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The Features of Opisthorchiasis' Epizootic Process in West Kazakhstan Region

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Abstract

In this study, opisthorchiasis' epizootic processes in West Kazakhstan Region and the sources of infestation were identified; its focus characteristic was defined. Currently, there is an opisthorchiasis morbidity rate in West Kazakhstan Region; opisthorchiasis is a parasitic natural-focal disease characterized by hepatobiliary system affect. It is also an important environmental problem, including not only medical-social but veterinary biological aspect as well. According to the Regional Department for Consumer Rights Protection, for the last 5 years, the population infestation with opisthorchiasis in 2009 was 18.6, in 2010—21.7, in 2011—16.9, in 2012—19.9, and in 2013—17.3 per 100,000 population. Opisthorchiasis' nosological area is limited by a number of environmental factors, the main among which is the relationship of the pathogen invasion with the basins. On the natural and social factors causing the infection risk, the regions ranking on the epidemiological risk levels were classified into two groups on the basis of epidemiological data: (a) areas with high risk of infection (Zelenovsky, Burlinsky, Akzhaik, Terektinsky, Taskalinsky, and Chingirlausky areas of the region and Uralsk city) are confined to the forest area and parts of forest steppe in the valley of flood basins with well-developed river net, fish infection rate, developed fishing, and people's morbidity rate level; and (b) areas with low risk of infection (Bokeyordinsky, Zhangalinsky, Zhanibeksky, Kaztalovsky, Karatobinsky, and Syrymsky), occupying steppe zones with less water content, slightly developed fishing, and lack of infected fish.

Keywords

Opisthorchiasis; Epizootiological process; Carp bloodline fish

Introduction

Until the end of the 60s of the last century, it was believed that the Ural River basin within Kazakhstan was free from opisthorchiasis, but a few years later, these findings were reviewed. Since the early 70s, the existence of opisthorchiasis focus (or foci) in the Ural River pool was proved by the research of scientists [1].

Currently, there is an opisthorchiasis morbidity rate in West Kazakhstan Region; opisthorchiasis is a parasitic natural-focal disease characterized by hepatobiliary system affect. It is also an important environmental problem, including not only medical-social but veterinary biological aspect as well.

Opisthorchiasis (caused by *opisthorchis felineus*) is a widespread parasitic disease of humans and animals, the causative agent of which develops at different stages of ontogenesis both in a body of different hosts and in the environment (water biocenosis).

The greater part of opisthorchiasis' agent has a helminth circulation of epizootic (involving wild and domestic animals) nature and the rest part of mixed (involving animals and human) nature. In the latter case, it is necessary to consider the epizootic and epidemiological component of the circulation process. The share of each of them is different in different regions, but the process is not carried out anywhere only involving a human, animals also participate in it everywhere.

Apparently, there is no relationship between population invasion, pollution of the environment by helminth eggs, and shellfish and cyprinid infection rate. There are settlements with a high (40%) affected population in the absence of infested shellfish, and vice versa—people free from the infestation and high affected shellfish. The same can be said about the infestation of carp bloodline fish, which often does not correspond to population invasion. These facts indicate that humans do not always determine the level of helminth circulation [2].

Fish infectivity rate by metacercariae, that is, focus tension, depends on many factors. The infestation distribution within the focus depends on its size: the larger the area occupied by them, the more the uneven fish and shellfish invasion distribution.

Research objective: To examine the nature of opisthorchiasis' epizootic process and factors forming the causative-agent transfer mechanism.

Materials and Methods

To clarify the epidemiological situation of opisthorchiasis in West Kazakhstan Region, a sanitary-epidemiological surveillance analysis of data of the population's morbidity rate was carried out.

Ichthyological and hydrobiological researches covered the basins of inundated parts of the Ural River, its oxbows.

Visual assessment of basins was conducted to determine shellfish habitat. Shellfish was collected by conventional hydrobiological methods [3-5]. The main gathering of shellfish was carried in the daytime by benthic scoop net and manually. The scoop net was used for catching from the shore and boat at the basin coastline; gathered shellfish on the branches of aquatic plants or on the wood pieces surface on the banks of the basin manually. The scraper was used to gather from the coastal soil.

Further researches on the determination of shellfish infection rate with opisthorchis parthenitae were carried out in laboratory

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conditions. For lifetime determination of shellfish infection rate, they were kept in Petri's cups in light. In the absence of cercariae exit, the compression method with the subsequent microscopy was applied [2,3].

To establish fish infection rate with opisthorchis metacercariae, cyprinid species were investigated. Set nets and drift nets were used for catching fish. The study of fish was performed by conventional methods with the definition its species and measurement [6-8]. To determine the presence of opisthorchiasis metacercariae in the fish, they were examined by the compressor method, followed by microscopy using MBS [3,9]. Fish age was determined by standard methods [10]. The assessment of fish infection rate was carried out using infestation extent indicators (proportion of infected fish as a percentage of the total number of fish examined) and infection intensity (number of parasites encountered in one infected fish) [9].

Results and Discussion

The main waterway in West Kazakhstan Region, crossing from north to south, that flows through Zelenovsky, Terektinsky, and Akzhaik areas is the Ural River. It starts far outside of Kazakhstan, in the branches of the Southern Urals. By the nature of the channel, valley, and water content, the Ural River is divided into three parts (currents): upper, middle, and lower. The Ural River flows along the Caspian lowlands and into the Caspian Sea. The small rivers of the Ural River basin in the territory of West Kazakhstan Region are the Chagan River, the Derkul River, the Ilek River, the Utva River, the Rubezhka River, the Bykovka River, the Embulatovka River, the Barbastau River, etc.

There are also lakes and small rivers in the region's territory. Most of the floodplain-type lakes are in the valley of the Ural River. These are usually oxbow lakes formed in the old channel meanders.

The basins abound with target species of cyprinoids.

At considerable length, the Ural River has a well-developed floodplain with numerous perennial and non-perennial basins. Environmental conditions in such basins, characterized by slow flow or its lack, tend to be non-perennial (fully or partially) and flooded during the spring floods, and after the recession of water, they stand apart from the riverbed. Submerged vegetation (various pondweed, *myriophýllum*, bladderwort, hornwort, *charóphyceae*) develops in most basins abundantly. Coastal waters are occupied with reedbed, reed mace, sedge, reeds, and other aquatic vegetation. The basins are well warmed and overgrown with aquatic vegetation, which is a mandatory component of shellfish habitat. The bottom of these basins is silty, seldom sand-silty. All this creates habitats favorable for the life of *Bithynia leachi* shellfish.

According to the Regional Department for Consumer Rights Protection, for the last 5 years, the population infestation with opisthorchiasis in 2009 was 18.6, in 2010—21.7, in 2011—16.9, in 2012—19.9, and in 2013—17.3 per 100,000 population. Absolute morbidity rate indicators are shown in Figure 1. The number of diseased contains children less than 14 years as well.

The significant role in this disease spread is played by fish and fish products derived from amateur fishing, poaching, and its unauthorized sale from opisthorchiasis foci, at non-observance of cooking rules. The population morbidity rate may be due to two main factors: importation of infested fish from endemic areas and the presence of own infestation foci.

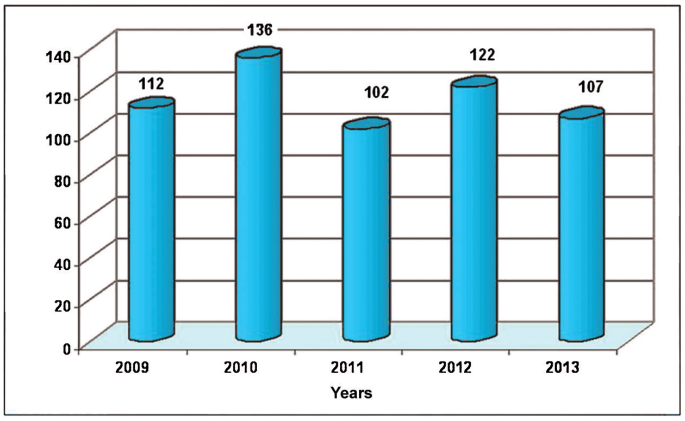

Figure 1: The number of people diseased with opisthorchiasis in West Kazakhstan Region

The epidemiological significance of opisthorchiasis focus is largely determined by social-demographic processes and stereotype of people's eating behavior.

Opisthorchiasis' nosological area is limited by a number of environmental factors, the main among which is the relationship of the pathogen invasion with the basins.

On the natural and social factors causing the infection risk, the regions ranking on the epidemiological risk levels were classified into two groups on the basis of epidemiological data: (a) areas with high risk of infection (Zelenovsky, Burlinsky, Akzhaik, Terektinsky, Taskalinsky, Chingirlausky areas of the region, and Uralsk city) are confined to the forest area and parts of forest steppe in the valley of flood basins with well-developed river net, fish infection rate, developed fishing, and people's morbidity rate level; and (b) areas with low risk of infection (Bokeyordinsky, Zhangalinsky, Zhanibeksky, Kaztalovsky, Karatobinsky, and Syrymsky), occupying steppe zones with less water content, slightly developed fishing, and lack of infected fish.

The unfavorable epidemiological situation of opisthorchiasis is also compounded by the migration of people, not only within Kazakhstan but to other countries as well. The important role in the establishment of epidemiological problem is due to sanitary illiteracy of the population as well.

The difficult link to define in opisthorchis' development cycle is its first intermediate host, bithyniidae shellfish, which requires certain conditions in its habitats—temperature, flow, light, and the presence of aquatic vegetation. However, even with a small infestation of the population, it may be sufficient to maintain opisthorchiasis foci, as opisthorchis larvae's parthenogenetic reproduction occurs in the shellfish body for a long time, resulting in the multiple increase in the numerosity and displacement forms of cercariae. In addition, the lifetime of bithyniidae is rather long, 4-6 years, which increases the foci stability additionally.

The first intermediate hosts were found in the basins of the Rubezhka, the Embulatovka, the Bykovka, the Utva, and the Esenankaty in shallow, well-warmed lots with underwater and emergent vegetation areas. The data on shellfish population density indicate a low abundance of shellfish and are in the range from 3 to 12 specimens per 1 m^2 in the surveyed area. The average density of shellfish was 10.7.

The low number of bithyniidae can be explained by their high mortality during freezing in winter while littoral drying. It is also

known that bithyniidae's natural conditions are 7-10 months in the state of anabiosis (depending on the geographical location of basins, length of warm season). This year, the summer was rather cool that undoubtedly affected their activity and viability.

At the study of infestation of opisthorchis' larval forms of 43 bithyniidae specimens, it was revealed that only three shellfish (6.9%) were infected with the trematode cercariae of *O. felineus*. Low infestation of shellfish with opisthorchis parthenitae may be due to the small number of invasive beginning—opisthorchis eggs in basins, shellfish active life period, and bithyniidae low numbers.

The duration of active life period has a positive effect on the shellfish infection rate with opisthorchis beginning. Many floodplain basins are filled during the spring flood and snowmelt, and then quickly become shallow and even dry. Remaining bithyniidae buried in the ground and hibernate. Accordingly, shellfish active life period is limited and, hence, the contact period with invasive beginning.

The second intermediate host of opisthorchis is cyprinoids, which are the host to opisthorchis population in floodplain river systems. Fish of younger age groups play a role in maintaining a constant circulation of parasites between the second intermediate link and definitive hosts. In fish of older age groups, the preservation and accumulation of invasive beginning occurs, which is used to distribute it to other floodplain-river systems under unfavorable environmental conditions for parasitic system [11].

The researches revealed that opisthorchis metacercariae carriers in the region basins are ide, rudd, white bream, and chub (Table 1). Among the studied 435 cyprinid specimens (89 specimens (20.4%) are ide, 67 specimens (15.4%)—rudd, 65 specimens (14.9%)—bream, 32 specimens (7.3%)—roach, 93 specimens (21.3%)—crucian, 30 specimens (6.8%)—tench, 30 specimens (6.8%)—saber fish, and 13 specimens (2.9%)—white bream), the proportion of roach is 25 specimens (10.6%), carp—8 specimens (3.4%), and chub had few specimens.

The extensiveness of ide in the Bagyrlay River of Akzhaik area was 100%, and infection intensity was from 1 to 327 metacercariae in the muscles of one fish. Ide is the main carrier of *O. felineus* metacercariae and it more often than other species has *O. felineus* metacercariae parasitizing. These results coincide with the data of previous studies [12] that also indicate that according to opisthorchis larvae's infestation, ide prevails among other additional hosts of Siberian fluke. Some of the species has the highest intensity of infection. Rudd infestation (the Bagyrlay River of Akzhaik area) with opisthorchis was 29.7%, and bream infestation extent was 28.5%.

The catches of the Bagyrlay reservoir had ides of three age groups: yearlings, 2-year-old, and 3-year-old. Ide infestation varies depending

Indicators	Species of fish			
	Ide	Rudd	White bream	Chub
Total investigated, specimen	36	37	7	1
Infection with *O. felineus*, specimen	36	11	2	1
Infestation extent, %	100	29.7	28.5	100
Infection intensity, specimen, range (on the average)	1-327 (53.4)	1-27 (12.9)	1-3 (7.5)	10
Infection intensity, specimen	53.4	3.83	2.1	–

Table 1: The infestation of fish with opisthorchis metacercariae

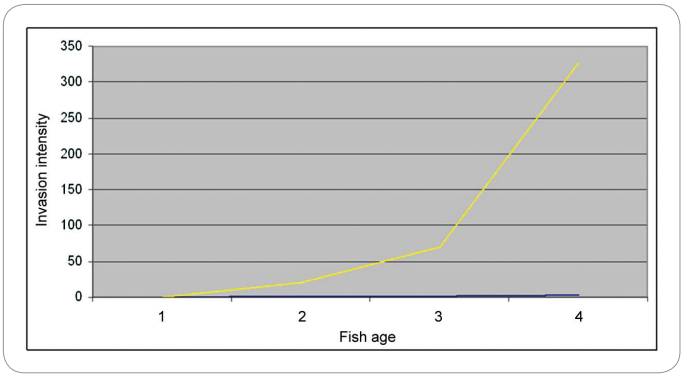

Figure 2: The intensity of ide invasion by age

on the age. One-year-old ide's infestation reached 13.8%, increased in 2 years old to 27.7%, and 3 years old to 58.3%.

At determining the intensity of infection, its dynamics was observed by fish age groups. The infection intensity increases with fish age. It should be noted that fish of one type and age for various reasons may be infested in varying degrees and may contain from single metacercariae to several hundred metacercarie or specimens [2].

In our studies, the average number of parasite metacercariae in ide was from 1 to 20 specimens found in fish at the age of 1 year, 2 years—10-70 specimens, and 3 years—from 10 to 327 (Figure 2).

The maximum intensity of ide infection at the Bagyrlay reservoir reached 327 metacercariae specimens per one individual fish of 3 years old.

There is a certain localization of parasite larvae in fish body. The main part of opisthorchis localization is in the anterior and middle part of fish. A slight amount of muscle is concentrated in a tail part. According to depth, larvae were located in the superficial layers of muscles. Unit amounts of cysts were found in the dorsal fins.

According to researches, a trend of fish infection rate is noted in spring and summer.

High infestation of the Bagyrlay River ides can be explained by the fact that the catches in this basin had more adult age groups, and also by the fact that this basin in the irrigation-watering system is located below all other basins (the fourth) and fish migrate to this basin particularly when water is discharged from the Ural River.

The feature of cyprinoids' ecology is their ability to undergo active migrations, that is, to undergo regular change of habitat that is caused by cyclic changes in the external environment. Cyprinoids of basins regularly migrate with the onset of flooding to the floodplain system for spawning and feeding, and return at the end of the flood to the main river channel, from where in the late autumn-early winter they move to the non-freezing part of the basin—to the outputs of groundwater from the bottom of the river, in the upper reaches of the tributaries [13].

The movements of fish, over dozens of kilometers, especially pre-spawning migrations, negate the spread of infested fish and distort not only the idea of their areas, but also the boundaries of the infestation focus [2].

Conclusions

In West Kazakhstan Region in recent years, there is a consistently unfavorable opisthorchiasis epidemiological situation. Thus, the number

of opisthorchiasis infestation in 2009 was 18.6, in 2010—21.7, in 2011—16.9, in 2012—19.9, and in 2013—17.3 per 100,000 of the population. The infested cases also included children less than 14 years of age. On the natural and social factors causing the infection risk, the regions ranking on the epidemiological risk levels were classified into two groups on the basis of epidemiological data: (a) areas with high risk of infection (Zelenovsky, Burlinsky, Akzhaik, Terektinsky, Taskalinsky, Chingirlausky areas of the region, and Uralsk city) are confined to the forest area and parts of forest steppe in the valley of flood basins with well-developed river net, fish infection rate, developed fishing, and people's morbidity rate level; and (b) areas with low risk of infection (Bokeyordinsky, Zhangalinsky, Zhanibeksky, Kaztalovsky, Karatobinsky, and Syrymsky), occupying steppe zones with less water content, slightly developed fishing, and lack of infected fish.

The unfavorable opisthorchiasis epidemiological situation is compounded by the migration to the CIS countries (particularly to the endemic areas of Russia), as well as to the territory of Kazakhstan in the northern and eastern regions, where tense opisthorchiasis epidemiological situation was noticed.

Another reason contributing to the unfavorable epidemiological situation is the sanitary illiteracy of the population.

At the study of infestation of opisthorchis larval forms of 43 bithyniidae specimens, it was revealed that only three shellfish (6.9%) were infected with the trematode cercariae of *O. felineus*. Low infestation of shellfish with opisthorchis parthenitae may be due to the small number of invasive beginning—opisthorchis eggs in basins, shellfish active life period, and bithyniidae low numbers.

According to the fish research, the infestation of four species of fish—ide, rudd, white bream, and chub—with opisthorchis metacercariae was detected.

The analysis of fish infection shows the infection intensity increases with the age. Fish infection trend was observed in the spring and summer period.

1. In the context of West Kazakhstan Region, the epizootic process in opisthorchiasis proceeds as a complex specific parasitic system at the interpopulation level: causative agent → intermediate → additional → definitive host.

Ecological-biological, natural-climatic conditions for the functioning of specific parasitic system of opisthorchiasis was formed in the region. Shellfish, cyprinoids (ide, rudd, white bream, and chub), and people are involved in opisthorchiasis parasite-host interpopulation relationship in this region. According to the literature, cats and dogs are involved in opisthorchiasis' epizootic process. In the literature, there is an evidence of wild animals' opisthorchiasis infestation in the last century, but today we cannot reliably talk about the role of wild animals in opisthorchiasis foci functioning. Therefore, to elucidate the role of wild animals, it is necessary to carry out comprehensive parasitological studies of wild carnivores.

2. Following humans, fish widely spreads causative agents beyond the foci during migration and thereby create the significant differences in the infestation intensity in the floodplain-river systems of the region.
3. According to biocenotic characteristics, opisthorchiasis foci in this region can be referred to the floodplain-river related to the Ural River basin and its tributaries and oxbows.
4. Epidemic and significant epizootic season is the spring and summer period.
5. The risk of population infection with opisthorchiasis remains at the use of uninfected *Cyprinidae* fish in food.
6. To reduce the epizootic's and opisthorchiasis' epidemiological intensiveness, it is necessary to carry out the following set of measures with joint efforts of medical and veterinary professionals: annual monitoring of opisthorchiasis foci, controlling the quality and sanitary safety of cyprinoids, improving health literacy of the population, and parasitologic screening of the population for timely detection of affected persons.

References

1. Sidorov EG (1983) Natural Foci of Opisthorchiasis. Alma-Ata, Republic of Kazakhstan: Nauka, p. 240.
2. Beer SA (2005) Biology of Opisthorchosis Causative Agent. Moscow: Association of KMK Scientific Editions, p. 336.
3. Beer SA, Belyakova YV, Sidorov EG (1987) Methods of Studying Intermediate Hosts of Opisthorchosis Causative Agent. Alma-Ata, Republic of Kazakhstan: Nauka, p. 83.
4. Bauer ON (1987) Guide to methods of hydrobiological analysis of surface waters and ground deposits. Determinant of fresh-water fish parasites of the USSR fauna. Nauka 3: 584.
5. Sharapova LI, Falomeeva AP (2006) Methodical Handbook at Hydrobiological Fishery Researches of Kazakhstan's Reservoirs. Almaty: Republic of Kazakhstan, pp. 10-23.
6. Bykhovskaya-Pavlovskaya IE (1985) Parasites of Fish. Study Guide. Leningrad: Nauka, p. 121.
7. Pravdin IF (1966) Study Guide of Fish. Moscow: Food Industry, p. 306.
8. Koblitsky AF (1980) Determinant of Fresh-water Fish Young Fish. Moscow: Food Industry, p. 139.
9. Kotelnikov GA (1974) Diagnostics of Animals' Helminthiasis. Moscow: Kolos, p. 40.
10. Chugunova NI (1959) Study Guide of Fish Age and Growth. Moscow: Izdatel'stvo Akademii Nauk SSSR, 164.
11. Fattakhov RG (1996) Ecology of opisthorchidae parasitic systems of the Ob-Irtysh pool in the conditions of interference. In The All-Russian Conference "Systematization, Taxonomy and Fauna of Parasites", pp. 183-185.
12. Report on Research Work (2011) Assessment of Epizootic Situation on Opisthorchosis in the Reservoirs of West Kazakhstan Region and Development of Actions for Opisthorchosis Prevention. Uralsk, p. 69.
13. Soldatov MS (2011) Mapping of Spatial Distribution of Opisthorchosis-carrier Fish in Western Siberia. Environmental Epidemiology. Kharkov, pp. 108-128.

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