

Alveococcus Multilocularis Sources and Factors of Pathogen Transmission in Arctic Yakutia

Kokolova Luidmila Michailovna^{1*}, Gavrilieva Lyubov Yurievna², Stepanova Svetlana Maksimovna³, Dulova Sargylana Vitalievna⁴ and Sivtseva Evgenia Vladimirovna⁵

¹Pr. Doctor. vet. sciences, head of the Laboratory Helminthology, Federal State Institution: M.G. Safronov Yakut Scientific Research Institute of Agriculture - Division of Federal Research Centre "The Yakut Scientific Centre of the Siberian Branch of the Russian Academy of Sciences"

²Candidate of Veterinary Sciences Senior Researcher of the Laboratory Helminthology, Federal State Institution: M.G. Safronov Yakut Scientific Research Institute of Agriculture - Division of Federal Research Centre "The Yakut Scientific Centre of the Siberian Branch of the Russian Academy of Sciences"

³Candidate of Veterinary Sciences Senior Researcher of the Laboratory Helminthology, Federal State Institution: M.G. Safronov Yakut Scientific Research Institute of Agriculture - Division of Federal Research Centre "The Yakut Scientific Centre of the Siberian Branch of the Russian Academy of Sciences"

⁴Junior Researcher Federal State Institution: M.G. Safronov Yakut Scientific Research Institute of Agriculture - Division of Federal Research Centre "The Yakut Scientific Centre of the Siberian Branch of the Russian Academy of Sciences"

⁵postgraduate student of the helminthology laboratory, Federal State Institution: M.G. Safronov Yakut Scientific Research Institute of Agriculture - Division of Federal Research Centre "The Yakut Scientific Centre of the Siberian Branch of the Russian Academy of Sciences"

ABSTRACT

This article presents data on the study of the ecological and epizootic situation of the helminth *Alveococcus multilocularis*, which is particularly dangerous for humans and animals. The main sources and factors of transmission of *Alveococcus* in susceptible animals and the regularity of the circulation of pathogens in natural foci in the Arctic are determined. According to the results of research, they have a rather dangerous epizootic potential and at any time it is possible to aggravate the epizootic situation. Therefore, the resumption of studies in natural foci of alveolar Echinococcosis is highly relevant, therefore, a study taking into account natural-climatic conditions and socio-economic change in Yakutia and features of distribution *Alveococcus multilocularis*, it is also necessary to reduce infection in domestic animals and humans.

*Corresponding author

Kokolova Luidmila Michailovna, Pr. Doctor. vet. sciences, head of the Laboratory Helminthology, Federal State Institution: M.G. Safronov Yakut Scientific Research Institute of Agriculture - Division of Federal Research Centre "The Yakut Scientific Centre of the Siberian Branch of the Russian Academy of Sciences". Address: 31/2 apt. 2 Lomonosova str., Yakutsk, Russia, 677000. E-mail: kokolova_lm@mail.ru

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Introduction and Brief Information About

The Republic of Sakha (Yakutia) belongs to the regions of the widest distribution of *E. multilocularis* in Russia. There was a report about the high intensity and extensiveness of alveococcal lesions in dogs in Yakutia back in 1959, when studying *Canis familiaris*. M. G. Safronov found alveococci in two dogs in the amount of 39,808 and 49,530 copies and in 1961, at the opening 88 dogs in the Arctic territory of Yakutia, alveoli was detected in 14 (16%) [1,2]. In 1960, N. M. Gubanov reported the discovery of the ribbon form of *E. multilocularis* in fur-bearing animals (*Vulpes vulpes*) [3]. Larvocysts *E. multilocularis* in rodents in Yakutia were first "found" by Yu. F. Morozov (1955) in the Vilyui district in *Clethrionomys glareolus* Sehr, 1780 [4]. N. M. Gubanov N. M. also reported the detection of larvocysts in *Lemmus sibiricus*, *Microtus gregalis*, *Myodes rutilus* and *Microtus hyperboreus* [3].

In the north, except for Yakutia, frequent infestation of *Alopex lagopus* in Chukotka [5].

In his monograph "Alveolar echinococcosis (*Echinococcus multilocularis*) and hydatosis" A. S. Bessonov in 2003, included an analysis of the literature data on the history of observations since the XIX century, which were given in many reports of European pathologists-anatomists, including Bühl (1852), Luschka (1856), they described a specific and rare liver tumor, which was called "alveolar carcinoma", a tumor having cellular structure, in 1855, Virchow discovered in the tumor hook echinococcus and expressed that the tumor has a parasitic nature, which is one of the varieties of the larval form of the cestode *Taenia echinococcus* now known as the *Echinococcus granulosus* and called the tumor "ulcerative multilocular hydatid". Other researchers used the materials of the Posselt (1890) study to establish two different hypotheses and determined the morphological difference, so an argument was put forward in support of the independence of the species *Alveococcus multilocularis*, the main reason for

this was the specific geographical distribution of this species [6,7]. In 1960, K. I. Abuladze (1960), using the materials of V. V. Nikitin, in consultation with K. I. Scriabin, justified the new genus *Alveococcus* with one species *Alveococcus multilocularis* (Leuckart, 1863) Abuladze, 1960, and translated *Echinococcus multilocularis* into synonyms [8].

Currently, *Alveococcus multilocularis* is not widespread in nature everywhere, in Russia it is found in Tatarstan, Bashkiria, Siberia (Omsk, Tomsk, Novosibirsk, Irkutsk regions, Krasnoyarsk Territory) and in the Far East (Yakutia, Chukotka, Magadan Region, Khabarovsk Territory). *Alveococcus multilocularis* is also distributed in Japan, Canada, Germany, Austria, Kazakhstan, and Kyrgyzstan.

Methodology

When performing the research, we studied materials collected independently from wild carnivorous animals: white foxes, red foxes, wolves, lynx, wolverine and carcasses of small rodents: Siberian lemming, field mice, dogs and cats were studied in reindeer herds during the slaughter of domestic deer carcasses, during the shooting of wild deer carcasses. Studies were carried out in reindeer herds, hunting and fishing farms and in rural settlements. Materials for the study of alveolar echinococcosis in the population were presented in the surgical department and in specialized departments of forensic medical examination Republican Center for Disaster Medicine №1 and №2.

Helminthological studies of organs and tissues of animals, rodent carcasses of feces, were carried out by conventional methods: helminthooscopy of feces, Fulleborn and Darling methods, incomplete autopsy according to K. I. Scriabin and the method of successive washing.

Just researched the types of:

Carnivora, Canidae: *Alopex lagopus* – 834; *Vulpes vulpes* – 28; *Canis familiaris* – 678; *Canis lupus* – 245;
Fidae: *Filex catus* – 593; *Filex lynx* – 3; *Gulo gulo* – 15;
Rodentia Muridae: *Misrotus agrestus* – 1019; *Misrotus rugestus* – 212, *Microtus gregalis* – 12, *Microtus oeconomus* – 3, *Myodes glareolus* – 214, *Myodes rutilus* – 61, *Ondatra zibethicus* – 17, *Mus musculus* – 57, siberian lemming *Lemmus sibiricus* – 784; *Sorex tundrensis* – 47.

Discussion

Morphological and physiological characteristics

The causative agent of alveococcosis was isolated in an independent genus quite recently, before that, due to its similarity, according to the classification of *Taenia*, it was referred to the genus *Echinococcus*–*Echinococcus* and was called *Echinococcus multilocularis* [3]. The source of the causative agent of alveolar echinococcosis of rodents, insectivores and primates (humans, etc.) for intermediate hosts are invasive predators–polar (white) foxes, red foxes, dogs are the final hosts of *Taenia*, releasing a huge number of eggs into the external environment, the development of larvocysts leads to the formation of alveococcosis disease. The main and almost the only way of infecting carnivorous *Alveococcus multilocularis* is alimentary, i.e. eating organs and tissues of herbivorous and omnivorous animals, rodents infected with larvocysts of tapeworm.

Alveococcus multilocularis

The ribbon form is very similar to *Echinococcus*. Distinctive features: number of hooks on the scolex and or decorated globular form of the uterus, i.e., no uterine side of the protrusions, the

location of the sexual openings in the front portion of the side edge of the segment, it is well seen in figure 2, and the structure alveococcosis cysts in the organs of intermediate host cyst (tumor) is a conglomerate consisting of small bubbles enclosed in a common connective capsule–stroma. The cyst is not hollow, does not contain fluid, has internal budding dense vesicles containing protoscolexes, they germinate in organs and tissues according to the type of tumor.

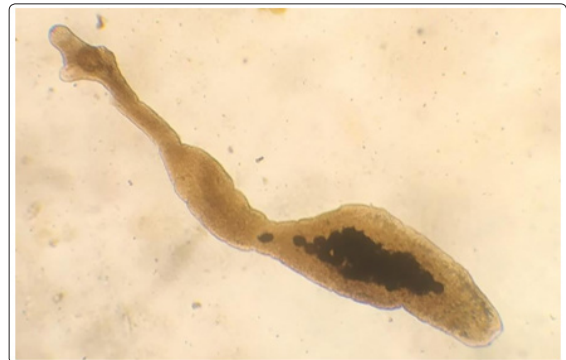


Figure 1: Cestode *Alveococcus multilocularis* found in *Vulpes vulpes*. microscope Biolam×300 (photo by L. Kokolova, original)

Objects of research - *Vulpes vulpes*, 28 samples of the cestode *Alveococcus multilocularis* were investigated in 1 animal, which amounted to 5.5% of the number of animals studied, the intensity of invasion was about 1800 specimens.

Alopex lagopus, a total of 834 intestinal samples were opened, of which sexually mature alveococci were found in 818 samples, which is $98.1 \pm 0.9\%$ of the number of individuals studied, the intensity of invasion was more than 15000 ± 3261 specimens. for 1 individual.

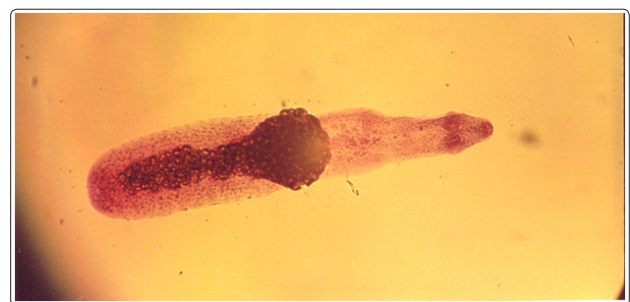


Figure 2: Cestoda *Alveococcus multilocularis* in the *Alopex lagopus*. microscope Biolam ×300 (photo by L. Kokolova, original)

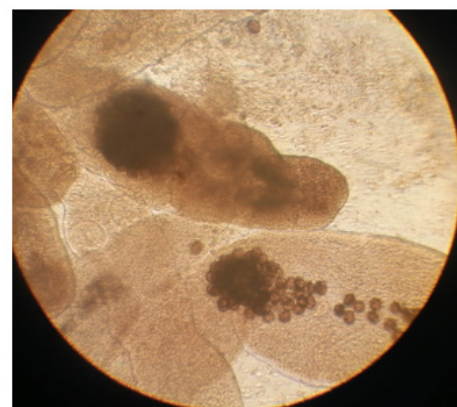


Figure 3: Detection of helminths of *Alveococcus multilocularis* parasitizing *Alopex lagopus* in the field of view of the microscope Biolam ×300 (photo by L.Kokolova, original)

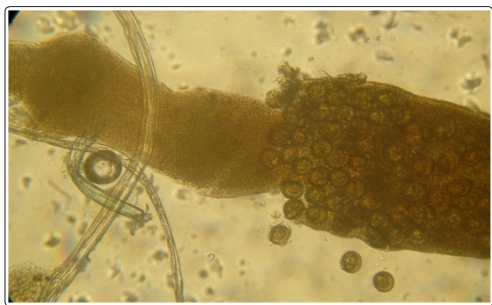


Figure 4: Rupture of the Alveococcus multilocularis parasitic segment in Alopex lagopus and the release of oncospheres at freezing -50°C . $\times 300$ microscope Biolam (photo by L. Kokolova, original)

Canis familiaris – 2678 of them in 356 (13.3%) were found different the types of cestodes, Alveococcus multilocularis was not found. Canis lupus a total of 361 Alveococcus multilocularis was not detected, cestode Echinococcus granulosus was detected in 231 (61%) animals, Alveococcus multilocularis was not detected. Larvacysta A. multilocularis it was found in 11 of the 784 Lemmus sibiricus (1,4%), 4 of the 57 Mus musculus (7,02%), 14 of the 214 Myodes glareolus (6,54%), 4 of the 61 (6,5%) Myodes rutil. In the Arctic zone of the cestode, Alveococcus multilocularis is often found in Alopex lagopus and Canis familiaris—the final hosts, and Lemmus sibiricus—intermediate hosts in the taiga zone in Vulpes vulpes and Canis familiaris mouse-like rodents less often than Echinococcus granulosus, in other mammalian animals it is almost not recorded [9]. There was 1 case of human disease registered in 2014 (the diagnosis was made posthumously), the disease was characterized by a malignant course for more than 10-15 years, the affected organ is the liver, with characteristic metastases of the mesentery, intestines and peritoneum. Over the past five years, 996 patients with echinococcosis were registered during mandatory medical examinations of the population, 25 people (2.51%) were identified with alveococcosis in the regions of the Arctic zone.

In the tundra zone, the cestode Alveococcus multilocularis is often found in Alopex lagopus and Canis familiaris, the final hosts, and Lemmus sibiricus, the intermediate hosts in the taiga zone in Vulpes vulpes and Canis familiaris of murine rodents, less often than Echinococcus granulosus, almost not recorded in other mammals. There was 1 case of human disease registered in 2014 (the diagnosis was made posthumously), the disease was characterized by a malignant course for more than 10-15 years, the affected organ was the liver, with characteristic metastases of the mesentery, intestines and peritoneum. Over the past five years, during the mandatory medical examinations of the population, 996 patients with echinococcosis were registered, in the regions of the Arctic zone, 25 people (2.51%) were identified with alveococcosis.

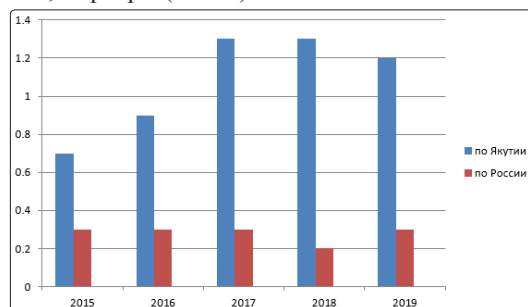


Figure 5: Dynamics of the incidence of Echinococcosis in the population in Yakutia

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