Teaching Notes for the Myiasis Case of Margret Anvil

This example case is similar to various myiasis cases in which we have been consultants. The objective is to determine how long the maggots have been on Ms. Anvil, with the implication that if the maggots have gone unrecognized for a long period (> 12 hours) they are a sign of poor care or even neglect. Students are provided case materials analogous to those we have been given in real cases – for good and bad. Ideally, samples of the maggots should be available so the age and species can be determined, but the absence of these materials is all too common in the real world.

To be successful with this exercise, the students will need to understand the phenomenon of myiasis. A summary on myiasis is provided in our report following these notes, and the CDC and Wikipedia pages on myiasis are particularly good resources. Additionally, students need to understand the life cycle of blow flies – egg, 1st stage larva, 2nd stage larva, 3rd stage larva, pupa, and adult. They also need to be aware that development of the maggots depends on temperature and time. Of importance for this case, the time necessary for eggs to develop and hatch to 1st stage larvae is approximately 8-12 hours, and the time for development to later stages is many additional hours/days. Also, most feeding occurs in in the 3rd larval stage which is also the stage in which movement from the egg laying site is most likely.

The students will have to read the provided documents closely to reveal important clues about the duration of this infestation (and hints may be appropriate). There are three to four important sources of evidence:

(1) the photograph shows a combination of eggs and 1st stage maggots, so we know from this that the infestation is at least 8-12 hours old;
(2) in the patient history, “Dr. Toboggan said the maggots have pretty well debrided most of the necrotic tissue”; this debridement or removal of necrotic tissue would be associated with later stage maggots (not 1st stage), therefore the infestation must have started at least a day or more before admission to the ER;
(3) in the operative report, it is noted that “There were several tunnels which were unroofed revealing more maggots.”; this is consistent with later stage (3rd stage) maggots and supports the conclusion that the infestation began some days before admission to the ER; and
(4) a similar statement regarding maggots in tunnels is made in the resident transfer form.

To maintain the guise of being forensic experts, we recommend that students provide their answers on the report template we provided. They could even keep track of their billable hours! And as a key to the assignment, we provide our own completed report template.

Could there be more to this assignment? Well, if this were the real world, we would go ahead and do some calculations of development times for the blow fly *Lucillia sericata*. This species has the fastest development rates of those in the U.S., so it serves as a model for looking at minimum

development times. By figuring out the development rates at body temperature, we could offer a more accurate estimate of the minimum time maggots were on poor Ms. Anvil.

You and your students might be wondering if the maggot infestation was a good thing, in that the doctors said it led to debridement of the wound. Unfortunately, in an uncontrolled situation, we have no way of knowing if the maggots involved were benign or malignant, and there was no monitoring for secondary infection. So, on balance, not a good thing.

Vocabulary in the reports (that the students will likely need to lookup)

eschar
necrotic
pulsavac
saphenous

Case #01:

Investigators: Leon Higley and Amanda Roe

Evidence Submitted:

1. Medical Records
2. Photograph of maggot infestation

Conclusion:
Photographs definitively show maggot eggs and 1st stage larvae. Reports describe extensive debridement and maggot movement in "tunnels" both of which are associated with late 2nd or 3rd stage maggots. Based on this combination of factors we conclude that the infestation had begun at least 2 days prior to the admission of Ms. Anvil to the ER.

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Scenario
A maggot infestation was found on the leg of a 69-year old woman on admission to the emergency room. The patient had been transferred from another medical facility upon discovery of the maggot infestation. A photo of the infestation was taken on admission to the ER, and maggots were subsequently removed (none were collected).

Background
The infestation of human tissue by flies (insects in the Order Diptera) is termed myiasis. The most common dipterans associated with myiasis are in the families Oestridae (bot flies), Calliphoridae (blow flies), and Sarcophagidae (flesh flies), although myiasis is possible with other groups (e.g., Phoridae). Biologically, myiasis-producing species have been characterized as obligate (requiring a living host) or facultative (able to develop on carrion or live hosts). Similarly, myiasis itself can be characterized as malignant (feeding on healthy tissue) or benign (feeding on necrotic tissue). Most examples of accidental human myiasis in temperate regions are associated with flies in the Family Calliphoridae, and most myiasis here is benign. Female flies are attracted to decomposing or necrotic tissue, and lay eggs at suitable sites during daylight hours. After the eggs hatch (in 8-12 hours at body temperature), the larvae (maggots) feed on rotting tissue and develop through three larval stages. Once development of the 3rd stage larva is complete, larvae migrate away from the feeding site, change into pupae, and eventually emerge as adults. Because insects cannot maintain constant body temperatures, the growth rate of fly larvae is a function of environmental temperature, although very large masses of maggots can generate sufficient metabolic heat to produce temperatures above ambient.

In some instances, sterile maggots are used medically to debride wounds in a procedure called surgical myiasis or maggot therapy. This procedure can only be conducted by a physician and must use sterile maggots producing benign myiasis to avoid secondary infection or unnecessary tissue loss.

Methods
Insights into the duration of the infestation were derived from a detailed examination of medical records and a review of the photograph of maggots on the wound.

Findings and Discussion
(1) The photograph shows a combination of eggs and 1st stage maggots, so we know from this that the infestation is at least 8-12 hours old;
(2) In the patient history, "Dr. Toboggan said the maggots have pretty well debrided most of the necrotic tissue"; this debridement or removal of necrotic tissue would be associated with later stage maggots (not 1st stage), therefore the infestation must have started at least a day or more before admission to the ER; and
(3) In the operative report, it is noted that "There were several tunnels which were unroofed revealing more maggots."; this is consistent with later stage (3rd stage) maggots and supports the conclusion that the infestation began some days before admission to the ER. This observation agrees with the resident transfer form which points out that "…magets [sic]… start to disappear up into what appeared a tunnel under the skin (incision line)."

From these findings we conclude that the infestation began at least 2 days before admission to the ER on July 15.

Disposition of Evidence
Records and photograph were retained in our files.

References
Haskell, N. A., and R. E. Williams (eds.) Entomology and Death: A Procedural Guide. 2nd edition. East Park Printing, Clemson, SC

Sherman, R.A, M. J. R. Hall, and S. Thomas. 2000. Medicinal maggots: an ancient remedy for some contemporary afflictions. Annu. Rev. Entomol. 45:55-81