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*Latent disorders of carbohydrate metabolism in patients with acute coronary syndrome (ACS)*

The role of glucose elevation above levels considered normal in non-diabetic patients with acute coronary syndromes (ACS) is not adequately defined. Patients with normal glucose had lower mortality than patients with impaired fasting glucose (IFG) or with glucose levels in diabetic range. There was no detectable glycemic threshold for these adverse effects. Patients with higher baseline blood glucose levels in the absence of diabetes have a significantly increased risk of heart failure (1–5).

Approximately 25–30% of patients with acute coronary syndrome are diabetics. Of the remaining, most have a spectrum of abnormal glucose metabolism, including previously undiagnosed impaired fasting glucose (IFG), impaired glucose tolerance (ITG) and diabetes mellitus (2–7).

These abnormalities can be detected early in the post infarction period. Norhammar and coll. (8) suggest that fasting and diagnosed in oral glucose tolerance test hyperglycemia in the early phase of an acute myocardial infarction could be used as early markers of high-risk individuals. The prognostic value of elevated glucose levels in non-diabetic patients is independent of other risk factors, biochemical and inflammatory markers.

The aim of the study was to assess the prevalence and forms of latent carbohydrate disorders in patients with ACS without previously diagnosed carbohydrate disturbances.

MATERIAL AND METHODS

The group of 53 (18 F; 35 M) non-diabetic patients, aged 32–90, mean  $63.2 \pm 11.9$  has been studied. After admission to the intensive coronary care unit blood glucose level (admission blood glucose – ABG) and the next morning fasting blood glucose (FBG) of every patient has been measured. Diabetes and abnormal glucose tolerance (IFG and ITG = ATG) were diagnosed according PDA 2006 recommendations (9).

The patients were divided and assessed basing on ABG concentrations in 4 groups. Group 1 with ABG < 100 mg/dl covered 8 subjects; group 2 consisted of 18 pts with ABG level between 101 and 130 mg/dL; in group 3 there were 16 subjects with ABG between 131–160 mg/dl, and in group 4 with ABG > 160 mg/dl there were 11 patients.

The number of patients with recently diagnosed type 2 diabetes as well as abnormal glucose tolerance (ATG) have been estimated in every group.

## RESULTS

Results are illustrated in Table 1 and in Figure 1. Just in time of hospitalization, the increased blood glucose values have been found in 84.9% subjects and otherwise in more than 50% of them the values exceeded the level of 130 mg/dl.

Table 1. Clinical picture and frequency of latent carbohydrate disorders in patients with ACS

Parameter	Number of pts (%)	Age Years (range)	Sex	ABG mg/dl X±SD (range)	FBG mg/dl X±SD (range)	RDD number of pts	ATG number of pts
Whole studied group	53 (100)	63.3±11.9 (38–90)	18 F;35 M	142.3±57.4 (71–446)	109.0±25.2 (82–188)	11 (20.7%)	12 (22.6%)
Group 1	8 (15.1)	58.6±8.3 (47–69)	3 F;5 M	92.9±10.3 (71–100)	104.5±26.4 (82–164)	1 (12.5%)	2 (25%)
Group 2	18 (33.9)	58.8±11.5 (38–82)	9 F;9 M	113.3±9.0 (101–128)	106.8±25.5 (84–187)	3 (16.7%)	3 (16.7%)
Group 3	16 (30.2)	69.7±10.9 (53–90)	1 F;15 M	143.7±10.7 (132–160)	105.7±25.0 (77–167)	3 (18.7%)	3 (18.7%)
Group 4	11 (20.8)	64.4±12.8 (49–82)	5 F;6 M	222.8±79.0 (169–446)	120.8±28.0 (89–188)	4 (36.4%)	4 (36.4%)
RDD	11 (20.8)	58.2±11.2 (38–73)	F 4;7 M	153.8±46.5 (98–254)	147.8±25.1 (125–188)	–	–
ATG	12 (22.6)	63.3±11.8 (49–81)	F 6;6 M	161.2±96.0 (71–446)	113.8±3.8 (108–121)	–	–

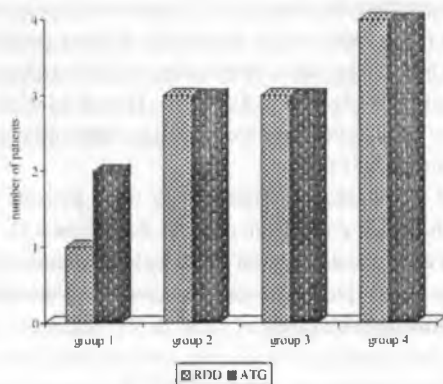


Fig. 1. Frequency of recently diagnosed diabetes (RDD) and abnormal glucose tolerance (ATG) in the studied groups of patients

In all the studied groups of patients, the mean of FBG values figured out slightly above the upper limit whereas significantly increased barely in group 4 with admission glucose > 160 mg/dl. In 23 (43.4%) subjects of the whole studied ACS patients group, the permanent disorders of the carbohydrate metabolism have been ascertained.

Previously non-diagnosed type 2 diabetes has been revealed in 12 (22.6%) patients, which constituted more than half (52.2%) of all the subjects with carbohydrate disorders. There were patients with latent diabetes and abnormal glucose tolerance in every group as well as in the group with normal glucose values just in time of hospitalization.

The percentage of patients with recently diagnosed diabetes and ATG markedly increased in the groups with glycaemia >130 mg/dl and figured out 51.8% compared with 34.6% in the group with admission glucose <130 mg/dl. Amongst the studied subjects with admission glucose >160 mg/dl. patients with non-diagnosed carbohydrate metabolism disorders constituted up to 72.7%. Patients with newly diagnosed diabetes were characterized by the lower mean of age as well as a slight prevalence of men, lower value of admission glucose while higher mean of FBG. AGT patients were older, men and women in equal proportion. The high mean value of admission glucose corresponded with rather low FBG value.

#### DISCUSSION

Abnormal glucose tolerance was almost twice as common amongst patients with acute coronary syndrome as in matched controls (10). Amongst patients Hashimoto et al. (7), newly diagnosed impaired glucose tolerance and diabetes were found in 37% and 10% patients with ACS, respectively. In a prospective cohort of patients with acute coronary syndrome, Conaway et al. (5) using a simple fasting plasma glucose value identified previously unrecognized diabetes mellitus in approximately 66% of 57% of subjects with abnormal glucose metabolism and acute coronary syndrome. Bandurska-Stankiewicz et al. (2) observed unknown glucometabolic disorders on the 5th day of hospitalization in 67% of patients with ACS. In Ramahandran's et al. (3) study, diabetes had 37%, stress hyperglycemia 13.7% and normal glucose tolerance only 16.4% of patients with myocardial infarction. The survey of Bartnik et al. (10) demonstrates that in patients with coronary artery disease normal glucose regulation is less common than abnormal glucose regulation. OGTT easily discloses the glucometabolic state and should be a routine procedure.

The results of our investigations, similarly as in the reports cited above (2–7, 9) confirmed high frequency of latent carbohydrate disorders in ACS patients including non-diagnosed type 2 diabetes in more than half of them. In rather small percentage of these patients, carbohydrate metabolism disorders have not been found. The role of admission and fasting glycemia as prognostic markers in patients with acute coronary syndromes is discussed. Though both parameters are correlated, they give different prognostic information and are related to both in-hospital complications, including death, and long-term outcomes (11).

The knowledge of glucometabolic state among these patients should influence their future management because it has great potential to improve the outcome (1, 12).

As hyperglycemia at the acute stage of myocardial infarction is an independent predictor of untoward cardiovascular events, blood glucose measurements should become routine in all patients presenting with acute coronary syndromes.

#### CONCLUSIONS

Prevalence of previously non-diagnosed diabetes and abnormal tolerance glucose in patients with acute coronary syndrome is very high and growing with an increasing the level of admission blood glucose.

#### REFERENCES

1. Bartnik M., Malmberg K., Norhammar A. et al.: Newly detected abnormal glucose tolerance: an important predictor of long-term outcome after myocardial infarction. *Eur. Heart J.* 25, 1990, 2004.

2. Bandurska-Stankiewicz E., Moczulska B., Myszkowska-Podgórska K. et al.: Zaburzenia gospodarki węglowodanowej u pacjentów z ostrym zespołem wieńcowym. Przegląd Kardiodiabetologiczny, 1, 41, 2006.
3. Ramachandran A., Chamukuttan S., Immaneni S. et al.: High incidence of glucose intolerance in Asian-Indian subjects with acute coronary syndrome. Diabetes Care, 28, 2492, 2005.
4. Lankisch M., Futh R., Schotes D.: High prevalence of undiagnosed impaired glucose regulation and *diabetes mellitus* in patients scheduled for elective coronary angiography. Clin. Res. Cardiol., 95, 80, 2006.
5. Conaway D. G., O'Keefe J. H., Reid K. J. et al.: Frequency of undiagnosed *diabetes mellitus* in patients with acute coronary syndrome. Am. J. Cardiol., 96, 363, 2005.
6. Conaway D. G., O'Keefe J. H.: Frequency of undiagnosed and untreated *diabetes mellitus* in patients with acute coronary syndromes. Expert Rev. Cardiovasc. Ther., 4, 503, 2006.
7. Hashimoto K., Ikewaki K., Yagi H. et al.: Glucose intolerance is common in Japanese patients with acute coronary syndrome who were not previously diagnosed with diabetes. Diabetes Care, 28, 1182, 2005.
8. Norhammar A., Tenerz A., Nilsson G. et al.: Glucose metabolism in patients with acute myocardial infarction and no previous diagnosis of *diabetes mellitus*: a prospective study. Lancet, 359, 2140, 2002.
9. Zalecenia kliniczne dotyczące postępowania u chorych na cukrzycę, 2006. Stanowisko Polskiego Towarzystwa Diabetologicznego. Diabetologia Praktyczna, supl. A, A1, 7, 2006.
10. Bartnik M., Ryden L., Ferrari R. et al.: Euro Heart Survey Investigators. The prevalence of abnormal glucose regulation in patients with coronary artery disease across Europe. The Euro Heart Survey on diabetes and the heart. Eur. Heart J., 25, 1880, 2004.
11. Kadri Z., Chaib A., Henegariu V. et al.: Admission and fasting blood glucose are important prognostic markers in acute coronary syndromes. Ann. Cardiol. Angiol. (Paris), 54, 168, 2005.
12. Bartnik M., Malmberg K., Hamsten A. et al.: Abnormal glucose tolerance – a common risk factor in patients with acute myocardial infarction in comparison with population-based controls. J. Intern. Med., 256, 288, 2004.

#### SUMMARY

Patients with ACS and normal blood glucose had lower mortality than patients with impaired fasting glucose or with glucose in diabetic range. Non-diabetic patients with higher baseline blood glucose have a significantly increased risk of heart failure. The aim of the study was to assess the prevalence and forms of latent carbohydrate disorders in patients with ACS without previously diagnosed carbohydrate disturbances. 53 (18 F; 35 M) non-diabetic patients, aged 32–90 (mean 63.2±11.9) were studied. After admission to the intensive care unit admission blood glucose (ABG) and the next morning fasting blood glucose (FBG) of every patient have been measured. Diabetes and abnormal glucose tolerance (ATG) were diagnosed according to PDA recommendations. The group with ABG<100 mg% included 8 pts (15.1%). The mean ABG and FBG were 92.9±10.3 and 104.5±26.4 mg%, respectively. There was one patient with recently diagnosed diabetes (RDD) and 2 pts with ATG. The group with ABG ranged 101–130 mg% comprised 18 pts (30.2%) and had the mean ABG and FBG: 113.3±9.0 and 106.8±25.5 mg%. There were 3 pts with RDD and 3 with ATG. The group with ABG 131–160 mg% included 16 pts (30.2%). The mean ABG and FBG were: 143.7±10.7 and 105.7±25.0 mg%. There were 3 pts with RDD and 3 with ATG. The 11 patients (20.8%) with ABG> 160 mg% had mean ABG 222.8±79.0 mg% and FBG 120.8±28.0 mg%. There

were 4 pts with RDD and 4 ATG. The prevalence of previously non-diagnosed diabetes and latent carbohydrate disorders in patients with ACS are growing parallel with increased level of ABG.

Utajone zaburzenia metabolizmu węglowodanów u chorych z ostrym zespołem wieńcowym (OZW)

Chorych z OZW i prawidłową glikemią charakteryzuje niższa śmiertelność niż chorych z nieprawidłową tolerancją glukozy lub cukrzycą. Osoby bez cukrzycy, z wyższym podstawowym stężeniem glikemii, cechuje wyższe ryzyko niewydolności serca. Celem pracy była ocena częstości występowania utajonych zaburzeń węglowodanowych wśród chorych z ostrymi zespołami wieńcowymi, bez wcześniej rozpoznawanej nieprawidłowej tolerancji glukozy. Zbadano 53 (18K;35M) osoby; wiek 32–90 (średnia 63,2±11,9) lat. U każdego chorego oznaczano glikemię w momencie hospitalizacji (ABG) w OIOK, a następnego dnia glikemię na czczo (FBG). Cukrzycę i utajone zaburzenia węglowodanowe diagnozowano zgodnie z zaleceniami PTD. Grupa z ABG <100 mg% liczyła ośmiu (15,1%) chorych. Średnie ABG i FBG wynosiły odpowiednio 92,9±10,3 i 104,5±26,4 mg%. W grupie tej był jeden chory ze świeżo rozpoznaną cukrzycą (RDD) oraz dwie osoby z nieprawidłową tolerancją glukozy (ATG). Grupa z ABG między 101 a 130 mg% liczyła 18 chorych (30,2%) i miała średnią ABG i FBG: 113,3±9,0 and 106,8±25,5mg%. W grupie tej były trzy osoby z RDD i trzy z ATG. Grupa z ABG 131–160 mg% obejmowała 16 chorych (30,2%). Średnie ABG i FBG wynosiły: 143,7±10,7 oraz 105,7±25,0 mg%. W grupie tej były trzy osoby z RDD i trzy z ATG. 11 (20,8%) chorych z ABG > 160mg% miało średnią ABG 222,8±79,0mg%, a FBG 120,8±28,0mg%. Wśród chorych tej grupy były cztery osoby z RDD i cztery z ATG. Częstość występowania nierozpoznawanej uprzednio cukrzycy i utajonych zaburzeń gospodarki węglowodanowej u chorych z ACS wzrasta równoległe ze wzrostem wartości glikemii w momencie hospitalizacji.