Disturbances in Glucometabolic State in Patients Suffering from Acute Coronary Syndrome

Akut Koroner Sendrom Tanısı Almış Hastalarda Glukometabolik Durum Bozuklukları

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ABSTRACT Objective: Studies have shown that increased fasting blood glucose levels, even in the normal range and impaired glucose tolerance, as well as diabetes mellitus have increased risk of cardiovascular disease and mortality. In this study our aim was to determine the glucometabolic profile of patients with acute coronary syndrome without any history of diabetes and to compare their glucometabolic status at one year follow-up. **Material and Methods:** We enrolled 140 patients with acute coronary syndrome and a standardized oral glucose tolerance test was performed between 12-14 days. The patients were followed up one year and another oral glucose tolerance test was performed on patients who had not diabetes. **Results:** In the first oral glucose tolerance test we found that 34.3% of patients had normal glucose tolerance, 19.3% had impaired fasting glucose, 23.6% had impaired glucose tolerance, 7.1% had impaired fasting glucose+impaired glucose tolerance and 15.7% had diabetes mellitus. After 1 year, in normal glucose tolerant subjects we found that 81.2% of them stayed as normal, 4.2% became diabetic, 8.3% had impaired glucose regulation and 6.3% of these patients were missing. In the patients with impaired glucose tolerance, 21.4% became normal glucose tolerant and 12.9% had diabetes mellitus, 50.0% had still impaired glucose regulation and 15.7 % of them were dead. **Conclusion:** We found that undiagnosed impaired glucose metabolism was not uncommon in patients with acute coronary syndrome. These abnormalities can be detected with oral glucose tolerance test in postinfarction period before the patients are discharged and after 1 year follow-up. This strategy may offer us the chance of evaluating the prognosis and classifiying the risk of patients with acute coronary syndrome.

Key Words: Acute coronary syndrome; glucose metabolism disorders

ÖZET Amaç: Çalışmalar, normal sınırlar içinde olsa bile artmış açlık kan şekeri ve bozulmuş glukoz toleransının, diabetes mellitus gibi katlanmış kardiyovasküler hastalık ve mortalite riskine sahip olduğunu göstermiştir. Bu çalışmamızda diyabet hikayesi olmayan akut koroner sendrom tanısı almış hastaların glukometabolik profillerini belirlemeyi ve bir senelik takipten sonra hastaların glukometabolik durumlarını ilk halleriyle kıyaslamayı planladık. **Gereç ve Yöntemler:** Yüz kırk akut koroner sendromlu hastayı çalışmaya dahil ettik ve 12-14. günlerde standardize oral glukoz tolerans testi yaptık. Hastalar 1 sene süreyle takip edildi, diyabet saptanmayanlara ikinci bir oral glukoz tolerans testi yapıldı. **Bulgular:** İlk oral glukoz tolerans testi ile %34,3 hastada normal glukoz toleransı, %19,3 hastada bozulmuş açlık glukozu, %23,6'sında bozulmuş glukoz toleransı, %7,1'inde bozulmuş açlık glukozu+ bozulmuş glukoz toleransı, %15,7'sinde diabetes mellitus saptandı. Bir yıl sonra normal glucose toleran kişilerin %81,2'sinin yine normal glukoz metabolizmasına sahip olduğu bulundu, %4,2'sinde diyabet, %8,3'inde bozulmuş glukoz toleransı gelişmişti, ayrıca %6,3 hasta kayıp idi. Bozulmuş glukoz toleransına sahip hastaların %21,4'i normal glukoz toleransına sahip, %12,9'u diabetes mellitus, %50,0'si hala bozulmuş glukoz regülasyonuna sahip bulundu, hastaların %15,7'si vefat etmişti. **Sonuç:** Çalışmamızda akut koroner sendromlu hastalarda tanı konmamış bozulmuş glukoz metabolizmasının nadir olmadığını saptadık. Bu anormallikler oral glukoz tolerans testi ile postinfarktüs peryotta, hastalar taburcu edilmeden önce ve taburculuktan sonra bir yıl içinde tesbit edilebilir. Bu stratejinin bize akut koroner sendrom tanısı alan hastaların prognozlarının değerlendirilmesinde veya risk sınıflandırılmasının yapılmasında katkı sunabileceği kanısındayız.

Anahtar Kelimeler: Akut koroner sendrom; glukoz metabolizması bozuklukları

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People having type 2 diabetes mellitus (T2DM) have twice the annual mortality rate of non-diabetic individuals, this increased rate is primarily owing to cardiovascular disease (CVD).[1] It was shown that fatal CVD is higher in diabetics than in non-diabetics (5.4% vs. 1.6%)[2] and incidence and severity of CVD events are higher in diabetic individuals.[1,3] Individuals with pre-diabetes, either impaired fasting glucose (IFG) or impaired glucose tolerance (IGT) also have an increased risk of cardiovascular events and mortality.[4,5] Furthermore studies have shown that relatively elevated fasting blood glucose (FBG) levels, even in the normal range have increased risk of cardiovascular disease and mortality.[6-9] After acute myocardial infarction poor prognosis due to abnormal coronary flow reserve and impairement of left ventricular function was found to be associated with newly detected or known diabetes and impaired glucose tolerance.[10-13]

There is a positive relation between admission blood glucose at hospital for acute coronary syndromes (ACS) and long-term mortality in patients with and without diabetes.[6,14] Strict glucometabolic control is shown to improve survival in patients with diabetes and ACS. As it was shown that a substantial proportion of patients with acute myocardial infarction have undiagnosed abnormal glucose regulation,[3,7] the need to determine the glucometabolic status of the patients with ACS has been emerged. Early identification of these metabolic abnormalities would enable initiation of potentially benefical treatment contributing to an improved prognosis.

It was not certain that which test would be used to identify the metabolic status of patients in ACS and when it would be performed. Also as there have been no systematic studies about the prevalence of impaired glucose regulation (IGR) in an ACS population in Turkey. In this study we planned to characterize the glucometebolic profile of patients with ACS without any history of diabetes and assess which test would improve the detection of abnormal glucose regulation in these patients and also determine their glucometabolic status after 1-year follow-up.

MATERIAL AND METHODS

PATIENTS

We enrolled 140 patients admitted to the coronary unit of Ankara Training and Research Hospital for suspected ACS between June 2009 and Semptember 2009.

We excluded patients with previously known diabetes or glucose intolerance, conditions which may effect metabolic parameters (such as thyroid dysfunctions in history or nowadays), pregnancy, infection and having conditions preventing an oral glucose tolerance test (OGTT). We did not recruit patients who had chronic renal failure or who were older than age of 80. All the subjects gave written informed consent and this study was performed according to the principles of Decleration of Helsinki 2008. Ethical approval for the study was obtained from Ankara Training and Research Hospital Ethics Committe.

Fasting venous blood samples were collected in the first morning after their admission for fasting blood glucose (FBG), HbA1c and fasting insulin (FI). A standardized 75 g OGTT was performed between 12-14 days (OGTT-I) to minimize any possible confounding effects of ACS on the glucose metabolism, such as acute stress, inflammation or left ventricular dysfunction. In the literature OGTT was performed in 4-28 days.[5-7] Body weight, height, waist and hip circumference were measured before discharge. Body mass index (BMI) was calculated. Waist and hip circumference were measured when fasting by a non-elastic masurement, as upright position.

The patients were followed up one year and then, 75 g OGTT was performed on patients who did not have diabetes (OGTT-II).

The diagnosis of ACS was based on the joint recommendations by the European Society of Cardiology and American College of Cardiology.[15] On admission ACS diagnosis was classified into ST elevated myocardial infarction, non-ST elevated MI and unstable angina pectoris. St-elevated myocardial infarction (STEMI) was defined as chest pain (or angina-equivalent symptoms) with ST elevation

>1 mm in >2 contiguous leads or new left bundle branch block (LBBB) and an elevated troponin T (>0.03 xg/L). Non St elevated myocardial infarction (NSTEMI) was defined as chest pain with an elevated troponin without ST elevation >1 mm in >2 leads or new LBBB. USAP was defined as chest pain, without a troponin rise and with electrocardiographic changes of acute ischaemia (ST elevation or depression, T wave inversion), or history of coronary artery disease, or age >65 years, or at least 2 vascular risk factors (hypertension, hyperlipidaemia, family history, smoking, diabetes).

All glucometabolic classifications according to ADA[16,17] criteria were based on the measurement of blood glucose before or 2 h after glucose intake to be reported as normal glucose regulation (NGR), normal fasting glucose, impaired fasting glucose (IFG), impaired glucose tolerance (IGT) or diabetes mellitus. Impaired glucose regulation (IGR) encompasses IFG and IGT, whereas abnormal glucose regulation (AGR) comprises IGR and diabetes mellitus. Individuals with fasting blood glucose concentrations of 5.6 mmol/l (<100 mg/dL) were considered to be normal, concentrations between 5.6-6.9 mmol/l (100-125 mg/dL) were considered to be IFG and concentrations of ≥7.0 mmol/l (≥126 mg/dl) were considered to be diabetes. 2 hour postload glucose values of the OGTT according to the WHO[17] and ADA[16,17] definitions were as follows; Normal glucose tolerance (NGT), <7.8 mmol/l (140 mg/dL), IGT, 7.8-11.0 mmol/l (140-200 mg/dL), and diabetes >11.1 mmol/l (200 mg/dL). Plasma insulin was analyzed in fasting samples.

Insulin resistance expressed as the homeostasis model assessment for insulin resistance (HOMA-IR) was calculated under fasting conditions as plasma insulin (microunits per milliliter) x blood glucose (millimoles per liter) / 22.5.[18]

CORONARY ANGIOGRAPHY

An analysis of the coronary angiograms was performed by an independent experienced observer. The presence of coronary artery disease was defined as >75% diameter narrowing. The coronary arteries were grouped as the left anterior descending or diagonal and septal branches, the left circumflex artery or obtuse marginal branch, and the right coronary artery or posterior descending and posterolateral branch to define one, two, and three vessel disease, respectively.[19]

RESULTS

This study was performed with 140 patients with ACS. One hundred and fifteen of our patients (82.1%) were male and 25 of them (17.9%) were female. 14 of the patients admitted to our coronary unit had unstable angina pectoris (USAP) (10%), 30 of them had NSTEMI (21.4%) (As their clinical courses were similar we decided to handle them together such as non-ST elevated acute coronary syndrome (NSTE-ACS) (31.4%). 96 of the patients had STEMI (68.6%). STEMI was diagnosed in 79 males (82.3%) and 17 females (17.7%). NSTE-ACS were diagnosed in 36 males (81.8%) and 8 females (18.2%).

Coronary angiography of the patients revealed the number of stenosed coronary vessels diseased. 92 of the patients had one vessel, 32 of them had two vessel and 16 of them had 3 vessel disease. 40 of the patients were treated by medical treatment, 74 of them had percutaneous coronary intervention (PCI) and 26 of them had coronary artery bypass grafting (CABG). In NSTE-ACS patients, 26 had 1 vessel, 10 had 2 vessel, 8 had 3 vessel disease. In STEMI patients 66 of them had 1 vessel, 22 had 2 vessel, 8 had 3 vessel involvement.

Clinical characteristics and metabolic data of patients, in 2 weeks examination were presented in Table 1. OGTT-1 performed just before the patients were discharged (Between 12-14 days) were presented in Table 2. After OGTT-I we found that 48 patients had normal glucose tolerance (34.3%), 27 had IFG (19.3%), 33 had IGT (23.6%), 22 had DM (15.7%) and 10 had IFG and IGT (7.1%). Totally 34.3% had normal glucose metabolism and 65.7% had abnormal glucose regulation (Table 2).

In Table 3 results of OGTT-I according to ACS types were presented. Out of 44 patients having NSTE- ACS, 12 of them were diagnosed as having normal glucose metabolism (27.3%), 7 of them having IFG (15.9%), 15 of them having IGT/IFG+IGT

TABLE 1: Clinical characteristics and metabolic data in 2 weeks examination.

	Normal	IFG/IGT/IFG+IGT	DM	Total
Patients	48	70	22	140
Age (year)	49.6±8.5	55.6±10.1	62.0 ± 11.0	54.5±7.6
Male	45	54	16	115
Female	3	16	6	25
STEMI	36	48	12	96
NSTE-ACS	12	22	10	44
BMI	28.2±2.3	28.6±2.4	30.3±1.2	28.7±4.5
Waist circumference (cm)	92.1±6.4	94.9±7.9	98.9±3.4	94.5±8.7
Hip circumference (cm)	99.6±1.1	99.5±1.2	104.1±0.9	101.3±1.0
HbA1c (%)	5.4±0.2	5.6±0.3	6.2±0.4	5.6±1.5
Fasting insülin (pmol/l)	8.5±3.9	12.8± 4.6	15.8±3.6	12.8±4.3
HOMA-IR	1.93±0.8	3.4±0.1	3.8±0.9	3.1±0.4
FBG (mg/ dl)	90.9±2.5	99.2±10.1	107.0±11.9	98.2±9.1
Number of stenosed vessels	1.5±0.7	1.3±0.6	1.7±0.7	1.5±0.6

IFG: Impaired fasting glucose; IGT: Impaired glucose tolerance; DM: Diabetes mellitus.

(34.1%) and 10 of them having DM (22.7%). Out of 96 patients having STEMI, 36 of them were diagnosed as having normal glucose metabolism (37.5%), 20 of them having IGT (20.8%), 28 of them having IGT/ IFG+IGT (29.2%) and 12 of them having DM (12.5%) (Table 3).

All the patients were followed up one year. 22 patients had had the diagnosis of DM by OGTT-I, 11 patients had died, we could not be able to reach 3 patients. So, after 36 patients had been excluded for these reasons, 75 gr OGTT was performed on 104 patients (Table 4). After 1 year we found that 54 patients had normal glucose tolerance (51.9%), 26 had IFG (25.0%), 10 had IGT (9.6%), 11 had DM (10.6%) and 3 had IFG and IGT (2.9%).

In Table 5 results of OGTT-II according to ACS types were presented. Out of 31 patients having NSTE-ACS, 14 of them were diagnosed as having normal glucose metabolism (45.2%), 13 were diagnosed as IFG/IGT/IFG+IGT (41.9%) and 4 were diagnosed as DM (12.9%). Out of 73 patients having STEMI, 40 of them were diagnosed as having normal glucose metabolism (54.8%), 26 were diagnosed as IFG/ IGT/ IFG+IGT (35.6%) and 7 were diagnosed as DM (9.6%) (Table 5).

TABLE 2: The summary of the OGTT-I.

Result of OGTT	Number of patients	%
Normal	48	34.3
IFG	27	19.3
IGT	33	23.6
DM	22	15.7
IFG + IGT	10	7.1
Total	140	100

OGTT: Oral glucose tolerance test; IFG: Impaired fasting glucose; IGT: Impaired glucose tolerance; DM: Diabetes mellitus.

TABLE 3: Results of of OGTT-I according to ACS types.

	Normal (%)	IFG (%)	IGT/IFG+IGT (%)	DM (%)	Total
NSTE-ACS	12 (27.3%)	7 (15.9%)	15 (34.1%)	10 (22.7%)	44 (100%)
STEMI	36 (37.5%)	20 (20.8%)	28 (29.2%)	12 (12.5%)	96 (100%)
Total	48 (34.3)	27 (19.3%)	43 (30.7%)	22 (15.7%)	140 (100%)

USAP: Unstable angina pectoris; NSTE-ACS: Non ST elevated acute coronary syndrome; STEMI: ST elevated myocardial infarctus; IFG: Impaired fasting glucose; IGT: Impaired glucose tolerance; DM: Diabetes mellitus.

TABLE 4: The summary of OGTT-II.

Result of OGTT	Number of patients	%
Normal	54	51.9
IFG	26	25.0
IGT	10	9.6
DM	11	10.6
IFG + IGT	3	2.9
Total	104	100

OGTT: Oral glucose tolerance test; IFG: Impaired fasting glucose, IGT: Impaired glucose tolerance; DM: Diabetes mellitus.

Out of the 11 patients who died in 1 year, 4 of them had had NSTE-ACS, and 7 of them STEMI. Three patients we could not be able to reach had had STEMI. It was interesting that none of the patients who died had not had DM, according to OGTT-I 3 of them had IFG, 6 of them had IGT and 2 of them had IFG+ IGT. We found that all the 3 patients we did not reach after 1 year, had had normal glucose metabolism. All the patients who were missed and death had been male (Table 6).

In Table 7 in the comparison of OGTT-I and OGTT-II of the patients with ACS who were diagnosed as normal, IFG, IGT, DM and IFG+ IGT was presented. 22 patients who were diabetic according to OGTT-I were not included in this table. In 45 patients which had normal glucose tolerance in OGTT-I, after OGTT-II 39 of them found to be still normal (86.7%), 4 of them had IFG (8.9%) and 2 of them had DM (4.4%). 17 of 24 patients who had had IFG in OGTT-I were still classified as IFG (70.8%) and 7 of them had normal glucose metabolism (29.2%). According to OGTT-I, 4 of 27 IGT patients developed IFG (15.4%), 8 of them became normal (29.6%) and 5 of them developed DM later (18.5%), but 10 out of 27 IGT patients according to OGTT-I were still classified as IGT (37.1%) in OGTT-II. In 8 patients with IFG+ IGT in OGTT-I, 1 patient was then classified as IFG (12.5%), 4 developed DM (50.0%) and 3 patients were still had IFG+IGT (37.5%) in OGTT-II (Table 7).

TABLE 5: Results of OGTT-II according to ACS types.

	Normal(%)	IFG/IGT/IFG+IGT(%)	DM(%)	Total(%)
NSTE-ACS	14(45.2%)	13(41.9%)	4(12.9%)	31(100%)
STEMI	40(54.8%)	26(35.6%)	7(9.6%)	73(100%)
Total	54(51.9%)	39(37.5%)	11(10.6%)	104(100%)

USAP: Unstable angina pectoris, NSTE-ACS: Non ST elevated acute coronary syndrome, STEMI: ST elevated myocardial infarctus, IFG: Impaired fasting glucose, IGT: Impaired glucose tolerance, DM: diabetes mellitus.

TABLE 6: Patients having OGTT-I and OGTT-II.

Number of patients	Normal	IFG	IGT	DM	IFG+IGT	Total
OGTT-I	48	27	33	22	10	140
Dead		3	6		2	
Missing and excluded	3			22		
Having OGTT-II	45	24	47	0	8	104

IFG: Impaired fasting glucose, IGT: Impaired glucose tolerance, DM: Diabetes mellitus.

In Table 8 we presented the comparison of OGTT-I and OGTT-II in terms of normal glucose tolerance (NGT) and impaired glucose regulation (IGR). Out of 48 patients who had normal glucose metabolism 39 patients (81.2%) was also normal after one year, but 4 of them (8.3%) developed impaired glucose regulation (IGR) and 2 of them (4.2%) developed DM. We were not able to reach 3 of (6.3%) the patients who had had normal glucose metabolism. After excluding 22 diabetic patients, out of 70 patients having IGR according to OGTT-I we found that 15 of them (%21.4) had NGT, 35 developed (50.0%) and 9 developed DM (12.9%). We learned that 11 of them died (15.7%). If we added 22 patients having DM according to OGTT-I into the IGR pool, with 104 patients having OGTT-II and 22 patients diagnosed and treated as DM before OGTT-I (total 126) 53.2% were diagnosed as IGR (Table 8).

DISCUSSION

Diabetes mellitus is a major risk factor for coronary heart disease.[1,3,20] Impaired glucose metabolism is also frequently observed after an acute coronary event in nondiabetic subjects.[4-6] The glycemic metabolic status at the time of acute myocardial infarction in diabetics and even in non-diabetics is a determinant of future cardiovascular events and it increases the risk of death.[6,21] European guidelines on DM, prediabetes and cardiovascular disease recommend that the glucose metabolism of patients

TABLE 7: Comparison of OGTT-I and OGTT-II.

	OGTT-I Normal (%) n:45	OGTT-I IFG (%) n:24	OGTT-I IGT (%) n:27	OGTT-I IFG+IGT (%) n:8	OGTT-II Total n:104
OGTT-II Normal (%)	39 (86.7%)	7 (29.2%)	8 (29.6%)		54 (51.9%)
OGTT-II IFG (%)	4 (8.9%)	17 (70.8%)	4 (14.8%)	1 (12.5%)	26 (25.0%)
OGTT-II IGT (%)			10 (37.1%)		10 (9.6%)
OGTT-II DM (%)	2 (4.4%)		5 (18.5%)	4 (50.0%)	11 (10.6%)
OGTT-II IFG+IGT (%)	8 (100%)			3 (37.5%)	3 (2.9%)

IFG: Impaired fasting glucose; IGT: Impaired glucose tolerance; DM: Diabetes mellitus.

TABLE 8: Comparison of OGTT-I and OGTT-II.

		OGTT-II			
	OGTT-I	NGT	IGR	DM	Missing+dead
NGT	48 (%100)	39 (%81.2)	4 (%8.3)	2 (% 4.2)	3 (%6.3) Missing
IGR	70 (%100)	15 (%21.4)	35 (%50.0)	9 (%12.9)	11 (%15.7) Dead

IFG: Impaired fasting glucose; NGT: Normal glucose tolerance; IGR: Impaired glucose regulation tolerance; DM: Diabetes mellitus.

without known diabetes, but with established cardiovascular disease should be investigated.[22,23]

Our study showed that abnormal glucose tolerance was present in a majority of the patients with ACS having no history of diabetes. Out of total patients, 15.7% was diagnosed as DM. In the literature, rates of diabetes were demonstrated as 5-37%, but in three large studies such as The Euro Heart Survey, GAMI study, The China Heart Survey, rates of diabetes were 22%, 31% and 28% respectively.[3,5-7,14,24-26] We think that the different results may be explained with the different time of the OGTTs performed, the age, gender, race, BMI and concomittant diseases of the patients. The use of different glucose threshold levels for diagnosis of diabetes must also be remembered.

Uncertainty still remains over the ideal test in order to diagnose the real glucose metabolism in patients with ACS. It has been stated that OGTT is time consuming, inconvenient for subjects and more expensive than FBG and random blood glucose and it has problems about reproducibility. It has been shown that random blood glucose lacks sensitivity and specifity. It was stated that FBG may be a useful alternative to OGTT in patients with ACS[27] by The Joint British Societies Guide, but studies have found that if FBG alone is used, up to 84% of patients with abnormal glucose tolerance may remain undiagnosed.[3,5-7] The results of abnormal glucose regulation detected with admission FBG and subsequent OGTT was also found to be discordant and the authors showed that FBG on admission had had only a modest sensitivity and spesificity for the detection of IGT/DM on subsequent OGTT.[5] Furthermore the rate of DM was found to be increased, when OGTT was performed after FBG in patients with ACS.[5,28] Thinking that although FBG has good reproducibility, small variability and easy application, fasting state will not be more reliable than OGTT, we insisted in OGTT in order to precisely detect abnormal glucose tolerance in ACS patients.

The optimal time for exact assessment of glucose regulation in patients with ACS is also unclear. Acute hyperglycemia post myocardial infarction is common and regarded as a response to adrenergic stress. Acute stress also effects OGTT. In the literature OGTT was found to be performed in 4 days-4 weeks after admission.[5-7,24,25,29] In order to eliminate the interference of the effects of acute stress, left ventricular dysfunction and inflammation we chose to perform OGTT approximately 2 weeks after the ACS. In European Heart Survey, OGTT was performed in 4-5 days, and its results were found to be correlated with 3-12 months glycemic condition of ACS patients,[7] but there are studies disaggreeing it. In GAMI trial, the number of patients with abnormal glucose metabolism and with ACS lessened up to 25% from 31% in 3 months.[8,9] Chih demonstrated that 50% of the patients with IFG in admission showed normal glucose regulation after 4 weeks.[5] There are more studies demonstrating lessened abnormal glucose rates 3 months after ACS.[26,30,31] In concordance with other studies our abnormal glucose metabolism rates also lessened after one year. According to these results we recommend to perform both OGTT in two weeks and in 1 year.

In 15 patients with IFG and IGT (7 IFG and 8 IGT) after one year normal glucose metabolism was obtained. This results may be interpreted with discharge of stress hormones after ACS or positive effect of lifestyle modification. In concordance with our assumption, accepting the drop of glucose levels in relation with the drop in stress hormones after the acute phase of ACS, Oswald et al. showed that stress hormones were the main determinants of plasma glucose in non diabetic patients with ACS.[32]

But in one year follow-up 11 patients developed DM (10.6%). Two of them had normal glucose tolerance, 5 of them had had IGT and 4 of them IFG+IGT in the beginning. These results points out that, patients with ACS, in days and months may also get worse as glucose metabolism is concerned, so it must be necassary to follow up these patients more closely. The high prevalance of IGT is worrying, as the conversion rate to frank DM is also high. Among 33 patients diagnosed as IGT according to OGTT-I, 5 of them (18.5%) were diagnosed as DM after OGTT-II. Out of 10 patients with IFG+ IGT %50 of them also developed DM in one year follow-up. None of IFG patients were diagnosed as DM and none of the patients with IFG+ IGT became normal. These results may show us that an OGTT close to discharge may not be sufficient, and another OGTT later in the first year may be relevant in order to demonstrate the accurate metabalic status of the patients with ACS. Our results also demonstrated that IGT was also an important risk factor for future DM at least in patients with ACS.

In Funagata study, it was determined that IGT but not IFG was a risk factor for death from cardiovascular disease.[33] In DECODE study, a high 2 hour glucose concentration was found to be associated with an increased risk of death, independent of the level of fasting blood glucose, whereas mortality associated with the fasting glucose concentration depend on the level of 2 hour, in all categories of fasting glucose.[34] Considering our results about IFG and IGT, we may speculate that patients in whom IGT is diagnosed when they are admitted to the hospital with ACS must be handled with more care.

A higher percentage of our patients had STEMI than NSTE-ACS both in OGTT-I and OGTT-II. STEMI in OGTT-I 68.6% and 70.2% in OGTT-II, and NSTE-ACS in OGTT-I 31.4%, 29.8% in OGTT-II. Out of 11 patients who died 7 of them (63.3%) had STEMI and 4 had NSTE-ACS (36.4%). As patients with STEMI are thought to have more serious myocardial injury and have higher incidence of at least early complications,[22,30] our results about STEMI patients either their incidence or their death rates, seems to be in concordance.

Some studies have shown that hyperglycemia in patients with ACS who do not have previously known diabetes is associated with a poorer outcome compared with patients with diabetes.[32,35] The better prognosis of diabetic patients may be explained by the thought that these patients may have proper treatment and tight follow-up. It was

interesting that none of our patients who died in the first year had had DM. The relationship between the way of treating DM and long term mortality has been demonstrated by authors.[36-38] It was reported that diabetic patients treated with insulin had significantly higher mortality rate compared to patients not treated with insulin.[36,38] All of our diabetic patients diagnosed after OGTT-I were given diet and oral anti-diabetic drugs. Necessity of insulin use, that was the gravity of diabetes mellitus or complications of insulin; hypoglycemia being the most severe ones might explain the poor prognoses of the patients with ACS who were on insulin.

In conclusion, in order to determine glucose metabolism status of the patients with ACS, we recommend to perform OGTT before the patients are discharged and also in the first year. This will provide us the chance of early diagnosing patients with abnormalities of glucose metabolism, protecting them from harmful effects of insulin resistance, successful handling of cardiometabolic risks. Our results also demonstrated that, glucose metabolism abnormalities were found in high rates in our population with ACS and that random glucose concentration at admission and fasting blood glucose may not determine the prevelance of these abnormalities.

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