

IN BRIEF

THE PLAGUE OF ATHENS: AN ANCIENT ACT OF BIOTERRORISM?

Manolis J. Papagrigrakis, Philippos N. Synodinos, Angeliki Stathi, Chrysanthi L. Skevaki,
and Levantia Zachariadou

Recent data implicate *Salmonella enterica* serovar Typhi as a causative pathogen of the Plague of Athens during the Peloponnesian War (430-426 BC). According to Thucydides, the sudden outbreak of the disease may link to poisoning of the water reservoirs by the Spartans. The siege of a city was aimed at exhausting the supplies of a population, which often led to the outbreak and spread of epidemics. Poisoning of the water reservoirs of a besieged city as an act of bioterrorism would probably shorten the necessary time for such conditions to appear.

UNTIL RECENTLY, ALL THEORIES connected to the cause of the Plague of Athens were exclusively based on Thucydides' account of the disease.¹ Although many pathogens have been proposed as possible causative factors of the plague, none has been generally accepted as such, because profound differences exist between the reported (by Thucydides) signs and symptoms and the clinical appearance of any contemporary infectious disease.²

Recent data resulting from research conducted with ancient DNA provide evidence for the presence of *Salmonella enterica* serovar Typhi in putative victims of the Plague of Athens.³ The investigated skeletal material was discovered in a mass grave unearthed in the outskirts of Kerameikos' ancient cemetery of Athens, and it was dated on the basis of archaeological site documentation around the time of the epidemic outbreak.⁴ Although the concurrent presence of multiple infectious diseases in besieged Athens in 430-426 BC has not been excluded, typhoid fever has been definitely implicated as the cause of the epidemic.^{5,6}

In a review article by our group, clinical and epidemiologic data related to typhoid epidemics of modern times are correlated with Thucydides' account of the disease's signs and symptoms, while reasonable explanations are offered for their apparent differences.⁷ Infectious disease can be considered as a likely cause of the Plague of Athens.⁸ Infectious diarrheas and dysentery, as described by the ancients, imply that typhoid fever was an endemic problem of that time.⁹ The putative evolution of the genome of the specific *S. Typhi* strain over time, spanning between ancient Athens of 430 BC and today, may also account for the varying clinical symptomatology.¹⁰

Future molecular investigations could provide further evidence pertaining to the specific strain of *S. Typhi* or its speculative combination with other pathogens as the cause of the Plague, whereas the pathway of its introduction into the city of Athens remains to be addressed. In Thucydides' *History of the Peloponnesian War*, a very important relevant note is cited (Thucydides §2.48.2): "Suddenly falling upon

Dr. Manolis J. Papagrigrakis is Assistant Professor of Orthodontics, School of Dentistry, and Students' Supervisor, Museum Studies Research Centre, University of Athens, Athens, Greece. Dr. Philippos N. Synodinos, MSc, is an orthodontist and Research Fellow, Museum Studies Research Center, University of Athens. Angeliki Stathi, BSc, PhD, is a Biologist, Department of Microbiology; Chrysanthi L. Skevaki, MD, PhD, is a Resident in Medical Biopathology and a postdoctoral research associate; and Levantia Zachariadou, MD, is Director, Department of Microbiology; all at the Aghia Sophia Children's Hospital, Athens, Greece.

Athens, it first attacked the population in Piraeus—which was the occasion of their saying that the Peloponnesians had poisoned the reservoirs, there being as yet no wells there—and afterwards appeared in the upper city, when the deaths became much more frequent.” Thus, according to Thucydides, the sudden outbreak of the disease in the city of Athens may be linked to the speculated poisoning of the water reservoirs by the Spartans.^{1,11}

Acts of bioterrorism have been described since antiquity. A wide variety of biological agents such as microorganisms (bacteria, fungi, viruses), insects, reptiles, toxins, and poisons, as well as various technical applications, have been used on different occasions.^{1,11-13} Poisoning the water reservoirs in antiquity has been reported by Pausanias to have been implemented as an act of war in at least one case during the siege of ancient Kirra (595-585 BC) to completely exterminate the population of the city.¹⁴

The crowded and unsanitary conditions in besieged Athens of 430 BC undoubtedly favored the spread of the epidemic, as is usually the case in modern typhoid epidemics that take place in developing countries, especially where water supplies are contaminated by the pathogen.^{15,16} Historically, the siege of a city aimed at exhausting the supplies of a population, thus forcing it into desperate living conditions. These situations often led to the outbreak and spread of epidemics, which further weakened the surrounded population's defense. Poisoning of the water reservoirs of a besieged city would probably shorten the time necessary for such conditions to appear.

Taking into consideration the molecular evidence that implicates typhoid fever in the Plague of Athens,³ Thucydides' hypothesis seems now more than ever possible to be true. It is therefore not difficult to imagine Spartan spies or accomplices sneaking within the great wall surrounding the besieged city and intentionally poisoning the water reservoirs with contaminated material. The reported initial outbreak of the epidemic in Piraeus is not surprising at all since, according to Thucydides, no wells or running water were available in Piraeus, thus rendering its limited water supplies more valuable and vulnerable.

In conclusion, ancient Athenians may have been affected by a deadly pathogen as a result of a deliberate Spartan offense, which could be considered as an ancient act of bioterrorism using modern day terms.

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Address correspondence to:

Dr. Angeliki Stathi
Papadiamantopoulou & Thivon str.
11527 Athens
Greece

E-mail: astathi@otenet.gr