

Praca poglądowa • Review Article

Alaria alata infection - threatening yet rarely detected trematodiasis

Alaria alata – przywrycza aktualnie zagrażająca choć rzadko wykrywana

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Summary

The aim of this study was to present the diagnostic difficulties and the possibility of infection with the trematode *Alaria alata*. The living environments were defined for *Alaria alata* parasites with necessary access to water. Many types of hosts of this trematode were described: intermediate (snails, frogs, tadpoles), final and paratenic hosts. The growing importance of wild boars and foxes in the spread of alariosis was emphasized. Stages of development of the pathogen and the infection route of humans as potential paratenic hosts were described. Current possibilities of mesocercaria detection in animal meat were presented, resulting in increased detection of alariosis in different countries, mainly Europe and Asia. The pathogenic effects of *Alaria alata* location in the connective tissue and muscles were described. Various symptoms of alariosis in humans were described in detail with a focus on multiorgan changes. The possibility of eye and skin forms of alariosis was emphasized. Changes in autopsy were described. We found that alariosis is difficult to identify and it requires the exclusion of various diseases. Alariosis prevention consists of avoiding eating the meat of wild boar, wild birds, frogs' legs, or snails cooked at insufficient temperatures.. Consumption of untested venison is also dangerous.

Streszczenie

Celem pracy było przedstawienie trudności diagnostycznych i możliwości zarażenia przywrą *Alaria alata*. Określono w jakich środowiskach żyją pasożyty *Alaria alata* z koniecznością dostępu żywicieli do wody. Opisano wiele rodzajów żywicieli tej przywry: pośrednich (ślimaki, żaby, kijanki), żywicieli ostatecznych oraz paratenicznych. Podkreślono rosnące znaczenie dzików i lisów w rozprzestrzaniu się alariozy. Opisano stadia rozwojowe tego patogenu, drogi zarażenia człowieka jako potencjalnego żywiciela paratenicznego. Przedstawiono aktualne możliwości wykrywania mezocerkarii w mięsie zwierząt, wskutek czego nastąpiła zwiększona wykrywalność alariozy w różnych krajach, głównie Europy i Azji. Określono patogenetyczne skutki umiejscowienia *Alaria alata* w tkance łącznej i mięśniach. Opisano szczegółowo różne objawy alariozy u człowieka, ze zwróceniem uwagi na wielonarzędowość zmian. Podkreślono możliwość postaci ocznych i skórnych alariozy. Opisano zmiany autopsyjne. Stwierdzono, że alarioza jest chorobą trudną w rozpoznawaniu, wymagającą wykluczenia wielu różnych chorób. Profilaktyką alariozy jest unikanie spożywania mięsa z dzika, dzikich ptaków, żabich udek, ślimaków bez pełnej obróbki termicznej. Zagrożenie stwarza również spożywanie nie badanej dziczyzny.

Key words: *Alaria alata*, alariosis, trematodiasis

Słowa kluczowe: *Alaria alata*, alarioza, przywrycza

Introduction

Alariosis, caused by the larvae of *Alaria alata*, is the least known among distomiasis. Formerly included among emerging diseases [1], although the pathogen *Alaria alata* was discovered by Goeze in 1782, there was insufficient data on its pathogenicity. In recent years there have been significant advances in knowledge about the biology of *Alaria* [2], the hosts, especially paratenic, and the diagnostic methods for

the detection of *Alaria alata* mesocercariae in animal meat [3, 4]. Cases of alariosis among humans and animals are increasingly detected in different countries, mainly in Europe and Asia [5, 6, 7, 8, 9]. The scope of occurrence in humans requires research.

Epidemiology

Epidemiological studies conducted in different regions of the

world have proven that *Alaria alata* is widespread in many environments. This is due to a broad range of hosts, which include: birds, amphibians, reptiles, and mammals [10]. Humans are involved in the epidemic chain as paratenic hosts. Because snails, frogs and tadpoles play an essential role in the chain, an aquatic environment is a prerequisite. Parasitological studies conducted by Wójcik in Poland proved the presence of *Alaria alata* in snails, frogs and wild boar in one hunting area. Wild boars not infected with *Alaria alata* in a different area could have been the result of a lack of snails [10]. Wójcik et al. [10] showed that the percentage of infected snails and frogs in Poland depends on the season. In the spring it is sometimes even 100% of amphibians and 30% in the autumn.

In Poland, an increasing role is played by foxes due to their growing numbers, synanthropic existence as well as large extensiveness and intensity of infection [11, 12]. According to data from 2005, foxes as the final hosts show a rate of infection from 2-31% in Poland; these fluctuations depend on the availability of aquatic environments for the intermediate hosts, mainly snails and frogs [11]. According to other studies in western Poland, 21.8% of foxes [13] and 2.2% of wolves were infected in the Beskidy Mountains [14]. In Belarus, *Alaria alata* was found in wolves; the authors described the importance of drainage channels as potential foci of infection [15]. A total of 42.6% of foxes was infected in Belarus [16].

According to the Veterinary Academy, Lithuanian University of Health Sciences in Lithuania, the study of 310 carcasses of hunted red foxes (*Vulpes vulpex*) and raccoon dogs (*Nyctereutes procyonoides*) found that both species were highly infected with *Alaria alata* (94% of foxes, 96% of raccoon dogs) [5]. The parasites' evolutionary success is the ability to colonize new host organisms. The raccoon dog (*Nyctereutes procyonoides*) was introduced in Poland from East Asia in 1955, and its population is constantly growing. Two species of *Trichinella* (*Trichinella spiralis*, *T. britovi*) were found in this host in Poland [17].

In many countries around the world, the role of the wild boar is increasing, as they are a very important host of *Alaria alata*. Considering the increasing human habitation of suburban areas, increased use of land for agricultural purposes, increased hunting activity, and increasing wild boar meat consumption, the risk of human infection with *Alaria alata* is also rising [18]. In Germany, during a 2-year study conducted by veterinary services on samples of fresh wild boar meat from different hunting areas in the states of Brandenburg and Saxony-Anhalt using the larval migration technique, researchers found that 11.5% of meat samples were infected with *Alaria alata* [9]. According to Manke et al., 13% of foxes were infected with *A. alata* in Germany [19].

According to the most recent data published in 2011, more than 100 cases of *Alaria alata* mesocercariae were found every year in wild boars and red foxes in the eastern part of France [7].

Alariosis is a sporadically spreading zoonosis. Wild animals, such as wild boars, play a far greater role than livestock animals such as pigs. This is due to significant contact with the natural environment in contrast with pigs. Human infection occurs after ingestion of food of animal origin, mostly wild boar meat or frog legs. Epidemiological investigations have also demonstrated an important role of wild birds, especially wild geese [10]. Kramer et al. described a case of human infection with *Alaria alata* metacercariae in undercooked wild goose meat [20].

The biology of *Alaria alata*, proliferation in the environment

The trematode causing alariosis is a pathogen for humans and animals. Veterinary sources on this trematode are more abundant than medical. The scope of alariosis occurrence in humans requires research. *Alaria alata* requires many links in the life cycle. It is characterized by a complex, multi-host life cycle [1, 2, 10].

Alaria alata (Goeze, 1782) is a little-known trematode. The probable causes of this are diagnostic difficulties and some similarities to *Trichinella spiralis*. Without preceding trichinosis with artificial digestion, both these parasites can be mistakenly identified [10]. The newly recognized species of *Alaria* are: *marciana*, *americana*, *canis*, *arisemoides*, *mustelae*, *intermedia* [2]. The Polish name of *Alaria alata* has not been determined (Fig. 1).

The spread of this parasite in nature is great. It lives in the environment thanks to a broad range of hosts: snails and amphibians, mostly frogs; reptiles such as snakes and lizards; wild birds; and other animals as final hosts (dogs, cats, wolves, foxes, raccoon dogs, bobcats, rabbits and others). The importance of carnivores is increased by their ability to pass the trematode onto their offspring.

As final hosts, foxes and wandering dogs excrete eggs measuring 110-140 x 70-80 µm [2]. The eggs contain larvae of *Alaria alata*. They are transmitted from the environment to intermediate hosts. The final hosts must have access to water.

Obligatory links in the form of intermediate hosts are: common snails (*Planorbis planorbis*, *Anisus vortex*) [21], frogs (*Rana esculenta*, *temporaria*, *arvalis*) [10], and tadpoles [2]. Research on snails and frogs in Poland shows high proliferation (80% of animals infected) and intensity (10-20 larvae per cm² of isolated muscle) [10].

In water, miracidia escape out of the eggs in search of mandatory intermediate hosts, which are snails of the species *Planorbis planorbis* and *Anisus vortex* [20], and frogs of the species *Rana: esculenta*, *arvalis*, *temporaria*. The miracidia develop into sporocysts in the hepato-pancreas of intermediate hosts. Daughter sporocysts develop in the mother sporocyst. Furcocercous cercariae, equipped with two penetration glands, are the next larval stages. Furcocercous cercariae leave the snail to swim in the water to look for the

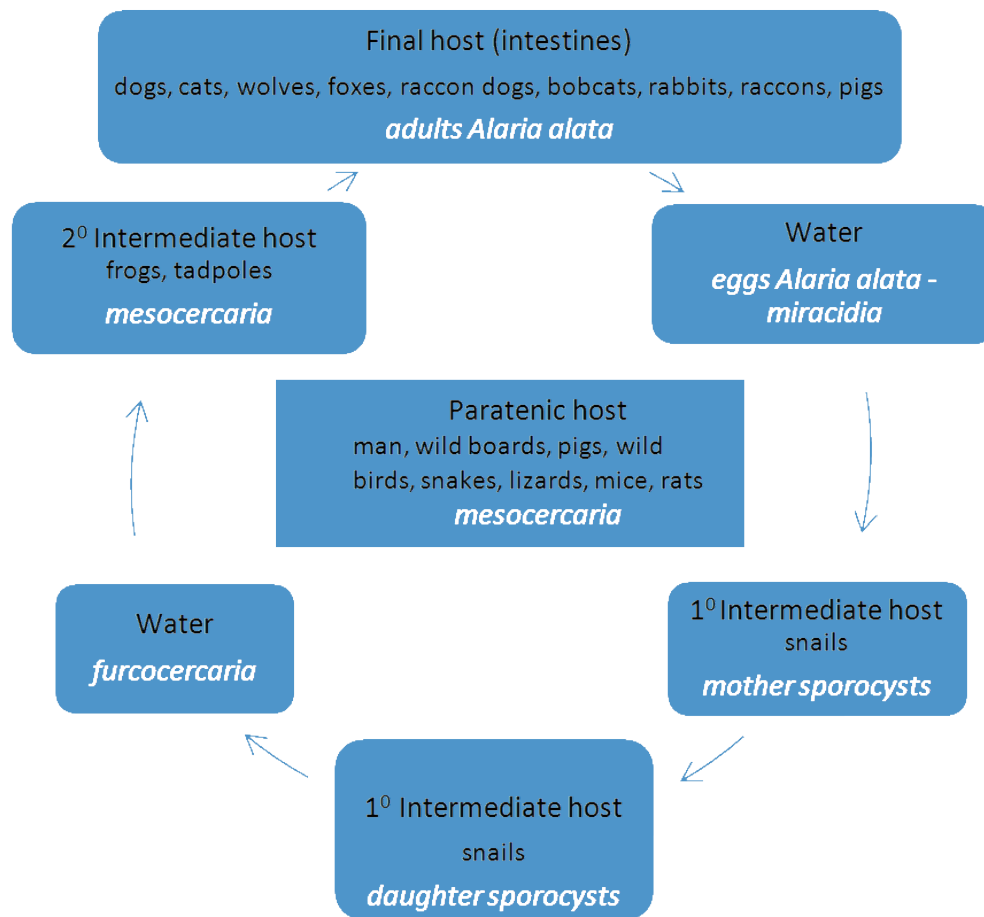


Figure 1. Schematic circulation in the environment *Alaria alata*, stages of development [1, 2].

second intermediate host, where they form the fourth larval stage - mesocercariae. Frogs have a special significance at this time. In these amphibians, mesocercariae live as a free and mobile or encysted form.

Humans and other vertebrates - wild pigs, fur animals, lizards, snakes, mice, rats and wild birds - are paratenic hosts. Humans become the paratenic hosts by eating the meat of wild geese or frog legs cooked at insufficient temperatures, for example during grilling.

Eating a frog by an animal leads to the formation of a paratenic host. In such an acquired accidental host, the mesocercariae localize in the connective tissue between the muscle fibers. In humans, it can lead to multiple organ spread - in the liver, kidneys, lungs, brain, and adipose tissue. Rodents, such as rats and mice, are third intermediate hosts. In their muscles and lungs, the mesocercariae transform into encysted metacercariae. Rodents consumed by carnivores develop the mature forms, reaching maturity after 10 days [1]. The aquatic environment is essential in the spread of these trematodes.

Recognition of animal and human infection with *Alaria alata*

Diagnosis is difficult. Finding *Alaria alata* larvae in muscle tissue or organs is crucial. In Poland, such diagnostic success was achieved by Wójcik et al. [10] studying wild boar meat using the trichinoscopy method preceded by artificial

digestion. The presence of living *Alaria alata* metacercariae was found in the diaphragm pillars of these animals. They also studied snails excreting *Alaria alata* larvae and containing sporocysts, metacercariae in the tongue muscles of frogs, and dog feces from the Kujawsko-Pomeranian region for the presence of parasite eggs [10].

Jastreb et al. [22] presented information on the usefulness of their method of material condensation for testing animal blood. Using this method, they detected *Alaria alata* in 1.9% of dogs (of 2128 tested animals) and 1.1% of cats (of 543) from the Moscow area. Szczęsna et al. [23] describe the examination of European bison feces from Białowieża that were sporadically positive.

In Poland, mandatory testing of meat for trichinosis using the artificial digestion method, which enables detection of *Alaria alata* larvae, has been in force since 1998 [10].

Recently, progress in alariosis diagnosis has been made: in 2010, Riehn published a new method of detecting *A.alata* mesocercariae in wild boar meat [3]; in 2011, the PCR (polymerase chain reaction) method was used to identify *A.alata* mesocercariae [4].

Alariosis is a parasitosis that is difficult to diagnose. As a result, it might rarely be recognized in practice.

A muscle sample of human tissue may be used for testing; it should be sent to the laboratory in 0.9% NaCl. Artificial gastric juice digestion (pepsin/HCl) is used to detect larvae,

which then undergo parasitological and molecular analysis [2, 24].

According to Polish recommendations [24], the following are indications for molecular examinations in medical parasitology: low infection intensity, below the microscopic threshold detection methods, difficulty in differentiating similar or twin species (differentiation of species - genotypes of *Trichinella*), need for confirmatory tests, and the need to determine the drug resistance of the parasite.

Tissue fragments, including biopsy and autopsy material, should be examined by a histopathologist and a parasitologist [24].

According to Freeman [6], if there is proliferation of *Alaria alata*, autopsy may be important in the detection of meso-cercaria in organs such as: the stomach wall, the liver, heart, kidneys, lungs, and peritoneal or bronchial fluid.

Clinical data - case studies, treatment and prophylaxis

Until recently, the pathogenicity of *Alaria alata* was denied. This view was revised due to the documented changes observed in humans and animals as a result of trematode invasion.

According to Jaksić et al. [25], the reason for inaccuracies in this case could have been suspicion of trichinosis as the cause of the changes found. This is increasingly important considering the common location in the muscles, and typical symptoms of both diseases are: muscle pain, swelling, and sometimes fever and rash.

The main symptoms of this little-known parasitosis are muscle pains [26]. A particularly severe course is characterized by shortness of breath, cough with hemoptysis, chest pain, abdominal pain, weakness, fever, confusion, hypotension, and skin lesions in the form of micromacular or hemorrhagic rashes. We observe DIC (fibrinogen degradation products, thrombocytopenia) in the most severe, poor prognosis forms. Eosinophilia may occur as well. Diagnosis is complicated due to multi-organ changes causing the symptoms and lack of a pathognomic symptom.

A special form of alariosis is in the eyes. McDonald et al. [27] suspected neuroretinitis while observing two men. Before the presence of *A. americana* was detected, many diseases such as tuberculosis, syphilis, Lyme disease, Behcet's disease, sarcoidosis, and others were taken into consideration in the differential diagnosis.

Among the few case reports of alariosis, Kramer et al. presented an interesting description [20]. They documented the disease of a 38-year-old man with symptoms of bronchial spasms, recurrent urticaria, and a subdermic tumor in which the presence of *Alaria alata* was confirmed. These symptoms were the result of consuming undercooked wild goose meat.

Skin lesions caused by various trematodes may result from human contact with snails, as in an example of a 27-year-old man gathering snails in the Kujawsko-Pomorskie province [28].

Freeman et al. wrote a description of the death of two Canadians who ate frog legs in the same region of Canada [6]. Retrospective analysis of frogs' and snakes' fatty tissue in that area detected *Alaria americana*, *arisaemoides* and *marcianae*. Both men died in the course of severe disease with multi-organ failure, with diagnostic difficulties. Autopsy found generalized invasion of *Alaria alata*. In both cases, the clinical picture and post-mortem examination revealed surprisingly large inflammatory, hemorrhagic and granulomatous lesions, partly necrotic, in the stomach, lymph nodes, intestine, liver, spleen, pancreas, adrenal gland, kidneys, lungs, heart, brain, and the spinal cord.

These descriptions indicate that alariosis is a currently relevant disease, which is underdiagnosed due to lack of pathognomic symptoms and the presence of multi-organ lesions.

The differential diagnosis of alariosis should also take into account trichinosis and allergic and inflammatory changes or lesions of various causes. The allotropy of this parasitosis makes diagnosis difficult. It appears that alariosis, an emerging disease, may currently remain not fully explained in both the epidemiological characteristics as well as the clinical picture.

Praziquantel is an antiparasitic drug that affects most human pathogenic trematodes [29]. Its action is based on causing immediate contraction and immobilization of parasites - even at drug concentrations above 0.4 µg/ml - and degeneration of their cuticle.

The best prophylaxis is common sense in nutrition. Prevention consists of avoiding consumption of untested meat, especially venison and wild birds, frogs' legs, and snails. Almost raw, undercooked meat prepared on a bonfire or barbecue also poses a threat. Travel, stay in the woods, and trying exotic food, sometimes almost raw, predispose to infection with *Alaria alata*.

The significance of this trematode is proven by the fact that the Swiss Federal Office for the Environment (FOEN) categorized *A. alata* as a stage 2 risk for parasites with zoonotic potential as pertaining to occupational health risks [2].

Conclusion

Data from the literature suggests that increase in the populations of wild animals (foxes, wild boars) infected with *Alaria alata* increases the risk of disease in humans.

Diagnostic difficulties in detecting the disease and no specific treatment pose a serious threat to life and health.

Alariosis prevention consists of avoiding eating the meat of wild boar, wild birds, frogs' legs, and snails cooked at insufficient temperatures. Consumption of untested venison is also dangerous.

As medical doctors and veterinarians, we care for the health of humans and animals; it is important to spread practical knowledge about alariosis.

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