Abstract

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PREDICTION METHODS FOR RISK FACTORS OF CARDIAC RHYTHM AND CONDUCTION DISTURBANCES

Using clinical and statistical analysis for patients with coronary heart disease (CHD), we selected patients with and without signs of arrhythmias and conduction of the heart. We also highlighted their risk factors and, based on these findings, developed a system of predicting the diseases. To identify patients with CHD risk factors of violations of rhythm and conductivity of heart was used prospective and retrospective surveillance methods. Based on the data regarding risk factors and anti-risk using the methods of Wald and Bayes developed a diagnostic prognostic table (map) in the form of predictive coefficients (PC) this informative weight of each trait.

Keywords: violations of rhythm and conductivity of heart, cardiovascular disease, system of prediction, risk and anti-risk factors, the prevalence of disorders of rhythm and conduction of the heart, prognostic indices, the methods of Wald and Bayes, informative weight of each trait, the observations map, the mathematical tools.

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Резюме

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МЕТОДИКА ПРОГНОЗУВАННЯ ЧИННИКІВ РИЗИКУ ПОРУШЕНЬ РИТМУ ТА ПРОВІДНОСТІ СЕРЦЯ

Шляхом проведення клініко-статистичного аналізу серед хворих на ішемічну хворобу серця (ІХС) відібрані хворі з ознаками та без порушень ритму і провідності серця. Виділено чинники їх ризику і на основі одержаних даних розроблена система прогнозування цих захворювань. Для виявлення у хворих на ІХС чинників ризику порушень ритму і провідності серця був використаний проспективний і ретроспективний методи спостереження. На основі одержаних даних щодо чинників ризику та антиризику за допомогою методів Вальда і Байєса розроблена оцінно-прогностична таблиця (карта), в якій у вигляді прогностичних коефіцієнтів (ПК) подана інформативна вага кожної ознаки.

Ключові слова: порушення ритму та провідності серця, серцево-судинні захворювання, система прогнозування, чинники ризику та антиризику, поширеність порушень ритму та провідності серця, прогностичні коефіцієнти, методи Вальда та Байєса, інформативна вага кожної ознаки, карта спостереження, математичний апарат.

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МЕТОДИКА ПРОГНОЗИРОВАНИЯ ФАКТОРОВ РИСКА НАРУШЕНИЯ РИТМА ПРОВОДИМОСТИ СЕРДЦА

Путем проведения клинико-статистического анализа среди больных ишемической болезнью сердца (ИБС) отобраны больные с признаками и без нарушений ритма и проводимости сердца. Выделены факторы их риска, и на основе полученных данных разработана система прогнозирования этих заболеваний. Для выявления у больных ИБС факторов риска нарушений ритма и проводимости сердца был использован перспективный и ретроспективный методы наблюдения. На основе полученных данных относительно факторов риска и антириска с помощью методов Вальда и Байеса разработана оценочно-прогностическая таблица (карта), в которой в виде прогностических коэффициентов (ПК) приведена информативная важность каждого признака.

Ключевые слова: нарушения ритма и проводимости сердца, сердечно-сосудистые заболевания, система прогнозирования, факторы риска и антириска, распространенность нарушений ритма и проводимости сердца, прогностические коэффициенты, методы Вальда и Байеса, информативный вес каждого признака, карта наблюдения, математический аппарат.

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Introduction

Incidence of cardiac rhythm and conduction disturbances has been increasing from year to year and currently these diseases are the main cause of sudden death among the population especially among the people, suffering from CHD [2].

A high incidence of arrhythmias and conduction of the heart, as well as other cardiovascular diseases, are mainly explained by both demographic population aging and the influence of risk factors associated with economic hardship, ecological environment polluted by contact with chemicals, and unhealthy lifestyles etc. [3], therefore the strategy of prevention of these diseases is based on the concept of risk factors in order to prevent their harmful effects [5].

In this regard, epidemiological studies of risk factors, the study of patterns of influence in different gender and age, professional and social groups, their connection with working conditions, life, lifestyle, diets, addictions, concomitant diseases and those that a person had suffered from, environmental well-being etc [4].

The above issues are not covered either in domestic or foreign medical literature at all; especially little attention was paid to risk factors for arrhythmias and conduction of the heart [6]. There are no data in the available literature about the possibility of developing systems of prediction for arrhythmias and conduction of the heart in various diseases while using risk factors.

Objective. To identify the risk and anti-risk factors and characteristic of arrhythmias and conduction of the heart.

To evaluate their informative significance using the appropriate mathematical apparatus and to develop a system of predicting these complications on the basis of the data obtained.

Material and methods. Based on literature, medical experience, clinical logic and personal observations considering the etiology and pathogenesis of the disease, we selected possible for arrhythmias and cardiac conduction risk and anti-risk factors, which were later used to develop a special observation chart.

To detect risk factors for arrhythmias and conduction of the heart in patients with coronary artery disease we used prospective and retrospective methods of observation.

For this purpose, we conducted a clinical-statistical analysis of health condition of selected by randomization 185 patients with coronary artery disease with no signs of heart disorders during 3 years and 134 CHD patients with paroxysmal cardiac arrhythmias (for the same period we included new cases of arrhythmias and conduction of the heart, which occurred to patients with coronary

heart disease among residents of the city into the total number of the patients).

Each examined patient was provided with filled mentioned above chart, where we introduced data on risk and anti-risk factors, lifestyle, working conditions, life etc. We also used primary accounting medical records (individual charts of the outpatient, medical history, etc.) for data collection. If necessary, relatives of the patient were interviewed.

All these made it possible to obtain comprehensive data on risk and anti-risk factors for arrhythmias and changes in the health condition of examined patients as well as their causes.

To determine the probability of the impact of the selected factors on the occurrence of arrhythmias and conduction in the heart we used directional balanced selection with methods of pair samples, a method of control groups while grouping the material.

Mathematical tools for material handling were:
- Student's test;
- criterion χ_i – Pearson's chi-squared test;
- method of weighing indices;
- rank correlation index;
- Fisher angle convector;
- standardization method.

Results and discussion. The study found, that, along with biological and natural factors, risk factors of socio-cultural nature, unhealthy lifestyle, neuro-psychological strain, constant conflicts in the family or in the team, the physical and mental overload ,tobacco smoking, alcohol abuse, living without family, irregular medical check-ups produce a

significant impact on the occurrence of arrhythmias and conduction of the heart in patients with coronary artery disease.

We have found 77 signs that are sure to influence the onset of these complications in CHD.

However, some data on adverse signs allow to receive only a qualitative assessment of their impact and do not make it possible to identify people with an increased risk of these complications for differential medical check-ups. CHD patients with early signs of arrhythmias and conduction of the heart can be detected only through a clear definition of the totality of the factors. A collective assessment of the factors can only be obtained when you have the data on informative value of each feature.

To determine the informative value of the features (factors) we used a sequential Wald test and Bayes' theorem.

These methods, combined, have a number of advantages over others. Development of the prediction system does not require prior knowledge of the power of the factors. Risk factors with an extremely strong and weak action are eliminated during the system development.

The system can use an unlimited number of factors which increases the prognosis of the disease course.

Based on the findings as to the risk and anti-risk factors and on the assessment of their informative value by means of sequential Wald test and Bayes' theorem, we developed an evaluative and prognostic chart where the informative value of each feature is shown by prognostic indices(PI) (table1).

Table 1 – Instruction chart of predicting arrhythmias and cardiac conduction disturbances in patients with coronary heart disease

№ of sign groups	A sign group	№ of signs	A sign name	PI
1	2	3	4	5
1.	Sex	1 2	Male Female	-4.7 6.3
2.	Age	3 4 5 6 7 8	Under 30 years old 30-39 40-49 50-59 60-69 70	x -4.6 -5.2 -5.6 -7.4 -120.3
3.	Type	9 10 11	Normosthenic Asthenic Hypersthenic	9.8 14.0 -12.4

1	2	3	4	5
4.	Character features of the person and mode of behavior	12	Type A (hot-tempered, lacking self-control, ambitious)	-24.3
		13	Type B(calm, reserved, phlegmatic)	5.4
5.	Features of the work	14	Phisical	27.8
		15	Intellectual	-6.6
		16	Night shifts	-4.3
		17	Overhours	-40.1
		18	Frequent businesstrips	-23.1.
		19	Contact with chemicals	-41.8
6.	Degree of exercise stress	20	High	-91.2
		21	Medium	2.4
		22	Low	1.5
7.	Degree of mental stress	23	High	-11.0
		24	Medium	-5.7
		25	Low	1.5
8.	Frequent changes of jobs	26		-21.4
9.	History of closed craniocerebral injury	27		-46.3
10.	Nature of relationship in the family and in the team	28	Conflict	-20.7
		29	Good	14.9
11.	Other disease than CHD at the moment	30	Gastrointestinal disturbances	-112.3
		31	Gallstone disease	-140.6
		32	Cholelithiasis diseases of the urinary system	-116.0
		33	Chronic non-specific pulmonary diseases	-117.9
		34	Thyrotoxicosis	-160.7
		35	Diabetes	-138.0
		36	Ear-Nose-Throat diseases	-61.8
		37	Cerebrovascular accident	-140.3
12.	Arterial pressure	38	130/80 mm Hg	16.5
		39	140/90 mm Hg	-9.2
		40	140/90-154/90 mm Hg	-15.0
		41	160/96 mm Hg and more	-51.2
13.	Family history of cardiovascular diseases	42	Father	-35.3
		43	Mother	-25.5
		44	Brothers	-11.2
		45	Sisters	-8.4
14.	Family history of arrhythmias	46	Father	-141.5
		47	Mother	-116.5
		48	Brothers	-138.0
		49	Sisters	-140.3
15.	Diets	50	Regular	30.8
		51	Irregular	-30.7
16.	Tobacco smoking	52	Does not smoke	8.2
		53	Smokes up to10 cig./a day	-11.5
		54	- " - to 20 cig./a day	-36.5
		55	- " - to 30 cig./a day	-60.7
		56	- " - to 40 cig./a day	-98.9
17.	Alcohol consumption	57	Does not drink	8.5
		58	Moderately	-25.5
		59	Abuses	-145.3
18.	Sleep	60	Regular	20.2
		61	Irregular	-40.1
		62	Suffers from insomnia	-45.3

| 1	2	3	4	5
19.	Climacterical period and meno-pause in women	63		-35.1
20.	Diminished function of gonads in men	64		-9.2
21.	Cholesterol level in the blood se-rum	65	Diminished	12.7
		66	Normal	6.1
		67	Higher	-94.5
22.	Electrocardiogram	68	Normal	5.6
		69	Peak T is lowered and flattened two phased negative.	-18.4
		70	Segment ST is 1 mm shifted from the isoline	-21.2
23.	Acute psychic traumas	71		-30.2
24.	Frequent athletic overexertion	72		-37.8
25.	Frequent chronic psycho-emotional traumas	73		-34.9
26.	Atherosclerosis of the brain ves-sels	74		-14.9
27.	Lives alone	75		-12.4
28.	Medical check-ups	76	Regular	33.4
		77	Irregular	-41.8

Individual risk of arrhythmias and conduction of the heart is determined by a prognostic chart according to risk and anti-risk factors that the patient has by finding and dividing into 100 the algebraic sum of prognostic indices which are underlined in the chart. The results are compared with a scale of threshold value of the total action of the factors.

The scale is developed based on clinical trials of the system.

Three prognostic groups are underlined on the scale:

- group with favorable prognosis (total PI > +1,996);

- group of unfavorable prognosis (total PI < -1,996);

- the group that needs an additional examination – doubtful prognosis (total PI ranges tween -1,996 and +1,996) (Figure 1).

Figure 1 – Scale of threshold value of combined effect of factors
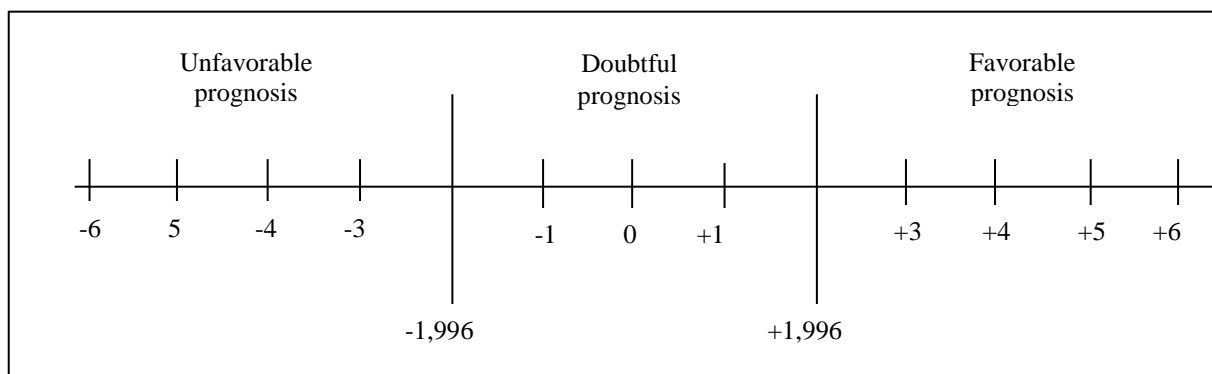
Defining thus the risk, the doctor notes it in its individual card of the outpatient or in their history, and, according to this, holds therapeutic measures and correction of risk factors.

The system is easy to use and has a high reliability (probability of faultless prognosis is 90-92 %). The prediction by the system can be carried out by a junior health worker.

The use of such a system in the practice of health care will promote early detection of CHD in patients with an increased risk of arrhythmias and conduction of the heart, reducing temporary incapacity, disability and mortality caused by these complications.

Conclusion

1. The strongest influence on the occurrence of arrhythmias and conduction of the heart, along with biological and natural factors have: unhealthy lifestyle; neuro-psychological strain; constant conflict relations in family and team; physical and mental fatigue; tobacco smoking, alcohol abuse; living alone; irregular clinical examinations.

2. Based on the risk and anti-risk factors of arrhythmias and conduction of the heart with the use of sequential Wald test combined with probabilistic Bayes' method we developed a prediction system for these complications in patients with coronary artery disease.

The system is easy to use and can be realized on personal computers; it is reliable (probability of faultless prognosis is 90-92 %).

3. Using this prediction system in practice will not only contribute to the timely detection of risk groups, but also give an opportunity to establish the risk of developing this disease. This will create real conditions for a differentiated approach to the development of individual measures for the prevention of CHD.

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