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DEVELOPMENT OF AN ALGORITHM FOR ASSESSING THE RISK OF DEPRESSION AFTER ISCHEMIC ATTACK

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Abstract: ***The aim is to determine the integration between risk factors for the occurrence of depressive disorders and to develop an algorithm for assessing the degree of risk of post-infarction depression. This study included patients with MI admitted to a cardiological hospital (754 patients). To achieve this goal, patients with depressive disorders were selected from this cohort. Of the total number of patients, 31% (233) had symptoms of depression (main group). For comparative analysis, the control group included patients with MI without depressive disorders - 108 observation units.***

Statistical data processing was carried out in two stages:

1) preparation for statistical analysis;

2) the actual statistical analysis.

To distinguish persons with different risk probabilities, the range is divided into three intervals: the smallest, average, and largest. Accordingly, the prediction groups are also distinguished according to the ranges: a group with a relatively favorable prognosis, a group of attention, a group of an unfavorable prognosis. The use of the prognostic table allows us to identify the degree of probability of the risk of developing DS among patients with MI. It will enable cardiologists as well as primary care physicians to identify the symptoms of DS at earlier stages of myocardial infarction. The development of criteria for assessing the risk of developing DS among patients with MI will allow timely detection of DS and adjust the treatment of patients with MI, taking into account DS. Thus, in the first hours after myocardial infarction after the patient is admitted to the clinic, it is necessary to carry out measures to assess the risk of depressive disorders with the determination of anxiety states, low mood and predisposing factors by a cardiologist, possibly with the appointment of tranquilizers with a pronounced anxiolytic effect. In the first week after myocardial infarction, in the presence of depressive symptoms in patients, it is necessary to consult a psychiatrist for the clinical diagnosis of depression and to determine its severity using the Mothgomery-Asberg scale. If depressive disorders are detected, it is necessary to determine the clinical characteristics (the leading component of the depressive triad, the type of affect, the presence of suicidal components, the severity) of depression and the appointment of appropriate antidepressant treatment, with the agreement of a cardiologist and a psychiatrist at the same time.

Keywords: myocardial infarction, depression, risk factors, comorbidity, integrated assessment.

INTRODUCTION

Depressive disorders are among the most common types of mental illness. According to various epidemiological data, depression affects from 4 to 10% of the world's population [3, 11,13]. The widespread prevalence of depressive disorders is correlated with the most severe somatic diseases. The consequences of depression in the absence of treatment are extremely severe and include early mortality from various somatic diseases, disability (disability), which is more significant than that caused by such common chronic diseases as diabetes mellitus or chronic collagenosis. WHO reports indicate that depressive disorders are among the diseases causing the most significant loss of active years of life through illness and disability. Depressive disorders also significantly increase the risk of suicide and suicide attempts.

Depression is often comorbid with other, somatic, diseases, and in such cases, diseases of two different spheres - mental and somatic - aggravate each other, sometimes leading to serious consequences. Among patients with cardiovascular diseases, the incidence of concomitant depression is 22–33%. In 17-27% of patients with coronary artery disease undergoing coronary angiography, depression is detected, and in patients in the postinfarction period, depression is found in 16-45% of cases. The presence of depression in patients with cardiovascular diseases not only complicates the course and therapy of these disorders, but also shortens the life expectancy of patients. It is clear and predictable that the most pronounced emotional disorders are observed in patients who have had myocardial infarction, since even with a satisfactory state of health, the diagnosis of myocardial infarction in a person is associated with a threat to life. Along with worrisome fears about health, there are dark thoughts about the future, depression, fear of possible disability, disturbing thoughts about the well-being of the family. Without appropriate intervention, these disorders are fixed and persist for one year in 25% of survivors. According to other data, mental disorders were diagnosed in 28% of cases. An intensification of neurotic features was observed in 50% of patients [7, 6, 13,17].

The development and course of mental disorders depends on many factors: the patient's living conditions, bad habits, repeated ischemic episodes, the degree of myocardial damage, provoking factors, support for somatic health in dynamics, support of loved ones. The complex relationship of these factors explains the diverse manifestations of mental disorders developing against the background of myocardial infarction [1, 2, 4, 14, 18].

The cascade of pathophysiological changes characteristic of the development of depressive disorder is comparable to metabolic changes in the development of cardiovascular pathology, in particular myocardial infarction. Consequently, the possibility of a reverse effect of acute coronary circulation disorder as an acute stress effect that activates the sympathoadrenal system, as a factor provoking the development of affective symptoms, is not excluded. In addition, both in depression and in myocardial infarction, the level of caspase activity of blood plasma increases, on the one hand, reflecting the severity of apoptosis processes, and on the other, the level of endogenous intoxication. In addition, during the development of myocardial infarction, some of the cardiomyocytes of the ischemic zone undergo apoptotic death (Saraste A., Pulkki K., Kallajoki M. et al., 1997). Apoptosis and mediator disorders developing during MI can affect the metabolism of biologically active substances in the brain [5, 9, 10].

In economically developed countries, about 2500 people suddenly die every day, and only in 2-5% of cases death occurs in medical institutions (Boytsov S.A. et al. 2011). In the world annually about 3 million people die suddenly with the possibility of survival no more than 1% [12]. According to the American Heart Association (2004), within 6 years after myocardial infarction (MI), despite optimal treatment, 18% of men and 35% of women experience recurrent MI, 7% of men and 6% of women die suddenly, 22% of men and 46% of women become disabled due to the development of severe heart failure (HF). The probability of successful resuscitation of suddenly died outside the hospital, even in economically developed countries, is no more than 5% of cases. To date, the results of numerous studies have made it possible to single out three main points that determine the prognosis of the life of patients with MI: residual myocardial ischemia, left ventricular dysfunction, and electrical instability of the myocardium [1, 7, 14].

Recognition of functional states based on the analysis of data on vegetative and myocardial-hemodynamic homeostasis requires a certain amount of experience and knowledge in the field of physiology and clinical practice. In order to make this experience the property of a wide range of doctors,

a number of formulas that allow calculating the adaptive potential of the circulatory system for a given set of indicators using multiple regression equations. One of the simplest formulas providing a recognition accuracy of 71.8% (compared to expert estimates) is the Baevsky`s index (IB), named after the Russian scientist - Roman Markovich Baevsky, who first applied it in 1987. This index is a calculated index of the adaptive potential of the cardiovascular system and determines the functional state of the patient.

Differentiated psychopharmacotherapy of ADS in patients with CVD leads to an earlier and significant normalization of the psychological state, potentiates the effect of antihypertensive drugs and improves the clinical course of CVD [11, 12, 14].

The **aim** of this study was an integrated assessment of risk factors for the occurrence of depressive disorders and the development of an algorithm for assessing the degree of risk of post-infarction depression.

MATERIAL AND METHODS

The object of the study were patients with MI admitted to the hospital (754 patients). To achieve this goal, patients with depressive disorders were selected from this cohort. Of the total number of patients, 31% (233) had symptoms of depression (main group). For comparative analysis, the control group included patients with MI without depressive disorders - 108 observation units. Clinical and dynamic observation of patients in the postinfarction period was carried out with control of the state after 1, 3, 6 months and 1 year after the attack. Statistical data processing was carried out in two stages:

1) preparation for statistical analysis;

2) the actual statistical analysis.

Preparation for statistical analysis included the study of the types of analyzed variables (accounting attributes), the type of distribution of each attribute and the formulation of the problem.

At the second stage, the choice of a specific statistical method was carried out depending on the three main factors studied at the first stage:

• the type of the analyzed accounting signs;

• the nature of the distribution of the analyzed features;

• the number and type of samples studied (dependent or independent).

The normal distribution criteria were the following parameters:

• average value, mode and median of the feature are approximately equal;

• about 68% of the trait values are in the M±σ interval, 95% - in the M±2σ interval, 99% - in the M±3σ interval.

• The normal distribution of a feature is symmetrical about its value.

Since more than 80% of the analyzed quantitative characteristics were normally distributed, the statistical analysis was based on the methods of parametric statistics.

The data obtained in the study were subjected to statistical processing using the methods of variational parametric and nonparametric statistics with the calculation of the arithmetic mean of the studied indicator (M), standard deviation (σ), standard error of the mean (m), relative values (frequency,%), statistical significance of the obtained measurements when comparing the mean values were determined by the Student's test (t) with the calculation of the error probability (P) when checking the normality of the distribution (by the kurtosis test) and the equality of the general variances (F - Fisher's test). The level of reliability P <0.05 was taken as statistically significant changes. Statistical significance for qualitative values was calculated using the χ2 test (chi-square) and z-test (Glantz S., 1998) using the following formula:

$$z = (p_1 - p_2)\sqrt{\frac{n_1 \cdot n_2}{p(1-p)\cdot(n_1+n_2)}}$$

$p_1=\mu_1/n_1$ и $p_2=\mu_2/n_2$ - compared experimental frequencies, $p=(\mu_1+\mu_2)/(n_1+n_2)$ - average frequency of occurrence of the trait for both groups.

The first and important step in risk analysis is the construction of a contingency table. Schematically, the contingency table looks like this:

Table 1.

Controversy table schema

Risk factor	The studied effect (outcome)		Total
	Yes	No	
Available	a	b	A
Not avialable	c	d	B
Total	C	D	Q

Relative risk, RR - is the ratio of the frequency of the observed outcome in individuals exposed to and not exposed to risk factors. The relative risk does not carry information about the magnitude of the absolute risk (morbidity). Even with high relative risk values, the absolute risk may be very small if the disease is rare. Relative risk shows the strength of the relationship between exposure and disease. With RR> 1, the probability of developing an unfavorable outcome in the main group is higher, and with RR <1, it is lower than in the control group**.**

1. Calculating the RR:

$$RR = \frac{a/A}{c/B} = \frac{a(c+d)}{c(a+b)}$$

To compare the results obtained in two independent populations (patients with MI with DS and patients with MI without DS), we used an assessment of the reliability of differences between the two populations:

$t = \frac{P_1 - P_2}{\sqrt{m_1^2 + m_2^2}}$, where

P1 and P2 - indicators

m1 and m2 – error indicators

t - is a confidence criterion.

The value of t is determined from the Student table.

Determination of the factors and prediction of the risk of DS in patients with myocardial infarction was carried out using the probabilistic Bayesian method - normalized intensive indicators (Mamatkulov B., Iskandarov T.I. 1994).

To determine the strength of the influence of various factors on the development of DS and its progression among the surveyed contingent, the indicators of the "relative" risk were calculated. Relative risk is the ratio of incidence rates in a group of persons exposed to the factor under study to the same rates in persons not affected by this factor.

Statistical analysis of the material was carried out by calculating intensive, extensive indicators, average values.

The software for statistical processing of the results was carried out on the basis of the goal and objectives of the study, based on mock-ups, development tables using modern computing systems, such as IBM / PQ. The layot of standard programs “Microsoft Excel”, Statgraf, STATISTICA_6 was applied, which includes a set of modern statistical techniques, including descriptive variational statistics, programs for correlation and regression analysis.

RESULTS OF THE STUDY

The study of individual specific factors contributing to the development of DS does not allow us to generally assess the degree of their influence. Therefore, it is necessary to carry out the integration of factors and assess their impact in combination on the development of DS.

We have carried out an integrated assessment of the development factors of DS taking into account the degree of risk. What was used the method of normalized indicators (NPI) - the probabilistic Bayes method.

The initial data for an integrated risk assessment of the development of DS for each factor are presented in the form of a prognostic table (Table 2). It includes all factors selected and based on the Student’s criterion for forecasting and their gradations and values (X), indicators of integrated risk assessment depending on the strength of the influence of an individual factor (X`), indicators of relative risk for each factor (R) and their sum according to the set of factors ($\sum$ Rn), as well as the normative value which is taken as 1. As can be seen from the table, the most significant factors contributing to the development of DS are the presence of family problems (RR -16,3) such as material liability in the family, death one person, parental violence, divorce. The next most important factors are the patient's family status (RR-10,5), the presence of concomitant diseases (8,1), alcohol consumption (4,1), the patient's social status (RR-3,6), and educational level (RR- 2,8). Among emotionally unstable patients, the risk of developing DS is 3.3 times higher than among emotionally unstable patients; the presence of psycho-traumatic factors can also contribute to the development of DS (RR -2,6); in patients with a burdened heredity for mental illness, the risk of developing DS is 2,2 times higher than among those whose heredity is not burdened. Some biochemical blood parameters, such as caspase level (RR -6,8)

and 5-hydroxyindoleacetic acid (RR -3,3), also indicate the presence of DS. The later primary care is provided, the higher the risk of developing DS (RR-1,6), the relatively higher risk of developing DS in patients with a passive lifestyle (RR-1,6), as well as among those who have had MI again (RR-1,4) (table 2).

Table 2

Factors	**Gradation factors**	**NPI (X)**	**indicator RR risk (R)**	**Integrated risk indicator (X`)**
Gender	Male women	64,4 35,6	1,8	115,9 64,1
Age	Up to 50 years 51-60 years old Over 60 years old	25,7 44,7 29,6	1,7	43,7 76,0 50,3
Social status	workers employees village workers entrepreneurs family members	19,7 15,0 19,7 9,9 35,6	3,6	70,9 54,0 70,9 35,6 128,1
Education	Secondary education secondary special and in.higher higher	47,6 35,2 17,2	2,8	133,2 98,5 48,2
Nature of labor	predominantly physical predominantly mental	70,4 29,6	2,3	162,0 68,0
Position	Managing Performing	39,0 61,0	1,6	62,4 97,6
Marital status	Married Widow / divorced not married	35,6 58,8 5,6	10,5	373,8 617,4 58,8
Relationships in the family	benevolent unfriendly	39,8 60,2	1,5	59,7 90,3
relations outside the family, at work, with friends	benevolent unfriendly	40,0 60,0	1,5	60,0 90.0
Personality type	Emotionally stable Emotionally unstable	23,2 76,8	3,3	76,6 253,4
Psychotraumatic factors	No yes	27,9 72,1	2,6	72,5 187,5

Existing family problems	Divorce The death of a loved one Parental abuse in the past Financial responsibility in the family (wedding, other events, child education) Problems with children (drugs, sexual abuse, leaving the family, illness, etc.) Cheating on spouse Others	12,9 17,2 15,0 34,3 9,9 2,1 8,6	16,3	210,2 280,4 244,5 559,1 161,4 34,2 140,2
Mental health inheritance	Burdened Not burdened	21,4 9,9	2,2	47,1 21,8
Caspase level in the blood	with MI with DS with MI without DS	1,02 0,15	6,8	6,94 1,02
5-hydroxyindoleacetic acid content µg / ml for	MI with DS ИМ с ДС with MI without DS	48,02 14,6	3,3	158,4 48,2
Smoking	Yes no	55,0 45,0	1,2	66,0 54,0
Alcohol consumption	yes no	80,3 19,7	4,1	329,2 80,7
Lifestyle	passive active	61,5 39,5	1,6	98,4 63,2
The presence of concomitant diseases	Hypertension Endocrine diseases Obesity Kidney disease Gastrointestinal diseases Chronic hepatitis Cerebrovascular disease TBI Other diseases	62,6 28,7 29,2 7,7 38,6 65,6 18,9 12,9 21,5	8,1	507,1 232,5 236,5 62,4 312,7 531,4 153,1 104,5
Multiplicity of MI	Primary Re	41,2 58,8	1,4	57,7 82,3
Time for specialized care	Up to 1 hour More than 1 hour	39.1 60.9	1.6	62.6 97.4
The standard value (M) = 1.0		The amount of the indicators of relative risk (Rn) = 79,8		

Having identified the most significant risk factors for the development of DS in patients with myocardial infarction, we determined the possible risk range for the complex of the above factors. The risk range in our case is in the range of 9,7 – 49,23, it follows that the higher the value of the integrated indicator as a result of the influence of the complex of studied factors (P), the higher the risk of developing DS in a patient with MI and there are more reasons to highlight him into a poor prognosis group.

To distinguish between individuals with different risk probability, the range is divided into three intervals: smallest, average, highest. Correspondingly, the forecast groups are also distinguished by ranges: a group of a relatively favorable forecast, a group of attention, a group of an unfavorable forecast (table 3).

Table 3

The risk range for the development of DS

Risk probability	**Diapason**	**Forecast**
Smallest	9,7 – 22,87	relatively favorable
Average	22,88 – 36,05	warning
The largest	36,06 – 49,23	unfavorable

Thus, the use of the prognostic table allows you to identify the degree of probability of the risk of developing DS among patients with MI. It will allow cardiologists, as well as primary care doctors, to identify symptoms of DS at earlier stages of myocardial infarction.

The development of criteria for assessing the risk of developing DS among patients with myocardial infarction will allow timely detection of DS and adjusting the treatment of patients with myocardial infarction taking into account DS.

DISCUSSION

After an ischemic cardiac attack, which has become a myocardial infarction, the patient is hospitalized in a hospital. Since post-infarction depression is a frequent condition that occurs in the post-infarction period, and in many respects complicates the treatment and rehabilitation period, it is advisable to carry out measures to assess the risk of depressive disorders already in the first hours after the patient arrives at the clinic. It is important that even non-psychiatrists can do this.

In the initial collection of anamnestic information from the patient or his relatives, it is necessary to focus on such moments as the lack of a higher education, the absence of his own family, addiction to bad habits (in particular, smoking), poor living conditions, the presence of concomitant diseases of chronic hepatitis, cerebral atherosclerosis and / or obesity, burden of family history of mental illness, duration of ischemic attack more than 15 minutes, the presence of attempts to self-unsuccessfully stopped be pain syndrome. Identification of the above factors allows the patient to be at risk for the occurrence of post-infarction depression. In this case, it is advisable to start antidepressant therapy in the conditions of resuscitation to prevent the development of post-infarction depression. Probably, taking into account the fact that the most frequently disturbed and inhibited variant of postinfarction depression is found, antidepressants with a pronounced anxiolytic effect should be the drugs of choice for preventive purposes.

The next step is to use the Mini-Mult Questionnaire to determine the patient’s personality type and the Hamilton and / or Montgomery-Asberg scales to identify a depression that has already developed and determine its severity. It is clear that this step becomes possible only with the patient's condition, allowing him to answer the researcher's questions. The reason for assigning the patient to the risk group for the occurrence of post-infarction depression is the predominance of anxious and psychasthenic traits in the structure of his personality. In this case, it is also advisable to conduct preventive antidepressant therapy with antidepressants with a pronounced anxiolytic effect.

Since the largest number of manifestations of post-infarction depression occurs in the first week after an ischemic attack, the use of the Montgomery-Asberg scale is advisable, in our opinion, daily during the first week for the timely detection of depressive disorders in all patients without myocardial infarction. In case of detection of depressive disorders, it is necessary to determine their severity (also on the Montgomery-Asberg scale) and clinical characteristics (the leading component of the depressive triad, type of affect, the presence of suicidal components), for which it is necessary to invite a

psychiatrist consultant. Given the clinical picture of post-infarction depression, it is necessary to prescribe the appropriate treatment, if agreed upon by the cardiologist and psychiatrist at the same time.

In the event that a patient has a mild or moderate depressive episode, a consultation with a psychiatrist is necessary for a coordinated decision on the appointment of adequate therapy. In the future, it is necessary to conduct clinical observation and continue to use the Montgomery-Asberg scale to determine the depth of depression. This can be done on a daily basis by a ward cardiologist with the possibility of calling a psychiatrist if necessary.

If a patient has a serious depressive episode, an urgent call of a psychiatrist is necessary, the patient is supervised by a psychiatrist consultant every day, it is possible to establish a round-the-clock medical post near him to prevent auto-aggressive actions and destructive actions directed outside, and also to resolve the issue of transfer to a psychiatric hospital. In this case, it is necessary to continue to assess the severity of the depressive episode using clinical observation and the Montgomery-Asberg scale. When symptoms are reduced and traits of a mild or moderate depressive episode are acquired, only a cardiologist is allowed to observe, a psychiatrist consultant is called only if necessary and to coordinate therapy.

A systematic approach to identifying depressive disorders in patients with myocardial infarction is the following algorithm of action:

Stage I. Identification of factors that allow the patient to be at risk for the occurrence of post-infarction depression: lack of higher education, lack of a family, addiction to bad habits (in particular, smoking), poor living conditions, the presence of concomitant diseases of chronic hepatitis, cerebral atherosclerosis and / or obesity, a burden of a family history of mental illness, a duration of ischemic attack of more than 15 minutes, the presence of attempts to self-relieve pain with syndrome. Given the fact that the most alarming variant of post-infarction depression is most common, antidepressants with a pronounced anxiolytic effect should be the drugs of choice for preventive purposes.

Stage II. In the first week after an ischemic attack in all patients who have had myocardial infarction, it is necessary to use the Mini-Mult questionnaire to determine the patient's personality type and the Motgomery-Asberg scale to identify depression that has already developed and determine its severity. The reason for assigning the patient to the risk group for the occurrence of post-infarction depression is the predominance of anxious and psychasthenic traits in the structure of his personality. In this case, it is also advisable to conduct preventive antidepressant therapy with antidepressants with a pronounced anxiolytic effect.

Stage III. In case of detection of depressive disorders, it is necessary to determine their severity (clinically and on the Montgomery-Asberg scale) and clinical characteristics (the leading component of the depressive triad, type of affect, the presence of suicidal components), which requires the participation of a psychiatrist consultant. Given the clinical picture of post-infarction depression, it is necessary to prescribe the appropriate treatment, if agreed upon by the cardiologist and psychiatrist at the same time.

Stage IV. If a patient experiences a serious depressive episode, it is necessary to supervise this patient by a psychiatrist consultant daily, it is possible to establish a round-the-clock medical post near him to prevent auto-aggressive actions and destructive actions directed outward, as well as to resolve the issue of transfer to a psychiatric hospital.

Thus, in the first hours after myocardial infarction after the patient enters the clinic, it is necessary to conduct measures to assess the degree of risk of depressive disorders with the determination of anxiety, low mood and predisposing factors as a cardiologist by prescribing tranquilizers with a pronounced anxiolytic effect. In the first week after MI, in the presence of depressive symptoms, patients need to consult a psychiatrist for the clinical diagnosis of depression and determine its severity using the Motgomery-Asberg scale. In case of detection of depressive disorders, it is necessary to determine the clinical characteristics (leading component of the depressive triad, type of affect, the presence of suicidal components, severity) of depression and the appointment of appropriate treatment with antidepressants, if agreed upon by the cardiologist and psychiatrist at the same time.

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