Correlation of Serodiagnosis with Morphological Verification of Cystic Echinococcosis, and the Association of Patients' Blood Types with Echinococcus Invasion

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ABSTRACT:
A retrospective analysis was carried out in 110 patients with echinococcosis of the liver and lungs operated on in various hospitals of the Russian Federation, in whom the diagnosis of Cystic Echinococcosis was morphologically verified (intra-vitam). According to the study, clinical and epidemiological features were identified: main factors predisposing to echinococcus invasion, average duration of medical history before visiting a doctor, main clinical symptom complex; the correlation between the blood type of patients according to the AB0 system and the average European blood type was shown: significant differences were obtained for III(B) and IV(AB) blood types ($p<0.05$). In addition, the role of serological diagnosis of echinococcosis as an auxiliary, the effectiveness of which in the Russian Federation for cysts of type CE1 (according to the WHO-IWGE classification) reaches 71%.

1. Introduction

Echinococcosis is a disease common in many countries around the world. According to literature data, this disease affects more than 1 million people and occurs in different foci with different frequencies, regardless of the endemic nature of the disease. Echinococcus is classified as cosmopolitan, although Echinococcus granulosus has now been reported not only in Iceland and Greenland, rare cases have been identified in New Zealand, Tasmania and Cyprus. Since 2000, there has been a significant increase in the incidence of echinococcus invasion and an expansion of the geographic boundaries of the disease, for this reason, congresses have been organized under the auspices of the International Echinococcosis Association (Budke et.al, 2017; World Health Organization, 2014; Deplazes et.al., 2017). Since this year, there has been a significant increase in the incidence of echinococcus invasion and an expansion of the geographic boundaries of the disease, for this reason, congresses have been organized under the auspices of the International Echinococcosis Association (World Health Organization, 2014).

In 2001, at the 54th session of the World Health Organization (WHO), it was stated that helminth infections are the third most important disease after HIV infection and oncology, therefore, the geohelminthosis control strategy was approved and named the WHO Informal Working Group on Echinococcosis (WHO-IWGE). Some WHO experts predicted that the problem of echinococcosis in many urbanized countries would be solved in the near future, but this strategy was not implemented (World Health Organization, 2014; Craig et.al., 2008).

In countries with enhanced sanitary and epidemiological regulations, echinococcus disease can also pose a serious threat. For example, in the United States, about 100 new cases of Cystic Echinococcosis (CE) are reported annually, among which 60% are detected in immigrants. The same is true for European countries that are thriving in their relationships, such as Germany, Switzerland and Italy (Kern et.al, 2017). Echinococcus infection is more common in rural areas where sheep farming is practiced and there are conditions where dogs can devour the insides of the livestock (Wen et.al., 2019). This disease is most common in parts of the world where dogs eat meat or are included in the diet (for example, in some areas of Kenya) (Global, regional, and national life expectancy, all-cause mortality, and cause-specific mortality for 249 causes of death, 1980-2015: a systematic analysis for the Global Burden of Disease Study 2015)[19]. Over the past few years, there has been an upward trend in the incidence of Cystic Echinococcosis among the population in the Russian Federation: more than 500 cases of CE are registered annually. In 2012, the

incidence of Echinococcus granulosus in Russia increased by 7.9% compared to 2011 (SanPiN 3.2.3215-14, 2014).

Echinococcus is a small parasite belonging to the class of tapeworms, measuring 3-5 mm, which consists of a head with four suckers and a double crown of hooks, neck and 3-6 segments, which parasitizes the small intestine of carnivores and causes Echinococcosis. This disease is widespread and pathogenic to both humans and animals (Thompson, 2019; Grieve, 2000).

There are genotypes of Echinococcus (G) (Brunetti, 2019), which were previously called strains: G1–G10, - each with an intermediate host necessary for the development of the parasite cycle. G1 (sheep strain), G2 (Tasmanian sheep strain) and G3 (bovine, buffalo strain) form the E. granulosus species and parasitize only humans. The G4 strain does not occur in humans. Strains G5 (cattle), G6 (camel), G7 (pig) and the two strains G8 and G10 (deer) can also parasitize humans. However, the assignment of strains to animal species is conditional, since G4-G8 are also found in dogs (Higuita,2016; John at al., 2016).

The question of underlying risk for helminth infections was first raised at the beginning of the 20th century on the basis of observations of the prevalence of helminth infections in different ethnic groups. Convincing evidence of the involvement of the genetic component in the development of resistance to helminths in animals was obtained in the 80s. This was further investigated in humans using multifactorial disease analysis approaches: Linkage analysis, candidate mapping, genome-wide association study, expression profile analysis. The identification of phenotypic differences between individuals is important for the study of host genetics in the context of the relationship with the helminth. A feature of the genetic study of helminthiases is the focus on assessing the intensity of invasion and the analysis of quantitative clinical signs indicating the severity of the course of the disease, rather than on the presence or absence of invasion. The intensity of invasion, i.e. the number of adult or larval forms in the body, in many cases correlates with pathological signs developing in the host. The number of helminths, in turn, correlates with the number of eggs, which are determined in different excretory products of the host depending on the location characteristic of a particular helminth. Thus, in many studies, the intensity of infestation is judged by the number of helminth eggs determined by laboratory methods [32]. Infectious diseases caused by protozoa are also sometimes correlated with blood types. Several studies have shown that blood types B and AB are associated with an increased incidence of salmonellosis. It is assumed that here, as in most previous cases, the polymorphism of antigens in different groups plays a key role (Abegaz, 2021). The severity of malaria caused by P. falciparum is directly correlated with the presence or absence of blood type A and B antigens. People with blood type O tend to suffer less from malaria, while people with blood types A and B are at greater risk of malaria-related anemia. This is because infected erythrocytes synthesize membrane proteins that bind antigen A and, perhaps to a lesser extent, antigen B of uninfected erythrocytes (Ewald et al., 2016). In 1989 P. Bouree et G. Bonnot conducted a study of 467 cases of various parasitic diseases and their association with the blood type according to the ABO system. Using classical statistical methods, they found no correlation whatsoever, although the factor analysis was used with a large number of variables and the relationship of hookworm, strongyloidiasis with blood type I, giardiasis with blood type II, and E. coli invasion with blood type III was obtained. The authors conclude that IV(AB) group does not appear to prone to all parasites. In addition, the authors pointed out that blood type and disease severity did not appear to be related (Bouree, 1989). AB0 blood group antigens were discovered over a century ago; however, it is still important to study their role in development of various pathological conditions. Today it is known that antigenic determinants of this blood group are present not only on erythrocyte membrane but also on other cells and tissues: platelets, gastrointestinal epithelium and salivary glands, respiratory system cells. In the last decade, a large number of studies have appeared to reveal the relationship between a specific disease and blood group type, meta-analyses have been published. Previously, the authors have studied the metabolic status, cell composition and coagulation profile of clinically healthy individuals for more than on 180,000 donations, that allowed to identify groupspecific features for each blood group (Gil'miyarova, 2022).

The diagnosis of CE consists of instrumental examinations (X-ray and ultrasound examinations, radionuclide methods), morphological examination when taking biopsy material, as well as studying laboratory parameters (general blood count, biochemical studies, serological diagnostics, such as enzyme-linked immunosorbent assay or ELISA) (Ammann, Eckert, 1995). In Russia, only one test system for the diagnosis of Cystic Echinococcocus is licensed, based on ELISA (Echinococcus-IgG, kit, Vector-best, Russia). The results of the enzyme-linked immunosorbent assay are interpreted as positive or negative in accordance with the manufacturer's recommendations and the proven effectiveness of the test system for CE

(Poletaeva et al., 2011). It is already known that serology is not always informative, although the detection of echinococcus antibodies remains a necessary criterion in the evaluation of patients, especially those with suspected cystic Echinococcus of the liver and lungs (Radonjić et al., 2007; Alver et al., 2021).

Laboratory tests for the diagnosis of Cystic Echinococcosis provide supporting information and are not specific to verify the diagnosis (Brunetti et al., 2010). Thus, eosinophilia, characteristic of helminthiases in CE, is detected in 18% of cases (Wen et al., 2019). A number of authors note leukocytosis and a decrease in the total number of lymphocytes in the complete blood count, as well as hyperproteinemia on biochemical examination of blood serum. Among other laboratory tests, an increase in the total number of immunoglobulins of all blood levels is often determined (Moro et al., 2009). A retrospective analysis of the years 2000-2012 at the University Hospital of Pavia was performed to evaluate the effect of the echinococcus cyst type on the results of the ELISA and indirect hemagglutination tests. Echinococcus cysts were classified based on visualization of cystic masses on ultrasound according to the classification of the informal working group on Cystic Echinococcosis (WHO-IWGE) (WHO Informal Working Group, 2003) and grouped as follows: active (CE1, CE2 and CE3b), transitional (CE3a) and inactive (CE4, CE5) cysts. This classification was chosen based on the results of the metabolic profile of echinococcus cysts assessed by magnetic resonance imaging in a review article written by Hosch et al (Hosch et al., 2008). Studies have shown that the stage of the cyst is variable and is related to serological findings, while patients with CE1 and CE4-CE5 cysts (in the liver) were found to be seronegative in a high percentage of cases (30-58% and 50-87%, respectively) while the seronegative variant rate is lower in CE2 and CE3 cysts (5-20%) (Lissandrin et al., 2016) [28].

The diagnosis of CE is based on the epidemiological history, clinical picture and the results of the comprehensive examination (instrumental methods of examination - X-ray, ultrasound, radioisotope, as well as serological) (Velasco-Tirado, 2018).

The introduction of modern high-tech research methods, the widespread use of instrumental methods (ultrasound, CT, MRI, X-ray) have led to an improvement in the diagnosis of Cystic Echinococcosis at the early stages of invasion and, as a result, the wider use of conservative therapy, the application of waiting and monitoring tactics (Akhan, 2020).

For treatment of CE, drugs from the benzimidazole group have recently become widespread, among which the drug of choice is albendazole, which is active against the neanic stage of unilocular echinococcus (Dandan, 2019). Albendazole is better adsorbed from the gastrointestinal tract than mebendazole, which makes it easy to achieve the required concentration in the blood by varying doses (Akimniyazova, 2021; Vuitton, 2020). A positive property of this drug is that its main metabolite (albendazole sulfoxide) is highly effective against Cystic Echinococcosis. Treatment with albendazole at a dose of 10 mg/kg of the patient's body weight is carried out in courses of 28 days with 14-day breaks[9] and continuous regimens for up to six months under the control of laboratory and instrumental methods of diagnosis (Mehdizad et al., 2019).

Our study aims to elucidate the main clinical and epidemiologic features of hepatic and pulmonary echinococcosis in the Russian Federation in patients with a confirmed diagnosis of cystic echinococcosis of these localizations, as well as the relevance of serologic diagnostics as a control of the effectiveness of antiretroviral therapy of morphologically confirmed echinococcosis by dynamic monitoring of antibody levels to echinococcus antigens after each anti-relapse course, and aims to assess the underlying risk of a person’s blood type according to the AB0 system for the echinococcus invasion, correlating it with the Central European.

Purpose of the study.

Elucidation of the clinical and epidemiological features of CE of the liver and lungs, determination of the correlation between morphological verification by diagnosis and seroreaction, as well as identifying the relationship between a patient's blood type and their predisposition to echinococcus invasion.

2. Patient groups and methods.

The study is based on a retrospective and prospective analysis of observations of 110 patients with CE, operated on at the Research Institute of Emergency Medicine named after. N.V. Sklifosovsky, FSBI National Medical Research Center of Surgery named after A.V. Vishnevsky, Russian Scientific Center for Surgery named after Academician B.V. Petrovsky, Sechenov University, as well as in other hospitals of the Russian

Federation for the period January 2016 to January 2020. All patients were operated on in various hospitals in the Russian Federation, but mainly in the city of Moscow. The surgeon determined the choice and extent of surgical treatment. The time to take the anti-relapse drug albendazole varied depending on the time of referral to our medical center and averaged from 2 to 6 weeks. Among the operated patients, sex distribution: there were a total of 53 (47%) females and 47 (53%) males, with a male to female ratio of 1:1.15. The mean age of the patients was 42.69 ± 16.85 years.

The largest lesions of Cystic Echinococcosis were observed in patients aged 26-35 (21.43%) and 36-45 years (20.63%) (Figure 1.1).

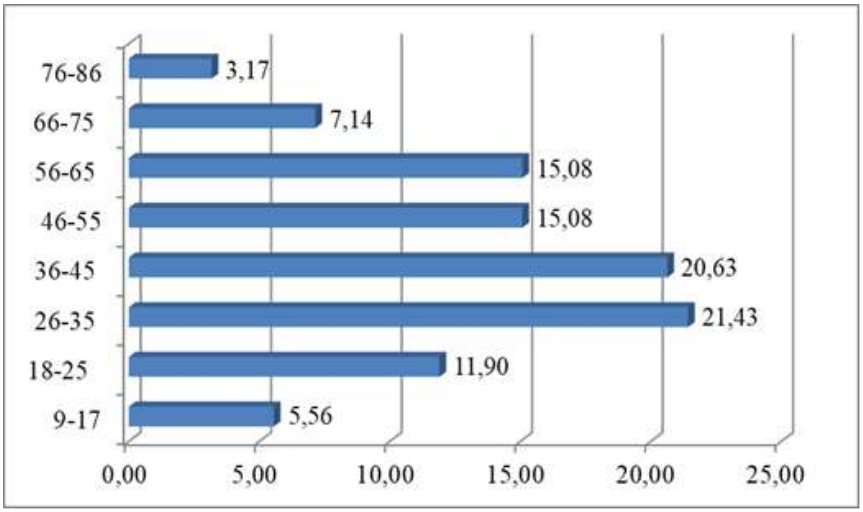

Figure 1.1 - Distribution of patients by age groups, %

The distribution of age groups by sex was heterogeneous, with the largest number of women in the 26-35 age group - 14 patients (24.14%), men aged 36-45 (11 patients, 18.97%). The group of patients under 18 years of age was represented by only two females (3.45%), against 5 males (5.56%), while in contrast, females predominated in the older age groups. Thus, the group over 76 years of age included only 4 women (6.90%), and among people aged 66-75 there were 6 women (10.34%) and 3 men (5.17%), $p<0.05$ (Fig. 1.2).

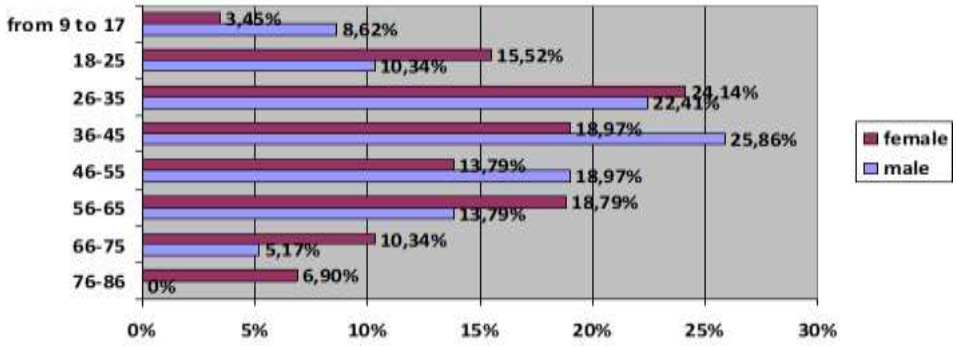

Figure 1.2 - Distribution of patients in groups by age and sex, %

The urban population rate was 42.06% (46 people), the rural population rate was 57.94% (64 people). Moreover, 38 patients living in the city were born in rural areas (71.00% of the urban population).

The analysis of the distribution of patients depending on the place of residence showed that against the background of the general increase in morbidity there was a tendency to increase of the number of persons with CE among urban residents. This may be due to the migration of the population from rural areas to large cities, the deterioration of the general epidemiological situation and poor sanitary and hygienic control over the quality of agricultural products.

When collecting anamnesis, epidemiologic environment, occupational activity, contact with farm and backyard animals were specified. Despite the fact that it is not possible to establish the exact route of infection, it was revealed that the majority of patients infected with Cystic Echinococcosis had close contact with dogs - 75 people (68.18%), 38 people (34.54%) handled farm animals. Also, 15 patients (13.63%)

reported regularly picking wild berries, 9 patients (8.18%) regularly hunted and took part in taking-up of hides (Fig. 1.3).

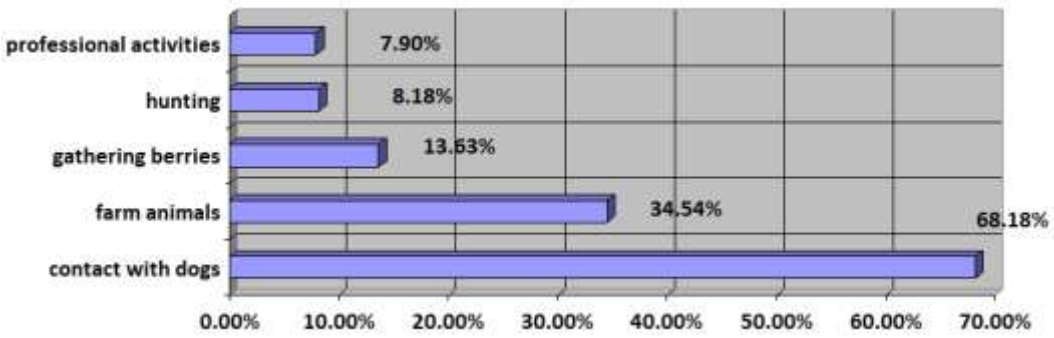

Figure 1.3 - Risk factors, %

Analysis of the social structure of patients with CE showed a predominance of employees – 31 people (25.40%), as well as the non-working population - persons engaged primarily in livestock farming, which accounted for 23.02%, pensioners accounted for 19.05%, students for 15.08%, and workers for 17.46% (Table 1.1).

Table 1.1 – Distribution of patients by social structure

	Male		Female		Total	
	abs.	%	abs.	%	abs.	%
Office employees	10	17.24	22	32.35	32	25.40
Unemployed	13	22.41	16	23.53	29	23.02
Pensioners	7	12.07	17	25.00	24	19.05
Workers	17	31.03	4	5.88	22	17.46
Students	10	17.24	9	13.24	19	15.08
Total	47	100.00	53	100.00	110	100.00

A comprehensive clinical, laboratory, and instrumental examination was used in all patients. Clinical information collection included determining the nature of disease manifestations; their progress; identification of signs of possible complications (pain, fever, skin rashes, jaundice, etc.), as well as signs of coexistent affection and concomitant diseases.

Most patients (75 people, 69.05%) sought medical help within the first two years after the onset of clinical symptoms of the disease. In 17 (16.67%) of patients, Cystic Echinococcosis was revealed incidentally in an asymptomatic stage during ultrasound or fluorography. Data on the length of the history is presented in Table 1.2.

Table 1.2 - Distribution of CE patients according to the length of anamnesis

Cystic Echinococcosis patients		Up to 1 year		1-2 years		2-5 years		Over 5 years	
abs.	%	abs.	%	abs.	%	abs.	%	abs.	%
110	100	41	36.51	36	32.54	21	19.84	12	11.11

The clinical symptom complex in Cystic Echinococcosis is represented by painful, general and local symptoms. With CE of the liver, pain syndrome was most often detected, which was noted by 86 (83.5%) patients. Six of them (6.98%) had attack-like pain, 58 (67.44%) reported dull pain and 22 (25.58%) had aching pain. No specific pain irradiation was noted.

Next in terms of frequency of manifestations was heaviness in the right hypochondrium, detected in 45 (43.69%) patients, as well as signs of compression by echinococcus cysts of adjacent organs in 19 patients (18.45%). Since the right lobe of the liver was most often affected, compression of the outlet of the stomach

and duodenum was most often noted, which was manifested by a feeling of heaviness in the epigastric region after a generous meal, periodic nausea and vomiting. The frequency of these symptoms was determined by the dietary patterns of the patients. Only 1 patient (0.91%) had an allergic reaction in the form of skin rashes, which hardly responded to drug therapy.

The presence of jaundice as a common clinical feature, was noted in 5 (4.85%) patients. Of these, in 3 (2.91%) cases, jaundice was accompanied by itchy skin with traces of scratching. The local symptom complex in Cystic Echinococcosis of the liver depended on the location and size of the cyst.

The distribution of patients by location of echinococcus cysts is presented in Table 1.3. In terms of localization, echinococcus cysts predominantly affected the liver – 62% (68 patients), CE of the lungs was detected in 38% (31 patients), coexistent affection of the liver and lungs in 10% of cases (11 patients).

Table 1.3 – Distribution of patients by location of echinococcus cysts

	Male		Female		Total	
Localization	abs.	%	abs.	%	abs.	%
Liver	30	27.2	38	34.8	68	62
Lungs	13	11.8	18	16.2	31	38
Liver и lungs	6	5.4	5	4.6	11	10
Total	47	43.4	53	53.6	110	100.00

Thus, the vast majority of patients (79 people) had liver affection - 72% (79 patients out of 110), of these, 68 people (86% of all liver lesions) were diagnosed with isolated liver affection, in 11 patients (14% of all liver lesions and 10% of the total number of patients), echinococcus cysts were found in the liver and lungs. Isolated lung lesions were observed in only 31 (28%) of all patients.

Serological diagnosis of CE was also carried out by determination of IgG antibodies to Echinococcus in blood serum (plasma) using a solid-phase enzyme-linked immunosorbent assay with a set of reagents "Echinococcus-IgG – ELISA-BEST" (D-3356 "VECTOR-BEST", Russia) after each anti-relapsing course of Cystic Echinococcosis. This is the only test system registered in the Russian Federation [15].

Antigen-antibody-conjugate complex was detected by color reaction with peroxidase substrate, adding stop reagent, the optical density of solutions in wells was measured at a wavelength of 450 nm. The intensity of staining is proportional to the concentration of IgG to Echinococcus antigens in the analyzed serum sample.

Using a spectrophotometer, the optical density was determined in two-wavelength mode: main filter - 450 nm, reference filter - in the range of 620-650 nm. The arithmetic mean values of optical density in wells with negative control sample (OPaveK-) were calculated, the diagnostic value of optical density (OPd) was determined according to the formula:

$$OPd = OP_{ave}K– + 0.14.$$

With $OP_{sample} \geq OP_d$ the test was considered positive, with $OP_{sample} \leq 0.85 \times OP_d$ - it was considered negative, when the result is in the range of $0.85 \times OP_d$ - OP_d - doubtful, they were repeated in a 2–4-week period. We monitored instrumental parameters after each course of albendazole to assess the size of the cysts, their calcification (indicating parasitic cyst death), and also monitored the condition of the internal organs through biochemical studies and in the event of severe adverse reactions (drug-induced hepatitis, anemia, allergic reactions, etc.) albendazole administration was temporarily canceled. In addition, in order to assess the relapse of the disease and the effectiveness of therapy, after each course of albendazole, the level of specific antibodies to Echinococcus antigens was monitored, and in the case of a positive seroreaction, and in the absence of cystic growth, we stopped prescribing albendazole, although the patients were under case follow-up for three years. Positive antibodies to echinococcus antigens in the absence of disease recurrence were regarded as immunological memory. Immunological memory is the retention of antibodies to pathogen antigens in the human body in the case of a cured disease and indicates the disease in the absence of the pathogen/recovery itself (Radonjić et al., 2007). In 2003, the World Health Organization (WHO) developed a standardized system for ultrasound classification of liver cysts, which also applies to parasitic cysts of other

organs, including the lungs, but excluding bones. In our study, all operated parasitic cysts were CE1 according to the WHO-IWGE classification (WHO Informal Working Group, 2003).

Based on the results of a retrospective study, the influence of the patient's blood type on the formation of certain diseases was also established. In the present study, the frequency of occurrence of different blood types in patients infected with CE was analyzed.

The incidence of echinococcus infections depending on the blood type of the ABO system showed that patients with A (II) and O (I) blood types compared to patients with B (III) and AB (IV) blood types, regardless of age and gender characteristics, were most intensively infected with CE (Diagram 1).

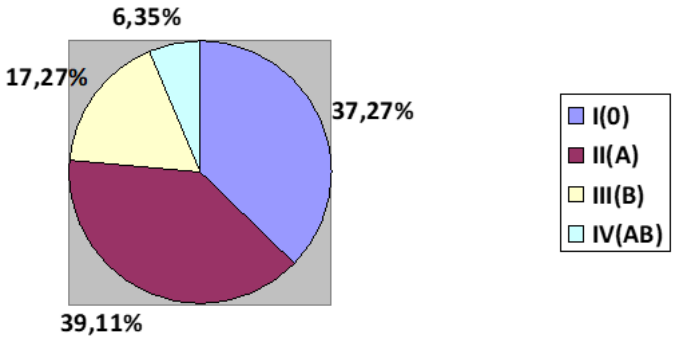

Diagram 1 - Frequency of Echinococcus infected persons depending on blood type, %

Some of the patients did not live in Moscow, so they were consulted via telemedicine. After each course of albendazole, patients sent the results of their laboratory and instrumental analyses to e-mail and analyzed by the attending physician, after which the attending physician made a correction: continue treatment, stop it, increase or decrease the dose of the drug.

It was retrospective study therefore ethical approval was not required. All patients were informed about this study and signed a voluntary informed consent for its passage.

For statistical analysis, we used the program named the SPSS Statistics 20.0 software package for Windows. The results of laboratory tests were recorded in special cards and then subjected to statistical analysis by this program. The basis of the program consists in rejecting the Student's criterion named t-criterion. If the t-criterion value is 2.0 or more, we can state that the difference in the indices is not random, depends on a certain cause, and the probability of error to detect non-existent differences does not exceed 5% ($p<0.05$).

3. Results

Serological confirmation of Cystic Echinococcosis.

The patients without chronic diseases received a continuous 60-day course of albendazole (ABZ) at intervals of 1-2 months summary 3 courses, depending on complications, but patients who have chronic diseases received a treatment regimen: 28 days of continuous treatment, followed by a 14-day break and 28 days of retreatment with ABZ. You can see the comparative characteristics and duration of the courses in my past article "Comparative analysis of anti-relapse treatment regimens in 110 patients with hepatic and pulmonary hydatid echinococcosis" (Galyavin, 2022).

ELISA was used as serological methods. Serological reactions for diagnosis were used in all patients with Cystic Echinococcosis of the liver and lungs at three stages of treatment, thus, enzyme immunoassay was performed 330 times. The results of serological tests are shown in Table 1.4.

Table 1.4 - Results of serological studies of patients

Results ELISA	Number of patients	%
Positive (all 3 tests)	78	70.91
Negative (all 3 tests)	8	7.3
Positive on the 1st of 3 stages		
1st stage	5	4.54

3 stage	7	6.36
Positive for 2 out of 3 stages		
1 and 2 stages	2	1.81
1 and 3 stages	3	2.72
2 and 3 stages	7	6.36
Total	110	100.00

The results of all performed serological tests are shown in Table 1.5

Table 1.5 - Results of performed serological tests

Research stage	Positive		Negative	
	Abs.	% of all positive reactions	Abs.	% of all negative reactions
All 3 stages	244	88.73	25	45.45
1 stage	9	3.27	12	21.82
2 stage	13	4.73	6	10.91
3 stage	9	3.27	12	21.82
Total	275	100.00	55	100.00

Positive results of serologic samples were detected in an average of 71% of cases.

In 8 patients (7.3%) out of 110 examined and operated on, there was no positive serological reaction during all three courses of chemotherapy, although, the diagnosis of Cystic Echinococcosis was confirmed morphologically, and therefore this cohort of patients received anti-relapse therapy. The negative result in these patients can be attributed to three factors: immune deficiency of patients (in the absence of HIV infection, as all patients were tested for the disease by ELISA), a special strain of echinococcus (Echinococcus antigen serology was developed for a common fraction that may not have been present in these patients), as well as radical surgery, which led to the complete elimination of the pathogen along with the antibodies bound to it. In addition, serologic tests can only indirectly show the success of the treatment: all operated patients also underwent instrumental monitoring (ultrasound and CT-control of abdominal cavity organs, chest) to assess treatment, risks of growth of possible "dormant" parasitic cysts, relapses.

Relation of blood type to echinococcus invasion

The association of AB0 blood type and Echinococcosis was carried out in 1990 by R. E. Chobanov and A. A. Salehov, who conducted a study in 624 operated patients with Cystic Echinococcosis of different localizations, this study showed that a higher incidence of the disease was reported in patients with blood type A (II), especially in men, compared to the control group. They were more likely to have simultaneous affection to the liver, lungs, and other organs (Chobanov et al., 1990).

In the average European population, according to the AB0 system, about 43% of people have the first blood type I(0), 42% have the second II(A), 11% have the third III (B) and about 4% have the fourth IV(AB) (Taktayeva, 2019), based on which the average calculation was carried out the expected occurrence of liver and lung echinococcosis by blood type in these patients. In our analysis of the obtained data in comparison with the frequency of occurrence of blood type in the Central European population is given in Table 1.4.

Table 1.4 – Comparison of the incidence of blood type in echinococcus-infected patients and the central European population

Blood type	Echinococcus granulosus patients		Expected frequency		p
	abs.	%	abs.	%	
I (0)	41	37.27	48	43.74	>0.05
II (A)	43	39.11	54	49	>0.05
III (B)	19	17.27	5	4.54	<0.05
IV (AB)	7	6.35	3	2.72	<0.05
Total	110	100.00	110	100.00	

If we take the percentage distribution of the frequency of blood type occurrence among the donors of the central European population as the expected frequencies, the distribution of blood type in patients with Cystic Echinococcosis of the liver and lungs should be as follows: I (0) blood type would have been determined in 48 people (43.74% of 110) instead of 41, II (A) — in 54 (49% of 110) instead of 43, III (B) — in 5 (4.54%) instead of 19, IV (AB) — in 3 (2.72%) instead of 7.

Thus, among the patients with CE in our study, those with blood type 2 predominated -39.11% (43 individuals) and first blood type (41 people). A comparative analysis of the frequency of blood types in patients infected with Cystic Echinococcosis and in the Central European population showed significant differences for the third and fourth blood types ($p<0.05$). The estimated number of individuals with III (B) type was 4,54% (5 out of 110), and among the studied series, 17.27% (19 out of 110) had this type; the estimated number of individuals with IV (AB) type was 2.72% (3 out of 110), and among patients with Cystic Echinococcosis this blood type was detected in 6.35% (7 out of 110).

4. Discussions

The diagnosis of Cystic Echinococcosis was confirmed morphologically in all patients. Clinical examination of the patients was carried out according to the generally accepted methodology, which included data of carefully collected anamnesis, subjective and objective data, laboratory data (blood test, urinalysis, biochemical blood test, immunological status, enzyme-linked immunosorbent assay for CE, instrumental examination (ultrasound examination of internal organs, CT of the chest organs).

It should be noted that the proportion of the urban population (42.06%) affected by Cystic Echinococcosis in the Russian Federation has increased, which may be due to labor migration from rural areas to cities (71.00% of the urban population was born in rural areas), worsening of the general epidemiological situation and insufficient sanitary and hygienic measures to control the quality of agricultural products. When collecting anamnesis, epidemiologic environment, occupational activity, contact with farm and backyard animals were specified.

Analysis of the probable route of infection revealed that 69.05% of Echinococcus-infected patients had close contact with dogs, 34.92% handled farm animals, 13.49% reported regularly picking wild berries, and 8.73% regularly hunted and took part in taking-up of hides.

In terms of localization, echinococcus cysts predominantly affected the liver – 62% and the lungs 38%. Coexistent affection of the liver and lungs was also detected in 10% of cases.

The majority of patients (69.05%) sought medical care within the first two years after the onset of clinical symptoms of the disease, in 16.67% of patients, Cystic Echinococcosis was detected incidentally in an asymptomatic stage by ultrasound or fluorography. Concomitant diseases that burdened the general condition of patients were detected in 59.20%.

Pain syndrome prevailed in the clinical symptom complex (83.5%), localized at the site of the cyst (chest, right subcostal area), of all 110 individuals with the confirmed diagnosis and only 1 person (0.9%) had allergic reaction in the form of skin itching, characteristic for worm infestations and not associated with jaundice.

The efficiency of serological reactions reaches 71% (in the Russian Federation) for CE1 cysts according to the WHO-IWGE classification, which corresponds to 29% of seronegative variants instead of 30-58%, which was shown by a retrospective analysis by Lissandrin R et al. (University of Pavia). Serologic studies are supplementary for the diagnosis of Cystic Echinococcosis. Dynamic control of parasitic cysts (instrumental monitoring) is necessary because, as seen in retrospective analysis, in 110 operated patients in 7.3% of cases there was no immune response to this type of parasite confirmed morphologically.

Thus, among the patients with CE in our study, those with blood type 2 predominated -39.11% (43 individuals) and first blood type (41 people). A comparative analysis of the frequency of blood types in patients infected with Cystic Echinococcosis and in the Central European population showed significant differences for the third and fourth blood types ($p<0.05$). The estimated number of individuals with III (B) type was 4,54% (5 out of 110), and among the studied series, 17.27% (19 out of 110) had this type; the estimated number of individuals with IV (AB) type was 2.72% (3 out of 110), and among patients with

Cystic Echinococcosis this blood type was detected in 6.35% (7 out of 110). This also correlates with our results, however, female patients with the 2nd and 1st blood groups were most often ill with Cystic Echinococcosis of the liver and lings instead of retrospective research of R. E. Chobanov and A. A. Salehov.

5. Conclusion

As the retrospective analysis shows, immunological examination for Cystic Echinococcosis by ELISA is an additional technique, which does not always confirm the diagnosis of "Echinococcus granulosus", but provides additional information for the attending physician to consider, since the frequency of false-negative studies reaches 29% in the Russian Federation (for CE1 type of cyst in accordance with the WHO-IWGE classification). Morphological examination (histological examination of biopsy material) remains the "gold" standard in the diagnosis of CE. Most often, Cystic Echinococcosis of the liver and lungs affects females of young and active working age, whose work is related to dogs and agriculture. In addition, among this nosology, individuals with I (0) and II (A) blood types are more frequently affected, which can also be attributed to a predisposing factor for infection and requires further study.

Declarations.

Ethical Approval

Ethical approval was not required for this retrospective study

Consent

All patients were informed about this study and signed a voluntary informed consent for its passage.

Informed Consent Informed consent was obtained from all individual participants included in the study.

Conflict of Interest

The authors declares that he has no conflict of interest to declare.

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Availability of data and materials

The processed data required to reproduce the above findings cannot be shared at this time as the data also forms part of an ongoing study.

Author Contributions

Alexey Victorovich Galyavin: Conceptualization, methodology, resources, supervision, writing—review and editing, formal analysis, investigation, data curation, writing—original draft preparation.

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