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Repolarization disorders in high coronary risk patients with metabolic syndrome and without metabolic syndrome

The interest in metabolic syndrome in the cardiovascular system diseases aspect relates to the presence of a chain of ischaemic heart disease risk factors which contribute to the syndrome diagnosis (1, 2, 13). The repolarization period registered on the ECG as the QT interval is bound to the influence of many factors in physiological and pathological conditions. A corrected QT/QTc time is a prognostic factor in sudden cardiac death, hence the interest in the influence of the ischaemic heart disease risk factors on the repolarization period and in a diffusion of these changes in epidemiological reserch (13, 10).

The objective of the present study is to estimate and compare the QTc interval in patients with the highest cardiovascular risk with and without metabolic syndrome.

METHODOLOGY OF THE TESTS

This research is a continuation of the tests on the ischaemic heart disease (i. h. d.) risk factors within the local epidemiological tests. Patients from a high and a very high-cardiovascular-risk group were tested according to a pattern including the data about the i. h. d. risk factors (NT hypertension, diabetes, overweight, obesity, education, burden family history (f. h.), smoking, previous vascular episodes). The patients with previous myocardial infarction and stroke were excluded from the tests.

The measurements taken twice were of the blood pressure after rest (the average result was registered) and of the ECG at rest which was the base to measure the QT segment. A segment between the beginning of the Q wave and the end of the T wave was taken as the QT distance (in the passage place from the T wave to the isoelectric line). If the T wave overlapped the U, the lowest T point was taken as the end of the T wave. The measurements were taken by 2 persons using a compass and a magnifying glass, from at least 2 leads, the average measurement result was registered. QTc was calculated from the Bazett's formula where the QTc taken as the regular was QTc < 0.45 for women (W) and QTc < 0.43 sec for men (M); the borderline 0.45–0.46 sec W, 0.43–0.45 M; the extended QTc > 0.46 sec W, QTc > 0.45 sec M (10).

The lipidogram values were determined with an enzymatic method using a bioMerieux test. Blood samples were taken on an empty stomach, after 12 h of starvation. The glucose concentration on an empy stomach was determined by the enzymatic method with glucose oxidase.

The metabolic syndrome was diagnosed using the metabolic syndrome definition given by the International Diabetes Federation in 2005 (14). The metabolic syndrome patients (MS) were separated from the high and very high ischaemic heart disease risk patients and were compared to those who did not comply with the metabolic syndrome criteria (WMS).

The material was analysed statistically using Statistica 5.0 computer programme. The averages were compared through parametric t-Student tests and one factor analysis of variance (ANOVA), cross-tabs, chi-square nonparametric test.

MATERIAL AND RESULTS

The examined population of high and very high-coronary-risk patients counted 203 persons, betwen 33 and 65 years, with the average of 52.18 ± 7.516. In this group 131 persons (64.5%) were women and 72 persons (35.5%) were men.

Sixty persons (29.6%) complied with the MS criteria, here 39 (19.2%) W and 21 (10.3%) M. The MS was not diagnosed in the rest of the patients i.e. 143 people (70.4%), here 92 (45.3%) W and 51 (25.1%) M.

Patients with BMI up to 25 had their average QTc 0.432 ± 0.045 sec, in those with BMI from 25 up to 29.9 QTc was 0.419 ± 0.412 sec. and QTc in patients with BMI >= 30 was 0.415 ± 0.033 sec ($P < 0.05$). In patients with BMI 25–29.9 the regular QTc occurs in 65 persons (69.9%), in 33 W (55.9%) and 32 M (94.1%), and with BMI >= 30 the regular QTc occurs in 41 (75.9%), in 20 W (62.5%) and 21 M (95.5%). Therefore, among the examined patients with BMI > 25 a considerable majority of men (over 90%) have a regular QTc, while among the women approx. 40% have a QTc borderline or extended ($P = 0.01$).

In the population examined the percentage of patients with abdominal obesity (WHR >= 0.9) was in fact statistically bigger in men – 52 (72.2%) in comparison to W (WHR >=0.85) in 50 (38.2%) W ($P < 0.05$). In all the patients (women and men) with abdominal obesity (WHR >0.85 W/WHR > 0.9 M) the average QT value was 0.378 ± 0.031 sec, and in patients without abdominal obesity (WHR < 0.85 W / 0.9 M) was smaller – 0.370 ± 0.034 sec. The difference of QT averages is close to the statistical significance ($P=0.067$). However, the QTc time, irrespective of the WHR value, is almost identical and its average in patients with abdominal obesity equals to 0.421 ± 0.037sec and without abdominal obesity QTc equals to 0.422 ± 0.44 sec. The statistically significant differences concern the comparisons in the group of men. In those with abdominal obesity (WHR>=0.9) there were observed higher average QT values (0.376 ± 0.031 sec) in comparison to men without abdominal obesity (QT=0.365 ± 0.03 sec) ($P = 0.017$). But such differences were not observed as regards the QTc and there was not such a dependence in the population of women. In W with abdominal obesity (WHR>=0.85) the average QTc time (0.423 ± 0.033 sec) in comparison to W without abdominal obesity (WHR < 0.85) (QTc – 0.424 ± 0.047 sec). The differences were statistically insignificant.

If the compared parameter is a diffusion of different QTc values, then extended / borderline QTc values in abdominal obesity (> 0.85 W />0.9 M) occur more frequently in women – in 42.9% women (21 persons) than in men – 13.5% (7 patients) and regular QTc values are more frequent in men – 86.5% (45 M) than in women 57.1 % (20 W). The difference was statistically significant ($P=0.01$).

In patients with diabetes, extended and borderline QTc values occur in 20% (2 patients) and in patients with coronary heart disease in 25% of those examined (5 persons). A small dimension of these groups does not allow to compare them. However, among men without diabetes and ischaemic heart disease the percentage of regular QTc is higher than that of women's QTc ($P = 0.001$).

Table 1. Average values and a diffusion of some coronary disease risk factors in patients with and without MS

Parameter		MS group	WMS group	P
Age (average)		52.17 ± 7.57	52.19 ± 7.52	
Burden family history	% (number)	46.7% (28)	26.6% (38)	*
BMI (average)		27.88 ± 4.81	27.26 ± 4.73	
WHR (average)		0.88 ± 0.09	0.86 ± 0.08	
QTc (sec) (average)		0.42 ± 0.04	0.42 ± 0.04	
QTc extended	% (number)	16.7% (10)	11.9% (17)	
QTc borderline	% (number)	16.7% (10)	21.7% (31)	
QTc extended and borderline	% (number)	33.4% (20)	33.6% (48)	

*P < 0.05

There were not found any statistically significant differences in average QTc values and in a diffusion of extended QTc values according to the diagnosis of arterial hypertension, hyperlipidaemia, glucose level on an empty stomach, menopause or using hormonal replacement therapy.

DISCUSSION

A burden family history is a recognized ischaemic heart disease risk factor. In the examined population of patients with MS in comparison to those who did not comply with the MS criteria, a diffusion of burden family history was bigger. It agrees with information about the participation of a genetic factor in the ischaemic heart disease and MS pathogenesis. The genetic tests results received up till now have shown the presence of many genes which reveal their influence depending on the environmental conditions. This belief in the coronary heart disease genetic determinations with a simultaneous influence of environmental factors has existed for a long time and it has been confirmed thanks to the recent genetic tests. The latest ECS recommendations concerning prevention take into account the genetic determination of the coronary heart disease and of the sudden cardiac death in population strategy and high coronary risk strategy (5, 12, 13).

In population tests published by Leotta G. et al. (6) the extended QTc was found in 10% of women and 5% of men in the general population. In our population of high and very high coronary risk patients, as predicted from the bibliography data, the percentage of persons with extended QTc values was bigger and concerned 13.3% of the population (27 examined patients). In the Leotta tests, a diffusion of extended QTc values in women and men was different, while in our population was very similar. These values were 13.0% among women (17 W) and 13.9% among men (10 M). The differences between women and men were observed by comparing the diffusion of extended/ borderline values. The diffusion of QTc values in women was bigger if compared to men and in men it was more often regular.

The metabolic syndrome is considered as simultaneously prior to the type 2 diabetes and cardiovascular incidents through the presence of metabolic and cardiovascular coronary risk factors. These factors modify the repolarization interval time (13, 14). In the examined population of patients with metabolic syndrome the diffusion of extended QTc values was 16.7% and it was bigger if compared to the patients without metabolic syndrome (11.9%); whereas the diffusion of extended / borderline values was similar in the examined groups of patients. Absence of any statistically significant diferences can be explained by a big global coronary heart risk resulting from an incidence of many risk factors in both groups and its dimension. The WHR factor reflecting a way of fat distribution seems to be a better abdominal obesity index than the BMI. In many epidemiological

tests the abdominal obesity being one of the main MS components is considered as an independent coronary heart disease and sudden cardiac death factor (4, 8, 9, 10).

In the examined population the abdominal obesity appears more often in men if compared to women, and men with abdominal obesity have higher QT average values in comparison to those without abdominal obesity, a fact not to be observed in women. Therefore, the abdominal obesity in the examined men population expressed in WHR value correlated in a significant way with the average QT time, though such a dependence in reference to the QTc was not observed.

However, the Esposito tests on W (4) revealed a prolongation of the repolarization time and a night pressure fall reduction in women with abdominal obesity if compared to those without obesity. It was to relate to disorders in the autonomous nervous system which were observed in case of obesity as the obesity used to be associated with a sympathetic overactivity. An influence on the brain stem centres and an increase of the sympathetic system activity through a stimulating influence of the food assimilated, is the reason for changes in the repolarization interval time (9, 11).

If our estimations concerning the repolarization disorders of the chambers in the obese people in our population we based then on a diffusion of different QTc values, in women with abdominal obesity the extended/borderline QTc was found more often than in men. The abdominal obesity is considered as an independent coronary risk factor and the extended QT accompaning this obesity can cause dangerous heart arrhythmia.

However, fat loss decreases an inclination to the arrhythmia by shortening an extended QT. In many researchers' opinion the visceral fat can be one of the risk factors for the appearance of the extended QT during the menopause period (3, 4, 7, 8, 9, 11).

In our research we did not observe any changes in the QT field which could depend on the menopause or on the use of the HRT while we observed such changes depending on the abdominal obesity.

CONCLUSIONS

A burden family history was found more often in the patients with a big global coronary heart risk having at the same time a metabolic syndrome. In the metabolic syndrome in comparison to the remaining group of high and very high coronary heart risk, the repolarization disorders are found more often depending on the incidence of different cardiovascular risk factors, here particularly on the abdominal obesity. Further research, here genetic tests, into the metabolic syndrome pathogenesis is essential for development of efficient prevention and therapeutic strategies.

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SUMMARY

The objective of this research is to compare the repolarization disorders on the basis of the QT interval in high cardiovascular risk patients with metabolic syndrome (MS) and without metabolic syndrome (WMS). The research methodology: MS was diagnosed according to the definition given by the International Diabetes Federation in 2005; the patients with MS were compared to the patients WMS. The QTc was calculated from the ECG according to the Bazett's formula, taking as an extended QTc > 0.46 sec for women (W), QTc > 0.45 sec for men (M), as a borderline QTc 0.45–0.46 sec for W, 0.43–0.45 sec for M, as a regular QTc < 0.45 sec for women (W) and QTc < 0.43 sec for men (M). There were examined 203 persons aged from 33 to 60 years, including 131 W and 72 M. The research results: 60 persons (29.6%) had MS, here 39 (19.2%) W and 21 (10.3%) M. An extended QTc was observed in 10 patients (16.7%) with MS and 17 patients (11.9%) WMS. The differences statistically insignificant. In patients with MS (28 persons / 46.7%) in comparison to patients WMS (38 persons / 26.6%) burden family history was observed more often ($P < 0.05$). Among the examined patients with the BMI > 25 approx. 95% of men have a regular QTc, while among the women tested approx. 40% have a borderline/extended QTc (P= 0.01). In patients with abdominal obesity (WHR>=0.85W/WHR>0.9 M) an extended/borderline QTc was observed in 42.9% of women (21 W) and in 13.5% of men (7 M), a regular QTc – in 20 W (57.1%) and 45 M (86.5%) (P=0.01). In men with abdominal obesity (WHR>=0.9) there were observed higher average QT values (0.376 ± 0.031 sec) in comparison to the patients without abdominal obesity (QT=0.365 ± 0.03 sec) (P=0.017), in QTc such a dependence was not observed. A diffusion of extended/borderline

QTc values in the abdominal obesity (>0.85W/>0.9 M) is found in 42.9% of women (21 persons) and in 13.5% of men (7 patients), and a regular – in 57.1% (20 W) and 86.5% (45 M) (P = 0.01). High and very high global coronary heart risk patients having simultaneously metabolic syndrome have more often a burden family history and repolarization disorders are also more often found depending on the incidence of cardiovascular risk factors, mainly the abdominal obesity.

Zaburzenia repolaryzacji w populacji pacjentów wysokiego ryzyka wieńcowego z zespołem metabolicznym i bez zespołu metabolicznego

Celem pracy jest porównanie zaburzeń repolaryzacji na podstawie odstępu QT u pacjentów dużego ryzyka sercowo-naczyniowego z zespołem metabolicznym (ZM) i bez zespołu metabolicznego (BZ). ZM rozpoznano według definicji International Diabetes Federation z 2005 r., porównano pacjentów z ZM i BZ. Z ekg obliczono QTc według Bazetta, przyjmując za przedłużone QTc >0,46 sek dla kobiet (K), QTc>0,45 sek dla mężczyzn (M), za graniczne 0,45–0,46 sek K, 0,43–0,45 M, za prawidłowe QTc<0,45 dla kobiet (K) i QTc<0,43sek dla mężczyzn (M). Zbadano 203 osoby w wieku od 33 do 65 lat, w tym 131 K i 72 M. Z ZM było 60 (29,6%) osób, w tym 39 (19,2%) K i 21 (10,3%) M. Przedłużone QTc obserwowano u 10 (16,7%) chorych z ZM, a u 17 (11,9%) z BZ. Różnice były nieistotne statystycznie. W ZM (28 osób 46,7%) w porównaniu z pacjentami BZ(38 pacjentów – 26,6%) częściej występował obciążający wywiad rodzinny (P<0,05). Wśród badanych z BMI>25 ok. 95% mężczyzn miało QTc prawidłowe, natomiast wśród kobiet około 40% wykazywało QTc graniczne/przedłużone (P=0,01). U pacjentów z otyłością brzuszną (WHR >0,85 K/WHR>0,9) obserwowano przedłużone/graniczne QTc u 42,9% kobiet (21K) i u 13,5%mężczyzn (7M), prawidłowe u 20 (57,1%K) i 45 (86,5%M)(P=0,01). U mężczyzn z otyłością brzuszną (WHR >=0,9) obserwowano wyższe średnie wartości QT (0,376±0,031sek) w porównaniu z pacjentami bez otyłości brzusznej (QT=0,365±0,03 sek) (P=0,017), w przypadku QTc nie obserwowano takiej zależności. Rozpowszechnienie przedłużonych/granicznych wartości QTc w otyłości brzusznej (>0,85 K/>0,9 M) występuje u 42,9% kobiet (21 osób) i u 13,5% mężczyzn (7 pacjentów), prawidłowe u 57,1% (20 K) i 86,5% (45 M). (P=0,01). Pacjenci z dużym i bardzo dużym globalnym ryzykiem wieńcowym jednocześnie występującym z zespołem metabolicznym częściej mają obciążający wywiad rodzinny oraz częściej występują u nich zaburzenia repolaryzacji zależnie od współistnienia czynników ryzyka sercowo-naczyniowego, szczególnie otyłości brzusznej.