review

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Wound myiasis in Western Europe: prevalence and risk factors in a changing climate scenario

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Summary
Background Myiasis is an infestation of neglected open wounds by fly larvae. Global warming, related climate changes, and increased traveling in tropical countries may contribute to the worldwide diffusion of new fly species. Common risk factors for myiasis are advanced age, poor hygiene, malnourishment, social isolation, diabetes, cancer, and peripheral artery disease. The aim of this study was to review the characteristics of cases of myiasis reported in Europe.
Methods A narrative review of cutaneous myiasis was performed using PubMed, EMBASE, Web of Science database, and the search terms "human," "myiasis," "cutaneous myiasis," "maggot," "Europe," "wound," with the combination of "AND" and "OR." In addition, hospital charts were reviewed to add personal experience to the literature review.
Results Overall, 52 articles, both single case reports and case series reporting cutaneous myiasis, were found in the medical literature of the past two decades. A total of 64 patients living in Europe were identified, of whom 36% had wound myiasis. In addition to the literature review, we report the case of a male patient who presented with myiasis within a deep scalp ulcer occurring after radiotherapy for basal cell carcinoma.
Conclusion Myasis is rare and possibly under-reported in Europe. The epidemiology of this infestation may be changing in the future due to climate variability, a rise in travel to tropical areas, and the migration of fly species.

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Keywords Cutaneous fly infestation · Maggot infestation · Skin cancer · Global warming

Main novel aspects

- Over the past two decades, cutaneous myiasis in Western Europe has mostly been imported by returning travelers.
- The incidence of myiasis in Europe could rise in the future due to the effects of climate change and to the migration of fly species from tropical and subtropical countries.
- Wound myiasis may worsen the symptom burden and cause distress both to patients and caregivers.
- Appropriate wound care is essential to prevent the occurrence of myiasis.

Introduction

Climate change is widely regarded as one of greatest challenges facing ecological systems and biosecurity in the coming century. The planet is warming from the north to the south pole, and the global average temperature has increased by approximately 1 °C over the past century. Climate changes have led some animal species including mosquitos, ticks, and flies to thrive and, as a consequence, to spread diseases such as malaria and Zika virus infection. Contrary to other insect species, flies are predicted to increase in this warming scenario (*Warming Climate Implies More Flies—and Disease*, Feb. 20, 2019, www.scientificamerican.com).

Myasis (from the Greek, *myia*, meaning fly), first described by Hope in 1840, refers to a condition where fly larvae (maggots) infest the skin of a living human or vertebrate animals, feeding on dead or living tissues [1]. Myiasis shows seasonal variations, and the prevalence of this infestation is related to the latitude and

Table 1 Cutaneous myiasis: summary of case reports in Western Europe (2000–2020)

Author	Year	Country	No. pts	Sex	Age	Location	Type of lesion	Fly species	Comorbidities/Risk factors
Delhaes [8]	2001	France	1	M	21	Leg	Wound	*Calliphora vicina*	/
Logar [9]	2001	Slovenia	1	M	25	Leg	Furuncular	*Dermatobia hominis*	Trip to Peru
Seppänen [10]	2001	Finland	1	M	41	Arm	Wound	*Cochliomyia hominivorax*	Trip to Brazil
Guruttxaga [11]	2001	Spain	1	F	34	Leg	Furuncular	*Cordylobia anthropophaga*	Trip to Senegal
Harbin [12]	2002	UK	1	F	39	Head	Furuncular	*Dermatobia hominis*	Trip to Belize
Hohenstein [13]	2004	Switzerland	1	M	30	Chest	Furuncular	*Dermatobia hominis*	Trip to Costa Rica
Maier [14]	2004	Austria	1	M	59	Scapular area	Furuncular	*Dermatobia hominis*	Trip to Mexico
Rubio [15]	2005	Spain	3	1 M/ 2 F	81	Head and neck	Wound	*Chrysomya* sp., *Sarcophaga* spp.	Head and neck tumor, radiotherapy
Fusco [16]	2005	Italy	1	M	50	Foot	Furuncular	*Cordylobia anthropophaga*	Trip to Senegal
Curtis [17]	2006	UK	1	F	61	Leg	Furuncular	*Cordylobia anthropophaga*	Trip to Portugal
Franza [18]	2006	Italy	1	M	57	Neck	Tracheostomy site	*Lucilia Caesar*	Overweight, pontomesencephalic hemorrhage
Logar [19]	2006	Slovenia	2	1 M/ 1 F	47	Shoulder	Furuncular	*Cordylobia anthropophaga*	Trip to Ghana
Diaz Ley [20]	2006	Spain	1	F	53	Gluteus	Furuncular	*Cordylobia anthropophaga*	Trip to Africa
Calderaro [21]	2007	Italy	1	M	28	Head	Wound	*Dermatobia hominis*	Trip to Brazil
Bongiorno [22]	2007	Italy	1	M	45	Head	Furuncular	*Dermatobia hominis*	Trip to Peru
Goksu [23]	2007	Germany	1	M	49	Back	Furuncular	*Cordylobia anthropophaga*	Trip to Gambia
Hakeem [24]	2008	UK	1	M	54	Back	Furuncular	*Cordylobia anthropophaga*	Work in West Africa, coronary heart disease
Pica [25]	2008	Italy	1	F	61	Back	Furuncular	*Cordylobia* spp.	Trip to Africa
Veraldi [26]	2009	Italy	1	F	34	Back	Furuncular	*Dermatobia hominis*	Trip to Jamaica
Dutto [27]	2009	Italy	1	F	78	Foot	Wound	*Lucilia sericata*	Chronic venous insufficiency
Sesterhenn [28]	2009	Germany	1	M	61	Neck	Wound	*Lucilia* spp.	Squamous cell oropharyngeal carcinoma
Kronert [29]	2009	Germany	1	F	61	Back	Furuncular	*Dermatobia hominis*	Trip to Central America
Dutto [30]	2009	Italy	1	F	79	Foot	Wound	*Sarcophaga cruentata*	Diabetes mellitus
Whitehorn [31]	2009	UK	1	M	40	Arm	Furuncular	*Cordylobia anthropophaga*	Trip to Uganda
Schreiber [32]	2010	Germany	1	M	31	Arm	Furuncular	*Dermatobia hominis*	Trip to French Guiana
Puente [33]	2010	Spain	1	M	34	Leg	Furuncular	*Hypoderma lineatum*	Trip to India
Dutto [34]	2011	Italy	1	F	75	Hand	Wound	*Cyclorrhapha* spp.	Cerebral hemorrhage
Cecchini [35]	2012	France	1	M	47	Foot	Wound	*Lucilia sericata*	Diabetes mellitus
Salvetti [36]	2012	Italy	1	M	30	Head	Wound	*Calliphora vicina*	Cocaine and alcohol abuse, suicide attempt, acute renal failure, rhabdomyolysis
Nagy [37]	2012	Slovakia	2	M	54	Urogenital	Wound	*Lucilia sericata*	Transitional cell carcinoma, alcohol abuse, urogenital gangrene
Dutto [38]	2013	Italy	1	M	81	Foot	Wound	*Sarcophaga africa*	Diabetes mellitus, peripheral arterial disease
Osborne [39]	2013	UK	1	M	36	Head	Wound	*Dermatobia hominis*	Trip to Belize
Kleine [40]	2014	Germany	1	M	55	Head	Wound	*Chrysomya bezziana*	Trip to Malaysia
Lowe [41]	2013	UK	1	M	38	Head	Wound	*Cordylobia anthropophaga*	Trip to Africa
Kay [42]	2014	UK	1	F	47	Foot	Wound	*Dermatobia hominis*	Trip to Panama
Rappelli [43]	2014	Italy	1	M	63	Back	Furuncular	*Hypoderma* spp.	Farmer
Wollina [44]	2015	Germany	3	M	82	Head	Wound	*Lucilia* spp.	Squamous cell carcinoma
Hirsch [45]	2015	France	1	M	47	Shoulder	Furuncular	*Dermatobia hominis*	Trip to Guyana
Pezzi [46]	2015	Italy	1	M	45	Head	Furuncular	*Cordylobia rhodaini*	Trip to Uganda
Gaci [47]	2015	France	1	M	60	Scrotum	Furuncular	*Dermatobia hominis*	Trip to South America

Table 1 (Continued)

Author	Year	Country	No. pts	Sex	Age	Location	Type of lesion	Fly species	Comorbidities/Risk factors
Landehag [48]	2011–2016	Norway	7	3 F/4 M	46	Head	Furuncular	*Hypoderma tarandi*	/
Villaescusa [49]	2016	Spain	1	M	62	Foot	Wound	*Wohlfahrtia magnifica*	Diabetes mellitus, poor personal hygiene, coronary artery disease
Giangaspero [50]	2017	Italy	1	F	101	Skin	Wound	*Sarcophaga argyrostoma*	Bedridden
Hong How [51]	2018	UK	1	F	32	Leg	Furuncular	*Cordylobia anthropophaga*	Trip to Gambia
Wade [52]	2018	UK	1	F	55	Head	Furuncular	*Cordylobia rodhaini*	Trip to Uganda
Bernhardt [53]	2018	Germany	1	M	/	Foot	Wound	*Phormia regina, Lucilia sericata*	Homeless, paranoid schizophrenia, drug and alcohol abuse
Demaj [54]	2019	Albania	1	M	48	Head	Wound	*Lucilia sericata*	Basal cell carcinoma
Watkins [55]	2019	UK	1	F	50	Head	Wound	*Dermatobia hominis*	Trip to Argentina
Toberer [56]	2019	Germany	1	F	35	Leg	Furuncular	*Dermatobia hominis*	Trip to Peru
Dunphy [57]	2019	UK	1	M	18	Head	Furuncular	*Dermatobia hominis*	Trip to Belize
Di Tullio [58]	2019	Italy	1	M	52	Head	Furuncular	*Dermatobia hominis*	Trip to Argentina
De Pasquale [59]	2019	Italy	1	M	34	Head	Wound	*Sarcophaga* sp.	Poor sanitary conditions, psoriasis, lymphoma
Oliva [60]	2020	Italy	1	F	22	Gluteus	Furuncular	Cor*dylobia anthropophaga*	Trip to Kenia

the life cycle of the fly species. According to the relationship between the host and parasite, there are three forms of myiasis: obligate (tropical in origin), facultative [2], and accidental [3]. The last two, although rare, can be found worldwide. Climate change and the migration of fly species due to increased travel to tropical areas may increase the incidence of this infestation in Western countries. Cutaneous myiasis is the most frequently encountered clinical form. Risk factors predisposing to this condition are open wounds, advanced age, poor hygiene, low socioeconomic conditions, psychiatric illness, alcoholism, metabolic disorders, vascular disease, cancer, and physical handicaps [4–7].

Materials and methods

We performed a search for articles reporting on cutaneous myiasis in adult patients, acquired in Western Europe or acquired overseas but diagnosed in Western Europe over the past two decades. A literature review was performed to identify all published articles on cutaneous myiasis in PubMed, EMBASE, and Web of Science database, using the keywords "human," "myiasis," "cutaneous myiasis," "Europe," "Western Europe," "wound," with "AND" and "OR." We also consulted the hospital electronic database to find the records of patients admitted to the emergency room for cutaneous parasitic infestations. Demographic and clinical patient data were extracted from the hospital charts. Written informed consent was obtained from patients.

Results

Human cutaneous myiasis in Western Europe

Our literature search yielded 1920 articles published between 2000 and 2020. Reports describing patients observed in countries other than Western Europe (Turkey, India, Pakistan, Malaysia, United States, Canada, Brazil, China, etc.) were excluded. A total of 52 papers were selected including 64 patients reported in Europe. The main patient characteristics are presented in Table 1 [8–60]. Myiasis was mainly described as furuncular (64%) or associated with a wound (36%). Reports comprised single case reports and case series including up to seven patients. The median age was 47 years (range 21–101), and 39 (61%) patients were males; in more than 50% of patients, myiasis was acquired in a tropical country but diagnosed in Western/Southern Europe, mostly Italy and Spain. The principal anatomical site was the head and neck region (38%), followed by lower limbs and trunk. Diabetes mellitus and head and neck tumors were the most common comorbidities. The main fly species involved where *Dermatobia* spp., *Cordylobia* spp., and *Lucilia* spp.

Case report

A 91-year-old man presented to the emergency department complaining of moderate bleeding from a skin lesion in the frontotemporal area. His medical history was notable for diabetes mellitus and invasive basal cell carcinoma treated first with surgery and then with radiotherapy (20 Gy) due to local recurrence. Physical examination revealed a deep, ulcerated lesion, 4 × 5 cm in size, with numerous maggots inside.

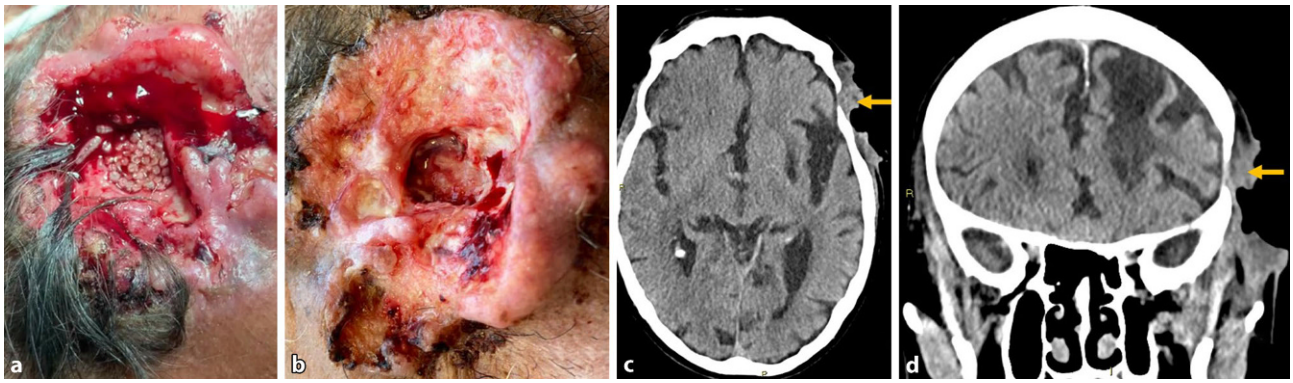

Fig. 1 **a** Maggots inside an ulcerated wound in the frontoparietal area; **b** 1 week after mechanical removal of fly larvae and debridement; **c, d** computed tomography showing bone destruction (*arrows*) after radiotherapy for recurrent basal cell carcinoma of the skin

Mechanical removal of all larvae, intensive irrigation with saline solution, and wound debridement were performed. Laboratory findings were normal. A computed tomography scan showed full-thickness bony destruction and no meningeal lesions (Fig. 1). After multidisciplinary team discussion (surgeon, neurologist, radiologist), only frequent dressing changes and antibiotic therapy were recommended. One week later, the patient was doing well with no evidence of maggots and no signs of wound infection or neurologic involvement.

Discussion

This review shows that wound myiasis is rarely reported and possibly underestimated in Western Europe, confirming that epidemiological data on human myiasis are scant [7]. In our case, myiasis complicated the clinical course of an elderly patient with recurrent basalioma of the scalp after failed surgical excision and radiotherapy. Half of the patients in our review had a history of recent travel, the majority from Central–South America. Compared with the United States [61], reports of autochthonous cases of myiasis in Western Europe appear less common. In the future, climate change and possible migration of new fly species from tropical and subtropical countries could increase the incidence of this condition and modify the epidemiologic characteristics of human myiasis in Europe. In view of this changing scenario, larval identification by an entomologist and registration of all observed cases should be pursued [7]. Well-known risk factors predisposing to myiasis are open wounds, frailty syndrome, poor hygiene, low socioeconomic conditions, psychiatric illness, alcoholism, diabetes, vascular disease, and cancer. Complex wounds are frequently seen in nosocomial, hospice, and palliative medicine settings, and wound myiasis may worsen the symptom burden and may cause distress both to patients and caregivers [62]. Health education and prevention of conditions that favor myiasis infestation represent the most effective intervention. For individuals traveling to rural endemic areas, covering the body with long-sleeve shirts, pants, and hats, use of insect repellents, and sleeping on raised beds, in screened rooms, or under a net are recommended. Clothes should be hot-ironed and dried to remove residual eggs. Simple antisepsis and dressing are adequate to prevent wound myiasis [7].

In general, myiasis is a self-limited infestation and carries minimal morbidity. Treatment of cutaneous-wound myiasis consists of application of toxic agents to kill the larvae or perilesional infiltration of local anesthetics to force the emergence of the larvae. Pharmacological treatment with ivermectin or tiabendazole has been proposed on the basis of anecdotal reports, mainly from veterinary medicine, but no controlled studies are available [7]. Mechanical debridement and frequent renewal of wound dressing are curative in the majority of cases [62, 63].

Interestingly, therapeutic myiasis involving sterile harvesting of facultative fly larvae applied on chronic wounds is a well-known option for necrosis debridement, disinfection, and enhanced healing [64–66]. *Lucilia sericata* is considered the most suitable species for therapeutic application [7].

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Declarations

Conflict of interest E. Andreatta and L. Bonavina declare that they have no competing interests.

Ethical standards All procedures performed in studies involving human participants or on human tissue were in accordance with the ethical standards of the institutional and/or national research committee and with the 1975 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent was obtained from the patient included in the study. Internal review board approval HSD 2020-077.

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