SPOROTRICHOSIS: AN EMERGING DISEASE FROM A UNIQUE HEALTH PERSPECTIVE

ESPOROTRICOSE: UMA DOENÇA EMERGENTE SOB A PERSPECTIVA DA SAÚDE ÚNICA

ESPOROTRICOSIS: UNA ENFERMEDAD EMERGENTE DESDE UNA PERSPECTIVA SANITARIA ÚNICA

https://doi.org/10.56238/sevened2025.021-022

Hoxana Xavier Lopes Kattah[1], Jaqueline Aparecida Sousa Pereira[2], Diogo Sena Couto[3], Fatima Christina França Alexandrowitsch[4], Fábio Nogueira Reis[5], Vinicius José Moreira Nogueira[6], Breno Henrique Alves[7], Ana Paula Peconick[8]

ABSTRACT

Sporotrichosis is a mycotic infection caused by a complex of fungal species of the genus Sporothrix. The domestic cat plays a crucial role in the transmission of the disease, being considered the main host and source of infection for humans, which accentuates its impact on public health. This study aimed to morphologically characterize Sporothrix spp. isolated from a feline diagnosed with sporotrichosis, using scanning electron microscopy (SEM). The methodology consisted of collecting exudate from the lesion followed by isolation and cultivation of the fungus on Sabouraud Dextrose Agar medium, incubated at 25°C for 12 days. Processing followed a standard protocol for preparing biological samples for analysis in the SEM, involving cutting, dehydration in increasing series of acetone, critical point, gold plating and mounting on stubs. The electromicrographs obtained on the TESCAN-CLARA SEM showed high resolution, allowing the morphological characteristics of the fungus to be identified. The phenotypic parameters described by Marimon et al. (2008) were used to characterize the findings of this study. The hyphae observed were classified as septate, narrow and branched, with dematiaceous and spherical conidia at the ends. The conidia were thick-walled, wrinkled in texture and small in diameter, ranging from oval to globose.

Keywords: Fungus. Felines. Zoonosis

RESUMO

A esporotricose é uma infecção micótica, causada por um complexo de espécies de fungos do gênero Sporothrix. O gato doméstico desempenha um papel crucial na transmissão da doença, sendo considerado o principal hospedeiro e fonte de infecção para os humanos, o que acentua seu impacto na saúde pública. Este estudo teve como objetivo caracterizar

[1] Master's student in Animal Health and Collective Health at the Federal University of Lavras (UFLA)
[2] Master's student in Veterinary Sciences at the Federal University of Lavras (UFLA)
[3] Graduating in the Biological Sciences course at the Federal University of Lavras (UFLA)
[4] Undergraduate student in Veterinary Medicine at the Federal University of Lavras (UFLA)
E-mail: fatima.alexandrowitsch@estudante.ufla.br
[5] Graduating in the bachelor's degree in Veterinary Medicine at the Federal University of Lavras (UFLA).
[6] Doctor student in Veterinary Sciences at the Federal University of Lavras (UFLA).
[7] Doctor student in Veterinary Sciences at the Federal University of Lavras.
[8] Professor in the bachelor's degree course in Veterinary Medicine at the Federal University of Lavras (UFLA).

morfologicamente Sporothrix spp. isolado de um felino diagnosticado com esporotricose, utilizando microscopia eletrônica de varredura(MEV). A metodologia consistiu na coleta de exsudato da lesão seguida pelo isolamento e cultivo do fungo em meio Ágar Sabouraud Dextrose, incubado a 25°C durante 12 dias. O processamento seguiu um protocolo padrão de preparo de amostras biológicas para análise no MEV, envolvendo cortes, desidratação em séries crescentes de acetona, ponto crítico, banho de ouro e montagem nos stubs. As eletromicrografias obtidas no MEV TESCAN-CLARA apresentaram alta resolução, permitindo a identificação das características morfológicas do fungo. Para caracterizar os achados deste estudo, foram utilizados os parâmetros fenotípicos descritos por Marimon et al. (2008). As hifas observadas foram classificadas como septadas, estreitas e ramificadas, com presença de conídios demáceos e esféricos nas extremidades. Os conídios apresentaram paredes espessas, textura enrugada e pequeno diâmetro, variando de ovais a globosos. Os conídios dispuseram-se ao longo das hifas, intercalados individualmente, mas principalmente em posições terminais, organizados em pequenos aglomerados. Os resultados estão em consonância com a forma de transmissão da doença e o dimorfismo térmico do fungo. Os achados reforçam a necessidade de investigações adicionais sobre a etiopatogenia da esporotricose, visando aprimorar o conhecimento sobre o agente etiológico e suas implicações clínicas. Agradecimentos: UFLA, FAPEMIG, CAPES, CNPq.

Palavras-chave: Fungo. Felinos. Zoonose

RESUMEN

La esporotricosis es una infección micótica causada por un complejo de especies fúngicas del género Sporothrix. El gato doméstico desempeña un papel crucial en la transmisión de la enfermedad, siendo considerado el principal hospedador y fuente de infección para el ser humano, lo que pone de relieve su impacto en la salud pública. El objetivo de este estudio fue caracterizar morfológicamente Sporothrix spp. aislado de un felino diagnosticado de esporotricosis, mediante microscopía electrónica de barrido (MEB). La metodología consistió en la recogida de exudado de la lesión seguida del aislamiento y cultivo del hongo en medio Agar Sabouraud Dextrosa, incubado a 25°C durante 12 días. El procesamiento siguió un protocolo estándar de preparación de muestras biológicas para su análisis en el MEB, que incluía el corte, la deshidratación en series crecientes de acetona, el punto crítico, el dorado y el montaje en talonarios. Las electromicrografías obtenidas en el SEM TESCAN-CLARA mostraron una alta resolución, permitiendo identificar las características morfológicas del hongo. Para caracterizar los resultados de este estudio se utilizaron los parámetros fenotípicos descritos por Marimon et al. (2008). Las hifas observadas se clasificaron como septadas, estrechas y ramificadas, con conidios dematiáceos y esféricos en los extremos. Los conidios eran de paredes gruesas, textura arrugada y diámetro pequeño, de oval a globoso.

Palabras clave: Hongos. Felinos. Zoonosis

INTRODUCTION

Sporotrichosis is a disease caused by the complex of fungal species of the genus Sporothirx, which comprises at least five pathogenic species, including S. schenkii, S. brasilienses, S. luriei, S. mexicana, S. globosa, being the most prevalent S. brasilienses in Brazil and considered the most virulent (Lecca, 2019). It is a mycotic infection of cutaneous and subcutaneous tissues, which can present in the localized, lymphocutaneous, disseminated cutaneous form, and in some cases can evolve to the extracutaneous form (Marimon et al., 2008; Rodrigues et al., 2014, Guedes, 2020). It is a zoonotic disease, that is, it can be transmitted from animals to humans and vice versa. The disease can affect dogs, felines, humans, among other animals, with the domestic cat (Felis catus) being the main host and also a source of infection for humans (Araujo, et al., 2020).

Transmission occurs by scratching, biting, or direct contact with exudate from lesions, or mucous membranes of sick animals (Orofino-Costa, et al., 2017). But it can also be transmitted by contact with places contaminated by the fungus, such as soil, organic matter and vegetation. In both routes of transmission, it is necessary for trauma to occur in the skin for fungal inoculation to occur (Rodrigues et al., 2016). The occurrence in animals, especially cats, and its transmission to humans have been described in several states of Brazil, becoming a public health problem. Isolated cases and small outbreaks have been documented in several Brazilian regions, such as in the case of Rio de Janeiro, which is currently considered a hyperendemic region, in which 4,703 cases in cats were recorded in the years 1998 to 2015 by the Oswaldo Cruz Foundation (Fiocruz). In addition, there are cases reported in other states, such as Rio Grande do Sul and São Paulo, although with a lower incidence. Its occurrence is more restricted to the southern and southeastern regions of Brazil (Gremião et al., 2017).

Sporotrichosis is prevalent in tropical and temperate regions, but it has a universal distribution, and some studies suggest that climate, atmospheric temperature, and relative humidity favor the growth of the fungus in its saprophytic state (Bazzi et al., 2016). It is considered an emerging disease and, in the last two decades, its incidence has been increasing exponentially, particularly in Minas Gerais. Precisely because it is a disease neglected by the government and with many cases of underreporting, this is one of the reasons that generates difficulties in diagnosis and effective treatment, which actually controls the increase in the number of cases (Assis et al., 2023).

The standard diagnosis of sporotrichosis is made by cytology, however, mycological examination is used as a complement. This test is based on the isolation and identification of the agent in culture, which can identify the fungus, but without differentiating at the species level. It is a saprophyte, dimorphic fungus, which at temperatures of 25ºC to 27ºC shows itself in the mycelial form, in which it is present in the environment. At temperatures of 35 °C to 37 °C degrees, it is present in the form of yeast, where it is present in abundance in the lesions of sick felines (Cruz et al., 2023). Aspects related to the etiological agent are relevant criteria for understanding the particularities of the disease and establishing prophylactic measures. Thus, several branches seek techniques to describe this pathogen, as an alternative to assist in the parameters related to the disease, such as therapeutic options and differential diagnosis. In view of the above, the objective of this work was to analyze, by means of Scanning Electron Microscopy (SEM), the morphological aspects of Sporothrix spp. isolated from a cat diagnosed with sporotrichosis, from the city of Lavras, Minas Gerais.

LITERATURE REVIEW

HISTORY OF THE DISEASE

Sporotrichosis was first described in 1898 by Benjamin Schenck, in the United States, in an isolate from a human male patient who had lesions on the hand. The sample was identified by mycologist Erwin F. Smith as belonging to the genus Sporothrichum (Basidiomycota: Polyporales) (Boechat, 2020). The second report was described two years later, also in the United States, in a 5-year-old human patient, who presented ulcerated lesions and nodules. With this, a new nomenclature was proposed and the fungus was reclassified as Sporothrix schenkii. However, due to numerous divergences in relation to taxonomic classification, this new nomenclature was considered invalid (Boechat, 2020; Colombo, 2022).

In 1910 the microorganism was described and named Sporotrichum schenckii, and this nomenclature was used until the 1960s. Over the years, many "new species" have been described in the literature as synonymous with the current Sporothrix schenckii. For years Sporothrix schenkii was considered the only pathogenic species, but Marimon and collaborators conducted a study and described the existence of three more pathogenic species: S. brasiliensis, S. globosa and S. mexicana. The first occurrence of animal infection in Brazil was described by Lutz and Splendore in 1907, who described the disease on a mule. The susceptibility of cats to infection by S.

schenckii was demonstrated experimentally in 1909, with this, the first report of feline sporotrichosis was described in 1956, in Minas Gerais. In Rio de Janeiro, in 1983, the first cases of feline sporotrichosis were described by Cruz et al. Subsequently, the first epidemic of sporotrichosis associated with zoonotic transmission described in the literature occurred, and since then the Oswaldo Cruz Foundation (Fiocruz) has been monitoring the evolution of the number of cases of sporotrichosis (Gremião, et al., 2017; Boechat, 2020).

ASPECTS RELATED TO THE ETIOLOGICAL AGENT

Genus Sporothrix

The fungus belongs to the genus Sporothrix, division Ascomycota, class Sordariomycetes, order Ophiostomatales and family Ophyostomataceae. It is a dimorphic fungus that can cause infections in a variety of animals, such as: humans, dogs, birds, rats, horses, and other mammals, with cats being the most affected by the disease. The genus comprises 53 species in total, but only the species S. schenkii, S. brasilienses, S. luriei, S. mexicana, S. globosa, are considered pathogenic (Rodrigues, et al., 2016; Colombo, 2022).

The species S. schenkii and S. brasilienses are the most predominant in Brazil, and are associated with zoonotic transmission. They are classified as eukaryotic organisms, heterotrophic, composed of chitin-rich cell walls and immobile, have their development favored in hot and humid places, have thermal dimorphism, that is, they can manifest themselves in the form of yeast or filamentous, depending on the temperature. The fungus can be found in the environment, in plant residues, soil, plants, subsoils, and organic matter, in filamentous form (Colombo, 2022; Gonçalves et al., 2019). The yeast-like form is considered parasitic and causes clinical manifestations, and can be found in the exudate of lesions and mucous membranes of sick animals.

Morphology and evolutionary forms

The species of the Sporothrix complex have subtle differences, macroscopically the colonies have a velvety texture, and may be pigmented with brown to black coloration, but they may also not be colored (Oliveira, 2019). It has thermal dimorphism, in its filamentous form, at a temperature of approximately 25 °C. Microscopically, it is characterized by conidia, which are reproductive structures, which can be hyaline (without pigmentation), small and ovoid, or dematiaceous (pigmented),

large and ovoid. These structures are organized into groups and form sets in the shape of daisies. Hyphae are cell formations that together form a tubular network called mycelium, which makes up the vegetative body and are responsible for promoting the growth and reproduction of the fungus (Madrid, et al., 2011; Oliveira, 2019; Jesus, 2020).

Species can have septate hyphae, where there is the presence of septa, which are cell walls that divide the cytoplasm and the nucleus into compartments, allowing the movement of organelles between them. As well, they can have septate hyphae, where there is no presence of septa and the nucleus is scattered in the cytoplasm, in addition to the possibility of being branched or not. At a temperature of approximately 35 °C, it has yeast-like cells, which can be hyaline or dematiaceous, small, globose to ovoid, with unipolar budding (Madrid, et al., 2011).

The yeast form is the parasitic form, being considered the main source of dissemination of sporotrichosis, as they are found in great abundance on the surface of ulcerated lesions of sick felines. Direct contact with these yeast-like cells can cause direct infection, in addition to enabling contamination of the environment (Cruz, 2013).

EPIDEMIOLOGICAL DISTRIBUTION

Sporotrichosis has universal distribution, but it is considered an endemic disease in Brazil, precisely because it is prevalent in certain regions, such as tropical, temperate, and metropolitan areas (Hernández-Castro, et al., 2022). It usually occurs in the form of isolated cases or in small outbreaks involving areas of exposure to the fungus (Barbosa, 2021). The largest outbreak ever reported in Brazil was in the state of Rio de Janeiro, where cases of the disease began to increase in 1990. A total of 759 cases of sporotrichosis in humans and 4,703 cases of feline sporotrichosis were reported from 1998 to 2015. Since then, the disease has reached epidemic levels that were recorded by the Oswaldo Foundation

Cruz (FioCruz) and are continuously monitored (Oliveira, 2009; Gremião, et al., 2017). In addition, there are cases reported in other states, such as Rio Grande do Sul and São Paulo, but with a lower incidence, their occurrence is more restricted to the south and southeast regions of Brazil (Gremião, et al., 2017). The main source of infection in urban areas is cats, in which the epidemiological profile of infected animals indicates that most are stray animals, males, adults, young, non-neutered, non-domiciled or semi-domiciled (Boechat, 2020). In humans, the disease affects people of all genders, ages, and professions, and the infection is directly associated with contact

with the pathogen (Barbosa, 2021). Previously, the disease was associated with residents of rural areas, gardeners, and professions related to work activities, with few cases reported from infected animals. As a result, the disease became popularly known as "gardener's disease", since these professionals were the most affected by traumatic fungal inoculation during soil manipulation (Alvarez, C. M.; Oliveira, M. M. E.; Pires, R. H., 2022).

Currently, studies indicate a new risk category, in which veterinarians, technicians, and cat owners are more susceptible to contamination due to zoonotic transmission (Colombo, 2022).

PATHOGENESIS

The pathogenicity of a microorganism is the ability to cause infection and is directly related to a set of virulence factors. Fungi of the genus Sporothrix spp. have some immune system evasion mechanisms that enable their development in the host, in addition to other factors such as thermotolerance, thermodimorphism, melanin production, presence of adhesins and extracellular enzymes, which corroborate tissue or systemic dissemination and ensure the success of the infection (Guedes, 2022; Barbosa, 2021).

The onset of infection occurs after traumatic fungal inoculation on the host's skin, and can occur through two main routes of transmission: plant and animal. In the plant route, there is inoculation of conidia present in the environment and, due to the thermal stimulus favored by the host's body temperature, the fungus changes its filamentous form to yeast. On the other hand, in animal transmission, which occurs through inoculation of the pathogen, through scratching, biting, or contact with exudate from lesions and mucous membranes of sick animals, there is direct transmission of yeast cells to the new host (Colombo, 2022; Rodrigues, et al., 2016).

The clinical form and extent of the disease depends on the immune status of the host (Thomson, et al., 2023). When present in the target tissues, the fungus' conidia convert to the yeast-like form and can stimulate active chronic inflammation as a result of the induction of cytokines, thus there is the appearance of nodules, ulcers, and verrucous plaques, which may or may not have lymphatic dissemination, in patients with normal immunity (Barbosa, 2021). A study carried out by Figueiredo et al. (2004), demonstrated a mechanism of invasion of the fungus by the stimulation of endocytosis by epithelial cells, which occurs through molecules of yeast cells that help in the recognition of fibronectins in host cells (Colombo, 2022). In addition, the fungus

is able to migrate through the transendothelial space, facilitating its tissue adhesion and dissemination. This process is mediated by proteins from the cell matrix, the main one being the transforming growth factor β1 (TGF-β1).

The immune response to fungal infections varies by species, but cellular immunity is the main line of defense, mediated by neutrophils, macrophages, and natural killers, which play key roles in the development of infection. In the first weeks, the tissue fungal load is high, so it is possible to observe a rapid development of the disease, due to the decrease in tumor necrosis factor (TNF-α) that stimulates macrophages to produce nitric oxide, which is a highly cytotoxic molecule for Sporothrix spp., this indicates an interaction between the pathogen and the immunological aspects of the host (Colombo, 2022). On the other hand, in the weeks following infection, after approximately eight weeks, there is an increase in the production of interleukin-1 (IL-1) and TNF-α which stimulate macrophages and favor the elimination of the pathogen (Boechat, 2020).

CLINICAL MANIFESTATIONS

Clinical manifestations vary according to the immune status of the host, fungal load, pathogenicity, and thermotolerance of the strain. It is a fungal infection that affects the skin and subcutaneous tissues. Depending on the distribution of the lesions, it can be classified as: localized cutaneous and disseminated cutaneous, which usually affects the cephalic region, face and limbs of cats. The lymphocutaneous form affects the skin, lymphatic vessels, and lymph nodes, which rarely evolves to extracutaneous when there is systemic invasion (Jesus, 2020; Colombo, 2022; Guedes, 2022).

The localized cutaneous form is characterized by a circular, ulcerated, granulomatous, papulonodular lesion fixed at the inoculation site, with the presence of purulent exudate, a border with thick crusts, and yeast-like structures only in the subcutaneous tissue (Figure 1) (Mori, 2022). This type of lesion can be identified two to four weeks after traumatic inoculation and mainly affects the animal's face and limbs (Gagliardi et al., 2023). When the patient has multiple, noncontiguous skin lesions spread throughout the body, which occurs as a result of the invasion of yeasts into the bloodstream, it is characterized by the disseminated cutaneous form (Figure 2), in which the lesions resemble the localized cutaneous form (Melo et al., 2023).

Figure 1 - Localized cutaneous form.

Legend: A single, circular, ulcerated, fixed lesion on the lower limb of a cat, characterizing the localized cutaneous form. Source: Han & Kano, 2021.

Figure 2 – Disseminated cutaneous form.

Legend: Multiple, circular lesions, spread over the body of a cat, characterizing the disseminated cutaneous form. Source: Han & Kano, 2021.

The lymphocutaneous form is characterized by the invasion of the fungus into the lymphatic vessels. Initially there is the appearance of a paponodular lesion, which later evolves into ulcers and fistulas, releasing a purulent exudate, after a few weeks the nodules progress through the lymphatic system. This clinical manifestation is the most common in humans. Feline sporotrichosis, on the other hand, predominates in the cutaneous form, but many cats may have more than one clinical form simultaneously (Barbosa, 2021).

The extracutaneous or systemic form is considered rare and difficult to diagnose, it can affect several organs such as the lungs, liver, nervous system, bones,

and joints (Colombo, 2022). The symptoms depend on the organ affected and hence the difficulty of diagnosis, as it is most often confused with other diseases (Jesus, 2020). The osteoarticular variant usually appears as monoarthritis, and affects the tibia, radius, ulna, skull bones, and also various joints. There is the presence of localized erythema and edema, which hinders locomotion and joint pain.

The pulmonary variant, on the other hand, is often acquired as a primary infection by inhaling conidia of the fungus. The clinical manifestations are similar to tuberculosis, with symptoms such as difficulty breathing, nasal lesions, fever, weight loss, and pulmonary cavitation (Guedes, 2022; Jesus, 2020).

Despite the typical clinical characteristics of sporotrichosis, there are reports of asymptomatic human patients who continue to be transmitters and cases of spontaneous cure observed in all forms of the disease. When they heal, these lesions can leave fibrotic scars that can alter the function of the organ depending on the location and extent of the infection (Barbosa, 2021).

LABORATORY DIAGNOSIS

Diagnosis is based on epidemiological data, clinical signs, laboratory tests, and patient history to determine a differential diagnosis. Differential diagnosis is necessary, as the clinical signs of sporotrichosis are not specific, and are often confused with other diseases (Gremião, et al., 2021).

There are several techniques to prove sporotrichosis that can be performed by mycological, serological, histopathological, and molecular approaches (Guedes, 2022). The most widely used method is the isolation of the agent in culture, which is a technique that allows the identification of Sporothrix spp. by morphology and phenotype. It consists of collecting samples of the lesions by means of swabs or biopsy, which are later seeded in a culture medium. Brain Heart Infusion Agar (BHI) or Sabouraud Dextrose Agar (ASD) plus Chloramphenicol and Cyclohehemide are usually used (Lecca, 2019). After 7 to 10 days after incubation, colonies are identified, using the tape technique, a percentage of the colony is transferred to a slide containing a drop of Cotton Blue or Lactophenol Blue dye. The analysis is done under a light microscope that identifies hyphae in the shape of bouquets, resembling daisies (Mori, 2022; Jesus, 2020; Lecca, 2019). Although it is considered a gold diagnosis for confirming the disease, it is an exam that is prolonged and requires other complementary tests to assist in the treatment.

Histopathological examination consists of microscopic analysis of the injured tissues for the detection of the fungus. It is possible to identify inflammatory infiltrate with the presence of macrophages, neutrophils, rarely giant cells, and plasma cells that involve the cutaneous and subcutaneous tissues. In the cytoplasm of these cells, there is the presence of abundant yeast-like structures, with a round to oval shape. To facilitate visualization, staining is done with hematoxylin and Eosin, which allows the identification of the fungal structures (Santos, 2020).

For serological diagnosis, it is possible to use several techniques, such as the double immunodiffusion reaction, immunoelectrophoresis, agglutination tests, immunoenzymatic techniques and ELISA. Both techniques demonstrated satisfactory specificity and sensitivity values, without presenting cross-reactions (Oliveira, 2009). It is important to note that in some cases, cats have a low fungal load despite presenting evident symptoms.

Thus, more than one examination technique is necessary for diagnosis, in addition to the analysis of other factors such as the host's immune response, which should be investigated to clarify these clinical findings (Santos, 2020).

TREATMENT

The treatment used is based on antifungals and medications for wound management and secondary symptoms. In felines, the prognosis is poor and treatment is difficult due to the need for prolonged use of the antifungal, which lasts an average of three to six months, and can reach up to more than a year. The most used drugs are: Itraconazole, potassium iodide, terbinafine, and amphotericin B. The dose administered and the exact time of treatment is determined by the veterinarian, in addition to varying according to the strain, immune status, and symptomatology of the patient (Guedes, 2022).

Itraconazole is the drug of choice in the treatment of sporotrichosis, due to the satisfactory results during therapy and its tolerability (Lecca, 2019). The recommended dosage is 5-10mg/kg every 12 to 24 hours, depending on the case higher doses are recommended (Ribeiro, 2021). The drug should be administered until the wounds have healed completely, which can last for months, but as a rule it should be maintained for at least one month, even after clinical cure, to avoid refractory cases (Rosa et al., 2018). During the use of the drug, it is necessary to monitor the patient's liver enzymes, due to its hepatotoxic potential, in addition to other possible adverse effects such as nausea and anorexia (Ribeiro, 2021).

Potassium Iodide is used in association with azole drugs, such as Itraconazole (Rosa et al., 2018). The recommended dosage is low and its use should be cautious, being administered preferably as secondary therapy. The drug has toxic potential, and can cause iodism in cats under treatment, in addition to adverse clinical signs such as: anorexia, vomiting, diarrhea, nasal discharge, jaundice, and heart failure (Lecca, 2019; Rosa et al.; 2018). The dosage varies from 20mg/kg to 40mg/kg every 12 or 24 hours, and the association with Itraconazole has a clinical cure rate of 63.2% of cases, even though cats are sensitive to this solution (Ribeiro, 2021).

Terbinafrine belongs to the class of allellamines, which has high in vitro activity against Sporothrix spp. isolates. Its therapeutic response is effective in the treatment of dermatophytosis and other superficial mycotic infections. Its clinical use in veterinary medicine for the treatment of feline sporotrichosis is still limited (Rocha, 2014). It is not the drug of choice for initial treatment, but it is commonly used for relapsing cases and associated with other drugs, it has demonstrated efficacy in some cases (Rosa et al., 2018). A dose of 30mg every 24 hours in treatment is recommended only when resistance, tolerance or inadequate response to the use of itraconazole is suspected (Kauffman et al., 2017).

Amphotericin B is an antifungal of the polyene class, and is recommended in the treatment of disseminated forms of the disease. It can be used intravenously, intraarticularly or intrathecally (Rosa et al., 2018). The use of this drug in felines is restricted and limited, and only inoculation in refractory lesions is recommended. It presents a probability of nephrotoxicity in patients when administered alone, and there are few reports on the use of this drug in feline sporotrichosis (Rocha, 2014; Rosa et al., 2018). However, there are some reports that when administered in combination with an oral antifungal, they have been shown to be effective, reducing the duration of therapy (Ribeiro, 2021).

Despite the availability of drugs proven to be effective and the high probability of cure, the treatment of feline sporotrichosis remains a challenge. The main factor is the need for prolonged treatment, which generates high costs of medication, daily care, difficulty in administering the medication, cat habits, among other adverse effects during therapy. Thus, adherence to treatment is low, with the possibility of abandonment by the tutor (Lecca, 2019).

SINGLE HEALTH

Approximately 75% of infectious diseases are defined as zoonotic, meaning that they can be transmitted from animals to humans and vice versa (Pires, 2022). Due to the proximity of humans to animals and the habit of owning pets, the emergence of zoonotic epidemics has become increasingly common. Consequently, they cause major impacts on the health of the population, social, economic, and environmental losses (Melo et al., 2023).

The concept of One Health involves multidisciplinarity, covering 3 pillars: human medicine, veterinary medicine, and the environment. The term was created to ensure a broad approach to public health policy issues in order to prevent and control diseases, promote health, awareness, research and systematic surveillance in endemic regions. However, there are few public health policies that comprise all the pillars of the One Health approach and apply it in an integrated manner (Duarte & Carvalho, 2021).

The term "One Health" was created in 2008 by the World Health Organization (WHO) together with the World Organization for Animal Health (OIE) and the Food and Agriculture Organization of the United Nations (FAO), which suggested a differentiated approach to achieve better health outcomes through interdisciplinarity (Rossow et al., 2020). To apply the practice of One Health effectively, multiprofessional, collaborative and articulated work is necessary. Thus, doctors, veterinarians, biologists, nurses, community health agents, and other professionals must act in a unified way in order to result in positive impacts and provide balance between these interfaces (Pires, 2022).

Despite the exponential increase in the number of cases and prevalence in certain regions of Brazil, sporotrichosis continues to be neglected by the government. In view of the above, controlling the disease is a great challenge, as it involves numerous problems that make the scenario even more unfavorable (Sampaio et al., 2023). Domestic cats occupy a greater importance when it comes to transmission to humans and other animals, due to their lifestyle and habits of hunting, digging the earth, burying their feces and scratching tree trunks, as both are reservoir sites for fungi (Tóffoli et al., 2022;).

In addition, the territorial practice of cats, especially those that are not domiciled and have free access to the street, facilitates the spread of the disease (Melo et al., 2023; Almeida, et al., 2018). Recently, sporotrichosis has changed from a sporadic disease to outbreaks and confirmed epidemics in several regions, where it has undergone changes in its form of transmission and species involved, highlighting the

need for more research to better understand the etiological agent and the aspects involving the disease (Tóffoli et al., 2022). To remedy or minimize the impacts caused by the fungus, it is essential to develop, execute, and supervise actions aimed at the community as a whole, aiming at raising awareness and promoting health (Sampaio et al., 2023).

PUBLIC HEALTH

Epidemics caused by fungal agents have emerged and resurfaced over time as a threat to public health. It can be observed as a result of changing host-pathogen interaction or introducing a new pathogen into a population of susceptible hosts. Domestic animals play an important role in the transmission of mycotic diseases to humans, especially in sporotrichosis (Montenegro et al., 2014). These animals are in frequent contact with their owners and have lifestyle habits susceptible to the transmission of the disease.

Recent epidemics have demonstrated the potential for zoonotic transmission, and have almost always involved cats as the main source of infection (Rodrigues et al., 2016). However, such a disease is often overlooked by government agencies. Within this context, the control of this disease is a great challenge, as it involves numerous problems that cause damage to public health (Andrade Júnior, 2023). This highlighted the urgency of further studies on the etiological agent to benefit the perception of aspects related to the disease, with the purpose of controlling the number of cases, assisting in diagnosis, promoting efficient therapeutic options and monitoring epidemiological data to achieve better results in health promotion.

It is impossible to control aspects of public health without considering the interaction between humans, animals and the environment. Because these agents play an important role in the transmission of diseases and with regard to the maintenance of disease-causing microorganisms, especially zoonotic ones (Silvestrini, A. R., Langoni, H., 2021). Inadequate surveillance leads to unnoticed emergence, in addition to the multifactorial difficulty in managing sick cats and the lack of knowledge of sporotrichosis control measures by the majority of the population, have contributed to the growing number of human and animal cases (Gremião, et al.; 2020).

In view of this, a One Health approach is essential for monitoring and controlling the disease. Unifying health professionals, biologists, community agents and government agencies, to act in the face of the problem in a multidisciplinary way in order to minimize the impacts caused by the disease.

FINAL CONSIDERATIONS

In view of the above, there is a need for further research to better understand the etiological agent and the aspects involving the etiopathogenesis of this disease. Understanding the pathogen directly influences the perception of aspects of the disease, such as the transmission cycle, forms of contagion, diagnosis, treatment, fungal resistance, evolutionary forms, and epidemiology. In addition, the emergence of new species or changes in the behavior of known species should also be evaluated, to identify variations in ecoepidemiology and host-pathogen interactions.

In this context, a One Health approach is critical for effective surveillance and successful control. In order to remedy or minimize the impacts caused by the disease, it is essential to elaborate, execute and inspect actions aimed at the community as a whole, aiming at raising awareness and promoting health.

REFERENCES

1. Almeida, A. J., et al. (2018). Sporotrichosis in domestic felines (*Felis catus domesticus*) in Campos dos Goytacazes, RJ. *Brazilian Veterinary Research, 38*(7), 1438–1443. https://doi.org/10.1590/1678-5150-PVB-5559

2. Alvarez, C. M., Oliveira, M. M. E., & Pires, R. H. (2022). Sporotrichosis: A review of a neglected disease in the last 50 years in Brazil. *Microorganisms, 10*(11), 2152. https://doi.org/10.3390/microorganisms10112152

3. Andrade Júnior, W. A. de S., Silva, R. C. V. da, & Souza, C. C. N. de. (2023). Zoonotic transmission of sporotrichosis and its impact on public health: A literature review. *Ibero-American Journal of Humanities, Sciences, and Education, 9*(6), 387–393. https://doi.org/10.51891/rease.v9i6.10174

4. Araújo, A. K. L., et al. (2020). Feline and human sporotrichosis: Report of a zoonotic case. *Brazilian Journal of Animal Hygiene and Health, 14*(2), 237–247. https://doi.org/10.5935/1981-2965.20200021

5. Assis, G. S., et al. (2022). Feline sporotrichosis and public health. *Veterinária e Zootecnia, 29*, 1–10. https://rvz.emnuvens.com.br/rvz/article/view/594

6. Barbosa, G. da S. (2021). *Diagnostic strategy, antifungal susceptibility, and epidemiology of sporotrichosis* [Master's dissertation, Federal University of Pernambuco]. https://repositorio.ufpe.br/handle/123456789/39392

7. Bazzi, T., et al. (2016). Clinical-epidemiological, histomorphological and histochemical characteristics of feline sporotrichosis. *Brazilian Veterinary Research, 36*(4), 303–311. https://doi.org/10.1590/S0100-736X2016000400009

8. Boechat, J. S. (2020). *Molecular epidemiology of Sporothrix spp. from the epizootic of Rio de Janeiro* [Doctoral dissertation, National Institute of Infectious Diseases Evandro Chagas]. https://www.arca.fiocruz.br/handle/icict/50862

9. Colombo, S. A. (2022). *Molecular characterization of Sporothrix spp. isolates and cats in an epidemic area in the state of Minas Gerais – Brazil* [Master's dissertation, Federal University of Minas Gerais]. http://hdl.handle.net/1843/44184

10. Cruz, L. C. H. da. (2023). Sporothrix schenckii complex: Review of part of the literature and considerations on diagnosis and epidemiology. *Veterinary and Animal Science, 20*, 8–28. https://rvz.emnuvens.com.br/rvz/article/view/1508

11. Duarte, T. L., & Carvalho, G. D. (2021). Sporotrichosis in the context of single health. In *Annals of the Brazilian Interdisciplinary Congress in Science and Technology*. UFVJM. https://www.even3.com.br/anais/cobicet/387965-ESPOROTRICOSE-NO-CONTEXTO-DASAÚDE-ÚNICA

12. Figueiredo, C. C., et al. (2004). The in vitro interaction of *Sporothrix schenckii* with human endothelial cells is modulated by cytokines and involves endothelial surface molecules. *Microbial Pathogenesis, 36*(4), 177–188. https://doi.org/10.1016/j.micpath.2003.11.003

13. Gagliardi, P. C., et al. (2023). Disseminated feline sporotrichosis: Case report. *Multidisciplinary Journal of Health (RMS), 5*(4), 118–124. https://revistas.anchieta.br/index.php/RevistaMultiSaude/article/view/2094

14. Gonçalves, J. C., et al. (2019). Sporotrichosis, the cat and the community. *Encyclopedia Biosphere, 16*(29), 769–787. https://www.arca.fiocruz.br/handle/icict/37963

15. Gremião, I. D. F., et al. (2017). Zoonotic epidemic of sporotrichosis: Cat-to-human transmission. *PLoS Pathogens, 13*(1), e1006077. https://doi.org/10.1371/journal.ppat.1006077

16. Gremião, I. D. F., et al. (2020). Geographic expansion of sporotrichosis, Brazil. *Emerging Infectious Diseases, 26*(3), 621–624. https://doi.org/10.3201/eid2603.190803

17. Gremião, I. D. F., et al. (2021). Guideline for the management of feline sporotrichosis caused by *Sporothrix brasiliensis* and literature revision. *Brazilian Journal of Microbiology, 52*(1), 107–124. https://doi.org/10.1007/s42770-020-00365-3

18. Guedes, F. E. B. (2022). *Sporothrix schenckii complex and sporotrichosis: An update of the literature* [Master's dissertation, Federal University of Rio Grande do Norte]. https://repositorio.ufrn.br/handle/123456789/48493

19. Han, H. S., & Kano, R. (2021). Feline sporotrichosis in Asia. *Brazilian Journal of Microbiology, 52*, 125–134. https://doi.org/10.1007/s42770-020-00274-5

20. Hernández-Castro, R., et al. (2022). Epidemiology of clinical sporotrichosis in the Americas in the last ten years. *Journal of Fungi, 8*(6), 588. https://doi.org/10.3390/jof8060588

21. Jesus, A. C. P. de. (2020). *Phenotypic and phylogenetic characteristics of Sporothrix spp. isolates isolated from clinical cases treated at the Hospital das Clínicas da UFM in Belo Horizonte* [Master's dissertation, Federal University of Minas Gerais]. http://hdl.handle.net/1843/35784

22. Kauffman, C. A., et al. (2007). Clinical practice guidelines for the management of sporotrichosis: 2007 update by the Infectious Diseases Society of America. *Clinical Infectious Diseases, 45*(10), 1255–1265. https://doi.org/10.1086/522765

23. Lecca, L. O. (2019). *Epidemiological diagnosis of sporotrichosis in Belo Horizonte, Minas Gerais, 2015 to 2018* [Master's dissertation, Federal University of Minas Gerais]. http://hdl.handle.net/1843/48655

24. Madrid, I. M., et al. (2011). Morphological analysis and thermotolerance of clinical isolates and the environment of *Sporothrix schenckii* from southern Brazil. *Brazilian Journal of Veterinary Sciences, 18*(2/3), 123–130. https://doi.editoracubo.com.br/10.4322/rbcv.2014.121

25. Marimon, R., et al. (2008). In vitro antifungal susceptibilities of five species of *Sporothrix*. *Antimicrobial Agents and Chemotherapy, 52*(2), 732–734. https://doi.org/10.1128/AAC.01012-07

26. Melo, N. A. V., et al. (2023). The importance of feline sporotrichosis in the context of single health: Review. *Brazilian Journal of Animal and Environmental Research, 6*(2), 1458–1479. https://doi.org/10.34188/bjaerv6n2-042

27. Montenegro, H., et al. (2014). Feline sporotrichosis due to *Sporothrix brasiliensis*: An emerging animal infection in São Paulo, Brazil. *BMC Veterinary Research, 10*, 269. https://doi.org/10.1186/s12917-014-0269-5

28. Mori, L. da S. (2022). *Sporotrichosis in felines: Literature review* [Bachelor's thesis, Universidade Brasil]. http://repositorioacademico.universidadebrasil.edu.br/xmlui/handle/123456789/646

29. Oliveira, M. M. E., et al. (2009). *Identification and phylogenetic analysis of species of the genus Sporothrix isolated in an endemic area of sporotrichosis in the State of Rio de Janeiro* [Doctoral dissertation, Oswaldo Cruz Foundation]. https://www.arca.fiocruz.br/handle/icict/9241

30. Orofino-Costa, R., et al. (2017). Sporotrichosis: An update on epidemiology, etiopathogenesis, laboratory and clinical therapeutics. *Anais Brasileiros de Dermatologia, 92*(5), 606–620. https://doi.org/10.1590/abd1806-4841-2017279

31. Pires, J. P. da S. (2022). *Saúde Única (One Health) applied to the field of collective health: Veterinary Medicine as an alternative to enhance actions of prevention and health promotion* [Master's dissertation, Federal University of Campina Grande]. http://dspace.sti.ufcg.edu.br:8080/jspui/handle/riufcg/33907

32. Ribeiro, E. K. M. (2021). *Diagnostic methodologies, treatments and perspectives of feline sporotrichosis in Brazil: Literature review* [Bachelor's thesis, Faculty of Education and Health Sciences]. [No URL provided]

33. Rocha, R. F. D. da. (2014). *Treatment of refractory feline sporotrichosis with the association of potassium iodide and oral itraconazole* [Master's dissertation, Evandro Chagas Clinical Research Institute]. https://www.arca.fiocruz.br/handle/icict/11962

34. Rodrigues, A. M., et al. (2014). Emerging sporotrichosis is driven by clonal and recombinant *Sporothrix* species. *Emerging Microbes & Infections, 3*, e32. http://go.nature.com/TgBknP

35. Rosa, C. S. da, et al. (2018). Therapy of sporotrichosis: Review. *Science and Animal Health, 5*(3), 212–228. https://doi.org/10.15210/sah.v5i3.11337

36. Rossow, J. A., et al. (2020). A One Health approach to combatting *Sporothrix brasiliensis*: Narrative review of an emerging zoonotic fungal pathogen in South America. *Journal of Fungi, 6*(4), 247. https://doi.org/10.3390/jof6040247

37. Sampaio, E. F., et al. (2023). Impacts caused by animal abandonment: Challenges and perspectives in the context of one health. *Coopex Magazine, 14*(2), 1780–1792. https://doi.org/10.61223/coopex.v14i2.255

38. Santos, Á. F. (2019). *Feline sporotrichosis: Distribution of lesions and anatomopathological characterization using various diagnostic methods* [Master's dissertation, Federal University of Minas Gerais]. https://pesquisa.bvsalud.org/portal/resource/pt/vtt-222361

39. Silva, A. E., et al. (2015). Outbreak of sporotrichosis in cats – Investigation and control actions, city of São Paulo/SP. *Bepa, 12*(133), 1–16. https://periodicos.saude.sp.gov.br/BEPA182/article/view/38191

40. Silva, M. B. T., et al. (2012). Urban sporotrichosis: A neglected epidemic in Rio de Janeiro, Brazil. *Caderno de Saúde Pública, 28*(5), 908–918. https://doi.org/10.1590/S0102-311X2012000500004

41. Silvestrini, A. R., & Langoni, H. (2022). Sporotrichosis: Case report and a reflection in the light of One Health. *Pubvet, 16*(10), 1–8. https://doi.org/10.31533/pubvet.v16n10a1230

42. Thomson, P., et al. (2023). Sporotrichosis outbreak due to *Sporothrix brasiliensis* in domestic cats in Magallanes, Chile: A One-Health-approach study. *Journal of Fungi, 9*(2), 226. https://doi.org/10.3390/jof9020226

43. Tóffoli, E. L., et al. (2022). Sporotrichosis: A public health problem: Review. *Pubvet, 16*(12), e1280. https://doi.org/10.31533/pubvet.v16n12a1280.