J Biochem Technol (2022) 13(4): 20-29
https://doi.org/10.51847/lXm5zetax6
ISSN: 0974-2328

Opisthorchiasis - Is an Urgent Medical and Social Problem in Russia

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Received: 10 September 2022 / Received in revised form: 16 November 2022, Accepted: 17 November 2022, Published online: 18 December 2022

Abstract

Opisthorchiasis is a natural focal zooanthroponosis that is widespread in many countries of the world and poses a serious threat to human health. The largest and most intense focus of opisthorchiasis in the world is the Ob-Irtysh, covering 10 territories and regions of Russia and Kazakhstan. The incidence of the population in Western Siberia reaches 51.82%, and in some areas - over 95%. The highest incidence index in Russia is observed among the indigenous coastal population. The incidence is noted among children aged 1–3 years, increases by the age of 14–15, and remains at this level until 50–60 years. To summarize the available literature data related to the epidemiology of opisthorchiasis, its high prevalence in various populations, the prognosis of the epidemiological situation, and social factors. According to the results of the review, Western Siberia should be considered a highly endemic region for opisthorchiasis in the Russian Federation. Helminthiases ranks fourth in terms of damage to public health. The absence of a specific clinical picture makes it difficult to diagnose opisthorchiasis. The predominance of the latent form leads to incomplete registration of all cases of invasion. The numerical scale of the disease indicates the global nature of the problem, which is becoming relevant today in practical medicine. In order to prevent opisthorchis, veterinary and sanitary education of the population about the danger of the disease and methods of disinfecting fish should be constantly carried out.

Keywords: Opisthorchiasis, Distribution, Human, Pathogenesis, Fish, The extensiveness of invasion

Introduction

Opisthorchiasis is a natural focal zooanthroponosis. The pathogens of opisthorchiasis are helminths belonging to the *Plathelmintes* phylum, class *Trematoda*, family *Opisthorchidae*, species *Opisthorchis felineus* (cat fluke) and *Opisthorchis viverrine*. The largest and most intense focus of opisthorchiasis in the world is the Ob-Irtysh focus, covering 10 territories and regions of Russia and Kazakhstan. The invasion of the population in Western Siberia with *O. felineus* reaches 51.82%, and in some areas up to over 95%. Opisthorchiasis is a serious medical and social problem for the population living in the area of vegetation of opisthorchiasis larval stages. The parasitic disease significantly reduces the activity and potential of the indigenous and alien populations of hyperendemic foci. Wild and domestic animals are actively involved in maintaining the epidemiological tension of foci, among which cats and dogs infected with opisthorchiasis are of great importance.

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Materials and Methods

The basis for the analysis and scientific approach was the available information published at different times on opisthorchiasis, included in electronic databases (RSCI, Cyberleninka). Analytical, comparative, and systematic methods of scientific research were applied. Keywords such as: "opisthorchiasis", "prevalence", "human", "pathogenesis", "fish", and "extent of invasion" were used. The selection of scientific papers was made by taking into account their scientific value relative to the research topic. More than 130 publications were analyzed, and 53 of them contained information about the prevalence of opisthorchiasis in Russia. Preference was given to publications from the E-library database since the article focuses on research in the Russian Federation.

Results and Discussion

Opisthorchiasis is a tissue biohelminthiasis, which occupies a leading position in terms of prevalence on the territory of the Russian Federation. In addition to its epidemiological significance, this invasion has medical and social consequences, as it is prone to chronization and in severe cases is accompanied by organ disorder with a possibly fatal outcome and disability (Plotnikova & Baranova, 2018; Federal Service for Supervision of Consumer Rights Protection and Human Welfare, 2018, 2021; Khadieva *et al*., 2021). Opisthorchiasis has a diverse pathological effect on the health of a growing organism. Helminths mainly affect the biliary system of the liver and pancreas. There may be nonspecific symptoms of gastrointestinal tract disorder and the absence of opisthorchis eggs in the feces. Chronic opisthorchiasis in children can be similar to various diseases of the gastrointestinal tract, which makes diagnosis difficult (Grosheva & Mikhailova, 2020). Pathogens of opisthorchiasis are carcinogens of group 1 and contribute to the development of cholangiocarcinoma and gallstone disease (Baikova *et al*., 2016). The main target organs are the liver, pancreas, and gastrointestinal tract. It is known that with opisthorchiasis, the digestive system and, in particular, the stomach gets affected (Yakubovsky, 2019). Damage to the stomach



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manifests itself mainly in the form of various types of gastritis (Zuevsky, 2015).

Opisthorchiasis is associated with precursors of pancreatic ductal carcinoma. Against the background of *O. felineus* invasion, the invasive component of cancer tends to lower differentiation and a higher stage of the tumor process. At the same time, the statistical significance of the association of opisthorchiasis with PanIN high grade (cancer in situ) has not been established, which may be due to a small number of observations and requires further research due to clinical significance (Rain *et al*., 2021). Opisthorchiasis is characterized by "polymorphism of clinical manifestations", they are due to the parasitization of helminths in both the liver ductus biliaris and the ducts of the pancreas. Opisthorchiasis is characterized by a long disease progression. The wide prevalence can be explained by an uncontrolled increase in the number of enterprises engaged in fish processing (and grossly violating the process technology: disinfection of fish from helminth larvae, sale of epidemiologically dangerous products to the population). High rates of morbidity in the population with opisthorchiasis are also aggravated by social factors, such as a decrease in the living standards of the population; an increase in the nutrition of the population of coastal cities and towns of fish, homemade fish products; an increase in the number of amateur fishermen and poachers; uncontrolled export of fish and fish products from the foci of opisthorchiasis; the sale of fish and fish products in black-markets (Lawal & Bichi, 2014; Pashchenko & Chuev, 2018). The progress of opisthorchiasis can be acute and chronic. The clinical picture of the infection depends on the number of pathogens, with a small number of parasites, the disease can proceed moderately or asymptomatically, which can lead to a missed or late diagnosis. In fact, these parasites cannot reproduce in the human body, and therefore the intensity of invasion with a high frequency of outbreaks can only be caused by repeated consumption of infected fish. The importance of timely diagnosis lies in the fact that untreated opisthorchiasis invasion can lead to severe complications, such as liver cirrhosis, hepatocellular carcinoma, etc (Aftaeva *et al*., 2018; Plotnikova & Baranova, 2018).

Currently, opisthorchiasis is distributed mainly in the areas adjacent to the basin of the Ob and Irtysh rivers (West Siberian and Kazakhstan foci), as well as in the basins of the Pechora, Kama, Volga, Don, Neman, and other rivers of Russia. The highest morbidity index in Russia is observed among the indigenous coastal population. The incidence is detected among children aged 1-3 years, increases for the age of 14-15 years, and remains at this level until 50-60 years. Fishermen and sailors are more often affected due to their occupation (Lawal & Ahmed, 2017; Denisov *et al*., 2021).

In 2018, more than 19.0 thousand cases of opisthorchiasis were registered in the country (the indicator was 12.99 per 100 thousand population), which accounted for 79.5% of all registered biohelminthiasis in the population. Opisthorchiasis is characterized by long progress and occurs with frequent exacerbations. The most serious complication is cancer of the liver, bile ducts, and pancreas – organs where opisthorchiasis parasites. Many authors reveal the connection and high incidence of cholangiocarcinoma in opisthorchiasis in countries with endemic foci of invasion of the Opisthorchiidae *family*. Prolonged opisthorchiasis invasion reduces the effectiveness of anthelmintic therapy, and recurrent forms of the disease may occur. In 2009, *Opisthorchis viverrini* was officially recognized by the International Agency on research for cancer as a biological carcinogen of the 1st group. The carcinogenic role of *O. felineus* has not yet been sufficiently studied. However, the life cycles, morphology, and localization in the human body of *O. viverrini* and *O. felineus* are similar (Bibik, 2020). The epicenter of the world's largest Ob-Irtysh focus of opisthorchiasis is the floodplain-river ecosystems downstream of the Irtysh and Konda. The main real sources of the pathogen of invasion are the water vole and muskrat, and the otter, the common beaver, and the European water shrew are secondary due to their small number. In the epicenter of the focus, where the abundance of rodents and the area of mass reproduction during the years of frequent increases in the number of water voles reach maximum values, the determining conditions for the functioning of the focus are a high number of rodents, their wide prevalence, a significant number of infected individuals, long periods of egg survival in water, close connection with water bodies, the coincidence of biotopes of animals and mollusks, fish as nutrition for water voles. The second place in these characteristics is occupied by the muskrat. Ecology and the number of hosts play a primary role in epizootiology, and, consequently, in the epidemiology of opisthorchiasis (Ushakov, 2019).

The study of the infection of *Cyprinidae* with *O. felineus* metacercariae in the Irtysh, Tobol, and Tura rivers showed that the highest degree of invasion was found in ide (46.4-98.2%), followed by roach (18.8-42.6%) and bream (12.3-34.9%). In two-year-old ide, the invasion was detected in 53.5% of individuals, 72.7% in the studies fish aged 3 years, and 96.0% in fish older than 3 years. In roach, these indicators were 38.8%, 63.2%, and 84.3%, respectively, and in bream - 26.8%, 54.7%, and 72.3%, respectively. At the same time, we surveyed the population to study the awareness of the population on the danger of opisthorchiasis invasion for humans. The survey showed that 29% of respondents were not aware of opisthorchiasis as a disease (this disease is not known), more than 61% do not know how to prevent this disease, and only 10% know about opisthorchiasis, infection routes, and prevention methods. Comparing the infection of carp fish of different species with opisthorchid metacercariae from various landscape-geographical zones, we can talk about the leading role of the ide in maintaining the Ob – Irtysh as the biggest focus of opisthorchiasis. The largest infection of ide with *O. felineus* (prevalence – 100%) was detected in the Middle Ob – central taiga zone. In another subzone – the northern taiga (Gorki settlement) and the forest-tundra zone (Aksarka settlement), the prevalence of *O. felineus* infection is either 100% or approaching it (80-97%). In terms of the intensity of infection, the maximum values (1756-2687 ind.) were found in the ide from the Middle Ob. In other, more northern subzones, the intensity of infection with *O. felineus* metacercariae was significantly lower than that of the Sredneobian ide (364-748 ind.). In terms of infection with opisthorchids, the second place is occupied by a roach. The greatest extensiveness was noted both in the Middle Ob (Sytomino village) (prevalence – 43-50%) and in the Lower Ob (Gorki village) – (prevalence – 16-50%) with low intensity (30-50

species). In the lowest part of the Lower Ob (Aksarka village), the prevalence of *O. felineus infection* was minimal (prevalence – 13%) in 2017, in 2016 these trematodes were not detected. The role of bream in maintaining the West Siberian focus of opisthorchiasis is gradually increasing due to the ever-growing fish population. According to the observations of previous years, the average prevalence reaches 20-30%, but in 2017, in the Middle Ob, the prevalence reached 50% with low intensity. Based on the above, we can talk about the greatest infection of carp fish in the Middle Ob. This is exactly the center of the focus of opisthorchiasis is located (Osipov & Abramov, 2019). The Middle Ob region is the largest focus of opisthorchiasis in the world. When the Samotlor deposit development was started, the population was little familiar with the problem of opisthorchiasis, and later, thanks to active sanitary and educational work, the population became well aware of this problem. It should be noted that only aborigines (indigenous Khanty) eat lightly salted fish and stroganina (deeply frozen fish) of the carp family. There is still a great loss of working capacity and health among the working population of the city of Nizhnevartovsk. A hyperendemic territory for opisthorchiasis is the city of Nizhnevartovsk, which is located in the Khanty-Mansi Autonomous Okrug in the middle Ob River. Studies of carp fish species caught in the Ob River and supplied as ready-made food products from other regions have been carried out. The morphological examination was carried out on fish delivered to the laboratory fresh and pre-processed. Two methods were used to detect the infection of fish with opisthorchid metacercariae: a compressor method and a method of digesting muscles in artificial gastric acid. Fresh fish of the following species from the Ob River and its tributary, the Vakh River were examined: ide, roach, dace, minnow. The following fish were investigated from Kazakhstan rivers: gustera, asp, blue bream, and white-eye bream. Dried bream and chehon, fresh tench, and rudd were examined from the Volga River. As a result, three species of trematode larvae were found: *Opisthorchis felineus*, *Pseudamphistomum truncatum*, and *Metorchis bills* (Pavlov *et al*., 2015). In the Irtysh river near Khanty-Mansiysk, fish were caught from 2012 to 2018. 540 fish were caught, of which 239 ind. of ide, 199 ind. of dace, 79 ind. of roach, and 23 crucian carps. The data obtained on the Irtysh River are similar to the results of similar studies for other rivers. A high extent of invasion was established in dace and ide; crucians were not infected. However, in the Irtysh, opisthorchid metacercariae were first detected in roach with an abundance index and invasion intensity lower than in ide (the difference in indicators is reliable) (Mayurova & Kustikova, 2019).

The results of long-term studies (2005-2012) in the Middle Ob basin showed the invasion of ide from 75.0 to 100.0%, dace from 70.0 to 90.0%, and lake minnow from 10.0 to 50.0% by larvae of the pathogen of opisthorchiasis. The level of invasion of the ide and the dace remained stable throughout the observation period. In the lake minnow, the level of parasite invasion had noticeable fluctuations. The dependence of fish infestation with opisthorchiaceae metacercariae on the nature of the hydrological regime of a water basin has been established (Fattakhov & Sharafutdinova, 2012; Osipov *et al*., 2018). Opisthorchiasis is one of the most common and dangerous trematodiasis for humans and carnivorous animals in the Tyumen region. The study of the population structure of the Carp fish family and the intensity of their invasion by Opisthorchid metacercariae in the Ishim and Alabuga rivers of the Kazan district of the Tyumen region was performed. The work was carried out in 2015, during which 445 individuals of fish of the *Carp family were caught.* It has been established that the species composition of the carp fish family in the Ishim (Peshnevo village) and Alabuga (Gagarye village) rivers is represented by six species: roach, bream, silver carp, ide, bleak and Siberian dace. Two species among the examined individuals were identified as the second intermediate host: roach and bream. The most common species were *O. felineus* and *Metorchis Xanthosoma*, which were detected in bream caught in both studied rivers and roach caught in the Alabuga River. Trematodiasis were found to the greatest extent in bream. Thus, in the muscles of bream caught from the Ishim River, *O. felineus* was detected in 4.62%, and *Metorchis xanthosomus* in 6.15%. Bream caught in the Alabuga River was infested by *O. felineus* in 5.88% of cases (Zhukova & Glazunova, 2017).

In 2020, the incidence of opisthorchiasis in the subjects of the country varied from 0.04 to 112.15 per 100 thousand population. The invasion was established in all age groups (the proportion of children under 17 years of age was 10.7%), in 2019-2020 there was an excess of the average Russian morbidity rate in 13 subjects of the Russian Federation. The specific weight of detection of helminth larvae in fish in 2020 was 0.8% and in 2019 – 1.6% (Federal Service for Supervision of Consumer Rights Protection and Human Welfare, 2021). There is an increase in the import of fishery products and fish processing enterprises in the country that violates the process technology of disinfection of fish from helminth larvae and selling epidemiologically dangerous products to the population (Federal Service for Supervision of Consumer Rights Protection and Human Welfare, 2018). The above dictates the need for timely clinical, epidemiological, and laboratory diagnostics of opisthorchiasis. Real clinical practice has the gold standard for lab tests, it is coproovoscopy using enrichment methods, among the serological test the preference is given to enzyme immunoassay (ELISA) with the determination of IgG, IgM+IgG, and the effectiveness of the determination of specific antihistorical antibodies in the composition of circulating immune complexes is also confirmed (Pal'tsev, 2005; Starkova *et al*., 2007; Grigorieva, 2012; Arinzhanov & Lyadova, 2016; Sergieva *et al*., 2016).

In 2019, an increase in the incidence of opisthorchiasis was registered in the Chelyabinsk region: 235 people were hospitalized with opisthorchiasis in Chelyabinsk alone, 145 of them with an acute form of the disease. The focus of acute opisthorchiasis was registered in June-August 2019 when 138 people with a diagnosis of acute opisthorchiasis were hospitalized in the infectious department of the MAUZ OZP GKB No. 8 of Chelyabinsk. A common factor of transmission of invasion was established - consumption of ide fish purchased in Chelyabinsk trade enterprises by all the sick. The diagnosis was confirmed by the detection of antibodies by enzyme immunoassay and coprooscopically. The clinical picture of acute opisthorchiasis was characterized by polymorphism. In 15% of patients, the initial period of opisthorchiasis was classified as surgical, therapeutic, or other diseases. In the above clinical observations, it was noted that the

debut of opisthorchiasis was hidden under the mask of non-communicable diseases with pronounced signs of damage to the gastrointestinal tract and hepatobiliary system. The goal of the clinical observations is to draw the attention of doctors to the expediency of examination for opisthorchiasis in patients with lesions of the gastrointestinal tract and hepatobiliary system, especially if these lesions have developed against the background of a pronounced intoxication syndrome. It follows from the presented observations that the epidemiological history can significantly reduce the time of the diagnostic search, prescribe etiotropic therapy promptly and prevent the formation of a chronic form of opisthorchiasis (Ratnikova *et al*., 2021; Ter-Bagdasaryan & Ratnikova, 2021).

The prevalence of opisthorchiasis in non-commercial fish in rivers and lakes of Tver, Moscow, Kaluga, and Yaroslavl regions in 2014-2018 was studied. A total of 90 ind. of non-commercial fish caught by amateur fishing in three rivers and three lakes of central Russia were analyzed. According to the results of the conducted studies, roach from the Desna River (Moscow region), Nara River (Kaluga region), roach and gustera from the Volga River (Tver region) are infected with *O. felineus metacercariae*, which was confirmed by PCR tests. Roach, gustera, and tench from the Istra reservoir, Lake Beloe and Lake Nero were free of *O. felineus metacercariae*. A biological test on Syrian hamsters was positive when feeding metacercariae from the muscles of roach caught in the Desna River of the Moscow region. In other cases, biological samples were negative, despite positive PCR in roach from the Nara River and roach and gustera from the Volga River (Shibitov, 2019).

From 2000-2018, 313 cases of infection with opisthorchiasis were registered in the Penza region. The increase in the incidence of opisthorchiasis (7.7–11.4 per 100 thousand population) in 2016 in the Penza region was associated with the weakening of control over entrepreneurs engaged in the reproduction of pond fish aquatic organisms in the reservoirs of the region and the lack of monitoring of fish infestation in the reservoirs and rivers of the region by the veterinary service. In 2018, the incidence of opisthorchiasis was 2.4 per 100 thousand population, which is 34.4% lower than in 2017. Opisthorchiasis mainly affects the hepatobiliary system and the pancreas. Opisthorchiasis is characterized by long progress and occurs with frequent exacerbations (Aftaeva *et al*., 2020).

In the Republic of Bashkortostan in 5 months (May-September 2017), 30 cases of acute opisthorchiasis were diagnosed. Men were more often infected (70.0%), which is due to their passion for fishing and shift work in the regions of Western Siberia. Among the clinical manifestations, symptoms of acute allergosis and damage to the hepatobiliary system prevailed. The determining value in the diagnosis of the acute phase of opisthorchiasis has the ELISA method (100.0%). Typhoid-like (50.0%) and hepatocholangitic (40.3%) variants of acute opisthorchiasis prevailed. The increase in the incidence of opisthorchiasis in the Republic of Bashkortostan is due to the activation of local foci located in the basins of the Kama, Belaya, and Ufa rivers, as well as the import of carp fish from endemic regions and labor migration of the population of the Republic to the regions of Western Siberia (Khabelova *et al*., 2018).

Opisthorchiasis is the most common biog helminthiasis of the Orenburg region, transmitted by infected fish of carp breeds that have not undergone proper heat processing. In 2020, 48 cases of opisthorchiasis were registered (2.44 per 100 thousand population), which is 2.9 and 3.7 times lower than in 2019 and 2018, respectively (2019 – 7.18, 2018 - 9.00). The age structure of the patients was dominated by adults – 97.9% (2019 – 96.5%; 2018 – 97.2%). Among children under 17 years of age, 1 case was registered (0.23 per 100 thousand children), in 2019 – 5 cases (1.14), and 2018 - 5 cases (1.15). The incidence of opisthorchiasis was registered in 15 administrative territories with a fluctuation from 1.07 to 16.78 per 100 thousand population, with an average of 2.44 per 100 thousand population in a region. The excess of the average regional indicator was registered in 5 territories (2019 – 7, 2018 – 6) with the maximum indicator in the Tashlinskiy district (Bibik & Terentyeva, 2022).

To study the clinical and epidemiological manifestations of opisthorchiasis in the Republic of Mordovia, an analysis of the medical records of 34 patients with opisthorchiasis (6 - acute stage and 28 - chronic) who were treated at the Republican Infectious Clinical Hospital from 2011-2020 was performed. The diagnosis of opisthorchiasis in all cases was confirmed by the detection of *O. felineus* eggs in the feces by coprooscopy. The territory of Mordovia is considered opisthorchiasis endemic. Cases of the disease in the republic are registered annually, while the incidence rates are lower than those in Russia in general. The greatest number of cases was observed among urban residents over the age of 40, mainly women. When collecting an epidanamnesis, in 100% of cases, the consumption of lightly salted and dried fish of the carp family, which has not been studied for safety, was established. Acute opisthorchiasis proceeded according to the hepatocholangitic variant of the disease, accompanied by feverish intoxication, pain, and biliousness syndromes. Chronic opisthorchiasis was characterized by more diverse, but less pronounced than in the acute form, there were clinical manifestations in the gastrointestinal tract; symptoms of general intoxication were less frequent. Clinical manifestations of allergosis were observed only in the chronic form, whereas its more pronounced laboratory signs were detected in acute opisthorchiasis. The chronic form of the disease was characterized by less pronounced changes and other laboratory parameters **(Figure 1)** (Markosyan *et al*., 2021).

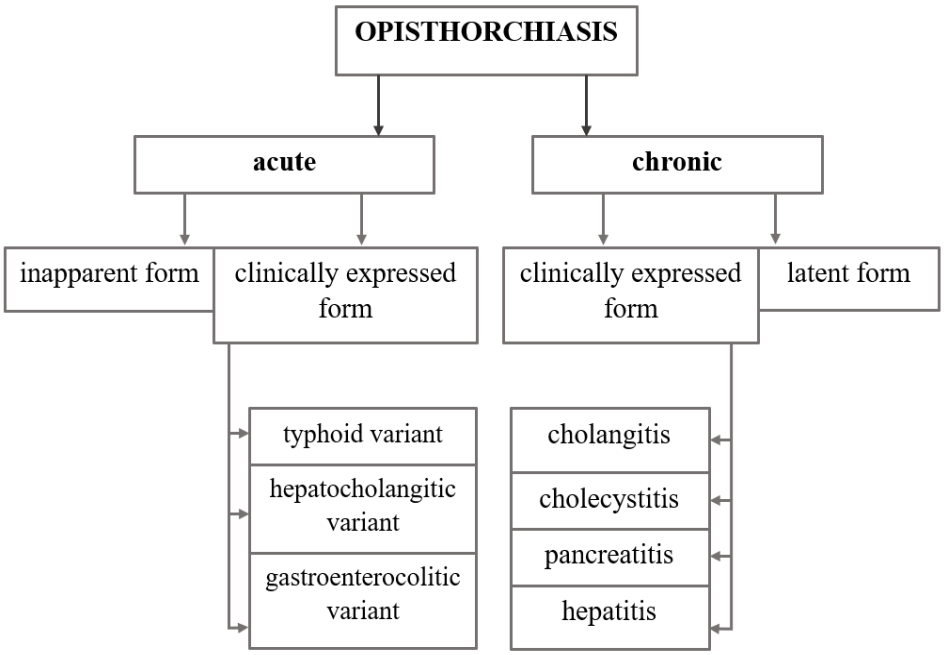


Figure 1. Clinical classification of opisthorchiasis (Belov & Feiginova, 1969)

In the city of Novosibirsk, in the rivers, Nizhnyaya Yeltsovka and Inya 121 ind. of five types of fish: ide, roach, dace, bream, verkhovka were analyzed. Metacercariae of pistorchids of three types were found: *O. felineus*, *M. bilis*, and *M. xanthosomus*. The first two types have epidemic significance, the last one is epizootic. The results of the studies showed that the level of infection of carp fish with larval forms of opisthorchids totals 48.8%, while infection with metacercariae of *O. felineus* -19.8%, of *M. bilis* - 27.3% and of *M. xanthosomus* – 4.1%. In Nizhnyaya Yeltsovka, the infection rate was 45.8%, and in Ina – 55.3% (Bonina & Troshkina, 2019).

The epidemic situation of the opisthorchiasis of the population of Berdsk was studied, the level of infection of fish of the *Cyprinidae* family by the larvae of opisthorchids in the Berdsky Bay was analyzed, as well as the number of the first intermediate host of the parasite - mollusks of the *Bithyniidae* family in the water body. It was determined that Berdsky Bay as a whole is troublesome in terms of opisthorchiasis. The incidence of people with opisthorchiasis in the city of Berdsk has registered annually, the long-term average annual morbidity rate was 89.85 per 100 thousand population, with a minimum of 21.4 in 1991 and a maximum of 188.5 in 2002. The level of infection of carp fish with opisthorchid metacercariae is quite high (33.3%). The epidemic danger is represented by fish infested with larvae of *O. felineus* (prevalence - 31.7%) and *M. bilis* (prevalence - 3.3%). Ide, dace, verkhovka represent a high potential danger in infecting the population with opisthorchiasis and are indicators of the reservoir's problems with regard to invasion. In the water area of the Berdskiy Bay, new actively functioning foci of opisthorchiasis invasion have been identified, located in the Lebedevskaya and Elban waterways, as well as at the mouth of the Sukhaya River, where not only infected fish are registered, but also the number of the first intermediate host of opisthorchids - shellfish of the *Bithyniidae* family (Bithynia troscheli and *B.* tentaculata) (Bonina & Zuykov, 2021).

The high incidence rates of opisthorchiasis in the Kemerovo region are explained by the proximity of some areas along the rivers in the north of Kuzbass (mainly rural and settlement municipalities) to the territory of the world's largest Ob-Irtysh focus of helminthiasis. In the territories of these municipalities, the incidence of opisthorchiasis may exceed the regional average (40.86) by 8.0 or more times. These territories account for more than 60% of all registered cases of opisthorchiasis in the region. The population of disadvantaged areas uses river fish in large quantities as the most affordable food product. Fish of the carp family (dace, ide, tench, roach, crucian carp, bream, wild carp) as an intermediate host in the *O. felineus* life cycle has a high percentage of infection with opisthorchis metacercariae, which is an invasive stage for humans with this disease (Bibik & Terentyeva, 2022).

An analysis of the epidemic situation of biohelminthiasis in the Arkhangelsk region with a description of rare clinical cases of helminthiasis for 2004-2017 was carried out. There is a regression in the incidence rate. The most common biohelminthiasis in the region are diphyllobothriasis and, less often, opisthorchiasis. The disease of biohelminthiasis is associated with the consumption of river fish, pike caviar. The highest incidence rates were registered in Lena, Onega, Leshukonsky, Kholmogorsky, Plesetsk, and Mezen districts, the cities of Severodvinsk and Arkhangelsk (Agafonov *et al.*, 2018).

However, it should be noted that this disease is widespread not only in those territories where fish and fish products are the basis

of the nutrition of the population living there. According to experts, for example, in the Voronezh region in 2017, "... in the structure of biohelminthiasis, opisthorchiasis accounts for 11.2% of cases; ...the incidence of opisthorchiasis remained at the level of 2016 and amounted to 0.09 per 100 thousand population" (Office of the Federal Service for Supervision of Consumer Rights Protection and Human Welfare in the Voronezh Region, 2018, p. 156).

Imported cases of opisthorchiasis have been registered among the population of the Republic of Sakha (Yakutia): in 2005 – 10 cases, 2 of them in children under 14 years old, in 2006 – 5, in 2007 – 17, including 5 in children, in the first half of 2008 – in 6 people. The disease of people with opisthorchiasis is associated with the migration of the population (Kokolova *et al*., 2010).

In the structure of the incidence of opisthorchiasis in the Penza region, eight cases (26.7%) are rural, and 22 cases (73.3%) are urban. In 2017, rural residents in the Penza Region accounted for 55.3% of cases, while urban residents accounted for 44.7% of cases. Infection with this helminthiasis occurs mainly among the adult population – 86.7% of all cases (26 cases). Epidemiological analysis showed that in 2018, the predominant infection factor was the consumption of fish with an "X" infection factor; the ratio of local, imported, and "X" infection factor cases was 9:6:15. Six imported cases were found (Mitrofanova & Morozov, 2019).

In total, 134 cases of opisthorchiasis were registered in the Ryazan Region from 1997 to 2016. The trend of morbidity is stable (0.4). The average predicted morbidity rate for 2017-2020 is 0.5 per 100 thousand population. In the last six years alone, 36 cases of opisthorchiasis have been reported. Moreover, 2014 and 2015 were the years of the rise in morbidity, the incidence rates were 0.6 and 1.3 per 100 thousand population, respectively. The results of the analysis for 2011-2016 show that male persons prevailed among the patients (61.1%). The age composition of the patients is from 14 to 70 years old, the most affected groups are 50-59 years old and over 60 years old (25% each). In 100% of cases, infection through fish occurred due to a violation of cooking rules. Including 82.9% of cases associated with the consumption of dried fish, 8.6% fried, 5.7% salted, and 2.9% raw and lightly salted. By the places of suspected infecting, 31 foci, or 86.1%, are identified as local, 4 foci (11.1%) are associated with staying in another territory [Astrakhan Region (3 cases) and the Taimyr Peninsula (1 case) (Baranova *et al*., 2017)].

In 2015-2019, 40 patients with chronic opisthorchiasis (2015 – 7 people, 2016 – 4 people, 2017 – 9 people) were recorded in 7 territories of the Krasnodar Territory (Goryachy Klyuch, Temryuk, Krasnodar, Sochi, Kanevskaya, Seversky, Dinskoy districts), as well as in Adygea, there is an increase in the level of sporadic morbidity in recent years (2018 – 8 people, 2019 - 12 people). More than a third (40%) of patients with chronic opisthorchiasis were detected at the inpatient or outpatient stage during examination for other diseases (chronic hepatitis C, toxic hepatitis, brucellosis), before upcoming surgical interventions, and during preventive examinations. More than half of the patients (60%) complained of dyspepsia, and asthenization and some of them noted allergic manifestations. This symptomatology lasted from 1-2-6 months (27.5%) to 1-2-3-5 years (32.5%), which was the reason for consulting a gastroenterologist, therapist, or dermatologist with subsequent detection of the invasion, mainly using coproovoscopy. The overwhelming majority (72.5%) of patients with chronic opisthorchiasis had a characteristic epidemiological history: more than half (57.5%) had a stay in an area endemic to opisthorchiasis for 6 months and up to 10-29-57 years (regions of the North, Siberia, Southeast Asia: Krasnoyarsk, YANAO, KhMAO, Tyumen, Novosibirsk, Omsk, Kemerovo, Irkutsk region, Nizhnevartovsk, Altai Krai, Novokuznetsk, Transbaikalia, Astrakhan), 15% mentioned the consumption of raw and dried river fish imported from the same areas. The duration of residence in the territory of the region after leaving the endemic zone before the detection of opisthorchiasis was 2-7-10- 16 years. Four patients (10%) had in their past medical history documented opisthorchiasis - 2 -5-11-15 years ago. The clinical and epidemiological features of imported chronic and acute opisthorchiasis and the effectiveness of microscopic (coproovoscopy) and serological (ELISA) diagnostic methods in a series of observations in patients with chronic and acute opisthorchiasis were analyzed. In chronic opisthorchiasis (40 patients), the clinical findings are nonspecific, most patients (75%) lack eosinophilia; a combination of asthenic and dyspeptic syndromes with a characteristic epidemiological history is important (stay in the endemic zone from 2 to 16 years). Coprooscopy is positive in 90% of patients, serology is negative in more than half (57%). In acute "imported" opisthorchiasis (41 patients, outbreak following the consumption of products from an invaded ide), intoxication (high and prolonged fever) and allergic (pronounced and persistent eosinophilia) syndromes are combined with signs of liver damage, which in a non-endemic zone with the severe course is followed by primary hospitalization in surgical departments. In the acute phase of the invasion, the serological examination is the most informative (the results of ELISA with IgM and IgG determination are positive in 100% of patients), and the result of coprooscopy is negative in 57% (Morenets *et al*., 2021). The analysis of cases of acute opisthorchiasis registered in Krasnoyarsk in June 2016 was performed and the features of its clinical progression in the natural focus when eating fish imported from other territories of the Russian Federation have been established. 13 patients were examined with the diagnosis of acute opisthorchiasis aged 18 to 47 years, who were on inpatient treatment in the infectious department of the N.S. Karpovich Emergency Hospital (Krasnoyarsk) in June 2016. Verification of the diagnosis of acute opisthorchiasis was established by the positive epidemiological history, pronounced eosinophilia in the blood, and the detection of specific antibodies to *O. filineus*. All observed patients were admitted 5-7 days after the onset of the disease. The incubation period was from 11 to 30 days from the moment of consumption of infected fish. Common symptoms at admission for all patients to the hospital were: fever, chills, fatigue, joint aches, headache, decreased appetite and sweating. A characteristic feature of acute opisthorchiasis (hypereosinophilia) was detected in all patients (100%), and it ranged from 21 to 37%. In addition to eosinophilia, all the examined patients had an increase in leukocytes from 8.5 x 109/l to 11.3 x 109/l with a shift of the formula to the left. Diagnosis: acute opisthorchiasis was confirmed by the detection of a high concentration of serum-

specific immunoglobulins of the JgM class to *O. filineus* (Tikhonova *et al*., 2017).

Studies to identify ecological patterns of circulation of opisthorchiasis pathogens in the Voronezh region have shown patterns of distribution of opisthorchid larvae in carp fish, identification of dominant species from among carp fish that play a leading role in the accumulation of opisthorchid metacercariae and infection of domestic animals and humans, as well as identification of environmental prerequisites for the formation of foci of opisthorchiasis in the area under study. According to the results, the dominant species among carp fish are roach, rudd, and bleak by the infection rate with opisthorchid metacercariae. These species are an important element in terms of the risks of infection of humans and domestic animals with opisthorchids. Metacercariae of opisthorchids have been observed almost throughout the region, while their local (focal) prevalence has been established. In the Voronezh region, foci of opisthorchidosis are correlated with the systems of tributaries of the Don and Khopra. 9 species of carp fish have been registered as the second intermediate host of opisthorchids in the conditions of the Upper Don basin: roach, rudd, bleak, ide, gustera, bream, chub, tench, and sneep. Among these fish, roach, bleak, and ide occupy the dominant position in terms of infection (prevalence is over 60%), the next level is formed by other four species of fish: rudd, bream, chub, gustera (prevalence is from 40 to 60%), the minimum infection rates are noted in tench and sneep. The highest indicators of relative values of the abundance index of opisthorchid metacercariae were noted in bleak – 21.6, followed by rudd and roach, respectively – 18.0 and 17.6, the minimum values are recorded in gustera – 2.8. The obtained indices show that the highest rates of infection with opisthorchid metacercariae were recorded in populations of three fish species: roach, rudd, and bleak. These species, both in the Don tributary systems and in individual reservoirs, play a leading role in the accumulation of invasive opisthorchid larvae. In settlements near these rivers, there are the highest risks of infection of humans and domestic animals with opisthorchidosis (Romashova, 2015).

A study of 229 pets and domestic animals was conducted in the Kursk region, including 130 cats, 56 dogs, and 43 pigs. 13 animals were infected with *O. felineus*, which was 5.7%. As a rule, cats for research were provided by local fishermen. As a result of the survey, it was found that all cats constantly ate fish caught in local reservoirs. In a study of 130 cats, *O. felineus* marit was found in 11 (8.5%). The intensity of invasion ranged from 1 to 86 trematodes. The results of the analysis showed that cats infected with *O. felineus* were recorded in all the studied areas. The highest infection rates were noted in Rylsky (15.8%) and Zheleznogorsk (10.3%) districts. The incidence of cats in the Gorshechensky district was 3.4%, in the Kursk district – 7.4, and the Kurchatov district – 7.7%. The difference in the degree of the extensiveness of cat opisthorchiasis in the districts is explained by the unequal conditions of circulation of pathogens of this helminthiasis in the beds of these reservoirs. Dogs infected with *O. felineus* were recorded only in the Rylsky and Kurchatov districts with an invasion intensity of 6.3 and 4.8%, respectively. No pigs infected with *O. felineus* were found in the studied areas, which is due to the small specific weight of fish in the nutrition of pigs or its complete absence therein. When studying the role of domestic carnivores in the spread of invasive material in opisthorchiasis, it was found that the main source of the release of opisthorchis eggs into the external environment is cats, whose extensive infection rate is almost 2 times greater than that of dogs. However, as a real source of the invasion, it is inferior to the dog, since the latter is a constant companion of a person when people visit the floodplain, and dogs can serve as a direct source of contamination of the environment with eggs of the pathogen of opisthorchiasis, and bring them on their bodies from contaminated soil into reservoirs. Thus, we believe that cats and dogs in coastal rural settlements contribute to the foci of opisthorchiasis and their stabilization (Buryak, 2008).

Currently, there are two main methods used to diagnose opisthorchiasis in humans and host animals - parasitological and immunological. The detection of eggs in feces by microscopic examination is considered the gold standard for the diagnosis of opisthorchiasis. The disadvantage of coprological diagnostics is that suckers can be easily missed with a very small number of eggs at low infection levels or due to periods of low egg production of parasites. At this time, immunological diagnostic methods come out on top in diagnostics. However, immunological methods are less effective in differentiating the pathogen due to the homogeneity of antigenic proteins (Lovis *et al*., 2009; Smagulova *et al*., 2020).

Conclusion

Today, one of the urgent problems in medicine is opisthorchiasis and its associated complications. Helminthiasis ranks fourth in terms of damage to public health. The absence of a specific clinical picture causes difficulties in diagnosing opisthorchiasis. The predominance of the latent form leads to incomplete registration of all cases of invasion. The numerical scale of the disease indicates the global nature of the problem, which is becoming relevant today in practical medicine. Particular attention is paid to the issue of complications, the most significant of which is acute pancreatitis, purulent cholangitis with the possible formation of liver abscesses, perforation of the bile ducts, and the development of peritonitis, in the chronic course of invasion – liver cancer and pancreatic cancer. This dictates the need for timely diagnosis, and it is impractical to be limited to any one study, and the widespread introduction of the PCR method is impossible due to the high cost. It is also important that the invasion of opisthorchiasis has an adverse effect on the metabolic processes of the "mother - placenta - embryo (fetus)" system, which causes an increase in the frequency of pregnancy pathology. The urgency of the problem of opisthorchiasis and its complications, combined with a complex and vulnerable diagnosis of this disease, demonstrate the importance of finding effective methods for their detection. Opisthorchiasis is a social and medical problem that affects tens of millions of people around the world. Due to the insufficient specificity and sensitivity of immunological tests (ELISA), they should be used as an auxiliary method in combination with clinical and laboratory diagnostics. Despite the advantages, the PCR method is not widely used in practice due to the high cost. Severe surgical complications of opisthorchiasis dictate the expediency of carrying out preventive measures in territories troublesome in terms of opisthorchiasis.

Protection of reservoirs from ingress of opisthorchis should be carried out comprehensively, starting with proper sanitary culture in settlements adjacent to the reservoir, so that eggs of opisthorchis are not washed into reservoirs together with sewage. In settlements troublesome in terms of opisthorchiasis, cats and other carnivorous animals should not be fed raw, dried, or cold-smoked fish and its internal organs. The waste of fish processing is to be sent for processing to fish meal or neutralized in boilers by boiling within 30 minutes from the moment of boiling start. Veterinary and sanitary education of the population on measures to prevent opisthorchiasis should be constantly performed.

Acknowledgments: None

Conflict of interest: None

Financial support: The article was prepared in accordance with the research plan for the program of fundamental scientific research of the Russian Academy of Sciences (No. 121042000066-6 “Study and analysis of the epizootic state of diseases of invasive etiology of agricultural and unproductive animals, bees and birds, changes in the species composition and bioecological patterns of the development cycle of parasites in conditions of displacement of boundaries their ranges).

Ethics statement: The study was conducted in accordance with international ethical standards. The study did not involve animals or humans.

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