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DEVELOPMENT OF DIAGNOSTIC CRITERIA AND CONSTRUCTION OF A PROGNOSTIC MODEL FOR THE COURSE OF THE PANCREATIC NECROBIOTIC PROCESS IN INFECTED PANCREATIC NECROSIS AGAINST THE BACKGROUND OF DIABETES MELLITUS USING ARTIFICIAL INTELLIGENCE TECHNOLOGIES

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Abstract:

The scientific article presents the development of diagnostic criteria for predicting the severity of infected pancreatic necrosis (IPN) in 64 patients with diabetes mellitus (DM) and evaluates their effectiveness. It analyzes the scale proposed by the authors for assessing the intensity of pancreatic necrosis (PN) in IPN against the background of DM, as well as a predictive program based on the PN AI scale. The study reports on the results of applying digital and artificial intelligence (AI) technologies in implementing a therapeutic-diagnostic algorithm. Based on the conducted research, the authors concluded that the developed scale allows for the assessment of necrobiosis intensity, while the predictive program complements its capabilities by forecasting the dynamics of the process, significantly increasing the practical value of the proposed model. The developed NP AI scale criteria demonstrate high diagnostic and prognostic efficacy, with a sensitivity of 88.7% and a specificity of 85.3%.

Keywords: Infected pancreatic necrosis, diabetes mellitus, PN AI scale, prediction of pancreatic necrosis.

THE RELEVANCE AND DEMAND FOR THE DISSERTATION TOPIC. Acute pancreatitis (AP) occupies a leading position among urgent abdominal surgical pathologies, with an annual incidence of 13 to 45 cases per 100,000 population, with up to 20% of patients developing a necrotic form, and more than 1/3 of them developing infection of pancreatic gland (PG) necrosis zones [3, 7, 6]. Against the background of diabetes mellitus (DM), the risk of developing a severe course and infection with pancreatic necrosis increases more than 2 times, which is associated with impaired microcirculation, decreased phagocytic activity, and activation of pro-inflammatory pathways. Modern registries emphasize that up to 15-25% of cases of infected pancreatic necrosis (IPN) are registered in patients with already established or newly identified diabetes, especially type 2 [4, 9, 10].

Literature emphasizes that prognostic uncertainty remains one of the reasons for both the delayed escalation of surgical tactics and the premature application of aggressive interventions [8]. Furthermore, clinical and clinical-laboratory scales of acute pancreatitis severity, developed for the general population of patients, are widely used in practice. Such systems are focused on assessing systemic response and early organ dysfunctions, which allows for the stratification of adverse outcomes at the population level [1, 2]. However, in IPN, their prognostic value decreases, as they poorly reflect local morphological dynamics and do not account for the specifics of infecting necrotic tissues.

In recent years, against the backdrop of realizing the limitations of traditional prognostic scales, attempts have been made to apply more complex analytical approaches aimed at integrating clinical and laboratory parameters to assess the risk of adverse outcomes in patients with IPN. In a prospective cohort study, a group of Chinese scientists led by C. Ning et al. [5], which included 344 patients with IPN, the authors developed and validated a 90-day mortality forecasting model based on machine learning methods, which demonstrated high discriminatory ability during both internal and external validation. The study demonstrated that signs of polyorgan insufficiency (PON), high scores on clinical severity scales, duration of organ dysfunction, presence of bacteremia, timing of first intervention, and patient age had the greatest significance for prognosis, emphasizing the complexity

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and multifactorial nature of the unfavorable course of IPN.

Thus, existing approaches to predicting the course of IPN are characterized by insufficient sensitivity to local morphological changes, limited applicability in patients with comorbid pathology, and weak focus on practical tasks in choosing surgical tactics. These limitations create prerequisites for finding new prognostic criteria capable of integrating the clinical, morphological, and personal characteristics of the patient and ensuring more informed decision-making during the treatment process.

THE AIM OF THE STUDY WAS: To develop integrated diagnostic criteria for assessing the intensity of the necrobiotic process of the pancreas in infected pancreatic necrosis in patients with diabetes mellitus.

RESEARCH MATERIALS AND METHODS

The clinical material for the study was compiled based on observations of 64 patients with diabetic nephropathy receiving treatment from 2019 to 2025. The study was conducted at the Andijan branch of the Republican Scientific Center for Emergency Medical Care of the Ministry of Health of the Republic of Uzbekistan.

In the structure of the examined patients, a moderate predominance of men was noted in the study group (Table 1).

Table 1
Characteristics of patient distribution by gender and age (WHO classification)

GENDER / AGE	Number of patients
	Multi-organ failure
Men, n (%)	41 (64.1%)
Women, n (%)	23 (35.9%)
18-44 years, n (%)	8 (12.5%)
45-59 years, n (%)	18 (28.1%)
60-74 years, n (%)	30 (46.9%)
75-89 years, n (%)	8 (12.5%)

In patients with IPN against the background of diabetes mellitus, men accounted for 64.1% and women for 35.9% of the total number of observations. The age structure of the patients was characterized by a predominance of middle-aged and elderly patients. The largest share falls on the age intervals of 45-59 and 60-74 years. The proportion of young patients aged 18-44 remained relatively low and did not exceed 10-15%. Elderly individuals aged 75-89 years accounted for 8 (12.5%) patients.

In the structure of DM in patients with IPN, type 2 DM predominated, which was diagnosed in the vast majority of patients. The etiological structure in patients with IPN against the background of diabetes mellitus is shown in Table 2.

The leading etiological factor was biliary stone disease, reaching a share of up to 43.8%. The dietary factor occupied a significant place and its specific weight fluctuated within the range of 20.3%. The contribution of metabolic causes, including hypertriglyceridemia, which was observed in 8 (12.5%), deserves special attention, while the alcohol factor occurred in 2 (3.1%), traumatic injury, and idiopathic and other causes occurred in 3 (4.7%) and 5 (7.8%) patients, respectively.

Table 2
Etiological structure of infected pancreatic necrosis in the examined patients

ETIOLOGICAL FACTOR	Number of patients
	(n=64)
Gallstone disease, n (%)	28 (43.8%)
Nutritional factor, n (%)	13 (20.3%)
Hypertriglyceridemia and metabolic causes, n (%)	8 (12.5%)

World Bulletin of Public Health (WBPH)
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Volume-57 April, 2026
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Alcohol factor, n (%)	2 (3.1%)
Post-manipulative IPN, n (%)	5 (7.8%)
Traumatic injury of the gastrointestinal tract, n (%)	3 (4.7%)
Idiopathic and other causes, n (%)	5 (7.8%)

Methodology for utilizing digital and AI technologies in the implementation of therapeutic and diagnostic algorithms

The use of digital and AI technologies in this study was aimed at the practical implementation of the developed therapeutic and diagnostic algorithm (LDA) and ensuring a standardized assessment of the severity of the condition of patients with IPN associated with diabetes mellitus. The application of software tools was considered not as an independent research method, but as a tool for integrating clinical, laboratory, and instrumental data into a unified algorithm to support clinical decision-making in emergency surgical care.

The digital module was based on clinical criteria, laboratory indicators, and instrumental characteristics. The input data included indicators of systemic inflammatory reaction systemic inflammatory reaction (SVR), organ dysfunction parameters, laboratory test results, imaging method data, and information on the dynamics of the patient's condition in the early postoperative period (POP). All parameters were entered into the program in a standardized form, ensuring data comparability and eliminating the influence of subjective factors during their interpretation.

The information processing algorithm provided for an automated assessment of a set of signs, followed by the formation of an integral profile of the patient's condition for the future in the form of a prognosis. The software module performed the calculation of probability indicators for the severity of the disease course and the risk of adverse outcomes based on algorithm-based rules and weight coefficients formed based on clinical and statistical analysis results. The AI mechanisms used provided multi-dimensional data processing and allowed for the consideration of the combined impact of several factors, which is difficult in traditional clinical assessment.

The use of digital and AI technologies was carried out within the framework of current clinical protocols and did not violate medical care standards. All data entered into the program was depersonalized and used in accordance with the requirements of medical ethics and regulatory documents for protecting personal information. The application of the software module was integrated into the daily clinical practice of the hospitals involved in the study and did not require changes to the basic principles of managing patients with IPN against the background of diabetes mellitus.

Thus, digital and AI technologies in this study were utilized as a tool for the implementation and practical implementation of LDA, providing standardized prognostic assessment of patient condition severity and support for clinical decisions at various stages of the ongoing comprehensive treatment.

RESULTS AND THEIR DISCUSSION.

The transition to developing a prognostic scale requires conducting a multi-factor analysis that allows for the determination of independent indicators that retain statistical significance after accounting for the combined influence of clinical, laboratory, and morphostructural changes. This approach ensures a transition from simple correlation to assessing the real contribution of each parameter to the formation of the severity of the necrobiotic process of the pancreas (PC) and allows for the exclusion of variables whose connection is determined by intermediate factors. At this stage, it is necessary to evaluate the set of indicators identified during the correlation analysis, establish their relative influence on the risk of disease progression, and form a set of features suitable for the integrated model. The resulting structure will serve as a basis for constructing a diagnostic scale that reflects the intensity of the pathological process and provides the opportunity to further predict the course of IPN in patients with DM.

The results of the multifactorial analysis allowed for the identification of a combination of indicators that most closely reflect the behavior of the necrobiotic process in the pancreas during IPN against the background of diabetes mellitus (Table 3). Among the variables included in the model, morphostructural characteristics remained the leading role, which were consistently associated with increasing tissue destruction.

Dynamic changes according to ultrasound examination data (ultrasound) and computer tomography (CT), the degree of maturity of the necrotic site wall, and the extent of gastric juice lesion formed the core of the model, as these features demonstrated the greatest association with the development of an aggressive course. These indicators reflect the fundamental mechanism of localized inflammation transitioning into rapidly progressive necrobiosis in patients with diabetes mellitus, where impaired microcirculation and

World Bulletin of Public Health (WBPH)
Available Online at: https://www.scholarexpress.net
Volume-57 April, 2026
ISSN: 2749-3644

decreased tissue repair potential create conditions for the rapid deepening of the process.

Systemic inflammatory parameters occupied the second most important position, complementing the morphological link of the model. Signs of CVR, changes in levels of C-reactive protein (CRP) and procalcitonin (PCT), as well as the degree of organ dysfunction, showed a stable association with the risk of an unfavorable course. Their preservation in the model indicates that the development of necrobiosis in patients with diabetes mellitus is accompanied by an early and intensive systemic response that intensifies the severity of the process. Indicators characterizing the diabetic background, specifically chronic hyperglycemia, disease duration, and clinical manifestations of angiopathy, also maintained their independent significance. Such signs highlight the role of metabolic and vascular disorders in limiting the PUF's ability to locally stabilize the focus and explain the lack of a trend toward the formation of a full-fledged capsule in a number of clinical situations.

Table 3

Results of multifactorial logistical analysis of indicators associated with the intensity of pancreatic necrobiotic process in cases of infected pancreatic necrosis on the background of diabetes mellitus

INDICATOR	β	SE	OR	p
Ultrasound/MSCT dynamics	1.61	0.38	5.00	0.003
Pancreatic necrosis volume	1.92	0.41	6.81	0.001
Wall thickness / maturity (capsule)	1.74	0.39	5.69	0.002
Presence of free fluid	0.41	0.34	1.50	0.118
Thickness of peripancreatic infiltrate	0.38	0.33	1.46	0.142
Number of SRB signs	1.37	0.35	3.94	0.005
Dynamics of CRO changes	1.84	0.37	6.30	0.002
Dynamics of PCT changes	1.71	0.36	5.55	0.003
Number of organ dysfunctions	2.11	0.44	8.26	0.001
Episodes of hyperglycemia	0.33	0.29	1.38	0.164
Hypotension episodes	0.44	0.28	1.55	0.098
Duration of DM	0.87	0.31	2.38	0.026
Increased HbA1c level	0.98	0.33	2.66	0.017
Clinical signs of angiopathy	1.41	0.38	4.10	0.008
Body temperature	1.03	0.34	2.80	0.013
Pain syndrome	1.09	0.36	2.99	0.014
Answer to ABT	-1.52	0.40	0.22	0.004
Heart rate dynamics	0.29	0.30	1.33	0.188
Dynamics of daily diuresis rate	0.27	0.31	1.31	0.201

A portion of the variables included in the preliminary analysis did not retain independent influence after multi-factor adjustment. This includes indicators characterizing free fluid, the thickness of the peripancreatic infiltrate, episodic changes in glycemia and arterial pressure (BP), as well as the dynamics of pulse and diuresis. Such signs did not strengthen the prognostic model, which is associated with high dependence on intensive therapy and significant physiological variability. The exclusion of these 6 parameters allowed for focusing on 13 features that reflect the key mechanisms of progressive necrobiosis in IPN against the background of diabetes mellitus and form a pathogenetically consistent basis for creating an integral scale. Such selection increases the reliability of the model and emphasizes the scientific novelty of this approach, as it combines morphological, inflammatory, metabolic, and clinical elements into a unified system for quantitative risk assessment.

Based on the conducted multifactorial analysis, we developed a scale for the intensity of pancreatic necrobiosis in IPN against the background of diabetes mellitus ("Pancreatic necrosis intensity assessment scale – PN") based on the combination of morphostructural, systemic, metabolic, and clinical indicators, which collectively reflect the degree of compensatory mechanism impairment and the rate of the disease's transition into a destructive phase. Each of the 13 parameters is characterized by three levels of severity, which allows for a quantitative assessment of the patient's condition through a system of sequential scores from zero to maximum value. This structure allows for the detection of subtle changes in the early stages of the disease and simultaneously reflects the pronounced pathological dynamics characteristic of severe cervical necrobiosis in patients with diabetes mellitus. The advantage of a three-level approach is its reproducibility, as the transition between categories is based on objective features available in clinical settings (Table 4).

World Bulletin of Public Health (WBPH)
Available Online at: https://www.scholarexpress.net
Volume-57 April, 2026
ISSN: 2749-3644

The total score of the scale is formed by adding the qualitative and quantitative values of all indicators and reflects the integral picture of the pathological process. For clinical interpretation, three ranges of necrobiosis progression probability were identified, in accordance with the degree of gastric necrobiosis we previously noted.
Values at ≤13 points correspond to low process intensity, where pathological changes are limited and the possibility of continuing conservative therapy without switching to surgical intervention remains. Between 14 and 38 points, a high-probability zone is formed where compensatory mechanisms are partially preserved, but their stability decreases and the need arises to strengthen treatment, apply minimally invasive draining operations, and monitor the condition more frequently. Values of ≥39 points characterize the critical level of necrobiosis intensity, reflecting a significant probability of further deterioration and serving as a basis for discussing the need for active surgical interventions. This distribution of total scores forms an objective tool for choosing further tactics and allows the doctor to rely not on subjective impressions, but on the quantitative assessment of risk.

Table 4

Structure and gradations of the scale for assessing the intensity of pancreatic necrosis "PNP" in infected

pancreatic necrosis in diabetes patients

INDEX	PROBABILITY DEGREE AND POINTS		
	Low (0)	High (2)	Critical (4)
Ultrasound/MSCT dynamics	Reduction of the source	Lack of dynamics	Enlargement of the focus / appearance of new zones
Pancreatic necrosis volume	<30%	30-50%	>50%
Thickness / maturity of the PJS focus wall	Capsule formed	The capsule is partially expressed	No capsule
Number of SRB signs	0-1	2.	3-4
CRP dynamics	Decrease ≥30%	Decrease <30%	Growth
PCT dynamics	Decrease ≥30%	Decrease <30%	Growth
Organ dysfunction	no	1 organ	≥2 organs
Duration of diabetes	≤5 years	6-9	≥10 years
HbA1c	≤7%	8-9%	≥10%
Clinical signs of angiopathy	No!	Retinopathy	Nephropathy or diabetic foot syndrome
Body temperature	Normal	Subfebrile	Febrile with fevers
Pain syndrome	Reduction	Lack of dynamics	Increased pain
Answer to ABT	Adequate	Partial	Missing or deteriorating

Improving this scale using AI technology by integrating its matrix into an intelligent program allowed us to develop a program for predicting the intensity of the necrobiotic process in advance ("Pancreatic necrosis intensity forecasting program – PN-AI,"). This program, based on machine learning elements, expands its practical potential and allows for a transition from static score calculation to dynamic analysis of clinical data and the real situation. The "PIP-AI" program generates a digital profile of PPE necrobiosis based on the entered parameters and compares it with the database of previously registered cases. Such an architecture allows for the consideration of not only absolute values but also their mutual relationships, which is especially important when combining a pronounced morphological component and systemic manifestations of the disease.

In practical applications, the physician enters data available during daily monitoring, including clinical signs, indicators of light laboratory tests, and elements of previous treatment dynamics. Parameters requiring complex diagnostic methods or unavailable at a specific moment are generated automatically by the program through an internal system of probabilistic connections, which ensures the continuity of analysis and creates the opportunity to predict changes even with incomplete information. The methodology for applying "SPS-AI" is based on the sequential use of a scale and an intelligent algorithm. After determining the total score, the doctor receives the intensity category and makes a primary decision on further actions. The program is used in the next stage and calculates the probability of process

World Bulletin of Public Health (WBPH)
Available Online at: https://www.scholarexpress.net
Volume-57 April, 2026
ISSN: 2749-3644

escalation or de-escalation, which is important under conditions of dynamic IPN progression.

In low categories, the analysis is conducted to assess the stability of the condition and the need to strengthen therapy. With high probability, the program determines the direction of expected changes, which avoids a delayed transition to more active tactics. At critical values, a prognostic model is formed that reflects the rate of necrobiosis deepening and the possible consequences of delaying intervention, allowing for the optimization of decision-making time. This approach creates a cyclical control system where the doctor receives both a static assessment on the scale and a dynamic interpretation from AI.

This logical structure for applying the scale and program is reflected in the graphical diagram in Figure 1, where the sequence of actions is constructed as a step-by-step algorithm.

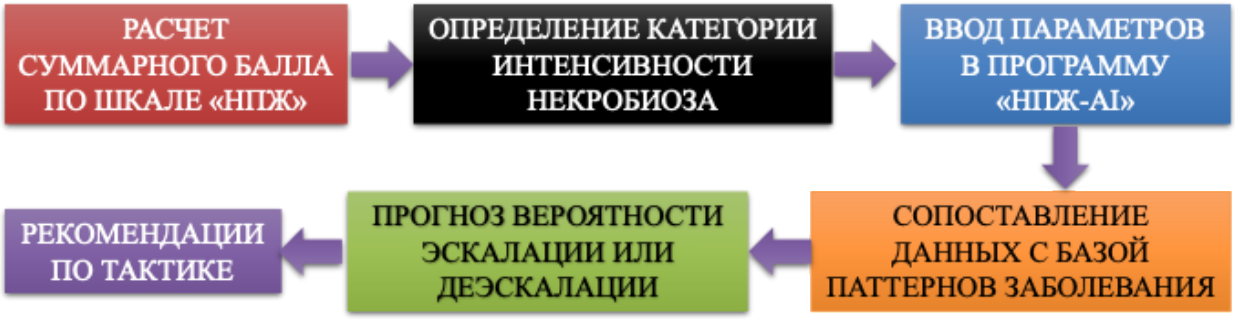

Figure 1. Operating diagram of the "NPP-AI" program based on artificial intelligence technology

In the first step, an assessment is conducted using the "PN" scale and the risk category is determined. In the second step, the data are entered into the "PN-AI" program, which generates a forecast of the likely change in necrobiosis intensity and proposes the direction of further therapeutic measures based on the analysis of the integral profile. In the third step, the program results are used to clarify observation tactics, increase or decrease therapeutic effects, and make a decision on the feasibility of surgical intervention. This design creates a system where each subsequent stage relies on the previous one and forms a unified clinical-analytical space.

Concluding the description of the scale and program, it can be noted that their combination creates a solid foundation for clinical prognosis and increases the accuracy of tactical decisions for IPN in patients with diabetes mellitus. The scale provides a quantitative assessment of necrobiosis intensity, and the program complements it with the ability to predict the temporal dynamics of the process, which significantly enhances the practical value of the proposed model. A comparative assessment of individual information blocks showed that each of them demonstrates acceptable, but not maximum diagnostic and prognostic value in relation to the intensity of the necrobiotic process of the pancreas. The morphological structure of the pancreas, including three leading features, was characterized by AUC=0.782 with a sensitivity of 76.4%, specificity of 72.5%, positive prognostic value of 70.8%, and negative prognostic value of 78.6%. Such a profile reflects the important but limited role of a single morphological component. The block reflecting the effectiveness of conservative therapy dynamics demonstrated AUC=0.765 with a sensitivity of 74.2%, specificity of 70.3%, positive prognostic value of 68.7%, and negative prognostic value of 76.1%. The listed values are similar to the morphological block and show that clinical dynamics during treatment alone possess moderate diagnostic efficacy, but do not provide high accuracy in predicting the further course of the process (Figure 2).

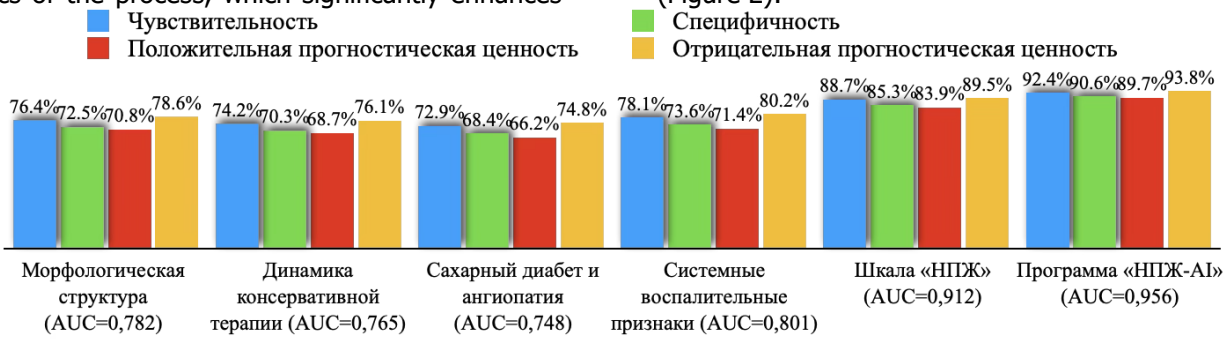

Figure 2. Comparative diagnostic and prognostic effectiveness of various methods for assessing the intensity of the necrobiotic process of the pancreas in patients with IPN with diabetes mellitus

World Bulletin of Public Health (WBPH)
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The group of indicators characterizing DM and angiopathy had somewhat lower but stable parameters, confirming the significance of the metabolic background as a modifying factor. The AUC for this block was 0.748, with a sensitivity of 72.9%, specificity of 68.4%, positive prognostic value of 66.2%, and negative value of 74.8%. Such indicators illustrate that the duration of the disease, the level of chronic hyperglycemia, and the presence of vascular complications create conditions for an unfavorable course, but without integration with morphological and inflammatory signs, they do not allow for a sufficiently reliable assessment of the risk of rapid necrobiosis progression. The group of systemic inflammatory signs showed somewhat higher informativeness, with AUC for this block reaching 0.801 with a sensitivity of 78.1%, specificity of 73.6%, positive prognostic value of 71.4%, and negative prognostic value of 80.2%. The set of systemic responses to infection and organ dysfunction was closer to the integral characteristic of process severity than the other blocks, but even in this case, there remains a significant reserve for increasing accuracy.

The "NPS" integral scale demonstrated significantly higher indicators, confirming the superiority of a comprehensive approach over individual groups of features. The area under the ROC curve for the PN scale was 0.912 with a sensitivity of 88.7%, specificity of 85.3%, positive prognostic value of 83.9%, and negative prognostic value of 89.5%. This combination of parameters shows that combining morphostructural characteristics, systemic manifestations of inflammation, signs of diabetes mellitus, and clinical dynamics into a single point system allows for a significant reduction in the number of erroneous both positive and negative prognoses. The high negative prognostic value of 89.5% is particularly important when deciding whether to refuse surgical intervention in a patient with a severe somatic background, as a low total score in this case reliably precludes the rapid progression of necrobiosis. At the same time, the positive prognostic value of 83.9% supports the validity of transitioning to more active tactics at high scale values.

Maximum informativeness values were obtained using the "PN-AI" program, which relies on the same 13 indicators but complements them with the ability to analyze complex combinations and hidden dependencies. For this model, AUC reached 0.956 with a sensitivity of 92.4%, specificity of 90.6%, positive prognostic value of 89.7%, and negative value of 93.8%. Such a profile shows that the intelligent algorithm allows for a further reduction in the number of missed serious cases and reduces the share of unjustified escalation of tactics.

A high negative prognostic value of 93.8% creates an additional safety zone when choosing conservative management, while a positive prognostic value of 89.7% ensures a high level of confidence in the decision regarding intensive intervention. A comparison of all methods between themselves demonstrates that each block individually possesses moderate informativeness; however, the integral scale and, moreover, its intellectual continuation in the form of "PN-AI" significantly exceed the structural, inflammatory, and metabolic groups in all key criteria, confirming the feasibility of using them as the primary tools for diagnosing and predicting the intensity of the necrobiotic process in the pancreas during IPN in patients with diabetes mellitus.

A comparison of the diagnostic and prognostic effectiveness of various methods showed that individual blocks of signs reflect only individual aspects of the pathological process and possess a limited ability to predict its further development, while the "PIP" integral scale and its intelligent modification form the most accurate and reproducible representation of the probability of PIP necrobiosis progression. The high sensitivity, specificity, and prognostic value of both models confirm their practical applicability and justification for use in inpatient settings, where rapid and objective selection of treatment tactics is required. The obtained results complete the stage of developing and verifying the scale and AI program, creating a basis for further testing their clinical effectiveness and determining the role of an integrated approach in improving IPN outcomes in patients with diabetes mellitus.

The obtained data confirm that the course of IPN in patients with diabetes mellitus is determined by a combination of morphological, inflammatory, and metabolic changes that accelerate the development of peptic necrobiosis, which aligns with foreign observations emphasizing the influence of diabetic microangiopathy on parenchymal destruction rate and the limitation of tissue demarcation capacity. Our results, specifically the relationship between lesion volume and the absence of a capsule and the severity of the process, align with data from European and Asian clinical centers and confirm the importance of early structural analysis in this category of patients.

Indicators associated with diabetes also maintained independent significance and demonstrated a stable association with the severity of the process, which aligns with the data of foreign authors regarding the role of chronic hyperglycemia and angiopathy in accelerating necrotic changes. Clinical indicators, including body temperature, pain severity, and response to antibacterial therapy (ABT), strengthened the integral nature of the model and confirmed the need for a comprehensive assessment of the patient's condition.

World Bulletin of Public Health (WBPH)
Available Online at: https://www.scholarexpress.net
Volume-57 April, 2026
ISSN: 2749-3644

A comparative analysis of the effectiveness of various blocks showed that individual groups of signs possess moderate informativeness and do not allow for a reliable assessment of the probability of necrobiosis progression. The "PN" integral scale and the "PN-AI" intelligent system demonstrated significantly higher accuracy compared to individual parameters, which aligns with global trends in AI application in assessing severe inflammatory and necrotizing conditions. The obtained results confirm that combining morphological, metabolic, and clinical characteristics into a single model creates an objective basis for risk stratification and treatment tactics selection, forming a promising tool for personalized management of patients with IPN with diabetes mellitus.

FINDINGS:

1. The progression of the necrobiotic process in infected pancreatic necrosis in patients with diabetes mellitus has a direct correlation with the severity of morphostructural changes, systemic inflammatory reactionand organ dysfunction, which is confirmed by the correlation between the intensity of necrobiosis and the number of signs of systemic inflammatory reaction syndrome (r=0.742), C-reactive protein level (r=0.816), and organ dysfunction degree (r=0.844).
2. Based on the established clinical-pathogenetic relationships, integral diagnostic criteria for assessing the intensity of the pancreatic necrobiotic process have been developed, combined into a pancreatic necrosis point scale "PNP," including morphostructural, clinical-laboratory, metabolic, and clinical indicators, which allows for a quantitative assessment of the severity and direction of the disease's course.
3. Integral diagnostic criteria of the pancreatic necrosis scale "PNP" possess high diagnostic and prognostic efficacy, which is confirmed by an AUC value of 0.912 with a sensitivity of 88.7% and a specificity of 85.3%, exceeding the informativeness of isolated use of morphostructural, inflammatory, and metabolic indicators.

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