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ASSOCİATİON BETWEEN METABOLİC SYNDROME PARAMETERS AND QT DİSPERSİON

Health Science

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ABSTRACT

Aim: The aim of the present study was to compare QT dispersion between normoglicemic patients and metabolic syndrome patients to investigate the effect of cardiovascular risk factors.

Methods: 119 patients with metabolic syndrome who have impaired glucose tolerance and type II Diabetes and 115 patients with metabolic syndrome who are normoglicemic were included in the present study. All patients underwent ECG examination. QT interval, measured and corrected QT(QTc) interval value and QT dispersion (QTd) and corrected QT dispersion (QTcd) were calculated.

Results: Significant difference was found between patients with hyperglicemia and those who are normoglicemic in terms of QT dispersion, (p:0.029). There was positive correlation between QT dispersion and systolic arterial blood pressure and metabolic syndrome parameters (16.3%).

Conclusion: It was suggested that hyperglicemia in patients with metabolic syndrome, led to the prolongation of QT dispersion, which reflects heterogenity of ventricular repolarization anr risk of arryhthmias.

KEYWORDS

metabolic syndrome, cardiovascular risk, QT dispersion

INTRODUCTION:

Metabolic syndrome is a disease associated with industrialization and urbanization and assumes importance increasingly. Therefore, many studies have been carried out on it. It was originally defined by Reaven at the end of last century and termed as syndrome X. Obesity and metabolic syndrome, which has become one of the most important health problems at present, is an issue that should be adressed rapidly, as its prevalence increases throughout the World and is accompanied by the risk of other comorbid diseases. Since 80% of type II DM patients are obese, it can be stated that obesity is an important risk factor for type II Diabetes. Whether obesity by itself leads to glucose intolerance or there is another factor leading to both obesity and diabetes still remains to be explained. However, current consensus is that obesity aggravates hepatic inslin resistance(IR), which is already present in type II DM. Hypertension is among the best known risk factors of both diseases and is a significant health problem affecting particularly adult population. The most important cause of cardiac origin sudden death is cardiac arrhythmias associated with ventricular tachycardia and ventricular fibrilation. In action potentials of patients who have long QT in their ECG, non homogenous changes are present, which in turn, facilitates the development of ventricular fibrilation by leading to development of early or late repolarization. QT dispersion (QTd) is a a parameter indicating the heterogenity of ventricle repolarization and which can be calculated non invasively from electrocardiography Increased QT dispersion was found to be associated with severe arrhythmia and risk of sudden death in many patients and patient groups. The aim of the present study was to compare QT dispersion between normoglicemic patients with metabolic syndrome and the patients who also have impaired glucose tolearnce and diabetes mellitus in additin to metaboklic syndrome and to investigate the effect of cardiovascular risk factors and biocehmical parameters on QT dispersal in these patients.

METHODS:

Patients who referred to Internal Medicine outpatient clinic of Haseki Training and Investigation Hospital and met at least three criteria of metaboic syndrome parameters and whose waist circumference was over 88 cm in women and 102 cm in men were included in the present study. The definition of metabolic syndrome according to criteria of; Adult Treatment Panel III(ATP III) were as follows: (1) waist circumference in male>102, female>88, (2) Trigliceride>150 mg/dl (1,69mmol/l), (3) HDL cholesterol in male<40mg/dl (1,04mmol/l), in female<50 mg/dl (1,29mmol/l), (4) Systolic blood pressure>130mmHg and/or diastolic blood pressure>85 mmHg or receiving hypertension treatment, fasting blood glucose>110 mg/dl (6,1mmol/l) or diabetes treatment. Patients who meet three or more of the above criteria were considered to have metaboic syndrome. Those who have other chronic diseases, who are on drugs affecting heart rate and ECG findings, and alcohol users were excluded from the study. Anthropometric measurments were made and age, sex, and BMI and waist circumference of patients were recorded. All patients underwent 12 lead ECG. Heart rate, RR; and QT intervals were measured. From QT intervals, QT values corrected according to heart rate (QTc) were calculated with Bazzet formula: (QTC=(QT/(√RR))) QT interval was considered as the distance from the beginning of QRS complex to the end of T wave. In ECG's with U wave, the lowest point between T and U waves was considered as the end of T wave. Leads in which the end of T wave could not be completeley detected were not analyzed. Patients whose QTc interval was calculated at at least 9 leads were included in the study. QT dispersion (QTd) was calculated based on the diference between smalest QT interval and the largestQT interval. Corrected QT dispersion (QTcd) were calculated by finding the difference between longest corrected QT and shortest corrected QT. All measurements were carried out manually. In venous blood samples drawn following 12 hours fasting, biochemical values were evaluated. Those with abnormal findings were not included in the study. Patients included in the study were divided into two groups, i.e. those who are diabetic and have fasting blood sugar level over 110mg/dl and those who are normoglicemic. All data obtained in the study were recorded on the computer and were evaluated using SPSS (Statistical Package for Social Sciences) for Windows 16.0 program. In descriptive statistics, continuous variables were expressed as mean and standard deviation and categorical variables as percentage. Their distribution was evaluated using Kolmogorow-Smirnow test. In the comparion of two groups, if numerical data were distributed normally, Student's t test was used. If they were not normally distributed, Mann Whitney U test was used. Categorical variables were evaluated with chi square test. In the comparion of more than two groups, Anova test was used.

In the comparion of two numerical data, Pearson Spearman correlation test was employed. A p<0,05 value or %95 confidence interval was considered statistically significant.

RESULTS:

Qtcd was found to be significantly different between patients with impaired glucose tolerance and type II Diabetes Mellitus and normoglicemic ones, (table 1). There was positive correlation between systolic blood pressure and QTcd at the rate of 16.3%, between diastolic blood pressure and QTcd at the rate of 16% (p<0.05) and a stitically significant positive correlation between mean blood pressure and QTcd at the rate of 17.3%. (p<0.01).There was also a significant positive correlation at the rate of 15.7% between serum glucose level and QTcd (p<0.05), (table 2). There is no interaction between impaired glucose tolerance and type II Diabetes Mellitus and hypertension, (p:0.990). According to the presence of absence of impaired glucose tolerance and type II Diabetes Mellitus, QT dispersion may vary, (p:0.009). In addition, QT dispersion may also change depending on whether hypertension is present. A (P=0.004), (table 3). Patients whose waist circumference was over 88cm in women and 102 cm in men and who satisfied at least 3 parameters of metabolic syndrome (obesity plus 2), were divided into three groups: i.e. those who meet 3,4 and 5 criteria. Grup 1, 2 and 3 included respectively 75, 94 and 65 patients. QT cd values were calculated separately for each group. When these groups were compared with each other, significant QT cd prolongation was found in the third group meeting all parameters of Metabolic Syndrome compared to the group meeting three parameters, (p<0.05). With multiple regression analysis, QT dispersion was evaluated as dependent variable and age, systolic blood pressure, diastolic blood pressure, impaired glucose tolerance and DM as independent variable. In the prediction of QT dispersion, the presence of impaired glucose tolerance and type II Diabetes Mellitus were found to be significant factors, (table 4).

Table 1: The frequency of parameters in patients with Metabolic Syndrome

		QT dispersion (Bazzet)	P
Sex	Female	35,93 ± 15,62	0,071
	n:164 (%70,1)		
	male	32,06 ± 13,24	
	n:70(%29,9)		
Impaired glucose tolerance and type II Diabetes Mellitus	yes	32,59 ± 13,74	**0,029**
	n:115 (%49,1)		
	no	36,88 ± 15,95	
	n:119 (%50,9)		
Hypertension	yes	25,55±9,29	0,047
	n:10 (%4,3)		
	no	35,18±15,12	
	n:224 (%95,7)		
Hypertrigliceridemia TG ≥150	yes	34,58±12,53	0,876
	n:93 (%39,7)		
	no	34,90±16,52	
	n:141 (%60,3)		
Low HDL HDL ≤40 (male) and/or HDL ≤ 50 (female)	yes	32,61±10,99	0,40
	n:30 (%12,8)		
	no	35,09±15,53	
	n:204 (% 97,2)		

Table 2. Correlation between QTcd (Bazzet) and demographic, clinical and biochemical parameters

	Number of cases	r value	P value
Body Mass Index	234	0,081	0,251
Waist circumference (cm)	64	0,171	0,174
Systolik Arterial Blood Pressure (mmHg)	234	0,163	**0,012**
Diastolic Arterial Blood Pressure (mmHg)	234	0,160	**0,015**
Mean Arterial Blood Pressure (mmHg)	234	0,173	**0,008**
Glucose (mg/dl)	234	0,157	**0,017**
Total Cholesterol (mg/dl)	234	-0,010	0,883
Triglycerides (mg/dl)	234	0,032	0,628
HDL cholesterol (mg/dl)	234	0,41	0,531
LDL cholesterol (mg/dl)	234	-0.035	0,590
VLDL cholesterol (mg/dl)	234	0,094	0,163

Table 3. Evaluation QTd values in the presence or absence of diabetes and hypertension

Diabetes mellitus	*Hypertension*	*Mean QTd*	*Std. Deviation*	*n*
no	no	22,9500	6,86659	4
	yes	32,9351	13,81340	111
	total	32,5878	13,73799	115
yes	no	27,2833	10,86415	6
	yes	37,3876	16,05363	113
	total	36,8782	15,95449	119
total	no	25,5500	9,28957	10
	yes	35,1813	15,11744	224
	total	34,7697	15,02906	234

Table 4. The relationship between patients with metabolic parameters and QTd values

Number of Metabolic Parameters In the Patients	QT dispersion	p value
3 Parameters (N:75)	32,41±12,54	
4 Parameters (N:94)	33,98±13,63	0,040
5 Parameters (N:65)	38,64±18,65	

DISCUSSION:

Increased QT dispersion has been found to be associated with severe arrhythmia and risk of sudden death in many disease groups (1,2). It is believed that homogenity of ventricular resting time is protective against arrhythmias. QT dispersion was originally defined by Cowan et al as the distance between longest and shortest QT intervals in standard 12 lead ECG. It is known that increased QT dispersion indicates the increased heterogenity of ventricle repolarization (3,4). Day et al

established that in patients with long QT syndrome, increased QT dispersion may indicate the risk of ventricular tachycardia. Increase in QT dispersion (QTcd), which reflcets the loss of homogentity in various cardiac pathologies, was used in order to determine the risk of fatal arrhythmia in various cardiac pathologies. However, the rate and prognostic value of this arrhythmia indicator in hypertension is not completely known. In various studies, it has been established that, in patients with hypertensive LVD, QTcd increased and there was a direct correlation with the degree of hypertrophy (5,6).

There are conflicting ideas on the effect of age on QT, QTc interval and dispersion. While it as been reported in some studies that age is an important factor and may lead to prolongation in all of these values, some suggested that age has no important effect or leads to minimal QT prolongation which becomes more marked only when it is evaluated together with sex parameter, or with exercise (7,8). In patients with Type II Diabetes, mortality is quite high compared to non diabetic individuals and cardiovascular diseases are among leading causes of mortality. In patients with diabetes, compared to non diabetic individuals, increased QT dispersion has been found independent of hypertension and cardivascular complications (9,10). In diabetic patients, QT prolongation and dispersion was found to be associated with sudden cardiac death related to ventricular arrhythmia, increased risk of death due to coronary artery disease and autonomic neuropathy and total mortality (11,12). In patients with diabetes, myocardial ischemia, hypertrophy and patch pattern fibrosis caused by ventricular dilatation have been suggested to be amoong possible causative mechanisms of QT prolongation and dispersion. Nevertheless, it is also thought that, autonomic dysfunction, which leads to heterogenous ventricle repolarization, also contributes to QT prolongation and increase in dispersion increase (13).There are some studies reporting that, especially in diabetic patients, hyperglicemia and hypoglicemia increase QT interval and dispersion (14). Acute hyperglicemia also exerts various effects on cardiovascular system. Hyperglicemia prevents ischemic preconditioning, which is a protective mechanism in ishemia. As a consequence of decreased collateral coronary blood flow, the size of infract increases. In addition, acute hyperglicemia may result in the death of myocytes in heart, via cellular injury due to apoptosis or ischemic reperfusion. It has been proposed that increased sympathetic activity caused by hyperglicemia, increase of calcium in myocytes or both increase ventricular instability, which is mirrored in QT prolongation (15). In a study carried out in 2000 over 27 healthy volunteers, which investigates the effect of acute hyperglicemia on QTc interval, it was established that acute hyperglicemia increased both QTc max duration and QTc interval. Authors have suggested that in patients with diabetes, hyperglicemia may be a mechanism contributing to prolongation of QTc interval in addition to other mechanisms. In the present study, in which the difference in QT dispersion between metabolic syndrome patients with hyperglicemia (impaired glucose tolerance and type II Diabetes Mellitus) and those who are normoglicemic was evaluated (16). The present study was demonstrated that in hyperglicemic patients, QT parameters are prolonged independent of the complications of diabetes. In metabolic syndrome, each metabolic syndrome parameter added, increases QT dispersion and independently contributes to arrhythmia and mortality increase. Therefore, it is recommmended that patients should be screened for each of metabolic syndrome parameters, necessary precautions should be taken against criteria which have not been fulfilled yet, and all MS syndromes should be controlled separately in patients. There was positive correlation between systolic arterialblood pressure and QTcd at the rate of % 16,3 ($p<0.05$), positive correlation between diastolic blood pressure and QTcd at the rate of 16%($p<0.05$) and significant positive correlation between mean arterial blood pressure and QTcd at the rate of 17.3%, ($p<0.01$). As solely the patients fulfilling the criteria of Metabolic Syndrome were included in the present study, large majority (95.7%) had hypertension. Many had recent onset or undiagnosed disease. In various studies, it has been established that in patients with hypertensive left ventricle hypertrophy, QTcd increases in direct correlation with the degree of hypertrophy (17).Several other risk factors were implicated in prolonged QT interval in diabetes, including systolic and diastolic blood pressure (18).

In the present study, a significant relation was found between hypertension and QTcd. However, when comparison is made between hypertensive and normotensive patients, as the number of normotensive patients is very few, correlation between arterial blood pressure in patients and QTcd is significant. Long-term high-intensity interval training associated with lifestyle modifications improves QT dispersion parameters in metabolic syndrome patients(19). Hyperglycaemia and coronary heart disease are strong predictors of high-risk QTc (20). In conclusion, it was thought that in patients with Metabolic syndrome, hyperglicemia and hypertension led to the prolongation of QT dispersion, which reflects the heterogenity of ventricular repolarization, causing more common vemtricular arrhythmias and sudden cardiac death. Therefore, it is suggested that good control and treatment of hyperglicemia and hypertension is of greater significance.

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