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Chagas Disease in Dogs

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Abstract

Chagas disease is zoonotic illness or an anthropozoonosis caused by flagellated protozoan parasite *Trypanosoma cruzi*. This infection presents alarming rates of incidence/prevalence, for this reason, is recognized worldwide as one of the 13 most neglected tropical diseases [1]. Numerous studies have demonstrated the existence of domestic dogs infected with *T. cruzi* across endemic areas ranging from southern United States of America to Argentina [2]. The reported prevalence varies widely (1.42-92%), depending on ecoepidemiological and sociocultural factors [3]. It is important to emphasize that the natural infection in dogs with *T. cruzi* occurs in the same way as in humans, that is to say, through active transmission by vectors, contamination by feces infected with the parasite through wounds or the conjunctiva, can also occur by ingestion of infected vectors or tissues of wild animals present in the peridomicile or home [4]. The transplacental transmission is also an important mode of transmission in dogs [5]. Nevertheless, the main mode of transmission in canine species seems to be the ingestion of infected vectors [6]. During the life cycle of *T. cruzi* the trypomastigotes present in the heces of the triatomines are introduced in the mammalian host by contamination of the insect bite or mucosal membranes. The metacyclic form can penetrate a variety of phagocytic and nonphagocytic nucleated cells. Once inside the cells the parasite becomes in amastigote, which are multiplicative forms that divide into cells. Due to the high parasitic load they produce the lysis of the cells and escapes into the cytoplasm. The amastigotes transform to slender trypomastigotes which can invade adjacent cells, this forms can be ingested by triatomines and they transform into epimastigotes Finally, after migration to the bug's hindgut, the epimastigotes differentiate into infectious metacyclic trypomastigotes, in this way the life cycle of this microorganism is completed [7].

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Introduction

Chagas disease is a zoonotic disease caused by flagellated protozoan parasite *T. cruzi*. The infection is recognized worldwide as one of the 13 most neglected tropical diseases [1]. Numerous studies have demonstrated the existence of domestic dogs infected with *T. cruzi* across endemic areas ranging from southern United States of America to Argentina [2]. The reported prevalence varies widely ranging from 1.42 to 92% depending on ecoepidemiological and sociocultural factors [3].

In both humans and dogs the mode of transmission of *T. cruzi* natural infection is through vectors, wound and conjunctiva contamination by feces of contaminated animals, and ingestion of infected vectors or tissues of wild animals living in the peridomicile or home [4]. Transplacental transmission is also an important mode of transmission in dogs [5]. The major mode of transmission in canine species, however, appears to be the ingestion of infected vectors [6].

Life Cycle of *T. cruzi*

In the life cycle of *T. cruzi* the trypomastigotes present in the heces of the triatomines are introduced into the mammalian host by contamination of the insect bite or mucosal membranes. The metacyclic form can penetrate a variety of phagocytic and nonphagocytic nucleated cells. Once inside the cells the parasite becomes an amastigote, which are multiplicative forms that divide into cells. The high parasitic load produces lysis of infected cells and escapes into the cytoplasm. The amastigotes transform to slender trypomastigotes which invade adjacent cells. The trypomastigotes are ingested by triatomines before transforming into epimastigotes, which migrate to the triatomine bug's hindgut and differentiation into infectious forms of metacyclic trypomastigotes completes the life cycle [7].

Clinical Manifestations

Clinical manifestations in dogs range from asymptomatic, acute myocarditis, chronic progressive cardiac disease to sudden death [8, 3]. The clinical signs such as the development of diffuse chronic myocarditis with histological and electrocardiographic changes in Chagas-infected dogs during both the chronic and acute stages closely resemble the symptoms of human disease [4]. This is the reason why canine species are considered the experimental model of choice for human Chagas disease study [2]. Acute illness has been reported more frequently in very young dogs (less than 1 year old) and generally involves myocarditis and cardiac arrhythmias [3]. The chronic phase of Chagas' disease in canine species chagasic, can cause severe cardiac damage involving dilated cardiomyopathy, electrocardiogram (ECG) abnormalities, and cardiac failure [9]. This clinical presentation is highly variable and depends on the type of strain, route of infection, and parasite burden [10].

Diagnosis of Chagas Disease Canine

The diagnosis is based on serology [11], direct or indirect parasitological tests, and molecular tests [12]. Parasitological diagnosis is made by microscopic examination of either the lymph node aspirates of blood, or cerebrospinal fluid (CSF) of infected dogs [13]. Polymerase chain reaction (PCR) technique could be used on any patient sample that contains trypanosome DNA [14].

Epidemiology of Chagas Disease in Canines

Canine species are considered an important reservoir of *T. cruzi* in the domestic cycle carrying a risk for human population; because, these animals living in close proximity to humans are within the transmission and maintenance cycles of the parasite and serve as a source of food for insect vectors [2,15]. Reservoirs may be considered as a complex ecological system consisting of one or more species responsible for maintaining a given parasite species in nature. The infestation of houses and peridomestic areas is considered to be a major risk factor for Chagas disease transmission. Dog infection with *T. cruzi* is an important veterinary health concern in many countries of South America and more recently in the United States, in which the seroprevalence of specific anti-*T. cruzi* antibodies has also been reported [16, 17]. Infected vectors have been reported in Texas military kennels, where some dogs showed clinical signs compatible with Chagas disease infection [18]. From the veterinary point of view, it is also important to consider that dogs are susceptible to acquire American trypanosomiasis characterized by heart conditions, such as electrical conduction disturbances, and ventricular and supraventricular arrhythmias, as well as secondary signs such as ascites,

respiratory distress, thoracic effusion, and cyanosis. Texas is a high-risk state for transmission of the parasite to dogs, considering the diversity of triatomine vectors, reservoir hosts, and previous documentation of canine disease [19]. A high seroprevalence of canine infection with *T. cruzi* has been detected from southeastern USA States of Louisiana, Oklahoma, Georgia, and Texas; showing the epidemiological role of the domestic dog [20]. In canines from countries in Latin American, various reports showed seroprevalences from 24% to 65% [21, 22]. The presence of infected canine species increases the risk of transmission of parasites to vectors, and thus the probability of infection in humans. Generally, canine infections are more prevalent than human infections, a fact likely related to oral *T. cruzi* transmission, a more efficient route of infection and apparently common to many mammals [23], and also the fact that dogs often sleep near houses and may come in greater contact with peridomiciliary vectors.

It has been considered that separating domestic animals, mainly dogs, from people can significantly reduce transmission to humans [24]. The fact that there is a high prevalence of canine infections represents a warning signal that should lead to the planning and execution of effective vector control strategies, i.e. it is essential to carry out fumigation strategies of areas infested with triatomines, to exterminate them and thus eliminate transmission [25].

In studies carried out by Meyer et al. (2017) [26] in along border Texas-México, the dogs showed an overall apparent seroprevalence of 7.4-18.9%. This values are similars to that described in dogs of endemic populations for Chagas in Peru (12.3%) [27], Argentina (45.6%) [11], Panama (11.1%) [28], Costa Rica (27.7%) [29], Yucatan State, Mexico (9.8%-14.4%) [30] and Mexico State, Mexico (10%-15.8%) [31].

The dogs are targeted in a Chagas' disease control strategy, because they are considered natural sentinels [26]. These animals generally inhabit a defined territory; are accessible, easy to enumerate and capture, and their population allows representative sampling [31].

Control Measurement

Control measures to prevent transmission of Chagas' disease in endemic areas include: removing litter from the surroundings of the house, keeping clean areas where dogs stayed longer, and conduct periodic assessments to ensure the animals are free of insects. Placing meshes on doors and windows, and covering cracks in the whole house helps prevent the entry of triatomines to the home and minimizes their contact with humans or canine species.

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