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Valentina K. Serkova
Sergey V. Pavlov
Sergey M. Ziepko
Valentina A.Romanava

INFORMATION MODELS FOR ASSESSMENT OF CORONARY HEART DISEASE DESTABILIZATION, BASED ON THE ANALYSIS OF THE LEVEL OF SOLUBLE VASCULAR ADHESION MOLECULES

Vinnitsa Pirogov National Medical University
Vinnitsa National Technical University

Abstract

Problem of atherosclerosis, coronary heart disease (CHD) is one of the most actual problems in modern medicine. Nowadays, according to WHU more than 15 mil people die of cardio vascular diseases every year: majority of them do not survive to the age of 65. In the structure of mortality rate of the population from the diseases of blood circulatory system the first place is occupied by coronary heart disease (CHD). According to WHU data, various clinical forms of CHD are diagnosed in 15-20% of the adult population [1].

Keywords: *medical-expert system, biomedical research, adhesion molecules, local vascular inflammatory process.*

Introduction

Two approaches are used in medical expert systems for processing of information and organization of medical data [1]: fragmentation complexing. In the process of fragmentation the problem of data processing is divided into separate parts for its more efficient solution. In the process of complexing for solution of separate problems the parameters are united in larger sections.

In practice in medical-expert system (MES) both approaches find application, as the data of different studies are closely interconnected . The results of processing are used for verification of the diagnosis , choice of treatment methods ,forecast conclusions, etc. Analysis of the parameters, used by modern medicine is of great importance for the development of medical diagnostic – information system.

For each of data bases corresponding membership function are defined to formalize the indexes [4,8]. That is why, logic equations for assessment of disease severity will have the following form (1-4).

$$\mu^{d1}(X_1, X_2) = \mu^{H}(X_1) \cdot \mu^{HC}(X_2); \tag{1}$$

$$\mu^{d2}(X_1, X_2) = \mu^{HC}(X_1) \cdot \mu^{HC}(X_2) \vee \mu^{C}(X_1) \cdot \mu^{HC}(X_2); \tag{2}$$

$$\mu^{d3}(X_1, X_2) = \mu^{C}(X_1) \cdot \mu^{HC}(X_2) \cdot \mu^{BC}(X_1) \cdot \mu^{C}(X_2); \tag{3}$$

$$\mu^{d4}(X_1, X_2) = \mu^{BC}(X_1) \cdot \mu^{BC}(X_2) \vee \mu^{BC}(X_1) \cdot \mu^{BC}(X_2) \vee \mu^{B}(X_1) \cdot \mu^{B}(X_2). \tag{4}$$

In the process of biomedical research the problem of adjusting neurofuzzy network appears. For adjustment of this network parameters the recurrent relations, suggested by Professor O.P. Rotshtein are used [4]. The essence of the adjustment is the selection of such parameters of membership functions ($b_i^{jp}(t)$, $c_i^{jp}(t)$) and weights of fuzzy rules ($w_{jp}(t)$)that provide minimum divergence between models and diagnostic results.

$$\sum_{i=1}^{M} (F_y(\hat{x}_1^l, \hat{x}_2^l, \ldots \hat{x}_{12}^l, W_i) - \hat{y}_l)^2 = \min_{W_i},$$

where $\langle \hat{X}_l, \hat{y}_l \rangle, l = \overline{1, M}$ - data of experimental research; b – maximum coordinate; C – parameter of compression and extension.

OBJECT AND METHODS OF STUDY

Studies, dealing with the investigations of sVCAM content in the blood of patients suffering from CHI are not numerous and controversial. According to Ridker P.M. [5,6], increase of sVCAM level in healthy people was connected with high risk of acute infarction. The increased content of sVCAM was revealed in patients, suffering ASC (acute coronary syndrome) and stable CHD [5,8].

However, there are reports about insufficient diagnostic and prognostic value of adhesion molecules in the patients, suffering from CHD[8].

173 CHD patients were under observation (124 men and 49 women, average age – 57,2± 5,12years), these patients formed 2 main clinical groups – 92 patients with stable CHD, including 45 persons with II functional class (FC) and 47 persons- with III FC, 81 patients , admitted to hospital with acute coronary syndrome (43 patients with unstable (progressing) stenocardia and 38- with acute infarction). Diagnosis of stable CHD and variants of acute coronary syndrome was established in accordance with European Guidelines of European Society of Cardiology [1]. The survey did not contain patients with clinical implications of chronicle cardial insufficiency of III – IV functional class, with the expressed disturbances of liver and kidneys functioning, alcohol and drug dependence, acute or chronic inflammatory processes, with decompensated diabetes mellitus, thyroid disorders, third – fourth degree obesity, infectious diseases. Examination of the patients included interview, physical examinations, weighting, registration of 12 lead ECG, clinical blood analysis, clinical urine analysis (UA) determination of lipidic blood values (cholesterin total and high and low density lipoprotein, triglycerides), enzymes, creatinine, CRP by high sensitive method , BUN (blood urea nitrogen), electrolytes. Level of soluble vascular adhesion molecules (sVCAM), was detected using test-system, manufactured by the company BENDER MED SGGVYSTEMS (Austria).

The control group for determination of reference values of the studied indices consisted of 30 volunteers – 22 men and 8 woman (average age 55,37± 4,82 years) without clinical manifestations of CVD (cardiovascular disease), whom, to exclude CHD, cycle ergometer test was carried out and lipid blood composition indices were detemined .

Statistical processing of the results was carried out by means of software package Statistica 10.0 and Microsoft Excel 2000.

Results of the research and discussion. Average content of sVCAM in the persons of the control group was 626.0 ± 343.1 ng\ml, reference values – 557.0-694.0 ng\ml. Increase of sVCAM level occurred in 126 out of 173 patients (72,8%), however, the frequency and degree of the increase were not the same in various groups. When comparing the level of sVCAM with the severity of the disease, limiting indices were established and three degrees of increase were defined: minimal (from 695 to 810 ng\ml), average (810- 1110 ng\ml) and high (more than 1110ng\ml). The most expressed and the most frequent was the increase of sVCAM level in the patient with ACS, the differences of average values in the patients with non-stable angina pectoris and myocardial infarction were not reliable (Tabl 1).

Tabl.1 Level of sVCAM and C – reactive protein in CHD (M±m)

Indices	stable CHD			Instable progress		
	FC II	FC III	THE WHOLE GROUP	NS	MI	THE WHOLE GROUP
sVCAM, ng\ml	1062,8±38,3*	1322,2±55,1*#	1195,3±29,3*	1661,7±31,6*	1753,2±47,6*	1737,5±32,5^{+}
CRP, mg/l	2,74±0,09*	3,87±0,13*#	3,34±0,11*	6,04±0,32*	8,12±0,23*^	7,09±0619^{+}

Notes 1^{x}- validity of indices differences as compared with the control group at P<0,05; 2 + –validity of indices differences of the patients with FC III as compared with the group of patients with FC II at P<0,05; 3^ - validity of indies differences of patients with myocardial infarction as compared with the group of patients with non-stable angina pectoris at P<0.05; 4 + –validity of indies differences of patients with stable and non-stable process progress at P<0.05.

Frequency of CRP increase was the least among the patients with II FC of stable CHD (66/7%) and the greatest among myocardial infarction patients (92.1%). In the course of stable CHD progress frequency of CRP increase grew with the increase of disease severity and was 70.2% in case of III FC. Destabilization of the process and the progress of angina pectoris was accompanied by further increase of CRP level increase frequency (74.4%). Definite connection between the level of sVCAM and CRP content was recorded both in the group of patients with stable CHD (r=0.44, p<0.01) and ACS (r=0.57, p<0.01), this testifies the role of inflammation activation in the disorder of the adhesive function of the endothelium.

CONCLUSIONS

The research carried out, showed that the increased level of soluble adhesion molecules sVCAM – 1 in the blood of CHD patients is the reflection both of system and local vascular inflammatory process of low gradation, instability of atherosclerotic plaque and the possibility of ACS development.

Medical expert system is developed for assessment of destabilization of coronary heart disease on the base of soluble vascular adhesion molecules analysis. The content of adhesion molecules in the blood shows the risk of CHD destanation to a far greater degree than CRP content and could be the criterion of its destabilization and may serve as an index of process activity and one of the targets for treatment order, including realization of angioprotective interventions.

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Павлов Сергій Володимирович *- д.т.н., проф., Вінницький національний технічний університет, Вінниця. e-mail:psv@vntu.edu.ua;*
Злепко Сергій Макарович *– д.т.н., проф., зав.каф. Біомедичної інженерії, Вінницький національний технічний університет, Вінниця. e-mail: s.zlepko@ukr.net;*
Валентина Романава *– Вінницький національний медичний університет, Вінниця. e-mail:psv@vntu.edu.ua*
Валентина Серкова *– Вінницький національний медичний університет, Вінниця. mail:serkova490@gmail.com*