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Opinion

Zoonotic potential of *Giardia lamblia* and control of giardiasis

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Giardia is the most common pathogenic intestinal flagellate protozoan in the world. The most studied species is *Giardia lamblia* (syn. *Giardia intestinalis*, *Giardia duodenalis*) that infects mammals, including humans. About the other seven species the scientific literature is very scarce and little is known about its characteristics and epidemiological importance. The exception is *Giardia muris* species that is frequently used in experimental infection to attempt to understand the parasite-host interaction in *G. lamblia* infection [1].

The classification of *G. lamblia* has been made based on the host of origin and morphomolecular characteristics [2,3]. The first divisions in *G. lamblia* assemblages were performed according to the host specificity from which the isolate originated [4]. This subdivision was corroborated in analyzes of intrinsic characteristics of the parasite, such as antigenic factors, isoenzymes, but mainly through DNA analysis that allows to reaffirm the heterogeneity of *G. lamblia* [4,5]. Eight assemblages are known, distributed with denominations A to H. Assemblages A and B are potentially zoonotic, as they infect humans and other mammalian hosts, including non-human primates, canids, felines, rabbits, beavers, muskrats, mustelids, rodents, marsupials, wild ruminants and livestock animals. Assemblages C to H are still considered host-specific. Assemblages C and D have already been described in canids; assemblage E was isolated from hoofed animals, as horses, swine, cattle; assemblage F, specific for felines; Assemblage G is found exclusively in mice and rats; Assemblage H was described from pinnipeds feces [1,5].

Although assemblage division and host affinity is maintained to this day, the characterization of *G. lamblia* assemblages has not yet been fully substantiated. The advancement of genotyping studies has demonstrated that host specificity is not so rigid. Possibly the strains of *G. lamblia* have undergone an evolutionary process of adaptation to other species hosts or the literature lacked the knowledge about the infective potential of these assemblage. The assemblage C and D, for example, have been reported in felines [6,7] and humans [8]. The assemblage E was described in rabbits [9], non-human primates [10], rodents, cats [11] and humans [12]. Assemblage F was reported in pigs [13] and cattle [14].

The *G. lamblia* transmission occurs by fecal-oral route from ingestion of infective cysts. These cysts, during the passage through the stomach, initiate a process of desencistamento (Ankarklev, 2010) and, in the small intestine, *G. lamblia* takes the form of trophozoite that fixed in the enterocyte and proliferates by binary division. When carried by the intestinal flow, the trophozoites begin the process of encystment and cysts are released into the already infecting feces [15]. Cysts are evolutionary forms resistant and able to survive in the environment from weeks to months according to the conditions that are exposed [5,16]. Although the water pathway is the main form

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of contamination and is closely associated with the outbreak'soccurrence [17], the animal hosts plays a fundamental role in the transmission dynamics of the different assemblages of the parasite, since it favors the maintenance of cysts in the environment. As stray animals do not have fixed residence, they can wander through different places, which can favor the dispersion of infectious cysts. Pets infected with *G. lamblia* may favor transmission within their home, involving other domestic mammalian and man. Once cysts are released viable for infection, transmission is favored and intensified in crowded places such as nursery, orphanages, asylums, kennels, and poor communities, among others.

The presumptive diagnosis of giardiasis consists in observing the symptoms of infected individual and the definitive diagnosis if by the detection of cysts (or derivatives) and, occasionally, trophozoites in feces. The parasitological examination of feces is still one of the most used methods, although negative false cases can occur, due to the intermittent elimination of this protozoan. Stool samples may present a low number of evolutionary forms which hinders and may mask host parasitic load and even the result of the diagnosis [18]. Diagnosis can also be made by the immunoenzymatic method or by immunochromatography, which may present greater sensitivity and specificity for single sample [19]. The molecular diagnosis by Polymerase Chain Reaction (PCR) for detection of *G. lamblia* genes specificis considered more sensitive than the parasitological examination and the immunodiagnosis [20-22]. However, especially in poorer countries, where a higher prevalence of giardiasis is expected, due to the high cost of immunological and molecular diagnoses, its use in human and veterinary clinical practice is not yet on routine and the indication if treatment is given by the observation of symptomatology.

In domestic animals, as in humans, the most common symptom is diarrhea, mostly observed in puppies. Many individuals may be asymptomatic. *G. lamblia* research is more frequent among economically important animals such as cattle, sheep, pigs and horses, as the infection may have an impact on animal weight gain [23]. In these animals the assemblages A, B and E that too have already been described in humans are expected. In addition, in farm environments the contact between different animal species may favor the occurrence of complex zoonotic transmission networks.

Another animals group that has epidemiological importance in giardiasis transmission are domestic animals, such as dogs and cats. The interest in acquisition of these animals has grown in the last century and it is common the adoption of street animals which do not have veterinary care. In addition, we have observed a process of increasing humanization of pets, which brings them closer to human interaction and favors the transmission of anthropozoonotic and zooanthroponotic diseases [24]. It is often reported in the literature genotypes of *G. lamblia* with anthropozoonotic potential (A and B) circulating in dogs and cats [25,26].

In this context, control actions of giardiasis should consider the potential hosts involved in zoonotic cycles in order to reduce the elimination and circulation of the etiological agent and to stop the transmission of the disease. In developing countries, when control measures are in place, they are often directed to human treatment and water quality control and no measures are directed at animals. Thus, for the effective control of giardiasis, basic sanitation is a priority, but it must be accompanied by health education strategies, to provide knowledge about self-prevention, and treatment of humans and too of animals infected by *G. lamblia*.

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