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Review

Pythium insidiosum: An overview

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ABSTRACT

Pythium insidiosum is an oomycete pathogenic in mammals. The infection occurs mainly in tropical and subtropical areas, particularly in horses, dogs and humans. Infection is acquired through small wounds via contact with water that contains motile zoospores or other propagules (zoospores or hyphae). The disease, though described as emerging has in fact already been described since 1884. Depending on the site of entry, infection can lead to different forms of pythiosis i.e. a cutaneous, vascular, ocular, gastrointestinal and a systemic form, which is rarely seen. The infection is not contagious; no animal–animal or animal–human transmission has been reported so far. Therapy includes radical surgery, antifungal drugs, immunotherapy or a combination of these therapies. The prevention to contract the disease in endemic areas is difficult. Avoiding stagnant waters could be of help, although the presence of *P. insidiosum* on grass and soil in enzootic areas renders this practice useless.

Contents

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1. Introduction

Pythium insidiosum is the only etiologic agent of pythiosis in mammals. Most cases of pythiosis have been reported in dogs, horses and humans. Only sporadic cases in other animals, such as calves (Pérez et al., 2005), cats (Miller et al., 1985; Thomas and Lewis, 1998; Rakich et al., 2005), sheep (Miller et al., 1985; Tabosa et al., 2004; Santurio et al., 2008), a bird (Pesavento et al., 2008) and tropical animals held in captivity (Camus et al., 2004; Wellahan et al., 2004; Buergelt et al., 2006) are known. Pythiosis is a rarely occurring, non-transmissible disease traditionally found in tropical, sub-tropical and temperate regions (De Cock et al., 1987; Mendoza et al., 1993; Mendoza, 2005). Recently however, pythiosis was also observed in California and Arizona, where the climate does not fit this description. These observations might indicate that the environmental niche for *P. insidiosum* is expanding, probably as a consequence of environmental changes like deliberate flooding of rice fields or irrigated landscape development (Berryessa et al., 2008; White et al., 2008). In Thailand pythiosis is considered to be endemic. Pythiosis in humans is life threatening with high rates of morbidity and mortality, especially in regions with a lack of tools for early diagnosis and effective treatment. While pythiosis is often described as an emerging disease (Laohapensang et al., 2009), the disease was already described in 1884 by British veterinarians working with horses in India (Smith, 1884).

The agent causing the disease (at that time named Hyphomycosis destruens equi) was isolated for the first time in 1901 by Dutch scientists working with horses in Indonesia and again in 1924 by another Dutch (de Haan and Hoogkamer, 1901; Witkamp, 1924). The disease has been known under various other names: bursattee or bursatte (derived from the Indian word Burus, Bursator or Bausette which means rainy season), espundia (Latin America), equine phycomycosis (Australia, USA), granular dermatitidis (Japan), hyphomycosis destruens equi (Indonesia), leeches (USA), swamp cancer (Australia, USA) and summer sores (Australia, Latin America, USA) (Kerr, 1829; Fish, 1895; Witkamp, 1924; Gonzalez and Ruiz, 1975; Ichitani and Amemiya, 1980).

The fungus-like nature of the causal agent of the disease was probably first reported by Smith (1884) and Drouin (1896). By lack of sporulation the agent could not be identified and it did not get a name until 1961 when Bridges and Emmons (1961) named the organism *Hyphomyces destruens*. This name was derived from the name of the disease Hyphomycosis destruens which was introduced by de Haan and Hoogkamer (1901) and later extended to Hyphomycosis destruens equi by De Haan (1902). However, the name *H. destruens* was not validly published and lacked a Latin description and the designation of a type. Bridges and Emmons called the disease phycomycosis because they thought the organism was a zygomycete, probably *Mortierella*. Austwick and Copland (1974) observed zoospore development when cultures grown on Sabouraud dextrose agar were transferred to an aqueous medium. They concluded that the *H. destruens* actually belonged to the Oomycete genus *Pythium*. Based on this discovery, Chandler et al. (1980) proposed the term pythiosis for the disease. In 1980, Ichitani and Amemiya (1980) isolated a *Pythium* sp. from a diseased horse and found it to be morphologically similar to *Pythium gracile* Schenk (Amemiya, 1982). However, *P. gracile* is a poorly described species of which the identity cannot be verified. Moreover, it was isolated from algae in Germany, where pythiosis does not occur. The oomycete was formally described as *P. insidiosum* when sexual sporulation was observed by De Cock et al. (1987). Almost simultaneously Shipton (1987) proposed the binomial *Pythium destruens* for a strain isolated from an Australian horse with pythiosis. Based on priority *P. destruens* is now considered a synonym of *P. insidiosum* (Mendoza and Marin, 1989).

P. insidiosum mainly occurs in surface water amongst others in standing inland waters and occasionally in soil (Mendoza et al., 1993, 1996). Not much is known about the ecological preference of *P. insidiosum*, but the presence of water which induces the formation of zoospores seems to be a prerequisite (Supabandhu et al., 2008). Since *P. insidiosum* usually occurs under wetland conditions, more cases are seen after heavy rain or floods (Miller, 1983; Miller and Campbell, 1983; Mendoza et al., 1993). Other risk factors for developing pythiosis have not yet been identified. Floods after heavy rain have been incriminated as one of the natural resources used by *P. insidiosum* to expand its ecological niche to new areas (Mendoza et al., 1993; Supabandhu et al., 2008).

Phylogenetic analysis has shown that *Pythium* spp. are closer related to diatomeae and algae than to true fungi (Kwon-Chung, 1994; Hudspeth et al., 2000; Martin, 2000). *Pythium* spp. belong to the kingdom Stramenopila, the