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Analysis of Efficiency of Mathematical Model of Prognosticating the Emergence of Heart Vehicle Restenosis Risk in Cardiological Practice.

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ABSTRACT

The article gives the results of efficiency check of mathematical model of prognosticating the emergence of heart vehicle restenosis risk in cardiological practice, developed on the basis of research of the influence of biochemical analyses and stenosis localization on the progress of heart vehicle restenosis by using Software Statistica 7.0 and Microsoft Excel.

Keywords: restenosis, mathematical modeling, inverse stepwise regression, prognostication, stenosis localization, biochemical blood analysis, heart vehicle, lipid profile.

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INTRODUCTION

In contemporary research works great attention is directed to the development of new methods of diagnosis of heart vehicle restenosis [1,2], and the development of materials and stent coating to decrease the probability of restenosis progress [3,4]. The less focus on the causes of restenosis emergence has prompted composite authors on conducting a number of researches. As a result of previous studies the composite authors have suggested the mathematical model of prognosticating the progress of heart vehicle restenosis risk based on biochemical and genetic analyses [5-7]. Introduction of the developed model into current clinical practice is complicated by high cost of doing genetic researches and also by absence of the required equipment for their conducting in most clinic patient care institutions. In this connection a simplified mathematical model based on the very biochemical analysis of the lipid profile has been developed [8]. The model has been represented by four equations for every stenosis localization under study: obtuse marginal branches (OMB), circumflex artery (CA), right coronary artery (RCA) and left anterior descending artery (LAD).

METHODS

Grounds for the choice of lipid profile as the component of simplified mathematical models are the revealed correlations [9-12] between separate indicators of lipid metabolism and the level of markers of acute inflammation phase as indicators of immunoinflammatory component of atherosclerotic process in patients with coronary heart disease (CHD).

Under medical observations there have been 122 patients with ischemic heart disease being on hospital treatment in Belgorod Clinical Hospital of Saint Joasaph. The diagnose of CHD was established according to guidelines of ARSSC (year 2004) on the basis of randomization by low degree of patient adherence to prescribed statin therapy at pre-hospital stage. Initially hyperlipidemia is detected in 33.4 % of patients: pancreatic diabetes – 44%, postinfarction cardiosclerosis – 45% of patients.

THE MAIN BODY

The results of coronary angiographic researches in the cohort of patients with CHD show dominating localization of clinically important stenosis in left anterior descending artery (78.1%), circumflex artery(54.7 %), obtuse marginal branches(29.2%), right coronary artery (57.6%).

In the population of patients with CHD to be examined intracoronary stenting with isolated metallic (64%) and medication- impregnated (36%) constructions has been employed. The stenocardia clinic has continued in 6.5±2.2 months after endovascular angioplasty in 15 patients (12.3%) with registered symptoms of restenosis in the zone of intervention by reangiography. Five patients with implanted metallic stent and ten ones with implants coated with medications turned out to be in the group of patients suffering from restenosis. In 3% of the cases there has been found hemodynamic important atherosclerotic lesion in the other coronary vessel, this fact corroborates the data about initiation by endovascular intervention of the mechanism of «accelerated» progress of atherosclerosis.

The control group consisted of 25 practically healthy persons aged 47.0±8.6 without symptoms of heart disease. The conducted researches have shown significant increase of indicators of C-reactive protein (CRP) and interleukin-6 (IL-6) in 4 patients with CHD in comparison with healthy persons. Lipid profile abnormalities have been revealed – the value increase of low density lipoproteins (LDP) to 4.18±0.2 mole per liter ($P<0.001$), of very low density lipoproteins (VLDP) to 1.05 ±0.11 mole per liter ($P<0.001$), of triglycerides to 2.14±0.19 mole per liter ($P<0.05$) and of total cholesterol to 5.13±0.2 mole per liter ($P<0.0001$) – in patients with CHD as compared to the result of the control group. The presence of coexistent diabetes, the symptoms of old myocardial infarction and also initially registered dyslipidémie had significant influence on the data of indicators as compared to opposite selected patients with CHD.

The obtained data prove the correlation between the level of exopathic lipids and the level of inflammation indicator and also confirm their impact on the progression of coronary insufficiency. By analyzing the symptoms of antiinflammatory markers, lipid metabolism and genetic factors in persons with phenotype of Tf CC, reflected in the previously presented mathematical model [8], it has been established the increase of value of the tumor necroses α-factor, LDL and triglycerides, especially in patients of Tf C1C1 phenotypes.

The obtained data postulate the validity of selected indicators of the lipid profile, localization and value of stenosis in simplified mathematical model of the restenosis progress risk after coronary vehicle stenting and predetermine the necessity of assessment of its efficiency in clinical practice.

Thus, it has been developed the models of prognostication of the restenosis value R_n. Then for each of these models the mean error of prognostication R_n has been determined. So for OMB the mean error of prognostication is 33.89%, for CA the mean error of prognostication – 37.19%, for RCA the mean error of prognostication – 52.06%, for LAD the mean error of prognostication - 39.32%. To determine model-sensitivity at different intervals of the values of restenosis R the following gradation of values has been introduced (see Table 1):

- At restenosis progress with vessel blocking from 30% to 60% (30%<=R<=60%).
- At restenosis progress with vessel blocking from 60% to 100% (60%<R<=100%).

Table 1: The results of the analysis of efficiency of mathematical model of prognosticating heart vehicle restenosis

Intervals of values of restenosis R	The mean error			
	OMB	CA	RCA	LAD
The value of mean error at the total interval of restenosis R	33.89%	37.19%	52.06%	39.32%
The value of mean error at the interval 30%<=R<=60%	27.08%	55%	35.77%	47.69%
The value of mean error at the interval 0%<R<=100%	44.1%	22.95%	77.23%	22.99%

CONCLUSION

The approbation of the developed models shows their practically significant efficiency with prognosticating 64%-78% risk of restenosis progress after coronary vehicle stenting and urges the importance of their introduction into cardiology departments to work out the ways of intensification of preventive pharmacology of elective intracoronary intervention.

SUMMARY

Thus, for each model localization the following intervals with high degree of efficiency are singled out:

- At the interval 30%<=R<=60% the value of mean error for OMB is 27.08%;
- At the interval 0%<R<=100% the value of mean error for CA is 22.95%;
- At the interval 30%<=R<=60% the value of mean error for RCA is 35.77%;
- At the interval 0%<R<=100% the value of mean error for LAD is 22.9%;

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