

Myiasis: Diagnosis, Treatment and Medical Use of Maggots

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ABSTRACT

Two myiasis cases are presented which illustrate aspects of this infestation, and the role of the medical laboratory scientist with regard to the importance of critical thinking, problem-solving, and interprofessional communication skills. The purpose is to heighten awareness of myiasis, and emphasize the role of the medical laboratory scientist as a member of the healthcare team in confirming diagnosis.

ABBREVIATIONS: MLS - Medical Laboratory Scientist, MDT - maggot debridement therapy

INDEX TERMS: myiasis, maggots, fly larva

Clin Lab Sci 2013;26(2):76

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INTRODUCTION:

Myiasis refers to infestation of vertebrates by fly larva. In the United States, human infestation has been reported from rural areas where humans have increased contact with domestic and wild animals, and has also been associated with travel to tropical/sub-tropical areas.¹ Though myiasis is infrequently seen in the United States, cases do occur. Myiasis presents a laboratory diagnostic challenge that requires the medical laboratory scientists (MLS) to utilize critical thinking, problem-solving, consultative and inter-professional communication skills. Two myiasis cases are presented

which illustrate the aspects of this infestation, and the role of the MLS as a member of the healthcare team in confirming diagnosis.

CASE 1

A vaginal specimen from the outpatient clinic was sent to the microbiology laboratory for routine culture, and was evaluated by the medical laboratory scientist (MLS). Several cracks/tracks in the blood agar plate (BAP) were observed, and noted as possible agar contamination. The clinic was notified, a repeat specimen was sent to the lab, and after incubation cracks/tracks were again observed in the agar. Opening the cracks/tracks wider revealed small white/grayish structures embedded in the tracks. The structures were extracted, placed on a glass slide, and examined using a magnifying lens and microscope. Consultation between the MLS and the clinical pathologist confirmed the identification of the structures as fly larva (maggots). Minimal patient information was provided, and the MLS contacted the clinic to obtain additional patient history that could assist in determining a rationale for observing fly maggots in the specimen. Patient history revealed a 42 year old homeless woman with extremely poor personal hygiene. The patient came to the clinic with symptoms of extreme discomfort in the vaginal area, as well as various other issues related to her homeless state, poor hygiene, and lack of medical care. Based on patient history and symptoms, and the identification of fly maggots from the genital area, the diagnosis of infestation of the genital tract with fly maggots, myiasis, was confirmed.

CASE 2

A specimen from a pediatrician's office was sent to the microbiology lab for ova and parasite workup. The specimen was sent in a white box that contained small white/grayish structures resting on a piece of gauze. The MLS viewed the structures using a magnifying lens and microscope, and identified the structures as fly larva. Consultation between the MLS and the clinical

pathologist confirmed the identification of the structures as fly larva (maggots). Minimal patient information was provided, nor was the source of the structures noted. The pediatrician's office was contacted by the MLS to obtain additional patient history that could assist in determining a rationale for observing fly maggots in the specimen. Patient history revealed an 18-year-old male with superficial abrasions on his abdomen. The small white structures sent to the lab were extracted from abdominal abrasions around the navel. Additional history noted that the patient sustained the abdominal abrasions while performing his work responsibilities. His summer employment was with the local fishing industry, mainly working on the fishing docks lifting crates, and he often worked without wearing a shirt. Based on patient history and symptoms, and the identification of fly maggots extracted from the dermal tissue, the diagnosis of myiasis was confirmed.

MYIASIS: EPIDEMIOLOGY/PREVALENCE

The root of the word myiasis comes from the Greek word for fly, *myia*.² Myiasis is worldwide in distribution, and a common condition in wild and domestic animals.¹ Though infrequently seen in humans, cases have been reported from rural areas where humans have increased contact with animals, both domestic and wild.¹ In the United States most cases are associated with travel to tropical and subtropical areas, and in cases with no travel history, infestation is usually associated with wounds. The literature also documents cases of human infestation in homeless persons, and patients with conditions including alcoholism, peripheral vascular disease, and cancer, and infestation of body areas include skin, wounds, genital, intestine, oral, nasal, aural and ocular.^{3,4,5,6,7,8}

Flies are in the Order *Diptera*, and several genera are associated with human myiasis.^{9,10} Genera associated with human infestation include *Dermatobia*, *Cochliomyia*, *Chrysoma* and *Cordylobia*, and the site of infestation and symptoms can vary based on the species and the life cycle.^{9,10} Common names often used are the human bot fly (*Dermatobia hominis*), New World screwworm fly (*Cochliomyia hominivorax*), and the Old World screwworm fly (*Chrysoma bezziana*). The tumbu fly (*Cordylobia anthropophaga*) is found in Africa.

Genera that primarily infest animals but may occasionally infect humans are *Cuterebra*, *Oestrus* and *Wohlfahrtia*.^{1,11}

CLASSIFICATION

There are several classification schemas for myiasis based on anatomical or ecological characteristics. However the anatomical model described by Bishopp and modified by James and Zumpt is considered the most practical in terms of diagnosis.¹² A common modification of this schema describes myiasis as (1) Bloodsucking; (2) Cutaneous (furuncular); (3) Wound; or (4) Cavitory.¹³ Cutaneous (furuncular and wound) and cavitory (i.e. nasal, oral, genital, ear, etc.) myiasis are the most frequently encountered in human infection.¹⁴ In furuncular cases, lesions form at the site of penetration and resemble boils or furuncles and diagnosis is based on clinical symptoms and patient history. The larvae do periodically emerge from the lesions for respiration.¹⁵ Cavitory myiasis is associated with infestation of external body orifices and open wounds, and cause tissue necrosis with possible sequelae such as bacterial infections.¹⁶

Because of the diversity of genera and species that can cause myiasis and life cycle variations, another classification schema based on parasite-host relations and the site of infestation has also been employed. This classification method describes four major categories. Specific myiasis (obligate) refers to flies which are parasites and whose larval stage requires a host to develop and continue the life cycle. Examples include the human bot fly (*Dermatobia hominis*), and the tumbu fly (*Cordylobia anthropophaga*).^{1,17} Semi-specific myiasis (facultative) refers to flies that usually develop on decaying organic matter, but may also deposit their eggs or larvae on live hosts. This category is sub-divided into three groups: Primary - in which the species can initiate infestation; Secondary - in which the species does not initiate myiasis but may be involved if the host has been infested by another species; Tertiary - may be associated with myiasis when the host is near death. Examples are the green-bottle fly (*Lucilia*), and the blowfly (*Calliphora*).^{1,17} Accidental myiasis refers to flies that do not have any specific requirements for a host, and larvae do not need a host for development. Eggs are accidentally deposited on the body or tissue, such as in the genital track and nasal passages (Figure 1), or larva may enter the intestinal tract. Examples are the

common housefly (*Musca domestica*), and the latrine fly (*Fannia*).^{1,17} Nosocomial myiasis refers to hospitalized patients acquiring an infestation, usually in open wounds or bed sores.^{1,18,19,20,21,22}

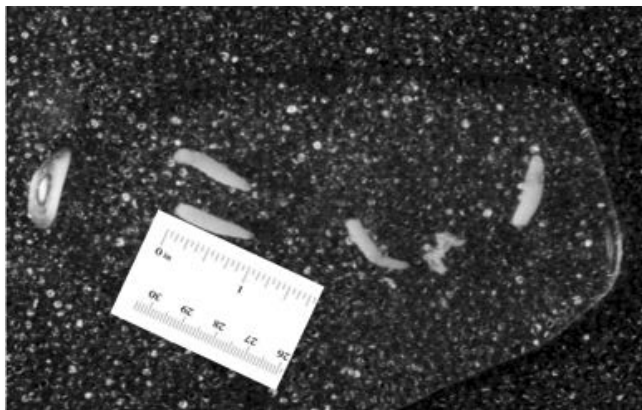


Figure 1. Larva from nose (VanHorn)

DIAGNOSIS AND TREATMENT

Diagnosis of myiasis can be challenging because of the numerous species associated with infestation, and symptom variation based on anatomical location. Misdiagnosis of myiasis is not uncommon. Symptoms are similar to other infections, ranging from a simply mosquito bite to cellulitis, impetigo, herpes zoster and parasitic infections such as *Dracunculus* and *Leishmania*.^{23,24} One case reported in the literature describes two athletes with myiasis infestation that were initially diagnosed as a methicillin resistant *Staphylococcus aureus* (MRSA) infection.²⁵ In this case, further investigation revealed a travel history to a tropical area, emphasizing the importance of a thorough patient history which includes questions about recent travel.

The removal of the maggots from tissue can be difficult due to the anterior hooks that function as an anchor.²⁶ (Figure 2) Preservation of maggots and mounting for observation can be performed in the laboratory. Larvae are killed by emersion in hot water, and preserved in 70% - 95% ethanol.⁷ Definitive speciation of the maggots involves viewing spiracular plates located on the posterior end of the larvae.^{17,27} Another method is to place the live maggots on raw meat in a container or petri dish with sand lining the bottom, wait for the development of the adult fly, and then view for identification.¹ Though these procedures can be performed in the clinical laboratory, identification at the species level requires considerable entomological

expertise. Laboratories who do not have the expertise should consider sending the larva to a reference laboratory for speciation. An internet search of the major diagnostic reference laboratories in the United States yielded information related to arthropod and insect identification services. Alternate options are entomology reference labs and state department of health clinical laboratories. From an epidemiological perspective, full speciation may be relevant. However, issues of cost, efficient utilization and delivery of laboratory services, and relevance of speciation related to patient care and outcomes must also be considered.

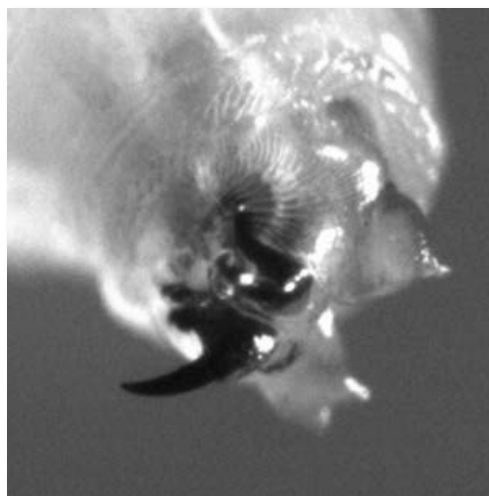


Figure 2. Anterior hooks of *Phaenicia* sp removed from surgical wound. (CDC-DPDx. Image courtesy of the Washington State Public Health Laboratories)

The first treatment option is removal of the larvae. Coating the area with petroleum ointment (Vaseline) or other substances that are easily available such as pork fat, or raw beefsteak will restrict oxygen flow and force the larvae to surface for respiration.¹⁵ Forceps are used to extract the larvae once they surface.^{15,17} If this procedure is unsuccessful, surgical or vacuum extraction is recommended.²⁸ Several reports in the literature demonstrate the successful use of ivermectin in treating human myiasis infestation.^{29,30,31,32,33} Ivermectin was approved by the US Food and Drug Administration (FDA) as an anthelmintic treatment for gastrointestinal roundworms, lung worms, cattle grubs, mites, lice and horn flies, but is not approved to treat human myiasis infestation.^{34,35} Though there are reports of success in treating human myiasis with ivermectin, the use of the drug in human myiasis infestation is off-label. The FDA does allow clinicians to prescribe medications for conditions that are unapproved by the FDA for use of a

drug. This is referred to as off-label use of a medication.^{36,37}

MEDICAL DEBRIDEMENT THERAPY

The medical use of maggots in a controlled environment using sterilized maggots is referred to as maggot debridement therapy (MDT), larva therapy, biodebridement and/or biosurgery.^{38,39} MDT is, in essence, a controlled induced myiasis employed as a therapeutic approach to wound debridement. There is evidence that certain cultures and civilizations, such as the Australian aborigines, Burmese, and the Mayans, used maggots as a form of wound therapy.^{40,41} The literature also cites history noting the use of maggots in treating war wounds.^{42,43}

There is renewed interest in MDT, particularly in the advent of antimicrobial resistance, and global interest in complementary and alternative medicine therapies/strategies as alternatives to antimicrobial and chemotherapeutic agents.^{38,44,45,46,47,48,49,50,51} The FDA approved the LB-01 strain of *Phaenicia (Lucilia) sericata* for use in medicinal maggot therapy.⁵² Cases have been reported of successful use of MDT in foot wounds of diabetic patients that have not responded well to conventional therapeutic regimes.^{53,54} The use of medicinal maggots is a cost effective treatment strategy (~\$100) versus more expensive treatment options such as antimicrobial therapy and surgery.⁵⁵ Research is being conducted to explore the use of sterile maggot secretions to prevent, inhibit, and break down biofilm formation in wounds and on medical devices, and efficacy has been reported with biofilms of *Staphylococcus epidermidis*, *Staphylococcus aureus*, and *Pseudomonas aeruginosa*.^{56,57,58}

DISCUSSION/CONCLUSION

The two cases presented were classified as accidental myiasis. Both cases demonstrate the importance of patient history as an essential component required by the medical laboratory scientist to aid in identification. Pertinent patient history, particularly in the microbiology laboratory, can aid in the decision-making process. The importance of critical thinking, problem-solving, and interprofessional communication skills, as well as a learning experience about an unusual infestation are important aspects of both cases. The cases provide a heightened awareness of myiasis, and emphasize the role of the medical laboratory scientist in diagnosis. Awareness and knowledge can increase a

medical laboratory scientist's efficiency in confirming diagnosis as a member of the inter-professional healthcare team dedicated to patient care.

ACKNOWLEDGEMENT: The author would like to acknowledge Dr. Kenneth G. Van Horn for Figure 1.

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