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## CLINICAL AND LABORATORY MANIFESTATIONS OF TOXOCAROSIS AND ANTI-EPIDEMIC MEASURES OF ITS PREVENTION

**Abstract.** A definite regularity is established between the antibody titer to toxocara in the EIA and the clinical and laboratory data. The highest percentage of serologically positive results is observed in children with high eosinophil count and a higher score of clinical symptoms according to Glikman. By analyzing the frequency and nature of clinical and laboratory indicators, it is established that the sum of the main clinical manifestations in patients with toxocarosis ( $29.19 \pm 3.5$  points) has been significantly higher than the sum of the indices in children without toxocarosis ( $7.37 \pm 2.4$  points). It is proved that the clinical and laboratory data are diverse and not specific. A complex of anti-epidemic measures for the prevention of toxocarosis is given.

**Key words:** toxocarosis, clinic, diagnostics, prevention, children.

**Introduction.** Toxocarosis is a parasitic disease (tissue helminthiasis), caused by the migration of ascarides' larvae of dogs (*Toxocara canis*) in various organs and tissues, which is characterized by a prolonged recurrent course and multiple organ failure of the allergic nature. According to foreign authors, the incidence of toxocarosis has increased by 300% over the past 50 years [17, 18].

The most probable reasons for the prevalence of human larval toxocarosis are progressive growth in the number of dogs, both in cities and in rural areas; high extensive and intensive rates of toxocarosis incidence in dogs; heavy environmental contamination, especially the soil, propagative stages of the pathogen, contributing to the infection of people, especially children [2, 4, 10, 11].

Recently there has been a trend to an increase in the number of toxocarosis diagnosed patients in Ukraine more than 10 times. Annually, the number of people having antibodies to toxocar increases 1.5-2 times and reaches pro 100,000 of population: in 1999 – 0.02; in 2000 - 0.11; in 2001 – 0.7; in 2002 – 0.8; in 2003 – 0.13; in 2004 – 0.13; in 2005 - 0.16; in 2010 - 0.20; in 2015 - 0.23. In Chernivtsy region, intensive incidence rates of toxocarosis are higher than nationwide [5, 6, 9], which can be explained to a certain extent, by more often use of serological diagnostic methods for toxocarosis. Not every region of Ukraine,

according to the reports of the sanitary and epidemiological supervision bodies, has the laboratory opportunity to conduct serological studies [1].

The objective of the study is to optimize the principles of diagnosis, improve the methods of treatment and prevention of toxocarosis based on the study of clinical, laboratory and epidemiological features of the invasion in children of Bukovina region.

**Materials and methods.** The screening of children is carried out through a detailed interview and a thorough examination. Based on the epidemiological history, a set of clinical and laboratory indicators (Glickman score above 20) and EIA results (with a specific antibodies titer of 1: 800 and above) in 369 (42.56%) of 867 examined children aged 1 to 14 years the diagnosis is established: toxocarosis, chronic phase, visceral form. The data obtained make it possible to a certain extent to estimate the prevalence of toxocarosis in children of Chernivtsi region as a whole. The distribution of children infected with toxocarosis is presented in Table 1.

During the research, epidemiological, epizootological, sanitary-helminthological, immunological, serological, clinical-laboratory, biochemical, instrumental methods and methods of statistical processing of the results obtained are used.

Table 1

**Children aged 1 to 14 years old, invaded by toxocarosis (distribution by sex and age)**

Age (years)	Screened total		Among them (%)	
	persons	%	boys	Girls
1-3	66	17.14	40.90	59.10
4-7	135	35.06	42.96	57.04
8-10	91	23.64	46.15	53.85
11-14	77	20.00	49.35	50.65
Total	369	100.00	45.19	54.81

The study of clinical manifestations in patients with toxocarosis is carried out according to the usual method in the dynamics before and after complex anthelmintic therapy and includes carefully collected epidemiological history, subjective and objective data, laboratory data (blood panel, clinical urine analysis, biochemical blood test, feces analysis for helminth eggs and protozoa, immunological status, EIA for toxocarosis) and instrumental research (chest X-ray, electrocardiography, ultrasound, fibrogastroduodenoscopy, rheoencephalography). All patients are obligatory examined by an ophthalmologist and a neurologist. With the collected epidemiological history, special attention is paid to the presence of dog pets in the family, the presence of household plots, the habit of pica (geophagy), and others.

The clinical diagnosis of toxocarosis is based on a combination of clinical symptoms and signs, which are evaluated using a 5-point scoring system of L.T. Glickman [16].

**Results.** In patients with toxocarosis, clinical manifestations are quite diverse: from asymptomatic to severe forms, which is consistent with the literature data [3, 7, 8, 12, 19].

Before the treatment, the patients had multiple complaints. As can be seen from Table 2, patients most often complained of fatigue (59.90%), headache (30.08%), dizziness (45.25%), a feeling of heaviness and / or pain in the epigastric region (40.92% %) and right hypochondrium (67.48%), dyspeptic disorders in the form of nausea (30.62%), decreased appetite (44.72%), intestinal obstruction (24.66%), diarrhea (21.14%), bloat (41.19%). The manifestations of a dyspeptic syndrome of varying severity were noted in half of those surveyed.

46.61% of patients with toxocarosis had complaints of cough, more often dry, 14.63% of

Table 2

**Complaints and their frequency in children aged 1 to 14 years with toxocarosis**

Symptoms	Number of patients	%
Weakness and fatigue	221	59.90
Sleep disorders	44	11.92
Irritability, emotional lability	67	18.16
Headache	111	30.08
Faintness	167	45.25
Heartache	35	9.49
Feeling of heaviness and pain in the right hypochondrium	249	67.48
Pain in the left hypochondrium	30	8.13
Epigastric discomfort	151	40.92
Sickliness	113	30.62
Regurgitation, epigastric burning	212	57.45
Bitter taste in mouth	197	53.39
Bloat	152	41.19
Decreased appetite	165	44.72
Weight loss	135	36.58
Intestinal obstruction	91	24.66
Diarrhea	78	21.14
Skin itch	109	29.53
Skin rash	165	44.72
Joint and muscular pain	56	15.18
Coughing	172	46.61
Choking sensation	54	14.63
Complaints are absent	32	8.67

patients complained of choking sensation. Pain in the chest was noted in 15.22% of patients. Pain in the joints, mostly of moderate intensity, was observed in 15.18% of patients. In most cases, the pain was localized in the small joints of the limbs.

On examination (Table 3), 84.25% of patients had pale skin, 14.36% had subicteric sclerae, in 44.72% of patients disease was accompanied by a different type of recurring skin rash. Elements of the rash had a maculopapular character and were localized on the trunk or on the trunk and upper limbs simultaneously. The increase in body temperature was more often observed in 55.28% of patients, the temperature rose usually in the evening, less often in the day, more often subfebrile, less often febrile, accompanied by a slight chill.

Objectively, 196 (53.12%) children had local pain in the right hypochondrium and / or in the region of the projection of the gallbladder with irradiation in the right shoulder, neck, under the shoulder and in the lumbar region. In 45.53% of patients, limited pain during percussion and palpation was determined predominantly in the epigastric area, less frequently (22.49%) around the omphalos. The plaqued tongue was observed in 33.88% of patients.

In the right hypochondrium, the liver was palpatory determined at the edges of the costal arch in 29.27% of the patients, and in 70.73%, the lower edge of the liver overlapped the edge of the costal arch by 2-3 cm. When palpated, the liver was thickened, smooth, often tense. An increase in the size of the spleen (splenomegaly) was noted in 11.11% of children.

In the lungs with auscultation, harsh breathing was determined in 181 (49.05%) patients, suppressed breath sounds in 45 (12.19%) patients and dry rales in 54 (14.63%).

As to the lesions of the urinary and reproductive systems, no objective symptomatology was revealed.

Focused abdominal sonogram in 61.3% of patients with complaints of pain in the right hypochondrium revealed signs of chronic

cholecystitis, in 42.9% of patients, hepatocholecystitis, cholecystopancreatitis, hepatitis. In 20 (5.42%) patients it revealed splenomegaly and in one, signs of gastroduodenitis.

With fibroadastroduodenoscopy 43 (11,65%) patients showed signs of gastroduodenopathy.

Dynamic long-term monitoring of patients allowed to summarize the obtained subjective and objective data, and highlight the main, the most common clinical syndromes and symptoms.

In analyzing the frequency and nature of clinical and laboratory manifestations, each child was found to have a clinical-laboratory score (according to Glikman) ranging from 24 to 37 points, and an average of  $29.19 \pm 3.5$  points (Table 4).

One of the most common syndromes (71.84% of patients), together with general astenization and recurrent fever, was abdominal pain syndrome caused by pain in the upper abdomen, which, as a rule, preceded other clinical manifestations and predominated throughout the disease. Pain in the right hypochondrium, in the epigastrium, and in the left hypochondrium, could be different in strength and character from weak and / or moderately pronounced, dull, wearing, to constant, sharply expressed, with irradiation. Pain has often been combined with various dyspeptic manifestations in more than a half of the patients. Relevant data of such clinical manifestations are also reported by other authors [12, 15].

In 48.27% patients, there was a pulmonary syndrome. On the background of subfebrile or, less often, febrile temperature, the patients had cough, choking, chest pain. X-ray in 50.94% of patients determined the increased pulmonary vascularity due to perivascular and peribronchial indurations, infiltrative changes.

Hepatobiliary syndrome was detected in 69.34% of patients with toxocarosis, and in 11.11% of patients it was accompanied by splenomegaly.

Neurological disorders of varying severity were observed in 72.37% of patients, which clinically manifested themselves as a headache, occurring more often by the end of the day and / or after overexertion, increased fatigue and irritability. In 41.7% of patients, the syndrome of angioneurosis was revealed, which manifested itself in the

Table 3

**Objective data and their frequency in children aged 1 to 14 years with toxocarosis**

Symptom	Patients	%
Pale skin	311	84.25
Subicteric sclerae	53	14.36
Skin rash	165	44.72
Body temperature increase	204	55.28
Lymphadenopathy	352	95.39
Plaqued tongue	125	33.88
Local pain in the right hypochondrium	196	53.12
Hepatomegaly	261	70.73
Splenomegaly	41	11.11
Epigastric pain	168	45.53
Pain around the omphalos	83	22.49
Muffled heart tones	32	8.67
Harsh breathing	181	49.05
Suppressed breath sounds	45	12.19
Dry rales	54	14.63
Excessive sweating	121	32.79
Sweaty hands	217	58.81

Table 4

**Changes in clinical and laboratory scores in children aged 1 to 14 years with toxocarosis**

Score	Changes rate (%) by age (years)			
	1-3 (n=66)	4-7 (n=135)	8-10 (n=91)	11-14 (n=77)
Eosinophilia	100.00	100.00	100.00	100.00
Leukocytosis	80.30	93.33	86.81	80.51
ESR acceleration	93.93	90.37	96.70	93.50
Hypergammaglobulinemia	96.95	100.00	100.00	93.50
Hypoalbuminemia	92.42	97.04	96.70	76.62
Anaemia	87.88	87.41	86.81	80.51
Recurrent fever	50.00	52.59	52.74	67.53
Pulmonary syndrome	59.09	40.00	47.25	46.75
X-ray signs of pulmonary involvement	53.03	47.40	52.74	53.24
Hepatomegaly	60.61	76.29	70.32	70.12
Abdominal syndrome	62.12	80.00	72.52	72.72
Neurological disorders	66.66	82.96	73.62	66.23
Skin manifestations	53.03	44.44	39.56	44.15
Lymphadenopathy	90.91	100.00	90.10	97.40
Total Glickman score	100.00	100.00	100.00	100.00

disorders of vegetative regulation and vegetative instability, which evidences a decrease in the adaptive capabilities of patients.

Rheoencephalography showed a tendency to vascular tone increase, mainly in the vertebrobasilar system, venous outflow disorder, brain congestion.

Symptom complex of toxocarosis eventually led to disorders in the emotional sphere, that is,

emotional disturbances of a secondary nature. Changes in the emotional sphere were manifested by various forms of neurasthenic syndrome (cyclothymia, asthenophobic reactions, asthenohypochondrical reactions), as well as hysterical syndrome and neurotic reactions.

Study of laboratory parameters showed that eosinophilia (100%), leukocytosis (80.30-93.33%), accelerated ESR (90.37-96.70%), anaemia (80.51-87.88%), hypergammaglobulinemia (93.50-100.00%), hypoalbuminemia (76.62-97.04%) are characteristic to children with toxocarosis. Similar clinical and laboratory studies were conducted in children aged 1-14 years without toxocarosis, who were examined and treated at the department of somatopathy of the regional clinical child hospital.

A comparative analysis of the frequency of the main clinical manifestations showed (Fig. 1) that in children with toxocarosis recurrent fever, pulmonary syndrome, lymphadenopathy occurred 2.5 times more frequently than in children without toxocarosis (P < 0.01). Abdominal syndrome, neurological disorders, hepatomegaly, skin manifestations were also more often observed in patients with toxocarosis than in children without toxocarosis, but only 1.2-1.3 times more frequently.

The most significant differences are found between some laboratory data (Fig. 2), which in patients with toxocarosis are 4-8 times higher than in children without toxocarosis.

Only the factor of ESR was not significantly

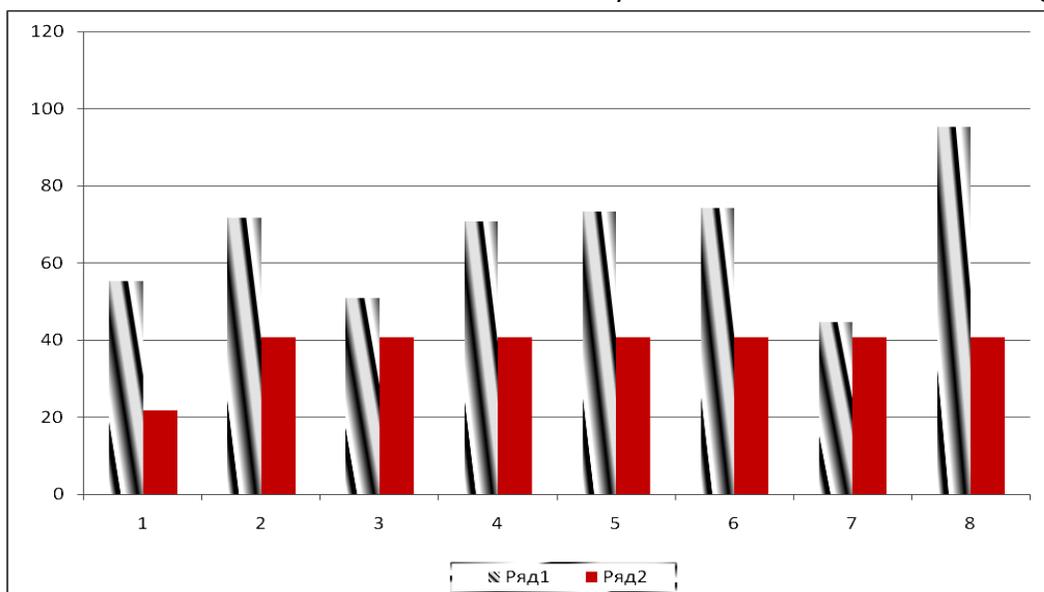


Fig. 1. Comparative frequency of changes (%) of some clinical data in children aged 1 to 14 years with toxocarosis (row 1) and without it (row 2). Legend: row 1 - children with toxocarosis; row 2 - children without toxocarosis. 1 - fever 2 - pulmonary syndrome 3 - X-ray signs of pulmonary involvement; 4 - hepatomegaly 5 - abdominal syndrome; 6 - neurological disorders; 7 - skin manifestations; 8 - lymphadenopathy.

different. In this case, not only the difference in the frequency of changes in some laboratory parameters was revealed, but also in the degree of their expression. Especially it concerned such diagnostically important parameters as eosinophilia and leukocytosis. Thus, eosinophilia was observed in all patients with toxocarosis, and only in 19.88% of patients without toxocarosis. But, as can be seen from Table 5, only in 103 (20.60%) patients without toxocarosis, eosinophilia did not exceed 20%, and in the remaining 395 children the number of eosinophils was 2-10%. At the same time, in 347 patients (94.04%) with toxocarosis the number of eosinophils was from 21% to 50%, and only in 22 (5.96%) was 11-20%.

Leukocytosis in peripheral blood with toxocarosis was observed 8 times more frequently than in patients without toxocarosis (Table 6). As can be seen from the table, more than a half of patients (58.84%) without toxocarosis had the level of white blood cells (WBC) within normal limits, and 30.32% of children in this group had leukopenia.

Thus, the analysis of the frequency and nature of clinical and laboratory factors made it possible to establish that the sum of the main clinical manifestations (according to Glikman) in patients with toxocarosis ( $29.19 \pm 3.5$ ) significantly exceeded the sum of the indices in children without toxocarosis ( $7.37 \pm 2.4$ ). The analysis of the survey results for children with and without toxocarosis at the age of 1-14 years showed that

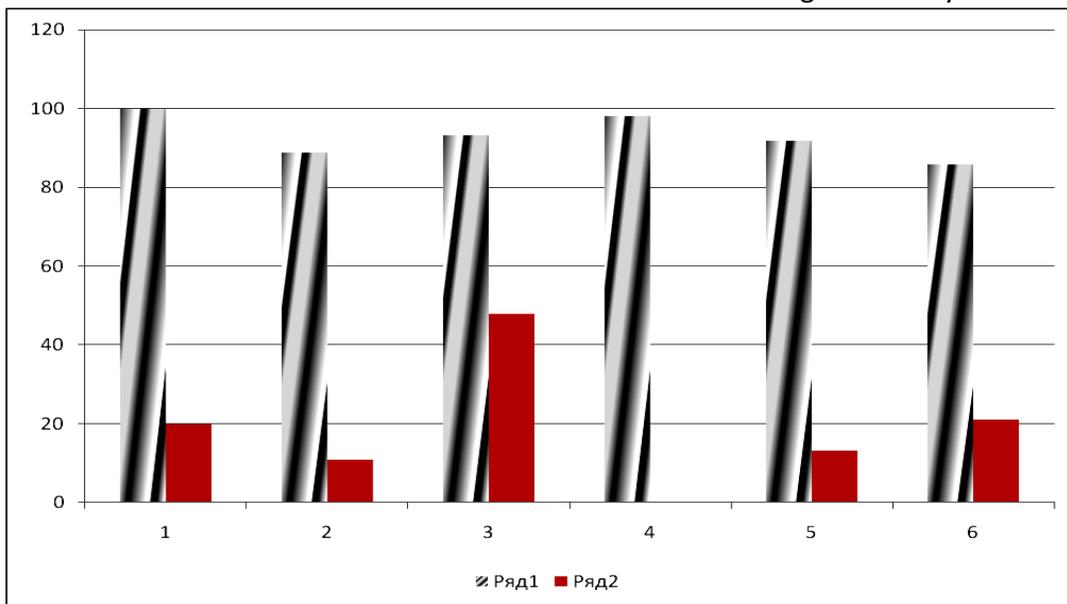


Fig. 2. Comparative frequency of changes (%) of some laboratory data in children aged 1 to 14 years, patients with toxocarosis (row 1) and without it (row 2) Legend: row 1 - children with toxocarosis; row 2 - children without toxocarosis. 1 - eosinophilia; 2 - leukocytosis; 3 - accelerated ESR; 4 - hypergammaglobulinemia; 5 - hypoalbuminemia; 6 - anaemia.

Table 5

**Eosinophilia frequency and intensity in children aged 1 to 14 years with and without toxocarosis**

Number of eosinophils	Children with toxocarosis		Children without toxocarosis	
	persons	%	persons	%
2-5	–	–	243	48.79
6-10	–	–		
11-20	22	5.6	103	20.69
21-30	134	36.32	–	–
31-40	133	36.04	–	–
41-50 and more	80	21.68	–	–
Total surveyed	369	100.00	498	100.00

Table 6

**The frequency and nature of changes in level of WBC in children aged 1 to 14 years with and without toxocarosis**

WBC level	Children with toxocarosis		Children without toxocarosis	
	persons	%	persons	%
Leukocytosis (over $10 \times 10^9/l$ )	320	86.72	54	10.84
Normocytosis ( $6-10 \times 10^9/l$ )	49	13.28	293	58.84
Leukopenia (less $9 \times 10^9/l$ )	–	–	151	30.32
Total surveyed	369	100.00	498	100.00

the changes in clinical and laboratory parameters in patients with toxocarosis are diverse and nonspecific, which is consistent with the literature data [10, 13, 14, 15].

Anti-epidemic measures of toxocarosis prevention should be carried out in several ways.

1. *Activities aimed at the main sources of infestation.*

These include, first and foremost, examination and timely de-worming of dogs. These measures include:

- de-worming of she-dogs during pregnancy;
- de-worming of pups up to six months of age;
- limiting the number of free-ranging dogs;
- the arrangement of special pet relief areas and their hygienic maintenance;
- keeping the public informed about the methods of treating pets, especially dogs.

Veterinary mebendazole, pyrantel, piperazine, albendazole (Albena-C), prazitsid (complex preparation containing praziquatel and pyrantel), asinox plus and others are used for the treatment of dogs.

2. *Influence on transmission factors of the invasion.*

Health-related measures include:

- washing hands after contact with soil and animals;
- careful washing of greens, berries, vegetables, which can be contaminated with earth;
- protection of sandpits with foil or shields preventing the visits of animals and regular sand replacement in children's sandpits, 3 times a year;
- protection of parks, squares from visiting by animals and their hygienic maintenance, and also sanitary clearing of territories of house-holds, child-care facilities, recreational zones, 3-4 times a year.

3. *Influence on human behavior.*

Since the majority of the population is not informed about the risk of helminth infection from dogs, public health education is important, which should include an explanation of possible ways of parasite infestation, methods of treating animals, and the need to eliminate fecal contamination from dogs during their walking. For this purpose it is useful to use the experience of some European countries, to protect parks and public gardens from fecal contamination, have special containers for polyethylene bags and containers for the

collection of dog feces in the most frequent dog-walking areas.

**Prospects for further research.** The results of the studies indicate a lack of significant differences in the rates of clinical and laboratory manifestations of toxocarosis in children, depending on age. However, eosinophilia, leukocytosis, hypergammaglobulinemia, hypoalbuminemia, combined with pulmonary syndrome, marked lymphadenopathy in the background of recurrent fever are much more frequent ( $P < 0.01$ ) in children with toxocarosis than without it. As to the frequency of abdominal and hepatobiliary syndromes, skin manifestations and neurological disorders, as well as anemia and accelerated ESR, in children with toxocarosis, these rates are 1.2-1.3 times more frequent, but there is no significant difference ( $P > 0.5$ ). At the same time, the value of these indicators should be taken into account when making differential diagnostics, as well as for further research.

Of particular relevance are the issues of anti-epidemic measures for the prevention of toxocarosis, since the prevalence of this invasion among the population, especially among children, continues to grow rapidly. In our opinion, the reasons for this are certain difficulties in carrying out preventive measures in full and the absence of a sanitary-helminthological surveillance system for environmental objects in Ukraine, which would take into account the specific features of epidemiology of toxocarosis in each specific case.

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