PROBLEMAS DE AVALIAÇÃO DA SEGURANÇA PARASÍTICA DA ÁGUA NAS FONTES USADAS PELA POPULAÇÃO

PROBLEMS OF PARASITIC SAFETY EVALUATION OF WATER IN SOURCES USED BY POPULATION

ПРОБЛЕМЫ ОЦЕНКИ ПАРАЗИТНОЙ БЕЗОПАСНОСТИ ВОДЫ ИСТОЧНИКОВ ВОДОПОЛЬЗОВАНИЯ НАСЕЛЕНИЯ

KUZNETSOVA, Kamalya Yu.*; ZELYA, Olga P.; ZHNAKINA, Zhanna V.; MANIYA, Tamari R.

Sechenov First Moscow State Medical University
20 Pirogovskaya Str., 119435, Moscow, Russian Federation

** Corresponding author
kama.123@yandex.ru*

Received 2018; received in revised form 2018; accepted 2018

RESUMO

A importância do monitoramento estatal dos corpos hídricos nos indicadores parasitológicos é atualizada no artigo. Estabeleceu-se que relatórios resumidos de empresas federais envolvidas no monitoramento estatal de corpos hídricos são formados sem levar em conta os sistemas parasitários naturais e a detecção insuficiente da poluição parasitológica local. Ao mesmo tempo, a taxa de incidência na Federação Russa em relação à giardíase devido ao fator de transporte de água tem sido consistentemente alta por vários anos. Criptosporidiose entre a população não é detectada devido ao uso de métodos insensíveis de diagnóstico. Com um estado tão inexplorado de fatores que afetam a saúde pública, o nível de causas etiológicas não identificadas de infecções intestinais agudas, infecções do trato respiratório superior e pneumonia adquirida na comunidade permanece alto na Federação Russa: 70% e 90%, respectivamente. O artigo apresenta dados sobre a contaminação parasitária de corpos de água na bacia hidrográfica do rio Moscou, obtidos com uma pesquisa de especialistas independentes.

Palavras-chave: estabelecimento de padrões ambientais (classificação higiênica), índices parasitológicos, monitoramento hidrobiológico, protozoários de vida livre, segurança parasitária.

ABSTRACT

The importance of state monitoring of water bodies on parasitological indicators is actualized in the article. It was established that summary reports of federal enterprises involved in the state monitoring of water bodies are formed without taking into account natural parasitic systems and insufficient detection of local parasitological pollution. At the same time, the incidence rate in the Russian Federation regarding giardiasis due to the water transport factor has been consistently high for several years. Cryptosporidiosis among the population is not detected due to the use of insensitive methods of diagnosis. With such an unexplored state of factors affecting public health, the level of unidentified etiological causes of acute intestinal infections, upper respiratory tract infections, and community-acquired pneumonia remains high in the Russian Federation: 70% and 90%, respectively. The article presents data on parasitic contamination of water bodies in the catchment area of the Moskva River, obtained with an independent expert survey.

Keywords: environmental standards (hygienic rating), parasitologic indices, hydrobiological monitoring, free-living protozoans, parasitic safety.

АННОТАЦИЯ

В статье актуализируется важность государственного мониторинга водных объектов на паразитологических показателях. Было установлено, что сводные отчеты федеральных предприятий, участвующих в государственном мониторинге водных объектов, формируются без учета природных паразитарных систем и недостаточны для обнаружения местного паразитологического загрязнения. В то же время уровень заболеваемости в Российской Федерации в отношении лямблиоза из-за фактора водного транспорта постоянно был высоким в течение нескольких лет. Криптоспоридиоз среди населения не выявлен из-за использования нечувствительных методов диагностики. При таком неизведанном состоянии факторов, влияющих на здоровье населения, уровень неопределенных этиологических причин острых кишечных инфекций, инфекций верхних дыхательных путей и внебольничной пневмонии остается высоким в Российской Федерации: соответственно 70 и 90%. В статье представлены данные о паразитном загрязнении водных объектов в водосборном бассейне реки Москва, полученном при независимом экспертном опросе.

Ключевые слова: гигиеническое нормирование, паразитологические показатели, гидробиологический мониторинг, свободноживущие простейшие, паразитарная безопасность.

INTRODUCTION

One of the priority tasks of the Russian Federation Water Strategy is the development of water-bodies' state monitoring system including the development and modernization of the state observation system within the frameworks of the Complex of Russian Water Bodies Control and agreements with the water policy of European Union (Directive..., 2000; Water Strategy..., 2009; Website of Federal Service...). World Health Organization recommends determining the quality of drinking water by the following parasitic parameters: *Fasciola hepatica*, *F.gigantica*; types of genus *Acanthamoeba*; *Balamuthia mandrillaris*, *Naegleria fowleri*, *Giardia intestinalis*, *Isospora belli*, types of genus *Cryptosporidium*; *Toxoplasma gondii*, *Balantidium coli* (Drinking Water..., 2004). Currently central for our country is the latter 8, for 5 of which hygienic standards for water epidemic safety have not been developed and the assessment of the water transmission routes risk of these pathogens for people have not been made. Of the listed agents the types of genus *Acanthamoeba* (*Acanthamoebidae* family), *Balamuthia mandrillaris* (*Leptomyxididae* family) and *Naegleria fowleri* (*Vahlkampfiidae* family) refer to the group of free-living water protozoan that can change to the parasitic way of life. There exist more than 11 types that refer to these 3 families, the medical importance of the biggest part of which remains unstudied (Krylov, 1996). Pathogenic power of *Naegleria fowleri* amebas during the past century was in reasonable detail studied on experimental animals (Centers..., 2011; Clin, 1980; Oddó, 2006; Swanson and

Hammer, 2000) and it was proved that in case of intranasal infection amebas penetrate nasal mucosa, cause its ulceration and destruction, penetrate via the olfactory nerve into b.olfactory, which leads to development of vast brain involvement, acute meningoencephalitis, focal pneumonia and quick death of animals. Numerous experimental and clinical researches proved causation of free-living amebas of *Acanthamoebae* family in the development of acute respiratory diseases (Cerva, 1967; Chang, 1974; Culbertson, 1971; Gordeeva, 1970, 1978; Pokrovskiy *et al.*, 2009). Independent types of free-living parasitic amebas were systematized into 2 classes: *Entamoebidae* and *Lobosea* (the family of *Acanthamoebae* Sawyer at Griffin, 1975; the family of *Hartmanellidae* Volkonsky, 1931; the family of *Naegleriidae* Page, 1976) (Culbertson, 1971; Krylov, 1996).

The group of protozoan free-living in soil and water systems are referred in Russian epidemiology to the agents of sapronosis – “an ancient group of diseases characterized by the absence of any specialization of the agent with respect to the hosts” (Sergiev and Filatov, 2010). However, the existing thesis on discretization of epidemic manifestations of sapronosis infections is subject in this work to critical analysis due to insufficient knowledge on the problem and absence of systematic observation and accumulation of information on the cause and mechanisms of the transformation of the saprophile existence phase of natural one-celled geobionts and reservoir inhabitants into the parasitic one (Onishchenko, 2003). Under the influence of anthropogenic load on the environment during the last years there have

been observed the activation of biological factors of human environment and changes of stable parasitic ecosystems (Aslanova *et al.*, 2016; Onishchenko, 2003) that "are not investigated in detail from the point of view of classification of their hazard for the health of population" (Guzeeva and Sergiev, 2011). In our research, we adhere to the systematic approach to parasitocenosis as a natural factor determining the multi-component structure of infectious process involved in which are agents of different taxonomical groups. The prove are low indices of etiological exposure of community-acquired pulmonary fevers, acute upper respiratory tract infections with multiple and unspecified localization (up to 90%) and acute enteric infections of unspecified etiology (more than 70%) (Guzeeva and Sergiev, 2011; Website of Federal Supervision..., n.d.) of the RF population over the period of many years. Modern condition of public the healthcare can be characterized as a failure of traditional epidemiological and ecological approaches to a health evaluation. The introduction of special account of natural and modified parasitocenosis and integration into the classification of the hazard by groups of water bodies presupposes perfection of legal and regulatory solutions substantiated by the relevant analysis of a single accounting base formed on the basis of dynamic and systematic observation data and its complex evaluation.

Purpose: to present scientifically grounded proposals on the introduction of parasitological indicators into the register of state monitoring of water bodies.

MATERIALS AND METHODS

A survey was conducted in 24 points of the Moskva River and its main tributaries. (Figure 1). A total of 216 water samples and 216 bottom sediment samples were examined by laboratory methods.

Laboratory methods were used, based on the filtration of 112 water samples, which were passed through analytical membranes (1.5 µm). The filtrate was then washed with distilled water and poured into test tubes. The resulting suspension was subjected to centrifugation, and the precipitate was examined. Preparations were previously stained with 1% Lugol solution and microscopized for the presence of helminthes eggs and protozoan cysts with an increase of

x100, x400, x1000.

Oocysts of cryptosporidium were identified by the method of immunomagnetic separation.

Re: Lugol solution (LS): 5.0g iodine +10.0 KI g +100m distilled water

1% Lugol solution = 5.0 ml LS + 20.0 ml Physiological saline solution of sodium chloride.

The results are summarized by the method of comparative analysis of the research results in relative values. Statistical tests were not applied.

RESULTS AND DISCUSSION

The infrastructure of the water-parasitic system in the observed points was represented by such types as *Sarcomastigophora* – 2.5%, *Ciliophora* - 84%, *Microspora* – 0.5%, and differed species diversity: *Protey*, *Entamoeba spp.*, *Paramecium caudatum*, *Euglena viridis*. The causative agents of intestinal protozoal infections were *Lambliia intestinalis*, *L.canis*, *Balantidium spp.*, *Cryptosporidium spp.* (Table 1).

Moskva river. There were conducted 156 studies of water- and bottom silt samples. The share of water samples not corresponding to hygienic requirements by the content of cysts of pathogenic intestinal protozoans *L.intestinalis* constituted 55.5%. The share of samples containing free-living forms of water protozoans *Entamoeba spp.* constituted 46.6%.

River Setun: There were conducted 30 studies of water- and bottom silt samples. The share of water samples was not corresponding to hygienic requirements by the content of cysts of pathogenic intestinal protozoans *Lambliia spp.*, *Cryptosporidium spp.* constituted 66 %. The share of samples containing free-living water protozoan *Entamoeba spp.* constituted 100.0 % (in all research points).

River Skhodnya: There were conducted 18 studies of water- and bottom silt samples. The share of water samples not corresponding to hygienic requirements by the content of cysts of pathogenic intestinal protozoans *L.intestinalis*, *Cr.muris* constituted 23 %. The share of samples containing free-living water protozoan *Entamoeba spp.* was 35.0 %.

River Yauza: 6 tests of water- and bottom silt samples were conducted. All water samples corresponded to hygienic requirements by

parasitologic indices. The share of samples containing free-living water protozoan *Entamoeba* spp. was 15.6%.

B. Novo-Devichiy pond: There were conducted 6 studies of water- and bottom silt samples. There were found cysts of intestinal protozoans *L.intestinalis*, *L.canis*, *B.coli*, *Cr.parvum*, *Cr.muris*, and vegetative forms of *Entamoebae* spp. The share of samples not corresponding to hygienic requirements was 100%.

CONCLUSIONS:

Preliminary results of conducted by us screening studies of water bodies in the Moscow Region speak for a sufficient prevalence of free-living protozoan of *Amoebae* group. This problem presupposes a specialized approach to the study and account of the results, formation of a data base on the bodies of water having an economic significance. The content of cysts and vegetative forms of free-living protozoans of *Amoebae* group in the researched water bodies constituted around 60 %. In 50 % of samples there were found cysts of intestinal protozoans pathogenic for animals; in 4 of 5 water bodies, there were found parasitic pathogens of an intestinal group not accounted for by the official statistics (cysts of intestinal protozoans *L.intestinalis*, *L.canis*, *B.coli*, *Cr.parvum*, *Cr.muris*).

Independent data have been obtained on the high level of contamination by pathogens of parasitic diseases of water bodies in the Moscow region, which increases the risk of contamination of people with the use of recreational waters. This is confirmed by the high prevalence of giardiasis (166.65 cases per 100.000 population) and the presence of a potential risk of infection of the population with cryptosporidiosis, respiratory infections of amoeba etiology.

It is established that the federal system of observations does not take into account parasitic pollution and does not possess reliable information on the sanitary status of water bodies on parasitological indicators.

The necessity to incorporate parasitologic indices into a special survey of hydro-biological monitoring will permit, in our opinion, to systematize the database of natural parasitocenosis of water ecosystems by their hazard class and to develop the methods for

health risk assessment.

Consolidated data on the condition of water bodies by the indices of parasitic safety is formed separately within the framework of highly specialized departmental researches of the participants of state monitoring and are not included into the single accounting base of the RF water bodies' status; this impedes a full-fledged analysis of relevant factors in contamination by parasitic pathogens of water-consumption sources and a complex health risk evaluation.

REFERENCES:

1. Aslanova, M. M.; Kuznetsova, K. Yu.; Morozov, Ye. N.; Effective Laboratory Diagnostics as the Basis of Parasitic Diseases' monitoring, *Health of Population and the Living Environment* **2016**, 1(274), 34.
2. Centers of Disease Control and Prevention/Supervision over the outbreaks of the diseases transferred by water connected with drinking water — the USA, 2007-2008, *MMWR* **2011**, 60(No. SS-12), 38.
3. Cerva, L.; Intranasal intrapulmonary and intracardial inoculation of experimental animals with *Hartmannella castellanii*, *Folia Parazitol.* **1967**, 14(3), 207.
4. Chang, S. L.; Cytopathic and pathogenic differences among geographic strains of pathogenic *Naegleria* and their bearing on the epidemiology of primary amoebic meningoencephalitis /PAM/, *3rd Intern. Congr. Parazitol., Munich* **1974**, 187.
5. Clin, J.; The pathogenicity of *Legionella* in fresh water and soil amoeba, *Pathol.* **1980**, 33, 1179.
6. Culbertson, C. C.; Pathogenic *Naegleria* and *Hartmannella* /*Acanthamoeba*/, *Ann. Rev. Microbiol.* **1971**, 25, 231.
7. Directive 2000/60/EEC of European Parliament and Council of October 23, 2000.
8. *Drinking Water Quality Assurance Manual*. World Health Organization, Geneva **2004**, 1, 63.
9. Gordeeva, L. M.; *Amoebae* *Limax*-group from respiratory tract of man: interaction

- with cellcultures, *IV Intern. Congr. Parazitol., Warszawa, Poland, 19-26 VIII 1978*, sec. A, 38. Gordeeva, L. M.; Primary Amebic Meningocephalitis caused by free living ameba *sp.Hartmannella, Akantamoeba* and/or *Naegleria*, *Meditinskaya parazitologiya i parazitarnye bolezni* **1970**, 2, 227.
10. Guzeeva, T. M.; Sergiev, V. P.; Condition of Parasitary Diseases Diagnostics in the Russian Federation, *Meditinskaya parazitologiya i parazitarnye bolezni* **2011**, 4, 43.
 11. Krylov, M. V.; *Identifier of parasitic protozoans*, Zoological Institute: Saint-Petersburg, 1996.
 12. Oddó, B. David, Infecciones por amebas de vida libre. Comentarios históricos, taxonomía y nomenclatura, protozoología y cuadros anatómo-clínicos, *Rev Chil Infect* **2006**; 23(3), 200. Available at: www.sochinf.cl. Accessed on 20/12/2017.
 13. Onishchenko, G. G.; Criteria for Determining the Danger of Environment Pollution, *Gigiyena i sanitariya* **2003**, 6, 3.
 14. Pokrovskiy, V. I.; Pak, S. G.; Briko, N. I.; Danilkin, B. K.; *Infectious Diseases and Epidemiology*, 2009.
 15. Sergiev, V. P.; Filatov, N. N.; *Human and His Parasites: Antagonism of Genomes and Molecular Interaction*, Nauka: Moscow, 2010.
 16. Swanson, V. S.; Hammer, B.; *Legionella pneumophila* pathogenesis: a fatal path from amoebas to macrophages, *Ann. Rev. microbiol.* **2000**, 54, 567.
 17. *Water Strategy of the Russian Federation for a period up to 2020. Approved by the Russian Federation Government Executive Order of August 27, 2009. No. 1235-p.*
 18. *Website of Federal Service for Supervision of Nature Resources.* Available at: <http://www.mnr.gov.ru>. Accessed on 20/12/2017.
 19. *Website of Federal Supervision Agency for Customer Protection and Human Welfare.* Available at: <http://rospotrebnadzor.ru>. Accessed on 20/12/2017.

Table 1. Results of parasitological research of water samples from Moskva River and Setun River

Sample	Name of the reservoir	Parasitological indicators		M+m n/25 l
		Viable Helminth Eggs	Viable cysts of pathogenic protozoa	
1	B. Novodevichiy Pond	0	<i>L.intestenalis</i> ++ <i>Balantidium coli</i> ++ <i>Cr.parvum</i> ++ <i>Entamoebae</i> ++	6+1.1 1.5+0.4 1.5+1.2 10+0.4
2	Savvinskaya Quay	Toxocara sp.	<i>L.intestenalis</i> + <i>Balantidium coli</i> + <i>Cr.parvum</i> ++ <i>Entamoebae</i> ++	2+0.4 1+0.9 1.5+1.1 5+1.5
3	Krasnopresnenskaya Quay	0	0	0
4	Shelepihinskaya Quay	Toxocara sp.	<i>L.intestenalis</i> + <i>Cr.parvum</i> ++ <i>Entamoebae</i> ++	2+0.4 1.5+0.9 10+1.1
5	Frunzenskaya Quay	0	<i>L.intestenalis</i> + <i>Entamoebae</i> +	2+0.4 5+1.1
6	Moskvoretskaya Quay	Helminth	<i>L.intestenalis</i> ++	6+1.1
7	Kotel'nicheskaya Quay	Toxocara sp.	0	
8	Serenebryanicheskaya Quay	Helminth	<i>Entamoebae</i> ++	5+1.5
9	Krasnokholmskaya Quay	Toxocara sp.	<i>Entamoebae</i> ++	5+1.5
10	Luzhetskaya Quay	0	<i>Entamoebae</i> ++	5+1.5
11	1-st Chobotovkaya Alley	0	<i>Entamoebae</i> ++++	18+1.8
12	Staroorlovskaya str.	Toxocara sp.	<i>L.intestenalis</i> ++	6+1.1
13	Skolkovskoye highway	Helminth Toxocara sp.	<i>Entamoebae</i> ++++	18+1.8
14	Berrshkovskaya Quay	0	<i>Entamoebae</i> +++	18+1.8
15	Pudovkina str.	0	<i>Entamoebae</i> ++++	18+1.8

Figure 1. Scheme of the sampling route from the Krylatskoye pier to the South River Port of the Moskva River

Note: ☹ - Sampling Point