Gastrointestinal symptoms resembling ulcerative proctitis caused by larvae of the drone fly *Eristalis tenax*

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We report a case of facultative intestinal myiasis due to larvae of the drone fly *Eristalis tenax*, also named the rat-tailed maggots. The development of larvae in the lower bowel was responsible for non-specific gastrointestinal symptoms that resembled ulcerative proctitis. The diagnosis was established upon the observation of four spontaneously excreted mobile larvae. The definite identification of the *E. tenax* species was made possible by scanning electron microscopy. The clinical outcome was satisfactory.

Keywords: *Eristalis tenax*, Drone fly larvae, Rat-tailed maggot, Proctitis, Facultative intestinal myiasis, Scanning electron microscopy

Introduction

Myiasis is defined as the parasitic infestation of live vertebrate organisms by fly larvae which, at least for a certain period, feed on the host's dead or living tissue, liquid body substances, or ingested food.^{1–3} Several classifications of myiasis have been proposed mostly depending on clinical criteria, like the existence of an obligate parasitic stage, the anatomical location of the infestation, and the stage of the larval development.²

Many families of fly (Diptera order) are known to be involved in myiasis. Among them, the Syrphidae family includes the *Eristalis* genus which has been proven to be of medical interest in such a context. Since the parasitic stage of its larvae is not obligate, the *Eristalis* genus is responsible for only a facultative kind of human myiasis.³ Within this genus, the drone fly *Eristalis tenax* has been the most described species. Despite the worldwide distribution of *E. tenax*, most cases of myiasis caused by the larvae of this species have occurred in developing countries where standards of hygiene are low. Observed in stools of infected individuals,^{3,4} the larvae have a long

posterior breathing tube that resembles a tail; hence they are often called 'rat-tailed maggots'.

Observation

A 42-year-old French woman with no significant medical history was sent for a gastroenterology consultation for suspected inflammatory bowel disease. The patient mostly complained of abdominal pains and pasty diarrhoea lasting for 3 weeks. She was besides afebrile. Blood tests showed no abnormalities. Bacterial stool cultures and parasitological examinations were negative. Proctological examination showed inflammation of mucosa, compatible with ulcerative proctitis. Digestive biopsy revealed a small number of non-specific inflammatory lesions (See supplementary material online for this article at www.maneyonline.com/doi/suppl/10.1179/2047773214Y.0000000135). Treatment with mesalazine, metronidazole, and a digestive antiseptic (tiliquinol and tilbroquinol in association) resulted in a substantial reduction of symptoms.

Surprisingly, a mobile 'worm' with a tail was spontaneously excreted by the patient in her stool (See supplementary material online for this article at www.maneyonline.com/doi/suppl/10.1179/2047773214Y.0000000135). The specimen was then caught in her toilet bowl and immediately brought to the parasitology laboratory. Its global shape and its terminal appendix allowed its rapid identification as a

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Figure 1 Macroscopic observation of the larva that was spontaneously excreted first. (A) Dorsal view and; (B) Ventral view which clearly highlights the six pairs of prolegs. The posterior breathing appendage is as long as the entire body. The body is brown and cylindrical.

larva belonging to the group of the long-tailed Syrphidae flies (Fig. 1). Although the Hartley's identification key was useful for the first step of the entomological observation,⁵ only the detailed ultra-structural analysis by scanning electron microscopy (SEM) enabled a reliable and complete identification of the species. Thus, all the morphological characters of the caught larva were in accordance with those of the third larval stage of *E. tenax*.⁶ Some specific examples are shown in Fig. 2.

The patient was subsequently treated with a single dose of ivermectin (200 µg/kg). Then, the patient, who was instructed to thereafter defecate into a sterile laboratory container, collected three other *E. tenax* larvae over the following 2 days (See supplementary material online for this article at www.maneyonline.com/doi/suppl/10.1179/2047773214Y.0000000135). The patient's symptoms improved, despite persistent flatulence and a swollen belly. There were no complications and there was no infectious relapse. Interestingly, the

Figure 2 Scanning electron micrographs that confirmed the *Eristalis tenax* species. (A) Extremity of the posterior telescopic breathing tube showing several spiracular openings (so) arranged in circle. Note the long hanging interspiracular setae (is). (B) Latero-dorsal view of the head showing several satellite sensilla positioned on top of the antennomaxillary organs (am), the lateral lips (lp), and the pair of the mesothoracic prolegs (mp); (C) Antero-dorsal view of an anterior retractile spiracle showing approximately 20 facets (f) arranged in one row around the edge. In *E. tenax*, the anterior spiracle is about two times longer than broad with rounded and slightly recurved tips. (D) Latero-ventral view of a pair of abdominal prolegs showing the crochets facing backwards, arranged in semi-circular rows. The spicules gradually become smaller below.

Figure 3 Adult male drone fly, *Eristalis tenax* (with courtesy of <http://www.insectes-net.fr/>; photo credits: André Lequet). The imago resembles a honeybee, but has only two wings, and exhibits no sting. The thorax is covered with short brownish hair. Note the orange marks on the side of the second abdominal segment, while a narrow yellow-orange band crosses the third abdominal segment.

patient reported having recently visited Colombia, where she spent 3 days living self-sufficiently in a small fishing village of the Caribbean coast (Cabo de la Vela, Guajira Peninsula). On site, she did not have any access to toilet blocks and ate plantain, mango, rice, fish, and goat meat. To note, the patient did not show any evidence of mental disturbance.

Discussion

The drone fly *E. tenax* belongs to the Syrphidae family in the Diptera order. *E. tenax* imago is a harmless hoverfly that resembles the honeybee *Apis mellifera* (Fig. 3). It is distributed worldwide, except in the extreme southern latitudes. *E. tenax* is an important pollinator of many crops and wildflowers.⁷

Its larvae thrive in conditions associated with poor hygiene, in wastewater, such as sewage or swamps contaminated by excrement where they feed on microorganisms and faecal organic matter. They are able to resist heat, high pressure, and salinity.^{3,4,8} As shown in Fig. 1, the larvae are about 3–4 cm long, and breathe through a snorkel-like tube. This global shape which could appear very particular is actually not so characteristic of *E. tenax* larvae, since it is shared by a few other fly species that also belong to the *Eristalis* genus. Therefore, confusion has been often made between all larvae of the genus. Most of the morphological descriptions that have been written up to date were too general. For instance, Hartley wrote in 1961 the first key that allowed the entomological identification for only six British *Eristalis* species.⁵ Since it has been progressively incremented,^{9–11} the identification key is now much

more complete and contains specific characters that enable reliable identification of a particular species. According to Rotheray and Gilbert,¹² *E. tenax* may be distinguished from other long-tailed Syrphidae larvae by its prolegs with crochets disposed in three rows with spicules gradually becoming smaller below. Besides, the last pair of prolegs of *E. tenax* larvae exhibits curved tips of most of the primary crochets facing backwards, but does not show transverse row of spicules just in front of it. Moreover, anterior spiracles are short in *E. tenax*, up to two times longer than broad, stout, with rounded and slightly recurved tips, and with no widened clear area in the lower part. On the abdominal segments, the primary crochets are just a little longer than they are wide, and the fourth lateral sensillum appears above the fifth and the sixth ones. Overall, *E. tenax* remains the only species belonging to the Syrphidae cited in the parasitological textbooks.¹³ Nonetheless, the lack of evidence implicating other *Eristalis* species in human myiasis raises the possibility that some of these might have been mistakenly identified as *E. tenax*. In our case, the *E. tenax* species was reliably confirmed by some characteristic findings definitely observed with SEM (Fig. 2).⁶

E. tenax may cause myiasis, and not pseudo-myiasis, unlike it was sometimes written in some descriptions,² since the eggs or immature stages may develop into mature larvae within the intestines (in case of pseudomyiasis, dipteran larvae are not able to continue their development).³ Nonetheless, as the parasitic stage is not obligatory and as the bowel constitutes an accidental site for their development (just like wounds, ulcers, and cavities for some other fly species), the infestation by *E. tenax* larvae should only be described as facultative myiasis. The most obvious point of entry appears as the ingestion of eggs or immature larvae in contaminated food or drink.^{3,14,15} The other point of accidental entry was hypothesized by Fritz KE Zumpt: according to him, the female *E. tenax* may lay eggs on the anal margin, e.g. at the time of defecation in the wild, and the hatched larvae may then enter the lower part of the digestive tract.^{3,16} Whatever is the way of infestation, the *E. tenax* larvae never cross the digestive epithelium to penetrate any tissues. The larvae are finally spontaneously expelled from the host organism after a period of partial maturation. Thereafter, it is believed that the transformation of mature larvae into pupae indeed occurs externally.¹⁵

Since human infestations due to *E. tenax* larvae have been probably neglected up so far, only 40 cases have been reported (including our case report) (Table 1). The degree and presence of symptoms, mostly non-specific, likely depended on the parasite burden, ranging from diarrhoea and abdominal pains

Table 1 Characteristics of reported cases of facultative digestive myiasis due to *Eristalis tenax* or related larvae

Year	Reference	Country	Region (environment)	Demographics (gender/age)	Symptoms	Treatments
1908	14	England	Hampshire (rural)	M (NA)	No symptoms: fortuitous discovery in stools	Santonin + mercury + other intestinal antiseptics
1909	25	US	Ohio (rural)	F (NA)	Intermittent spells of abdominal distress, colicky pain, nausea, and vomiting	Laxative (magnesium sulphate)
1912	26	US	Colorado (rural)	M (5)	Indigestion, obstinate constipation, muscular pain, headache, anaemia, and weight loss	Unknown anti-worm remedy
1925	22	US	Georgia (rural)	M (30)	Malaise, weakness, nausea, and constipation	Laxative + carbon tetrachloride
1927	27	Argentina	NA	NA	NA	NA
1941	28	Argentina	NA	1 case	Gastrointestinal symptoms	NA
1942	29	US	NA	1 case	NA	NA
1944	30	Paraguay	NA	NA	Intestinal signs	NA
1944	23	Belgium	Flemish region (rural)	M (47)	Anxiety, weakness, anaemia, and haemorrhoids	None
1950	31	Germany	NA	1 case	Colic	NA
1951	32	Spain	NA	1 case	NA	NA
1955	33	Chile	NA	1 case	No symptoms: fortuitous discovery in stools	NA
1957	34	Thailand	NA	1 case	NA	NA
1964	35	Italy	NA	1 case	Gastrointestinal symptoms	NA
1971	16	Zambia	NA	M (NA)	Dizziness, non-specific abdominal pain, anal pruritis and discomfort, and proctitis	NA
1975	24	India	NA	M (NA)	Abdominal pain and diarrhoea	Laxative
1976	36	Canada	NA	1 case	NA	NA
1982	37	Thailand	Central Thailand	1 case	NA	NA
1991	21	Japan	Kantō (urban)	3 cases	Gastrointestinal symptoms	NA
1995	13	Italy	Province of Roma	1 case	NA	NA
1998	17	Argentina	Patagonia (suburban)	F (25)	Diarrhoea and colic	Laxative + antibiotic
1999	3	Spain	Galicia (suburban)	M (15)	Nausea, epigastric pain and vomiting	Laxative + antibiotic
2000	38	Australia	South Australia	F (64)	Dizziness and non-specific abdominal pain	None
2000	39	New Zealand	Marlborough (suburban)	F (42)	No symptoms: fortuitous discovery in stools	None
2000	40	Morocco	Rabat-Salé-Zemmour-Zaër (suburban)	2 cases	NA	NA
2004	41	Belgium	Wallonia, (rural)	M (36)	Nausea and vomiting, abdominal pain, profuse diarrhoea, and weight loss	Traditional medicine (olive oil and garlic)
2005	15	Brazil	Goiás (urban)	F (1)	Diarrhoea and intestinal spasms	Metronidazole + nifuroxazide
			Goiás (suburban + rural)	M (27)	Intense pasty diarrhoea and abdominal pain	None
					Non-mucosanguineous pasty diarrhoea, colic, nausea, insomnia, and weakness	None
2006	42	Canada	Nova Scotia (rural)*	M (36)	No symptoms: fortuitous discovery in stools	None
2009	20	Denmark	Midtjylland (rural)	M (10)	Intermittent non-specific abdominal pain	None
2010	19	Spain	Valencia (urban)*	F (36)	No symptoms: fortuitous discovery in stools	Metronidazole + nitrofurantoin
2010	43	Iran	Mazandaran (rural)	F (22)	Sensation of rectal prolapse	Laxative (polyethylene glycol)
2011	8	Spain	Aragon (suburban)	F (51)	Non-specific abdominal pain and occasional diarrhoea	Laxative + co-trimoxazole (800/160 mg <i>bid</i> , 5 days)

Table 1 Continued

Year	Reference	Country	Region (environment)	Demographics (gender/age)	Symptoms	Treatments
2011	18	Venezuela	Falcón (urban)	F (39)	Colic	None
2013	4	France	Aquitaine (suburban)	F (53)	Intermittent abdominal pain and episodic liquid non-bloody diarrhoea	None
2013	Current report	Colombia	Guajira Peninsula (rural)	F (42)	Abdominal pains and pasty apyretic diarrhoea	Ivermectin (single dose 200 µg/kg)

Keywords searched on PubMed: 'rat-tailed' [All Fields] AND ('larva' [MeSH Terms] OR 'larva' [All Fields] OR 'maggot' [All Fields]) OR 'eristalis' [All Fields] AND ('tenax' [Supplementary Concept] OR 'tenax' [All Fields]) OR 'pseudomyiasis' [All Fields] OR 'myiasis' [All Fields].
Abbreviations: F, female; M, male; NA, not available; *bid*, *bis in die* (twice daily).
§ Immunosuppressive therapy using adalimumab (anti-TNF-alpha) for Crohn's disease.
¶ Probable artefactual contamination of the stool in an open cistern, after its excretion.

to proctitis or anal pruritus.^{3,17} The demographics of patients were diverse: the sex ratio was even (52% of cases involved women), and the median age was 36 years, including both infants and elderly (1–64 years). The distribution was wide, from tropical areas^{15,16} to semi-arid regions,^{18,19} and zones with temperate climates.^{4,20} Most cases have been reported in developing countries where sanitary conditions are poor, especially in rural environments, with the exception of a handful of cases in urban areas.^{15,18,19,21} Unfortunately, the source of contamination has been rarely described with precision. A few infestations have been related to the consumption of stagnant water from a garden fountain⁸ or water extracted from uncontrolled domestic supply systems that actually showed defects.^{4,17,22} Besides, a few cases may have been the result of the consumption of contaminated foodstuffs,^{23,24} such as French watercress¹⁴ or mangos.¹⁵

Empirical antiparasitic treatments, such as metronidazole^{19,41} or co-trimoxazole,⁸ have been prescribed in some cases. However, there is no validated proof of their efficacy, and their usage therefore remains disputable. The clinical outcome of all cases was anyway favourable, even in immuno-compromised patients,¹⁹ and no infectious relapse or clinical sequelae have been reported.

Conclusion

Intestinal myiasis caused by the rat-tailed maggot is accorded little space in the major textbooks of tropical medicine.² Nonetheless, physicians and microbiologists should be aware of the particular morphological features of the Syrphidae larvae when examining a stool sample, especially in tropical countries with low socioeconomic status. However, the definite identification of the fly larvae remains difficult, and additional tools, like SEM, may be useful to reliably confirm the *E. tenax* species. Although the usage of antiparasitic drugs appears disputable when considering the data of the few cases reported in the literature, the possible cause of contamination, most notably defects of the domestic water supply or the sewer evacuation system, should be thoroughly investigated.

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