Archaeoparasitological Analysis of Grave Sediments from Meadowlark Cemetery, Kansas

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Introduction

Scientists have been using different techniques to look for parasites in ancient material (Araujo et al. 1998; Bouchet et al. 2003a). Coprolites or desiccated feces or fecal remains mixed with soil sediment are commonly found in archaeological excavations. The parasitological analysis of such material yields rich information about paleopathologies, human migrations, cultural changes, dietary habits, paleoclimates, parasite dispersion, and host migrations throughout space and time (Reinhard et al 2001).

Materials and Methods

Sediments from an emergency excavation of the Meadowlark Cemetery (Figure 1), on the grounds of Meadowlark Hills Retirement Community, Manhattan, Kansas (Figure 2), used between 1860 and 1900 were analyzed. Archaeologists conduct the excavations in the summer and early fall of in order to verify the presence of graves and relocate encountered human remains. This project was undertaken to make way for the impending construction of new residences on the retirement community property. Soil samples were collected from the pelvic region of the skeletons from five of the seventeen graves excavated: MC F9, F10, F12, F13 and F17 (Table 1).

The material was submitted to standard paleoparasitological examination with optic microscope to search helminths eggs, resultant from an infestation by any number of species of parasitic worms. A commercially available enzyme-linked immunosorbent assays (ELISA) with monoclonal antibodies were also used to test for antigen from *Entamoeba histolytica* (Figure 3) (Haque et al. 2000) and *Giardia duodenalis* (Aldeen et al. 1998, Boone et al. 1999), two common intestinal protozoan parasites.

Figure 3: *Entamoeba histolytica*

For the standard paleoparasitological examination, the samples were rehydrated for a week in 0.5% trisodic phosphate and 5% glycerinated solution. The material was then crushed in a mortar. The suspension was submitted to an ultrasound device for [one minute] [delete- 1 min] at 50°C, on a frequency of 35 kHz, and the suspension strained through 315-µm, 160-µm, 50-µm, and 25-µm meshes. A portion of each sample was used for microscopic examination. The material was placed on a slide and covered with a cover-slip and examined for the presence of parasites and food remains. Twenty slides of each sample were examined at magnification of x 100 and x 400 (Bouchet et al. 2001).

For the ELISA tests, the *E. histolytica* II and the *Giardia* II assay (TechLab, Blackburg, VA, USA) were used. Sample preparation was quite different to provide physicochemical parameter modifications, especially due to formalin (Exbrayat 2000). The samples were rehydrated for one week in ultra pure water obtained from a purification system by Millipore® (Direct-QTM 5). Samples were preserved in the freezer (2-4 °C) during rehydration phase to avoid bacteria and fungi development. Manufacturer's directions were followed and results were interpreted by visual inspection and by a spectrophotometer. A test sample was considered positive if it had an obvious yellow color when compared to the negative control well. A test sample was considered negative if it was colorless or less yellow than the negative control well. The absorbance of each specimen was also measured at 450 nm wavelength (Haque et al. 2000).

Figure 4: Image of *Ascaris lumbricoides*

Results

Microscopic examinations revealed helminth eggs, resultant from an infestation of the parasitic roundworm species known as *Ascaris lumbricoides* (Figure 4) in only one of the five samples (MC F9). Samples MC F10, F12 and F13 tested positive for the presence of the *E. histolytica* antigen, which is the causal agent of amoebic dysentery and amoebic liver absces (Table 1), but all samples were negative for the *G. duodenalis* antigen (Giardia).

Table 1: Characteristics of burial features tested from Meadowlark Cemetery, and positivity for *Entamoeba histolytica* ELISA test and tests for helminth infestation.

Burial Feature	Age	Sex	*E.Histolytica* antigen present?	*A. lumbricoides* evidence present?
Feature 9	Infant	Unknown	Negative	Positive
Feature 10	Subadult, 3-4 years	Unknown	Positive	Negative
Feature 12	Subadult, 6-7 years	Unknown	Positive	Negative
Feature 13	Adult, 40-55 years	Male	Positive	Negative
Feature 17	Subadult, 18 months ± 6	Male? (clothing elements)	Negative	Negative

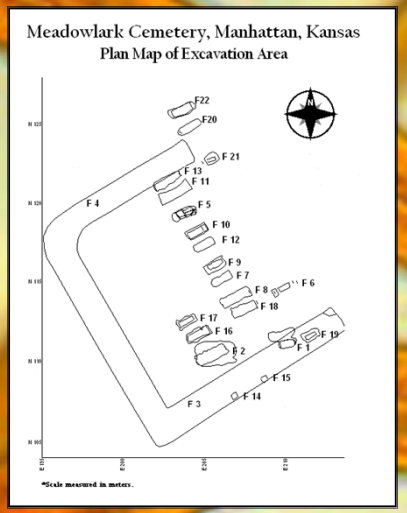

Figure 1: Plan map of Meadowlark Cemetery, Kansas

Abstract

During the excavations of the 19th century Meadowlark Cemetery in Manhattan, Kansas, samples of sediments were taken from five burials and analyzed for intestinal parasites. Immunological ELISA tests for *Entamoeba histolytica* were positive in three samples, and helminth eggs were found in the sample from one individual. These immunological techniques have been successfully used to detect protozoan infections. Amebiasis could have been a severe disease in the past, especially where poor sanitary conditions prevailed. Therefore, it can be shown that Archaeoparasitology is a useful tool in determining living conditions and quality of life in historic and prehistoric populations, but is a field that has been rarely utilized in historic cemetery studies. This study seeks to interpret the parasitological analysis within the framework of the historical archaeology of Meadowlark Cemetery.

Figure 2: Image of the sign of Meadowalrk Hills Retirement Community, NW of cemetery location

Discussion

It is possible to infer sanitation conditions and even lifestyle in human settlements through the recovery and identification of parasites in archaeological material (Araujo et al. 1998; Reinhard 1992). The parasitic agents discussed above are most commonly transmitted through contaminated food or water sources (see Figure 5), as well as poor waste management and education about proper cleanliness. Due to the factors of transmission listed above, often individuals of low socio-economic status fall prey to such parasites, particularly in the 19th century.

Health and evidence of skeletal and/or nutritional Stress are largely a reflection of quality of life, and therefore are strongly related to socio-economic status. While there are degrees of environmental factors involved in the assessment of quality of life, such as pathological stressors, they are often tied back into factors culturally created factors such as sanitation, access to resources, and education. Cultural adaptations act as a buffer between human populations and environmental stressors, however, stressors are sometimes effectively and often inadequately buffered by cultural adaptation. Culture also produces its own set of stressors, including those factors dealing with sanitation, where "certain segments of the populations may also be at greater risks because their biological requirements are not matched by biological resources." Thus, the identification of particular markers, which can elucidate the relationship between status and quality of life, such as the analysis of parasites, are important (Larsen 1997).

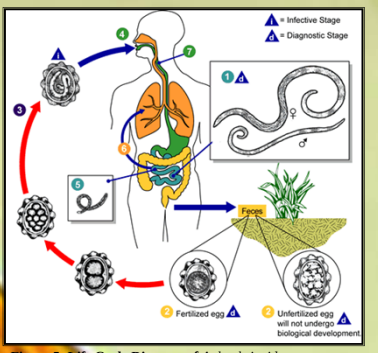

Figure 5: Life Cycle Diagram of *A. lumbricoides*

At the outset of the excavations of Meadowlark Cemetery, Manhattan, Kansas, the researchers learned that William H. Stillman had owned the land on which the cemetery was formed. Stillman, a physician from Rhode Island, homesteaded in Riley County, Kansas, in 1860. Two main threads of lore emerged from various local sources about the property. Pat Fry, a local woman related to the 1915 landowners, said that Stillman was running the county poor farm, as well as an orphanage. If an orphanage existed on this property during the use life of the cemetery, then one would expect to see a large proportion of subadults present, as well as a high incidence of infection due to low bacterial and parasitic thresholds.

Beginning in 1880, there are newspaper accounts of Dr. Stillman receiving money from the county for care of the poor (*Manhattan Enterprise*, 8/13/1880). Aside from the orphanage, the second explanation for the land was that it was used for a poor farm. At the end of the 19th century, almshouses, as well as private and county poor farms were established to provide care and work for the indigent and a means of subsistence to young laborers, often at the lowest possible cost to the federal or town government (Bell 1990). However, there are no records of Dr. Stillman running the county poor farm, in fact, there were heated debates in the newspapers about the need for a county poor farm until its eventual creation in 1894. By definition, orphans and poor migrant workers would not usually be able to attain high social status in the society, and therefore might also have lived in unsanitary conditions giving them high exposure to parasitic agents.

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