

CASE REPORT

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First report of *Tunga trimamillata* infection in a dog

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Abstract

Background Tungiasis is a zoonotic parasitic disease caused by *Tunga penetrans* and, less commonly, *Tunga trimamillata*. It affects the skin of humans and animals in rural or low-income communities. The disease is considered endemic in Ecuador, with most cases reported in the Amazon and Andean regions. There are few cases reported on *T. trimamillata* in Ecuador, most of which have been reported in the canton of Santa Isabel, Azuay Province. Unlike *T. penetrans*, no cases of canine infection have been reported for *T. trimamillata* before.

Case report A canine patient was presented for medical consultation with multiple white nodules in all four paws. Based on the anamnesis and clinical findings, tungiasis was established as the presumptive diagnosis. After careful removal and close inspection of the gravid female fleas, we noticed three protruding lobes in the anterior part of the neosome, a characteristic feature of the gravid *T. trimamillata*. After ten days of daily wound cleanings and antibiotics, the patient's paws were fully healed.

Conclusion To the best of our knowledge, we present the first case of *T. trimamillata* infection in dogs. This is also the first case of *T. trimamillata* detected in Guayaquil. However, the patient was imported from an area where *T. trimamillata* is considered endemic. Therefore, this report has further implications for the movement of domestic animals across the country and potential spread of parasites and other infectious agents from endemic to non-endemic areas.

Keywords Animal diseases, *T. trimamillata*, Zoonosis, Dog, Sandflea, Neglected tropical diseases

Background

Tungiasis is a zoonotic ectoparasitic skin disease caused by female fleas from the genus *Tunga*. The disease is primarily found in endemic resource-poor communities in tropical and subtropical endemic areas of Latin America and Africa [1–4]. Due to its high public health

implications, the World Health Organization (WHO) included tungiasis in their road map for Neglected Tropical Diseases (NTP) 2021–2030, which aims to reduce the burden of the disease [2, 5]. In addition, domestic animals, such as dogs, living within these communities are considered an important reservoir [1, 3, 5–7]. Thus, tungiasis is a One Health challenge in which veterinary Practitioners have a relevant role.

Only two tunga species are considered zoonotic, *T. penetrans* and *T. trimamillata* [7]. Although these two species have some shared hosts such as cows, pigs, goats and humans, to the best of our knowledge, there are no reports of *T. trimamillata* in dogs [7, 8], one of *T. penetrans* well-known hosts. *T. penetrans* is the most frequent and is widely distributed throughout endemic areas within Latin America and Africa. *T. trimamillata*, on the other hand, is

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endemic only in certain areas of Peru, Brazil and Ecuador [7, 8]. In Ecuador, *T. trimamillata* has mostly been reported in the canton of Santa Clara, Azuay Province [7–9].

The parasite cycle is well-known and has been extensively reviewed [4, 6, 7]. Briefly, the disease starts developing when a female flea penetrates the skin of the host. Once the penetration has been completed, the female undergoes abdominal hypertrophy and begins realising eggs. Each female can release up to 200 eggs. This enlarged structure is called neosome. Morphologically, neosomes are species-specific [7, 8, 10]. The cycle culminates six weeks later when the female dies. The Fortaleza classification system was developed to identify the neosome developmental stages, which is critical to assess and mitigate transmission risks. A detailed description of these five stages in dog patients was published in 2021 [4]. Here we report the first case of *T. trimamillata* in a dog [4].

Case presentation

Anamnesis

A 2.5 months-old mixed breed intact male dog was presented for medical consultation with skin nodules in all four paw pads. The patient had been recently rescued from a rural location within the Loja province, Ecuador and brought to Guayaquil. The dog's past medical history was therefore unknown. However, the patient is known to have shared the space with other domestic animals such as pigs and goats.

Clinical examination

The circular nodules were well-circumscribed and white-coloured with a dark central point (Fig. 1). There was no pain detected on palpation nor was there evidence of infection, pruritus or lameness. This case was a typical



Fig. 1 Patient's paw with tungiasis. The red arrow is pointing at an embedded gravid sand flea (neosome). The lesion is characterized by a cone-shaped projection with a central opening. This stage III neosome

presentation of tungiasis where the nodule is caused by a penetrated hypertrophic female tunga flea, also known as neosome. Due to its extended geographic and host range, *T. penetrans* was initially assumed to be the species infecting the patient. However, the species identification can be done with the naked eye once the neosomes are extracted and the anterior segment of the gravid flea is exposed [7, 8, 10, 11]. Thus, after establishing the diagnosis, we carefully removed and inspected the neosomes. The presence of

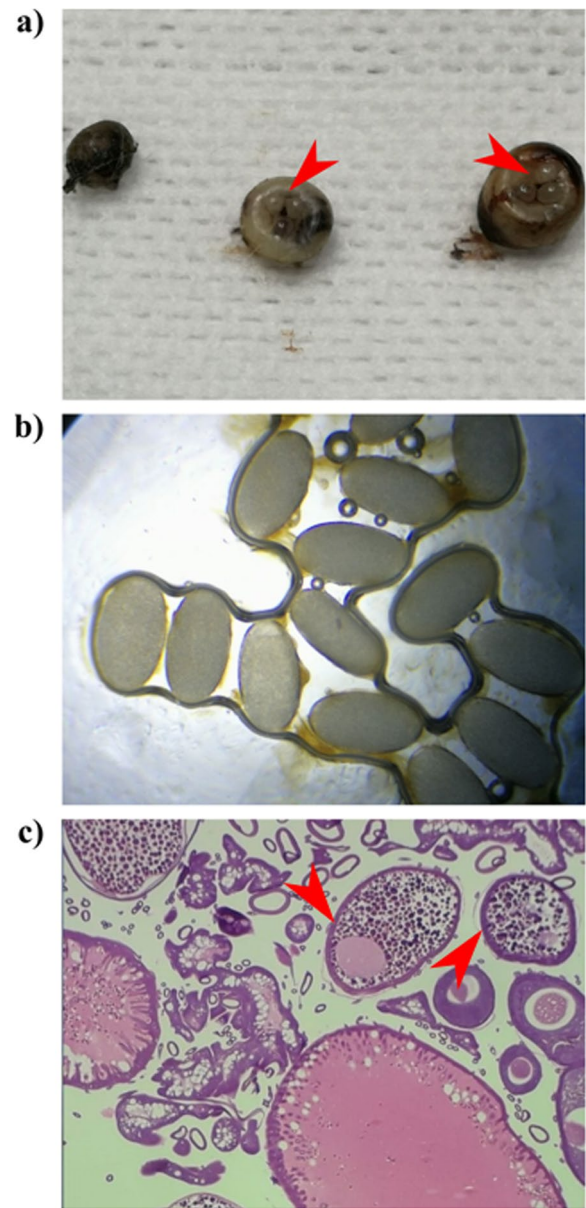


Fig. 2 *T. trimamillata* neosomes. **a** red arrowheads show three protruding lobes in the anterior portion of the neosome confirming the parasite species. **b** Optic microscopic view of the parasite's eggs after removal of the flea. **c** histopathologic image of the parasite, red arrowheads indicate enlarged ovaries filled with eggs. (haematoxylin-eosin stain)

three lobes in their anterior portions was evident (Fig. 2a). This structure is characteristic of *T. trimamillata*.

The Fortaleza Classification system, a classification system initially developed to identify the developmental stages of the embedded *T. penetrans* sand fleas [4], was used to identify the developmental stages of the *T. trimamillata* sand fleas found in this case. There is no evident difference in the developmental cycles between the two species [7]. Furthermore, the Fortaleza system has been used in the identification of *T. trimamillata* as well [11]. In this case, all the neosomes removed from the patient were in stage three [4]. This stage is characterized by hypertrophy of the yellowish-white halo that appears after the female has fully penetrated the skin (stage two), with well-demarcated edges and a central black dot. During stage three, the gravid female releases the eggs into the environment (Fig. 2b). See Fig. 2c for a histopathological view of a stage-three female flea.

Treatment and progression

The low number of neosomes made surgical removal a cost-effective treatment approach. This procedure was performed under sedation with ketamine and diazepam in combination with locally injected lidocaine. However, there might be better approaches in severely infected animals. A recently published review on treating animal tungiasis provides a good insight into different protocols for controlling, preventing and treating this disease in domestic animals [12].

After removing the neosomes, the wound was cleaned and stitched (Fig. 3a). The patient was sent home with superficial wound care instructions and Cephalexin 250mg/5ml oral suspension for eight days (dosage 22 mg/kg every 12 hours). A broad spectrum dewormer

(praziquantel/pyrantel pamoate, Praxtel®) was administered to treat any other parasitic infections the patient might have been carrying from its original location. After ten days, all four paw pads had fully healed (Fig. 3b)

Discussion

This report presented the first case of canine tungiasis in Guayaquil, Ecuador. However, the patient was recently adopted from the Loja province, where *T. penetrans* is prevalent in endemic communities.

Tungiasis is a relevant NTD by the WHO. Ecuador is among the most suitable regions for transmission of tungiasis [2] showing high prevalence in endemic communities. The increasing mobility of companion animals increases the risk of pathogen dissemination. Therefore, the need for veterinarians' ability to assess and diagnose non-endemic diseases, especially those included in the WHO NTD list, is critical for limiting transmission risks. For instance, the tungiasis case presented to us was in Fortaleza-stage three, meaning that eggs had been released to both outdoor and indoor environments.

Due to its wide distribution and prevalence of *T. penetrans*, cases such as the one we presented here, would be immediately associated with this species. Although the progression and consequences of the infection do not seem to differ between the species, careful identification of the tunga species for each reported case is critical for a better epidemiological understanding of the disease, including the host range [7, 8, 10]. Our close inspection of the neosome evidenced that our original assumption about the tunga species was incorrect.

Although this is the first report of *T. trimamillata* parasitising a dog, it is likely that it has gone undiagnosed until now. It is possible that the close interaction between dogs and other host species together with poor hygienic

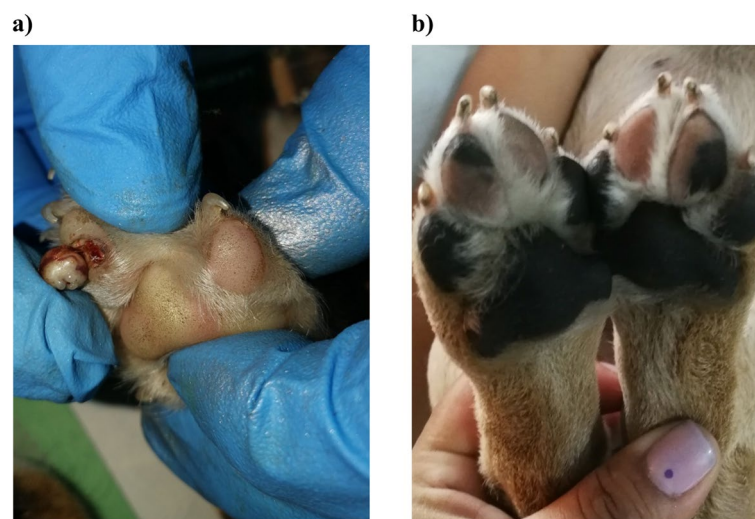


Fig. 3 a Removal of neosomes. b Paw pads fully healed after ten days of treatment

conditions creates an environment that facilitates the spread of *T. trimamillata* to previously unreported host species. Thus we strongly recommend the development of studies updating the information on host and geographic distribution of this sand flea species in Ecuador.

Conclusion

We present the first case of *T. trimamillata* infection in dogs. This is also the first instance of *T. trimamillata* detected in Guayaquil. However, the patient was imported from an area where *T. trimamillata* is considered endemic. Therefore, this report has further implications for the movement of adopted dogs across the country and potential spread of parasites and other infectious agents from endemic to non-endemic areas.

Abbreviations

WHO World Health organization
NTD Neglected Tropical diseases

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Authors' contributions

KCV was the primary clinician. All four authors were involved in the writing and editing of the manuscript.

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Data availability

All data generated or analysed in this case report are included in this published article.

Declarations

Ethics approval and consent to participate

The case we are presenting is a clinical report and no experimentation was involved. Therefore, we believe the statement does not apply to this manuscript.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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