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IMMUNOLOGICAL PREDICTORS FOR SHORT-TERM PROGNOSIS OF TREATMENT EFFICACY IN PATIENTS WITH BLASTOCYSTOSIS TREATED WITH SECNIDAZOLE

Igor P. Bodnia

Kharkiv National Medical University, Kharkiv, Ukraine

Abstract

Introduction. The role of immune defence mechanisms against parasitic infections, particularly blastocystosis, is undeniable. In this regard, its role as a predictor of the effectiveness of blastocystosis treatment, particularly during treatment with secnidazole, cannot be ruled out.
Aim. To determine the prognostic value of immune markers in relation to the efficacy of treatment with secnidazole in patients with blastocystosis, and to develop a prognostic algorithm based on these findings.
Materials and methods. In order to determine the prognostic value of immunological parameters, the values of these parameters were retrospectively analysed in 96 patients with blastocystosis aged between 17 and 54 years, divided into the following groups: Group A – with a good therapeutic response (n = 59) and Group B – with a satisfactory response (n = 37).
Group A comprised patients in whom the degree of regression of clinical symptoms was ≥ 31% one month after the start of treatment, whilst Group B comprised patients in whom it was ≤ 30%. The criterion for a short-term prognosis was the efficacy of treatment one month after the start of treatment.
Results. An initial analysis revealed statistically significant differences between the groups for most indicators, which formed the basis for developing a predictive algorithm using the Wald-Henkin heterogeneous sequential procedure (Gubler E. V., 1978). It was found that most of the parameters demonstrated high prognostic value, namely: Ig A levels (J = 4,36), Ig G (J = 4,23), Ig M (J = 1,69), Ig E (J = 1,57), CRP (J = 1,47), as well as CD^3 levels (J = 3,22), T-active lymphocytes (J = 2,22), CD^{19} (J = 1,58) and CD^4 (J = 1,10). Moderate prognostic properties were established for CD^8 count (J = 0,66) and low prognostic properties for IRI (J = 0,21).
Conclusions. Testing of the predictive algorithm with a 95% confidence level on the training set (n = 96) demonstrated high effectiveness, as the proportion of incorrect predictions was 2.4% and did not exceed the specified confidence level of 5%; correct predictions were recorded in 88.1% of cases, and uncertain predictions in 9.5% of cases.

Keywords: **blastocystosis, immunity, treatment efficacy, prognosis**

INTRODUCTION

Blastocystis spp. is a prevalent intestinal protozoan that infects humans and animals; its prevalence ranges from 0.5% to 30% in industrialised countries and from 30% to 76% in developing countries [1]. This difference can be explained by poor hygiene and the consumption of contaminated food or water [2-5], as the faecal-oral route is considered the primary mode of transmission for this protozoan [6]. Significant genetic diversity was identified among *Blastocystis* spp. isolates obtained from humans and animals, based on a comparison of small subunit rDNA (SSU rDNA) gene sequences [7]. To date, at least 26 subtypes of *Blastocystis* spp. have been described among isolates from mammals and birds [8, 9], nine of which (ST-1–ST-8 and ST-12) have been identified in the human population and are potentially zoonotic [10]. Since certain strains of *Blastocystis* spp. are found in both humans and animals, it has been suggested that some cases of human infection may result from zoonotic transmission. Indeed, a higher risk of *Blastocystis* spp. infection has been observed in people who have close contact with animals, particularly zoo staff [11].

Although several studies have reported the involvement of *Blastocystis* spp. in various intestinal diseases, potential pathogenic factors have been described, and its presence is often associated with symptoms in humans [12], its pathogenic role remains a subject of debate, and several variables, including the subtype and quantity of *Blastocystis* spp., the host's immune status and dysbiosis, may influence the onset of the disease [13, 14]. Although this protozoan has never been considered an opportunistic protozoan, it has also frequently been detected in immunocompromised individuals suffering from diarrhoea, with prevalence ranging from 15 to 72.4% [15].

Recently, data have shown that this protozoan is associated with specific gut microbiota profiles and health indicators. Accordingly, a positive correlation has been reported between high bacterial diversity and the presence of *Blastocystis* spp. [16]. Despite the widely held view that Blastocystis spp. is a non-invasive organism, its vacuolar form is capable of colonising the lamina propria, the submucosal layer and even the muscular layers, causing inflammation and active colitis in experimentally infected mice [17].

It has been demonstrated that the pathogenicity of *Blastocystis* spp. depends on the induction of apoptosis in intestinal epithelial cells [18]. Furthermore, *Blastocystis* spp. modulates the host's immune response by increasing or decreasing the levels of certain inflammatory cytokines [19]. Moreover, symptomatic isolates of *Blastocystis* spp. exhibit high levels of cysteine protease, which contributes to a reduction in the production of the antiparasitic nitric oxide in the epithelium [20, 21]. Some studies have shown that soluble antigens from *Blastocystis* spp. induce *in vitro* proliferation of human colon cancer cells [22, 23]. However, Chen et al. [24] demonstrated that large intestinal polyps (colonic adenomas) were detected in 17.3% of patients infected with *Blastocystis* spp.

Similarly, the prevalence of blastocystosis is 34% among patients with colorectal adenoma [25]. Colorectal adenomas are associated with a high risk of developing colorectal cancer (CRC) as a precancerous lesion [26]. Recently, *Blastocystis* spp. parasites were detected in 12.15% of European patients with CRC, compared with 2.42% in the control group [27].

It is worth noting that these precancerous polyps were detected in rats experimentally infected with *Blastocystis* spp. ST1 and ST3 [28, 29]. Furthermore, *Blastocystis* spp. isolates obtained from patients with CRC exhibited varying abilities to proliferate and invade tissues in experimentally infected mice [30].

Up to 20% of cancer cases worldwide are linked to infection (a key driver of chronic inflammation), which plays a significant role as a tumour-promoting factor during immune surveillance [31]. Furthermore, faecal secretory immunoglobulin A (sIgA), a potential marker for the screening and early detection of colorectal cancer [32], is elevated in blastocystosis [33, 34].

However, the immunological changes that occur during blastocystosis and lead to carcinogenesis have not been sufficiently studied. It is therefore clear that the immune system plays a vital role in protecting against parasitic infections, particularly blastocystosis.

An important issue in blastocystosis is selecting the most effective antiparasitic drug for a particular patient. This problem could be resolved if clinicians had access to criteria that could predict the effectiveness of treatment with a given drug before treatment begins.

In this regard, the role of immune defence mechanisms as predictors of the efficacy of blastocystosis treatment, particularly during treatment with secnidazole, cannot be ruled out.

AIM

The present study aims to determine the prognostic value of immune markers in relation to the efficacy of secnidazole treatment for blastocystosis, and to develop a prognostic algorithm based on these findings.

MATERIALS AND METHODS

The work was carried out at the Department of Infectious Diseases, Paediatric Infectious Diseases and Tuberculosis of Kharkiv National Medical University, in the Laboratory of New and Little-Studied Infectious Diseases of the State Institution 'I.I. Mechnikov Institute of Microbiology and Immunology of the National Academy of Medical Sciences of Ukraine', at the premises of the sole trader 'Private Practice of Medical Parasitology', as well as the 'Analytika' medical laboratory (licence No. 554074 dated 20 May 2010, certification certificate No. 100-4203/2011 dated 14 October 2011).

The study was conducted in accordance with the key provisions and the principles of the Declaration of Helsinki on biomedical research, whilst adhering to the ethical principles and recommendations regarding the participation of human subjects set out in the Belmont Report, the Council of Europe Convention on Human Rights and Biomedicine, and Ukrainian legislation. The study design ensured compliance with the principles of confidentiality and respect for the individual, the concept of informed consent, the consideration of the predominance of benefits over risks of harm, and other ethical principles regarding human research subjects.

The clinical group comprised 96 participants who had signed an informed consent form to take part in the

clinical trial and had been diagnosed with blastocystosis. The control group consisted of 32 otherwise healthy volunteers.

Inclusion criteria: Patients with a confirmed diagnosis of 'blastocystosis' in the acute phase were included in the study group following the obtaining of informed consent. The clinical diagnosis of blastocystosis was based on a combination of clinical symptoms and laboratory coprographic examination. To rule out mixed infections, the presence of antibodies to antigens of Ascaris, Giardia, Opisthorchis and Trichinella was determined using enzyme-linked immunosorbent assay (ELISA). In all subjects, stool samples were examined for helminth eggs and protozoa using a preservative, and perianal-rectal scrapings were examined for enterobiasis. To exclude patients with other concomitant pathologies from the study, all were screened for systemic, autoimmune and other infectious diseases.

Given that the immune system plays a significant role in the development of the pathological process, in assessing the severity of the disease and the effectiveness of treatment for parasitic diseases, a study of the immunological status was conducted to determine a set of indicators characterising cellular and humoral immunity, including the determination of the levels of leukocytes, blood lymphocytes and their subpopulations (CD3+, CD8+, CD4+, B-lymphocytes) and immunoglobulins of classes A, M, G and E.

For the conduct of all research related to the thesis topic: at the initial stage, approval was obtained from the Kharkiv National Medical University Ethics and Bioethics Committee (Minutes No. 5, dated 5 May 2021) confirming that the work was carried out in accordance with the guidelines of the Ukrainian Association of Bioethics.

In order to determine the prognostic value of immunological parameters, a retrospective study was conducted to analyse their values in 96 patients with blastocystosis aged between 17 and 54 years, divided into the following groups: Group A – with a good therapeutic response (n = 59) and Group B – with a satisfactory response (n = 37).

The degree of regression in clinical symptoms overall one month after the start of treatment was used as a measure of treatment efficacy. To justify the classification of patients into one group or another, the distribution curve of patients was first analysed according to the regression index of clinical symptoms. It has been established that the distribution curve of patients is abnormal and has a bimodal pattern. However, the mode of the first part is shifted far to the left (degree of regression 0%), whilst that of the second part is shifted to the right (40-60%). The distinguishing factor between these two groups of patients is a regression rate of 30-31%. Group A therefore included patients in whom clinical symptoms had improved by ≥ 31%, whilst Group B included those in whom improvement was ≤ 30%. The efficacy of treatment one month after the start of therapy was used as a criterion for the short-term prognosis. The predictive algorithm was developed using the heterogeneous Wald-Henkin sequential procedure. In this context, all indicators were divided into categories, followed by the calculation of predictive coefficients (PC) for each category of the indicator and its overall predictive power (J).

RESULTS

Given that patients were treated with three types of specific therapy (secnidazole, nifuratel and co-trimoxazole), an initial assessment of their prognostic significance was carried out (Table 1). Table 1 shows that, overall, the types of therapy demonstrated prognostic significance approaching high (J = 0.90). The use of secnidazole and co-trimoxazole has a positive prognostic value, whereas nifuratel has a negative one.

Table 1

The prognostic significance of treatments for blastocystosis

Treatment types	PC	J
Nifuratel + symptomatic treatment	– 3,4	0,90
Secnidazole + symptomatic treatment	+ 2,0	
Co-trimoxazole + symptomatic treatment	+ 2,6	

Note: A (+) sign indicates a good therapeutic effect, while a (–) sign indicates a satisfactory one.

Given that the different treatment modalities demonstrated varying prognostic advantages, as well as high overall prognostic value, this necessitates the development of prognostic criteria for each type of therapy individually. Furthermore, given that the degree of regression of clinical symptoms was assessed 1 month and 4-5 months after the start of treatment, it seems appropriate to develop criteria for both short-term (1 month) and long-term (4-5 months) prediction of treatment efficacy in patients.

A preliminary analysis revealed statistically significant differences ($p < 0.05$) between the groups, which formed the basis for the development of a prognostic algorithm (Table 2). The table shows that most indicators demonstrated high predictive value, with the exception of CD^8 and IRI.

Table 2

Algorithm based on immunological predictors for the short-term prediction of treatment efficacy in blastocystosis using secnidazole

Indicators	Grades of the indicator	PC	J
Ig A g/l	≤ 8.0	– 3,6	4.369
	≥ 8.1	+ 11.0	
Ig G g/l	≤ 10.0	– 7.2	4.23
	11.0-20.0	– 1.8	
	≥ 21.1	+ 11.0	
CD^3, %	≤ 31.0	– 10.0	3.22
	32.0-40.0	– 2.3	
	≥ 41.1	+ 4.6	
T-active lymphocytes, %	≤ 10.0	+ 1.5	2.22
	11.0-15.0	+ 4.5	
	≥ 16.1	– 6.6	
Ig M g/l	≤ 0.8	– 6.5	1.69
	0.9-1.6	– 1.8	
	1.7-2.0	+ 1.0	
	≥ 2,1	+ 6.0	
CD^{19}, %	≤ 30.0	+ 3.2	1.58
	≥ 31.1	– 4.5	
Ig E g/l	≤ 100.0	– 2.8	1.57
	101.0-200.0	0	
	≥ 201.1	+ 6.7	
CIC, MO/ml	≤ 70.0	+ 5.8	1.47
	70.0-90.0	– 3.8	
	≥ 91.1	0	
CD^4, %	≤ 25.0	– 4.0	1.10
	26.0-35.0	+ 2.6	
	≥ 21.1	– 3.0	
CD^8, %	≤ 20.0	+ 2.6	0.66
	≥ 21.1	– 2.3	
IRI, units	≤ 1.5	+ 1.0	0.21
	≥ 1.6	– 1.8	

Note: A (+) sign indicates a good therapeutic effect, while a (–) sign indicates a satisfactory one.
List of abbreviations: Ig A – total immunoglobulin A; Ig G – total immunoglobulin G; Ig M – total immunoglobulin M; Ig E – total immunoglobulin E; CIC – circulating immune complexes; T-active lymphocytes – activated T cells; IRI – immunoregulatory index; PC – prognostic coefficients; J – overall prognostic value.

According to the PC figures in Table 2, the following factors indicate a good therapeutic response: high levels of Ig A (≥ 8.1 g/l), Ig G (≥ 21 g/l) and Ig M (≥ 1.7 g/l), Ig E (≥ 201 μg/L), normal (≥ 41%) levels of CD^3, CD^{19} (≤ 30%), level of CIC (≤ 70 IU/mL), as well as a slight decrease in CD^4 counts (26-35%), normal CD^8 levels (≤ 20%), a decrease in the number of T-active lymphocytes (≤ 15%), and a decrease in the IRI (≤ 1.5 units).

Predictors of a satisfactory therapeutic response to secnidazole include: a slight or moderate increase in Ig A (≤ 8 g/l) and Ig G (≤ 20 g/l); reduced (≤ 1.5 g/l) Ig M levels, normal (≤ 100 μg/l) Ig E levels; improving the level of CIC (≥ 71 IU/mL); reduced CD^3 levels (≤ 40%); normal levels of T-active lymphocytes (≥ 10%); marked increase in CD^{19} levels (≥ 31%); increased CD^8 levels (≥ 21%); reduced CD^4 levels (≤ 25%), as well as a normal value (≥ 1.6 relative) of the IRI.

Consequently, a favourable therapeutic response is more likely in patients with high humoral immune activity and increased production of all classes of antibodies, including IgE, against a background of suppressed T-suppressor activity of T-lymphocytes.

Prediction using the algorithm is carried out by algebraically summing the PC features in descending order of their informativeness until a predictive threshold is reached; for a 95% confidence level ($p < 0.05$), this threshold is $\Sigma PC \geq 13$.

If there is a '+' sign next to the PC score, a good therapeutic response to secnidazole is predicted one month after the start of treatment; if there is a '–' sign, a satisfactory response is predicted. If, when summing up the PC scores for all indicators, the predictive threshold is not reached, the prognosis is indeterminate.

Testing of the algorithm on the selected group (n = 96) showed that correct predictions were made in 88.1% of cases, uncertain predictions in 9.5%, and incorrect predictions in 2.4% of cases.

DISCUSSION

Blastocystis spp. is the most common parasite found in human faecal samples. In a study conducted in the USA in 2000, this parasite was detected 28.5 times more frequently than Giardia lamblia [35]. The fact that, in some studies, a positive result for *Blastocystis* spp. was defined as the presence of five or more parasites in the field of view at 40× magnification, whilst in other studies a positive result was recorded regardless of the number of parasites, may explain the wide range of prevalence figures reported in the literature.

Although the specific pathogenicity of *Blastocystis* spp. has not yet been determined, it has been reported that intestinal inflammation caused by this parasite leads to specific inflammatory changes in the intestinal wall. In this regard, an experimental study in mice showed that the vacuolar form of the parasite invades the lamina propria of the mucosa, the submucosal and muscular layers of the colon, leading to mixed infiltration of inflammatory cells and active colitis in infected mice [36].

And although *Blastocystis* spp. is the most common parasite, doctors are reluctant to treat such patients due to the resistance of *Blastocystis* spp. to other antiparasitic drugs and its ability to readily colonise vacant niches in the gut following treatment of other pathogenic protozoa with standard drugs.

In our study, using standard laboratory methods, a significant prevalence of *Blastocystis* spp. infection was identified in patients with gastrointestinal symptoms.

Using the Wald-Henkin heterogeneous sequential procedure, an algorithm based on immunological predictors was developed for the short-term prediction of the efficacy of secnidazole therapy in patients with blastocystosis; this algorithm determines the values of prognostic coefficients for each grade of immune parameters and their overall prognostic value.

The following parameters demonstrated the greatest predictive value: IgA levels (J = 4.36), IgG levels (J = 4.23), as well as CD3 counts (J = 3.22) and T-active lymphocyte counts (J = 2.22).

During an extensive literature search on the topic of ‘blastocystosis’, having analysed international platforms such as PubMed, ClinicalTrials.gov and the Cochrane Library, we found no similar clinical studies described in the international literature.

CONCLUSIONS

1. Using the non-homogeneous Wald-Henkin sequential procedure, an algorithm was developed for the short-term prediction of treatment efficacy in patients with blastocystosis treated with secnidazole, and the values of the prognostic coefficients for each severity grade of symptoms, as well as their overall prognostic value, were determined.

2. The following parameters demonstrated the greatest predictive value: Ig A levels (J = 4,36), Ig G levels (J = 4.23), as well as CD^3 counts (J = 3.22) and T-cell counts (J = 2.22).

3. Testing of the predictive algorithm with a 95% confidence level on the training set (n = 96) demonstrated high effectiveness, as the proportion of incorrect predictions was 2.4% and did not exceed the specified confidence level of 5%; correct predictions were recorded in 88.1% of cases, and uncertain predictions in 9.5% of cases.

Perspectives for further research. The results obtained may be used to improve approaches to the provision of medical care for patients with blastocystosis. At the same time, the study has certain limitations that should be taken into account when interpreting the findings (sample size, single-centre nature and the absence of long-term follow-up). Prospects for further research lie in the development of practical recommendations for implementing the study’s findings into clinical practice and healthcare management. Thus, further research has the potential to provide an evidence base for managerial decision-making and the formulation of policies aimed at improving the accessibility, quality and effectiveness of laboratory diagnosis of blastocystosis.

COMPLIANCE WITH ETHICAL REQUIREMENTS

Author of the manuscript expressly states that the study was conducted using data from primary medical records and included clinical observations of patients. The study was conducted in accordance with the ethical standards of the World Medical Association’s Declaration of Helsinki on the ethical principles of medical research involving human subjects, European Directive 86/609 on the use of animals for experimental and other scientific purposes, and Order of the Ministry of Health No. 690 of 23 September 2009. Informed consent to participate in the study was obtained from all participants after they were provided with clear, complete and accessible information about the purpose, design and methodology of the study, its potential risks, expected benefits and possible alternatives. All participants confirmed their voluntary participation by signing an informed consent form.

Participants had the right to withdraw from the study at any time without giving a reason. In the case of studies involving minors or persons with limited legal capacity, informed consent was obtained from their legal representatives.

In accordance with data protection regulations, all data were collected anonymously and processed in compliance with current legislation on the protection of personal data, including the General Data Protection

Regulation (GDPR), to ensure the protection of personal information. All information was used exclusively within the scope of this study and was aggregated for further analysis of the results. Furthermore, the study forms part of a doctoral thesis entitled: 'Blastocystosis: Improving Clinical and Laboratory Diagnosis and Treatment', the aim of which is to develop methods for verifying blastocystosis and to improve the effectiveness of diagnosis and treatment for patients with blastocystosis through an in-depth study of the body's compensatory and adaptive capabilities.

Limitations of the research. The authors of the manuscript explicitly acknowledge that the present study has limitations arising from its design and conduct. The single-centre nature of the institution – the 'Private Clinic of Medical Parasitology' sole trader in Kharkiv – does not provide a basis for causal conclusions and retains the risk of selection bias and residual confounding, despite the use of multivariate models, selection by susceptibility and other approaches to controlling confounding factors. The size and composition of the sample of 96 patients with blastocystosis and 32 apparently healthy volunteers, representative in terms of gender and age, in accordance with the study's inclusion and exclusion criteria, limit the accuracy of the estimates and the generalisability of the results, given the specific characteristics of patient referral pathways and healthcare practices in Ukraine. The generalisability of the findings is limited by the context; confirmation requires prospective, multicentre studies, a robust power calculation, external validation and compliance with *Good Clinical Practice (GCP)*.

The search strategy covered PubMed (https://pubmed.ncbi.nlm.nih.gov/), Elsevier's Clinical Key (https://www.clinicalkey.com), the Cochrane Library (https://www.cochranelibrary.com/), the eBook Business Collection (https://www.ebsco.com/) and Google Scholar (https://scholar.google.com/), with specified indexing dates. The included studies varied in terms of design and methodological quality; some studies had an increased risk of bias, and inter-study variability in outcomes remained substantial, which reduces the internal validity of the pooled estimates and limits the generalisability of the findings to other populations and clinical contexts. To minimise these effects, independent double sampling and data extraction were employed, along with expanded combinations of keywords and logical operators.

Primary data and materials. The authors of the manuscript expressly state that primary medical records (medical histories, outpatient records, examination reports, and the results of laboratory and diagnostic tests for specific patients) and statistical databases were not used in this study. All statements and generalisations are supported by references to primary sources, which are available via open access or through academic library resources. Additional materials relating to the source selection process or details of the analytical methodology may be provided by the corresponding author upon reasoned request.

Declaration of AI use. Generative AI (GPT-5o, OpenAI, version 1.2, accessed on 5 July 2026) was used exclusively to improve the language in the 'Discussion' section, including requests for grammatical and stylistic editing. The author has reviewed all the content and confirms its accuracy, originality and the absence of plagiarism.

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The study has no external funding. There are no conflicts of interest. All authors have consented to the publication of this manuscript.

AUTHOR CONTRIBUTIONS

Bodnia I. P.[A–F]

The author was responsible for developing the research concept, collecting and verifying clinical data, interpreting the results, preparing the manuscript, critically reviewing its scientific content, and approving the final version submitted for publication.

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Резюме

ІМУНОЛОГІЧНІ ПРЕДИКТОРИ КОРОТКОСТРОКОВОГО ПРОГНОЗУВАННЯ ЕФЕКТИВНОСТІ ЛІКУВАННЯ ХВОРИХ НА БЛАСТОЦИСТОЗ СЕКНІДАЗОЛОМ

Ігор П. Бодня

Харківський національний медичний університет, м. Харків, Україна

Вступ. Безперечною є роль імунних механізмів захисту від паразитарних інвазій, зокрема від бластоцистозу. У зв'язку з цим не виключена її роль як предиктора ефективності терапії бластоцистозу, зокрема під час лікування секнідазолом.

Мета полягала у визначенні прогностичного значення показників імунітету щодо ефективності лікування хворих на бластоцистоз із застосуванням секнідазолу та розробці на цій основі прогностичного алгоритму.

Матеріали та методи. З метою визначення прогностичних властивостей імунологічних показників було ретроспективно проаналізовано значення імунологічних показників у 96 пацієнтів із бластоцистозом віком від 17 до 54 років у таких групах: група А – з добрим терапевтичним ефектом (n = 59) та група Б – із задовільним ефектом (n = 37).

До групи А були включені пацієнти, у яких через 1 місяць після початку лікування ступінь регресії клінічної симптоматики загалом становив ≥ 31%, а до групи Б – ≤ 30%. Критерієм короткостроковості прогнозу була ефективність терапії через місяць після початку лікування.

Результати. Проведений початковий аналіз показав, що за більшістю показників було виявлено статистично значущі відмінності між групами, що стало підставою для розробки прогностичного алгоритму за допомогою неоднорідної послідовної процедури Вальдо-Генкіна (Гублер Є. В., 1978). Було встановлено, що високу прогностичну інформативність продемонструвала більшість показників, а саме: рівень Ig A (J = 4,36), Ig G (J = 4,23), Ig M (J = 1,69), Ig E (J = 1,57), ЦІК (J = 1,47), а також вміст CD3 (J = 3,22), Т-активних лімфоцитів (J = 2,22), CD19 (J = 1,58) і CD4 (J = 1,10). Встановлено помірні прогностичні властивості щодо кількості CD8 (J = 0,66) та низькі – щодо IPI (J = 0,21).

Висновки. Апробація прогностичного алгоритму з рівнем достовірності 95% на вибраній групі (n = 96) показала високу ефективність, оскільки частка помилкових прогнозів становила 2,4% і не перевищила заданий рівень достовірності у 5%; правильні прогнози зафіксовано у 88,1%, а невизначені – у 9,5% випадків.

Ключові слова: **бластоцистоз, імунітет, ефективність терапії, прогноз**

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