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Review

Orientobilharzia species: Neglected parasitic zoonotic agents

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ABSTRACT

Parasites of the genus *Orientobilharzia* belong to Platyhelminthes, Trematoda, Digenea, Schistosomatidae, and the type species is *Orientobilharzia turkestanicum*. *O. turkestanicum* was first described by Skrjabin from cattle in Russian Turkestan in 1913. Adult worms of *Orientobilharzia* species live in the portal veins or intestinal veins of cattle, sheep and other mammals, and often cause orientobilharziasis in China, India, Mongolia, Pakistan, Iraq, Iran in Asia, and Russia and Turkey in Europe. More importantly, the cercariae of *Orientobilharzia* species can infect humans and often cause cercarial dermatitis. Though *Orientobilharzia* species have been confirmed as zoonotic agents, they have been largely neglected, compared with other pathogens causing cercarial dermatitis, such as *Trichobilharzia* spp., *Schistosoma spindale* and *Bilharziella* sp., which have attracted considerable attention. Here we review the current status of knowledge on the taxonomy of *Orientobilharzia* spp., human and animal infections with *Orientobilharzia* spp., and address some considerations for further work on the systematics and pathogenesis of these organisms.

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1. Introduction

Adult worms of *Orientobilharzia* spp. live in the portal or intestinal veins of a range of animals including cattle, sheep, goats, water buffaloes, horses, donkeys, mules, camels, and cause orientobilharziasis. More importantly, the cercariae of *Orientobilharzia* spp. can also infect human, in which they can cause cercarial dermatitis, and are considered the major pathogen of cercarial dermatitis in the Caspian Sea area of Iran (Sahba and Malek, 1979) and several provinces of the People's Republic of China (Bai et al., 1963; Li and Li, 1980; Lian et al., 1975; Liu et al., 1976; Tian and Li, 1980; Yang et al., 1983; Zuo et al., 1981).

Though they have been confirmed as zoonotic agents, *Orientobilharzia* spp. have been neglected for study compared with other pathogens causing cercarial dermatitis, such as *Trichobilharzia* spp., *Schistosoma spindale* and *Bilharziella* sp., which have attracted considerable attention (de Gentile et al., 1996; Hörweg et al., 2006; Kolárová et al., 1999; Lévesque et al., 2002; Liu et al., 2002; Lois et al., 2004; Tang and Tang, 1976). In order to provide up-dated information and to raise awareness amongst researchers, parasitologists, physicians, public health officials and veterinarians, this article reviews the current status of knowledge on the systematics of *Orientobilharzia* species, human and animal infections with *Orientobilharzia*, and presents some considerations for further studies concerning systematics and pathogenesis of these species.

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Table 1
Species, erector, geographical locations, and infected animal species of *Orientobilharzia* spp.

Species	Erector and year	Country	Infected animal species	References
O. turkestanicum	Skrjabin (1913), Dutt and Srivastava (1955)	Russia	Cattle	Skrjabin (1913)
		Mongolia	Cattle	Yamagiwa (1931)
		Iraq	Cattle, sheep, goats, horse, mules, camels	Machattie (1936)
		Pakistan	Sheep	Abdussalam and Sarwar (1952)
		India	Cattle	Srivastava and Trisal (1957), Dutt and Srivastava (1964), Kumar (1973)
		Iran	Cattle, sheep, goats	Arfaa et al. (1965), Massoud (1973)
		Turkey	Field rat	Witenberg and Lengy (1966)
		China	Sheep, cattle	Hsü (1938), Xiong (1943), Tang et al. (1983a)
O. turkestanicum var.*tuberculata*	Bhalerao (1932)	India	Cattle	Bhalerao (1932)
		China	Sheep, cattle	Wei (1963), Lian et al. (1975), Liu et al. (1976)
O. cheni	Hsü and Yang (1957)	China	Cattle, sheep	Hsü and Yang (1957)
O. bomfordi	Montgomery (1906)	India	Zebu	Montgomery (1906)
		China	Sheep, cattle	Hsü and Yang (1957)
O. dattai	Dutt and Srivastava (1952)	India	Water buffalo, cattle, guinea-pig (E)	Dutt and Srivastava (1952)
			Rhesus monkeys (E)	Das and Agrawal (1986)
O. harinasutai	Kruatrachue et al. (1965)	Thailand	Water buffalo, mouse, hamster, rabbit (E)	Kruatrachue et al. (1965)
		Laos	Water buffalo	Schneider et al. (1975)

Note: E represents experimental infection.

2. Systematics of *Orientobilharzia* spp.

The genus *Orientobilharzia* was originally called *Schistosoma*, and then re-named *Ornithobilharzia* by Price in 1929, the classification being based upon the presence of numerous testes (Price, 1929). In 1955, Dutt and Srivastava re-addressed the genus *Ornithobilharzia*, and established the new genus *Orientobilharzia* to accommodate blood flukes whose definitive hosts were mammals (Dutt and Srivastava, 1955). This was considered a sister genus of the Schistosomatidae. This traditional classification is based on multiple factors such as the morphological characteristics of adult parasites and eggs, the intermediate and definitive hosts, and geographical distributions of *Orientobilharzia*.

According to the literature, a total of six *Orientobilharzia* species have been recorded, namely *Orientobilharzia bomfordi* (Montgomery, 1906), *O. turkestanicum* (Skrjabin, 1913; Dutt and Srivastava, 1955), *O. turkestanicum* var. *tuberculata* (Bhalerao, 1932; Dutt and Srivastava, 1955), *O. cheni* (Hsü and Yang, 1957), *O. dattai* (Dutt and Srivastava, 1952) and *O. harinasutai* (Kruatrachue et al., 1965). Table 1 shows the species, authorities and years, geographical locations, and infected animal species for reported *Orientobilharzia* species.

Given the controversy as to the phylogenetic position of *Orientobilharzia* in relation to other members of the Schistosomatidae based on traditional approaches, several recent studies examined the phylogenetic relationship of *Orientobilharzia* species with other schistosomes using sequences of both nuclear and mitochondrial genes as genetic markers (Attwood et al., 2002; Brant and Loker, 2005; Li et al., 2008; Lockyer et al., 2003; Snyder and Loker, 2000; Webster et al., 2006), each of these studies placed *Orientobilharzia* species within the genus *Schistosoma*, indicating that *Orientobilharzia* species should be considered member (s) of the genus *Schistosoma*.

3. Infections in humans

Human cercarial dermatitis is an acute inflammatory response to the penetration of the skin by non-specific schistosome parasites. It is also known as 'Swimmer's Itch'. It has been called 'clam diggers itch' or 'sawah' (Malaysia), 'kubure' or 'kobanyo' (Japan), 'hoi con' (Thailand), 'Duck Itch' (New Zealand), 'Duckworms' or 'Duck fleas' (United States) and 'rice paddy itch' (China). Cercarial dermatitis is a skin disease characterized by itching and skin papulation, with a worldwide distribution. It has been reported from many countries ranging from Alaska to Argentina in America, Australia, and South Africa. Rice paddy itch has been reported in a number of provinces in China, including Heilongjiang Province in the north, Guangdong Province in the south, Zhejiang Province in the east and Xinjiang Uygur Autonomous Region in the west. Causative agents for human infection with cercarial dermatitis include the cercariae of *Trichobilharzia* spp., *Orientobilharzia* spp., *Bilharziella* spp., or *S. spindale*, which normally infect birds or mammals.

Adult worms of these schistosomes generally live in the portal or intestinal veins of the hosts mentioned above. Eggs are released in the faeces and develop into miracidia when released into freshwater. Thereafter, the miracidia infect snail intermediate hosts (e.g. *Lymnaea* and *Indoplanorbis* species). In the snail, infectious cercariae develop and are released whereupon they alternately swim to the surface of the water and slowly sink towards the bottom. Humans are usually infected by penetration of the cercariae into the skin while swimming, working or wading in lakes. Skin disease is characterized by itching and a highly pruriginous skin rash occurs within several minutes or hours. A diffuse eruption composed of prurigenous maculopapules appears following exposure within 3–4 days. If the initial itching is severe, scratching can cause abrasions and skin infections may develop. The disease aggravated by repeated contact with infectious cercariae. Regression is spontaneous within the following 7 days. The skin of legs and forearms, dorsa of both hands and feet are the commonest loci for water contact and subsequent infection. In humans, the secretion of protease by invading cercariae and the releasing of proteins and polysaccharides from dead cercariae cause localised skin inflammatory responses.

Human cercarial dermatitis caused by bird schistosomes has been reported in several areas of Europe, America, Australia, and Asia (de Gentile et al., 1996; Hörweg et al., 2006; Kolárová et al., 1999; Lévesque et al., 2002; Liu et al., 2002; Lois et al., 2004; Rao et al., 2007; Schets et al., 2008), however, human cases of cercarial dermatitis caused by *Orientobilharzia* spp. have been reported only in Iran (Sahba and Malek, 1979) and China (Bai et al., 1963; Li and Li, 1980; Lian et al., 1975; Liu et al., 1976; Tian and Li, 1980; Yang et al., 1983; Zuo et al., 1981). Nevertheless, due to the lack of a spe-