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MATHEMATICAL MODEL FOR PREDICTING THE EFFECTIVENESS OF TREATMENT OF PATIENTS WITH CHRONIC PANCREATITIS WITH EXOCRINE PANCREATIC INSUFFICIENCY AND VITAMIN D DEFICIENCY

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SUMMARY

of the article by Aripova N.N., Khamraev A.A. in the topic of "Mathematical model for predicting the effectiveness of treatment of patients with chronic pancreatitis with exocrine pancreatic insufficiency and vitamin D deficiency".

The article presents a created special coding map of the examination of 45 patients with chronic pancreatitis indicating clinical indicators. Using a statistical software package effective integral characteristic of the prognosis of complications of the course of the disease in patients with chronic pancreatitis with exocrine pancreatic insufficiency and vitamin D deficiency have been created.

Keywords

chronic pancreatitis, exocrine pancreatic insufficiency, vitamin D, mathematical model

The progress of clinical medicine to a certain extent depends on the level of diagnosis, prognosis and treatment of patients. Recent decades have been characterized by a rapid growth in the number of diagnostic methods and the introduction of the latest electronic equipment, which makes it possible to identify the subtle mechanisms of the pathological process.

In modern gastroenterology, the problem of chronic pancreatitis (CP) remains one of the most pressing. The incidence of CP in developed countries is 4-8 cases per 100 thousand population per year. At the same time, primary disability of patients reaches 15% and affects the working-age population. In specialized gastroenterological hospitals, patients with CP account for approximately 10% of the total number of hospitalizations [1,3].

Ivashkin V. T. et al. (2024) [2] emphasize that, occupying an important place in the general structure of diseases of the digestive system, CP not only serves as a common cause of disability, but also often leads to death. The issues of diagnosis and treatment of diseases of the pancreas (P) are among the most difficult in modern gastroenterological problems. Recently, conditions associated with vitamin D deficiency have become very relevant, since these processes affect the normal functioning of organs and systems, including the pancreas.

Against the background of exocrine pancreatic insufficiency (EPI), the absorption of nutritional fats and fat-soluble compounds, including vitamins A, D, E and K, is impaired, which leads to worsening malnutrition syndrome in patients with CP [7-9].

According to Martínez-Moneo et al. (2016) in patients with CP, the prevalence of vitamin A deficiency is 16.8% (95%), vitamin E – 29.2% (95%), and vitamin D – 57.6%. Recent meta-analyses demonstrate that the risk of vitamin D deficiency in patients with CP is higher than in the general population [10]. The formation of these conditions is aggravated by the comorbid background of patients with CP, which significantly

negatively affects the quality of life of patients [6]. Early detection and correction of vitamin D deficiency in patients with CP contributes to the prevention of the above-mentioned pathological conditions, which must be taken into account by the doctor when planning complex treatment tactics for a patient with CP [11].

Based on the foregoing, it is necessary to conclude that studying the features of the clinical course of chronic pancreatitis occurring against the background of vitamin D deficiency and developing ways to correct this condition is an urgent problem today, and resolving this issue makes it possible to increase the clinical effectiveness of the prescribed therapy.

The goal of the work was to develop effective integral characteristics for predicting complications of therapy in patients with chronic pancreatitis and exocrine pancreatic insufficiency.

Material and methods. To solve this problem, a data set of 94 patients diagnosed with chronic pancreatitis was used. To enter initial information into electronic computers for the purpose of its subsequent statistical processing, a special coding card for examining patients was developed, which included 45 clinical indicators related to the outcome and course of the disease.

The patients were divided into 2 groups:

1) with the prescription of enzyme therapy - pancreatin minimicrospheres 25,000 units 3 times a day with meals (20 patients);

2) without enzyme therapy (diet therapy only), where patients were given recommendations to take pancreatin, but for various reasons they did not take the drugs (25 people);

Statistical processing of the initial clinical data set made it possible to identify the most informative indicators, which were used as the basis for constructing linear integral prognosis characteristics.

The mathematical model was constructed using the least squares method in the form:

$$\Psi(x) = \sum_{i=1}^{n} a_i x_i + a_0 \qquad (1)$$

where $\Psi(x)$ – outcome of the treatment process;

a_i – feature weights;

x_i – clinical and laboratory parameters;

a_0 – free member

The construction of a mathematical model was carried out taking into account the following minimization criterion:

$$E\left[\Psi(x) - S\right]^2 \to \min \qquad (2)$$

where E - expectation operator;

S – expert assessment of the effectiveness of therapy based on treatment results.

The choice of the least squares method was due to the fact that when studying medical processes, we are dealing with statistical data. That is why statistical data processing is performed in almost every medical problem and serves as one of the stages of information processing.

To identify patterns, that is, to build mathematical models, regression analysis was used. And here the least squares method, which is the basic method of regression analysis, was widely used.

The least squares method (LSM) has been extensively studied and has several theoretical justifications. OLS estimates have the minimum possible variance in the class of all linear unbiased estimates and are, accordingly, the best linear unbiased estimates of unknown function parameters [4,5].

When constructing models of the severity and outcome of the disease using the least squares method, the condition of their effectiveness was imposed on the model parameters not lower than $p < 0.05$ according to the t-criterion.

Research results. As a result of the calculations, models of the following form were obtained:

Model for predicting the effectiveness of treatment without Enzyme therapy

(R2 = 0.73)

Eff (F0) = - 0.0225 + 0.0277*X3 + 0.0032*X15 + 0.5187*Y4 - 0.496*Y65

Model for predicting the effectiveness of treatment with Enzyme Therapy

(R2 = 0.60)
Eff (F1) = 0.1758 + 0.0041*X9 + 0.0117*X10 - 0.4425*Y18
Where

X3	vit D (ng/ml)
X9	blood amylase (U/l)
X10	hemoglobin (g/l)
X15	protein (g/l)
Y4	esophagitis
Y18	0 - yes, 1 - no
Y65	presence of a stone in the pancreatic duct

In this case, the following gradation was adopted for efficiency values:
0 – no effect
1 – minor effect
2 – significant effect
3 - high effect
Calculations were carried out on an IBM Pentium personal computer using the statistical software package "STATISTICA-10".
A high value of the coefficient of determination indicates the high efficiency of the resulting models.
Conclusions. Thus, the developed mathematical model for predicting the course of the disease in patients with chronic pancreatitis with exocrine pancreatic insufficiency helps prevent the development of serious complications and can be used in practice.

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