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Furuncular Myiasis Caused by *Cordylobia rodhaini* (Diptera: Calliphoridae): a Case Report and a Literature Review

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Abstract

Some African flies may cause myiasis not only in animals but also in humans, representing therefore a serious health problem for the local population and for tourists. We report a rare case of furuncular myiasis due to larvae of Lund's fly *Cordylobia rodhaini* Gedoelst (Diptera: Calliphoridae) a species which usually parasitizes small mammals. The myiasis was diagnosed in Italy in a tourist guide who travelled in Central African rainforests of Uganda. The clinical case and the morphological criteria used for species identification are here described, together with a review of all literature cases of human furuncular myiasis due to *C. rodhaini*.

Keywords

Lund's fly, human myiasis, Uganda, Kibale Park

Introduction

The term myiasis refers to infestation of live tissues of vertebrates (including man) by larvae of Diptera. According to host dependence, myiasis may be obligatory (the larvae completely depend on host for their life cycle) or facultative (the larvae are normally free-living but occasionally parasitize tissues) (Zumpt 1965). Myiasis can also be classified as cutaneous or external (invading mouth, nose, eyes, ears, anus and genitals), or internal (invading digestive and urinary tracts) (Dogra and Mahajan 2010). In turn, the cutaneous myiasis is classified as wound myiasis (the larvae feed on both living and necrotic tissue), creeping myiasis (the larvae migrate underneath the skin) and furuncular myiasis (the larva penetrates the healthy skin and a painful furuncle develops) (Caissie et al. 2008).

Among Diptera causing myiasis three species of the genus *Cordylobia* Gruenberg, belonging to the family Calliphoridae (*Cordylobia antropophaga* Blanchard, *C. rodhaini* Gedoelst and *C. ruandae* Fain), are known to cause furuncular myiasis (Geary et al. 1999). Here we describe a rare case of myiasis by *C. rodhaini* in a tourist guide returning to Italy from Central Africa, together with a literature review of all previously reported cases of human furuncular myiasis caused by this species.

Materials and Methods

The patient suffering from furuncular myiasis was a 45 year old man who travelled in June 2014 as a tourist guide in tropical rainforests of Kibale National Park (Uganda). After his return to Italy, he was admitted to the Emergency Department of the University Hospital of Ferrara (Ferrara, Italy) and treated at the Department of Medical Sciences, Section of Dermatology and Infectious Diseases of the same University. The analyses of samples for identification were performed at the Department of Life Sciences and Biotechnology. The patient had on his body 15 papules from which he self-extracted by tweezers and petroleum jelly 15 larvae, of which 8 (undamaged) were fixed in 4% formaldehyde in the Section of Dermatology and Infectious Diseases and later

transferred to the Laboratory of Urban Ecology, Department of Life Sciences and Biotechnology. Morphological investigations for species identification were performed by a Nikon SMZ 800 stereomicroscope (Nikon Instruments Europe, Amsterdam, Netherlands) connected to a Nikon Digital Sight Ds-Fi1 camera (Nikon Instruments Europe).

Results and Discussion

On physical examination the patient showed 15 erythematous papules with a diameter of 1-2 cm, tender, indurated and exudative with central puncta, scattered over the torso (2 papules), both arms (8 papules on the right arm and 3 papules on the left one) (Fig. 1A, B) and the scalp (2 papules). The patient had no significant previous pathologies and no other symptoms. After extraction of the larvae, he was advised to take antibiotics (doxycycline) for a week. Among the eight larvae brought to the laboratory, five were clearly identified as 3rd instars of *C. rhodaini* (Lund's fly). The other three were identified as 2nd instars of the same species, based on the body shape, according to Scholten and Hicks (1973), and also on the morphology of small conic spines according to Kremer et al. (1970) (Fig. 2A, B). Moreover, two of these larvae were in the process of molting to 3rd instar because they showed an exuvial space at the posterior end (Fig. 2A). The five 3rd instar larvae had variable size (6.5 ± 1.0 mm) and were whitish and barrel-shaped with 11 segments (Fig. 3A). Their body was almost completely covered by large conic spines with a brown apex, pointing towards the posterior end where they were less numerous (Fig. 3B). The anterior cephalic end, cylindrical with a flat top, showed two round symmetrical and slightly dorsoventral bulges. Paired mouth hooks protruded ventrally from the anterior end and were surrounded above and laterally by chitinous brown scales (Fig. 4A). The tail end was blunt with two copper-colored posterior spiracles, each bearing three sinuous spiracular slits branching from a button-shaped spiracle (Fig. 4B). Morphological details such as the body shape, the conical spines and the spiracular plates allowed a precise identification of the species (Kremer et al. 1970).

C. rodhaini is found in tropical Africa, mostly in rainforest. The larvae of this species parasitize mammals, among which primates such as the mona monkey (*Cercopithecus mona* Schreber), rodents such as the giant rat (*Cricetomys gambianus* Waterhouse) and small antelopes such as the bay duiker (*Cephalophus dorsalis* Gray), the black-fronted duiker (*Cephalophus nigrifrons* Gray), the blue (*Cephalophus monticola* Thunberg) and the grey duiker (*Sylvicapra grimmia* L.) (Zumpt 1965). The adult Lund's flies live about 30 days and feed on feces, decaying fruits and vegetables. They have crepuscular habits, resting from 8 a.m. to 5 p.m. and showing two peaks of activity in early morning and evening (Rodhain 1915). Flies are more abundant in the wet season (Geary et al. 1999). Females lay about 500 eggs in wet soil and often on damp clothes. Eggs hatch 2-4 days after laying and upon contact with a suitable host the larvae penetrate the skin. After 12-15 days they molt to 2nd and 3rd instar, the latter one about 1.5 cm long. When mature, the larvae spontaneously emerge from skin (Rodhain 1915).

The main cause of human furuncular myiasis in tropical Africa is *C. anthropophaga* (Cultrera et al. 1993). *C. rodhaini* infestations are rare, based on the limited number of cases reported in the literature and an unsuccessful attempt of experimental infection on the Guinea pig, *Cavia porcellus* L., by Rodhain and Bequaert (1916). The first *C. rodhaini* larva known to cause human infestation was recovered on 2 August 1902 from the arm of an individual only known as commander Lund: the larva was brought to Baron de Haulleville, director of the Royal Museum of Central Africa, and published in 1905 as "larve de Lund" (Lund's fly) (Gedoelst 1905). The same author later described the new species as *Cordylobia rodhaini*, based on four larvae collected in Belgian Congo (now Democratic Republic of Congo) by Broden and Rodhain (Gedoelst 1909). Since 1902 only 25 cases of human infestation have been reported (including the present one) and in two of them the number of people infested was not mentioned (Table 1). Human furuncular myiasis due to *C. rodhaini* has been recorded in eight countries of East and West Central Africa and in one country (Zimbabwe) of South Africa (Fig. 5). The country with the highest number of cases is the Democratic Republic of Congo (5 or more cases, all reported between 1902 and 1909). Based upon Veraldi et al. (2014) and

the present report, the Republic of Uganda has recently been included in the list of countries in which human furuncular myiasis by *C. rodhaini* has been reported.

The number and distribution of human furuncular myasis caused by *C. rodhaini* are considerably lower than those reported for *C. anthropophaga*. For the latter species more than 190 cases of human furuncular myasis have been reported in 19 African countries, in nine of which the myasis by *C. rodhaini* was also reported. The countries where only *C. anthropophaga* was reported as agent of human furuncular myasis are the Republic of Senegal, the Republic of Mali, the Republic of Sierra Leone, the Ivory Coast, the Republic of Benin, the Federal Republic of Nigeria, the Republic of Equatorial Guinea, the Republic of Angola, the Federal Republic of Somalia and the Republic of South Africa (Edungbola 1982, Hori et al. 1984, Bettoli et al. 1993, Cultrera et al. 1993, Alkorta Gurrutxaga et al. 2001, Izquierdo et al. 2001, Parkhouse 2004, Dehecq et al. 2005, Ogbalu et al. 2006, Lee and Robinson 2007, Deng et al. 2013, Kovaleva et al. 2013, Lowe et al. 2013, Sivelli et al. 2014). The third *Cordylobia* species responsible for furuncular myasis, *C. ruandae*, was reported only in the Republic of Rwanda and the Republic of Burundi (Zumpt, 1965) and none of the reported cases involved humans.

In the literature cases the number of larvae on each patient usually ranged between 1 and 16, but in a case described by Pampiglione et al. (1991) 150 larvae were found on the same patient (Table 1). Two other cases of extensive infestation on the same individual were reported in Broden and Rodhain (1909), the first one involving 92 larvae, and the second one involving 87 larvae, initially described by Gedoelst (Broden and Rodhain 1909). Extensive infestations with more than 90 larvae were also reported for *C. anthropophaga* (Alkorta Gurrutxaga et al. 2001, Ogbalu et al. 2006).

In the case we described the lesions occurred on arms, torso and scalp. The patient had resided in a camping place of a tropical rainforest within the Kibale National Park (Uganda) where he used damp towels; the contact with the species could have occurred through these towels, presumably infested by larvae or eggs. Pampiglione et al. (1991) and Tamir et al. (2003) reported as a possible

way of infestation clothes, bed linen or towels washed and dried but not ironed. The patient could also have accidentally leaned against an egg-infested surface.

From a clinical point of view the myiasis caused by *C. rodhaini* is similar to that caused by *C. anthropophaga* and *Dermatobia hominis* Linneus Jr (Veraldi et al. 2014). Bettoli et al. (1993) reported for *C. anthropophaga* myiasis the following clinical parameters: furuncle-like painless lesions, absence of bacteria and purulent discharge, secretion of exudates mixed with larval feces and presence of a small opening containing the respiratory spiracles in the central part. The same parameters also apply to *C. rodhaini*.

The same extraction method employed for *C. anthropophaga* and *D. hominis* is also used for *C. rodhaini*: topical applications of petroleum jelly or paraffin and covering of the lesion with adhesive tape, inducing hypoxia in the larva and forcing it to emerge after some time. In alternative, insecticides may be applied or the larva can be extracted by surgical abscission (Lee and Robinson 2007, Hannam et al. 2011). During this procedure the larva must not be broken or damaged in order to avoid an intense immune response (Lee and Robinson 2007). To prevent bacterial infections, abscesses and tetanus, larval extractions should be performed by trained medical staff using sterilized equipment (Tamir et al. 2003). Unsterilized sharp tools often employed in endemic regions may cause infections and other complications.

Travelers should be aware that furuncular myiasis can be prevented by avoiding contacts with wet soil and by abstaining from walking barefoot or with unprotected shoes over infested places. Moreover, to prevent or minimize the contact with the fly, clothes, bed linen and towels must not be hanged outside for drying unless the place is protected by mosquito nets. Clothes must always be hanged in a sunny and windy place and thoroughly ironed when dry (Dehecq et al. 2005, Logar et al. 2006, Kovaleva et al. 2013).

Some cases of furuncular myiasis by *C. anthropophaga* have been reported outside of Africa, namely in Spain (Laurence and Herman 1973), Holland (Baily and Moody 1985) and Portugal (Curtis et al. 2006). This species is apparently able to survive for some time on clothes or other

infested objects. In the case reported in Holland the two children probably were infested through their father's luggage brought back from Africa, but in those reported in Spain and Portugal the species apparently settled outside the African continent. This suggests that the same could happen for *C. rodhaini*, especially in Southern Europe. Considering the increasing number of people, animals and assets moving across states, myiasis case reports could be useful to collect a reference archive for entomologists and physicians. From a clinical point of view a multidisciplinary approach may help to achieve a correct identification of the species causing myiasis, and to obtain a quick and effective healing by the best possible treatment.

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243 **Table 1.** Case reports of human furuncular myiasis by *C. rodhaini* according to the literature.

244 Abbreviations: ♀, female; ♂, male; DR, Democratic Republic; R, Republic; UR, United Republic;

245 FDR, Federal Democratic Republic.

Year	Number and sex of patients (when reported)	Country	Origin of the patient	Number of larvae per patient	References
1902	1♂	DR of Congo	unreported	1	Gedoelst 1905
1907	1♂	R of Congo	Europe	2	Heckenroth and Blanchard 1913
1908	1♂	UR of Tanzania	unreported	unreported	Bertram 1938
About 1909	1♂	DR of Congo	unreported	87	Broden and Rodhain 1909
1909	unreported	DR of Congo	unreported	92 in one patient	Broden and Rodhain 1909
1911	2♂, 1♀	R of Congo	2♂: Europe 1♀: R of Congo	6 in one patient	Heckenroth and Blanchard 1913
1913	1♂	R of Congo	Europe	2	Heckenroth and Blanchard 1913
1917	1♂	R of Ghana	R. of Ghana	1	Bertram 1938
1931	1♂	R of Kenya	Europe	unreported	Symes and Roberts 1932
1936	1♂	R. of Zimbabwe	unreported	>1	Jack 1937
1938	1♂	R of Cameroon	unreported	16	Bertram 1938
1955	unreported	Africa	unreported	unreported	Scott 1964
1970	2	R of Cameroon	France	15 6	Kremer 1970
1973	1♂	R of Kenya	Canada	3	Scholten and Hicks 1973
1979	1♀	R of Cameroon	Japan	2	Hori et al. 1984
1991	1♂	FDR of Ethiopia	Italy	150	Pampiglione et al. 1991
1999	1♀	East Africa (probably R of Zimbabwe)	Australia	1	Geary et al. 1999
2003	1♂, 1♀	R of Ghana	Israel	2 in ♂, 1 in ♀	Tamir et al. 2003
2011	1♀	FDR of Ethiopia	Canada	1	Hannam et al. 2011
2014	1♀	FDR of Ethiopia	unreported (Caucasian)	1	Veraldi et al. 2014
2014	1♂, 1♀	R of Uganda	unreported (Caucasian)	5 in ♂, 1 in ♀	Veraldi et al. 2014
2014	1♂	R of Uganda	Italy	15	present report

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Figure Legends

Fig. 1. Clinical aspects of furuncular myiasis by *Cordylobia rodhaini* larvae. (A) Papules on forearm of the patient. (B) Detail of papules in A.

Fig. 2. Morphology of 2nd instar *Cordylobia rodhaini* larva. (A) Total body with anterior end at left; an exuvial space is visible at the posterior end. (B) Detail of cuticle spines.

Fig. 3. Morphology of 3rd instar *Cordylobia rodhaini* larva. (A) Total body with anterior end at left. (B) Detail of cuticle spines.

Fig. 4. Morphology of 3rd instar *Cordylobia rodhaini* larva. (A) Detail of the anterior end, showing two black mouth hooks. (B) Spiracular plates.

Fig. 5. Map of African countries (grey) where cases of human furuncular myiasis by *Cordylobia rodhaini* have been reported. The number of cases is within brackets. Abbreviations as in Table 1.