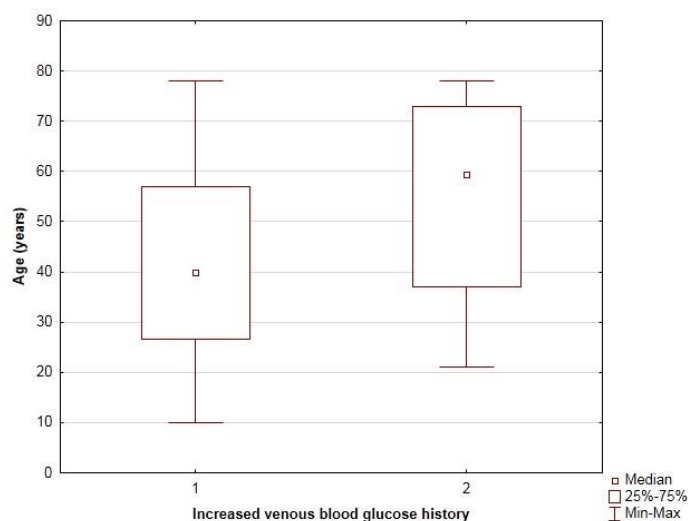


Fig. 1 Age in subjects with (1) and without (2) increased venous blood glucose history

Waist circumferences were significantly higher (the Mann-Whitney U Test, $p=0.01$) in group of subjects with increased blood glucose in the past (Fig. 2).

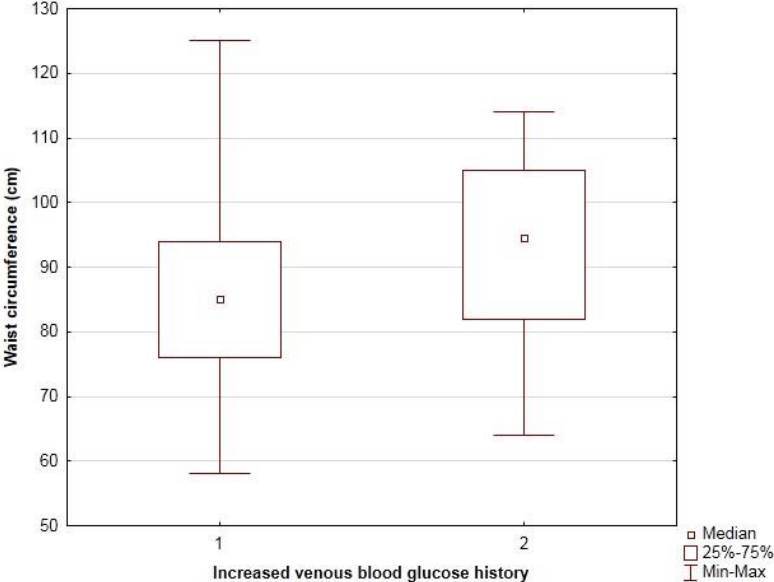


Fig. 2 Waist circumference in subjects with (1) and without (2) increased venous blood glucose history

Subjects with personal history of increased venous blood glucose showed a strong tendency (the Mann-Whitney U Test, $p = 0.055$) towards higher body mass index (BMI) values than subjects with history of normoglycemia (Fig. 3)

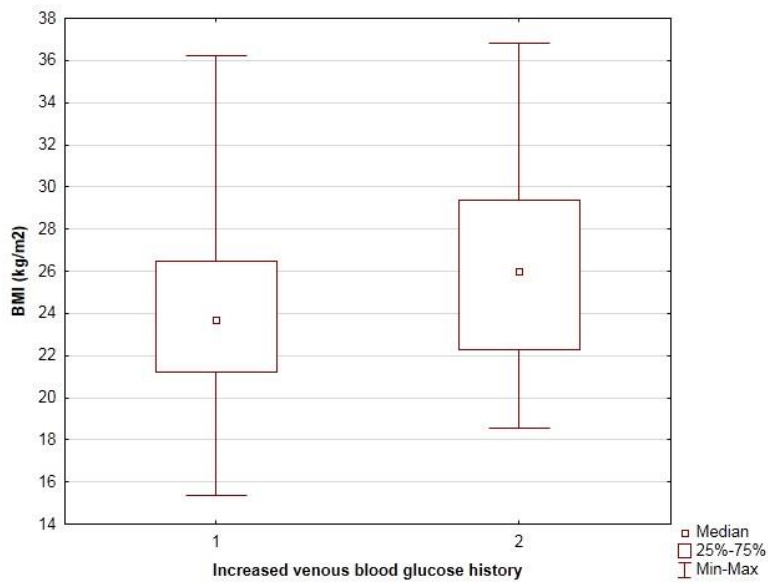


Fig. 3 BMI (Body Mass Index) in subjects with (1) and without (2) increased venous blood glucose history

Total FINDRISC scores (the Mann-Whitney U Test, $p < 0.001$) were significantly elevated in the group with increased venous blood glucose history (Fig. 4). Median in this group was 16, in group without venous blood glucose history was 5. Patients, who admitted increased blood glucose in the past, got extra 5 points in FINDRISC scale.

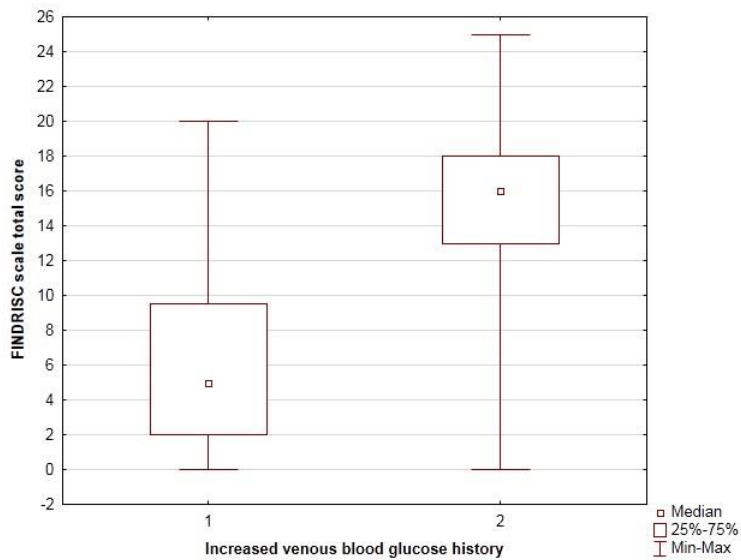


Fig. 4 FINDRISC scale total score in subjects with (1) and without (2) increased venous blood glucose history

Interestingly, subjects with personal history of increased blood glucose had significantly higher systolic blood pressure (the Mann-Whitney U Test, $p=0.03$), but not diastolic blood pressure (the Mann-Whitney U Test, $p=0.75$), than subjects with history of normoglycemia (Fig. 5, Tab. 1, Tab. 2).

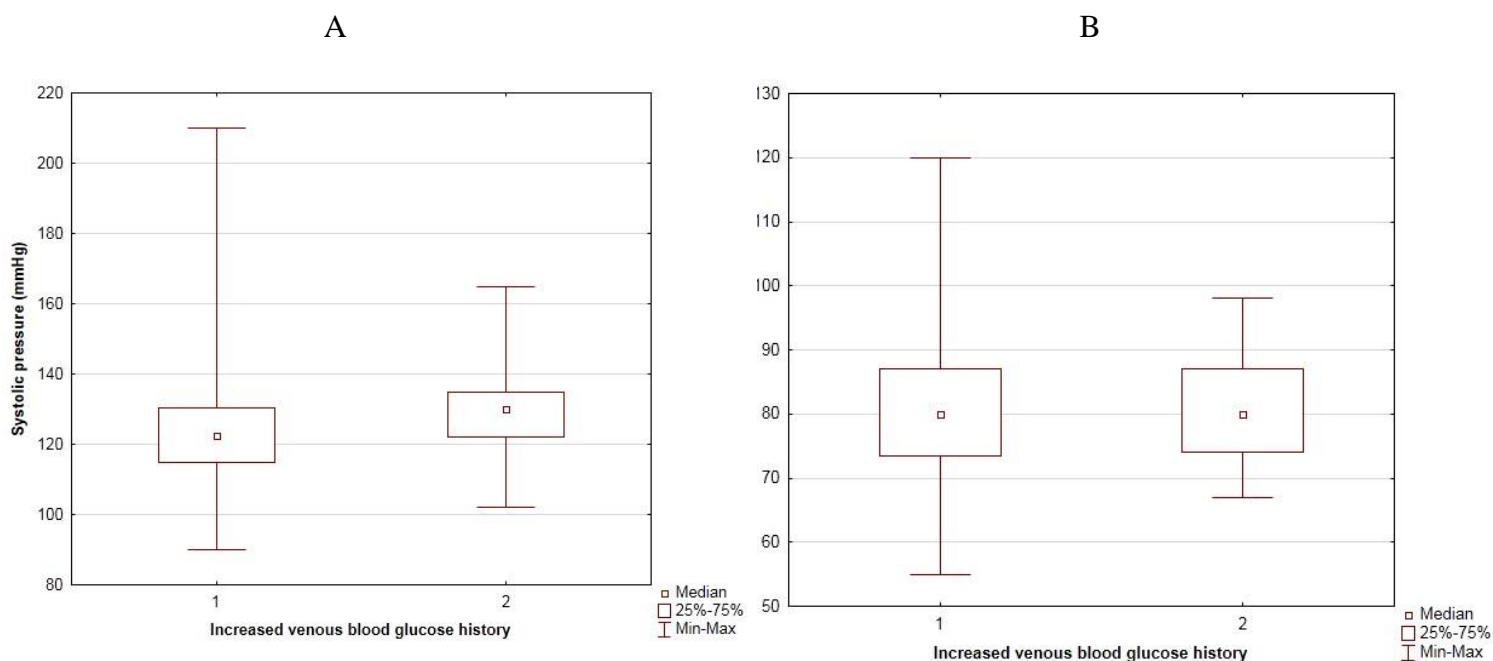


Fig. 5 Systolic (A) and diastolic (B) blood pressure in subjects with (1) and without (2) increased venous blood glucose history

Variable	Without increased venous blood glucose history Descriptive Statistics							
	Valid N	Mean	Median	Minimum	Maximum	Lower Quartile	Upper Quartile	Std.Dev.
Diastolic pressure (mmHg)	164	80,6585	80,0000	55,00000	120,0000	73,5000	87,0000	10,11191
Systolic pressure (mmHg)	164	125,5061	122,5000	90,00000	210,0000	115,0000	130,5000	16,75500

Tab. 1

Variable	Increased venous blood glucose history Descriptive Statistics							
	Valid N	Mean	Median	Minimum	Maximum	Lower Quartile	Upper Quartile	Std.Dev.
Diastolic pressure (mmHg)	26	80,8077	80,0000	67,0000	98,0000	74,0000	87,0000	7,86394
Systolic pressure (mmHg)	26	131,2692	130,0000	102,0000	165,0000	122,0000	135,0000	15,70365

Tab. 2

Discussion

Interestingly, Dimova R et al. demonstrated a high prevalence of cardiovascular autonomic dysfunction(CAD) in early stages of glucose dysmetabolism. Following parameters were related to the presence of CAD: age, waist circumference, visceral fat area, QTc interval, fasting and 120-min plasma glucose, HbA1c, arterial hypertension [11]. Our study also has proven association between increased (pre-diabetic) venous blood glucose and arterial hypertension, but only systolic blood pressure was increased in patient with history of hyperglycemia.

Luo WS et al. reported that both waist circumference and body mass index dynamic change were associated with decrease of hypertension, but reducing waist circumference is more significant for decreasing hypertension risk [12]. Our study confirmed stronger effect of waist circumference than BMI on development of pre-diabetes, hypertension and metabolic syndrome.

Elevated glucose levels and hypertension appear to contribute to the acceleration of atherosclerosis, abnormalities in platelet function, clotting factors, the fibrinolytic system, and dyslipidemia [13]. This coincidence indicates a important role of careful examination and diagnosis of patient with only one risk factor.

Conclusion

Increased pre-diabetic blood glucose level is an important risk factor of elevated systolic pressure, whereas diastolic pressure seems to be not affected by this factor. This study confirmed the influence of hyperinsulinemia on pathophysiology of arterial hypertension. Not only type 2 diabetes, but also hypertension should be considered in patients with history of pre-diabetic glycemia. It seems that prevention and screening metabolic disorders, especially diabetes mellitus type 2, conduces to early detection for arterial hypertension.

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