



Plague: A Re-emerging Life Threatening Bacterial Zoonosis of Public Health Concern

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Received: September 06, 2021

Published: October 11, 2021

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Abstract

Plague is a fatal zoonotic disease caused by *Yersinia pestis*, a Gram negative bacillus that is non-motile, rod-shaped, and a facultative anaerobe. Disease is transmitted by animals and their infected fleas. *Yersinia pestis* is found all over the world. Humans can contract plague by being bitten by infected fleas, coming into direct contact with contaminated tissue, or inhaling it. There are several types of plague, but the most prevalent are bubonic, pneumonic, and septicemic. Clinical symptoms and indications should always be supported by usual epidemiological aspects when diagnosing plague. Confirmatory diagnosis, on the other hand, necessitates laboratory testing. The drug of choice for treating plague is streptomycin. In endemic locations, quick reporting helps to prevent exposure of other animals and humans. Early diagnosis and immediate chemotherapy is highly imperative to mitigate the suffering of the patient. *Yersinia pestis* is susceptible to a variety of disinfectants, and therefore, proper sanitation is very essential.

Keywords: Diagnosis; Life Threatening; Plague; Prevention; Treatment; *Yersinia pestis*; Zoonosis

Introduction

Emerging and re-emerging zoonoses that occur in sporadic as well as in epidemic forms are significant causes of morbidity and mortality in developing and developed nations of the world [1]. Plague is a deadly infectious disease that affects humans and animals [2,3]. Plague is primarily a disease of rodents and their fleas, transmitted between rodents by rodent fleas, and can be transmitted to humans by infected rodent fleas, though it can also be transmitted by bites from infected animals, as well as by handling, inges-

tion, and inhalation of aerosolized droplets from infected tissues, animals, or humans. Plague is a very serious disease in people, as it is with many predominantly zoonotic diseases, with case fatality rates of 50-60%, if left untreated. During the fourteenth century, it was known as the "Black Death," and it killed an estimated 50 million people, half of whom died in Asia and Africa and the other half in Europe, where a quarter of the population died [4].

The Centres for Disease Control and Prevention (CDC) divides bioterrorism-related agents into three categories: A, B, and

C. Plague is classified as a Category A agent because it poses the highest risk to public health, has the potential to spread over a vast area, and necessitates advance planning to protect public health [5]. There are three types of plague in clinical practice: bubonic, septicemic, and pneumonic [2,6]. Bubonic and pneumonic plague is the most frequent types of plague infection [7]. It is possible to prevent plague by notifying individuals when zoonotic plague is present in their surroundings and encouraging them to avoid flea bites and not handle animal carcasses. The present communication is an attempt to describe plague as an important re-emerging life threatening bacterial zoonosis of public health concern.

Etiology

Plague is caused by *Yersinia pestis*, a Gram-negative bacillus that is non-motile, rod-shaped, facultative anaerobe, non-sporing and belongs to the family *Enterobacteriaceae* [2,4]. It is an obligatory parasite that can only thrive in the presence of an infected animal [8]. The ability to convert nitrate to nitrite and ferment glycerol distinguishes three biotypes or biovars of *Yersinia pestis* (antiqua, orientalis, and medievalis) [9]. *Yersinia pestis* virulence and survival in mammalian hosts and flea vectors are dependent on a number of chromosomal and plasmid-associated factors [10].

Epidemiology

Plague is a very dreadful bacterial zoonosis [11] that is found all throughout the world, although it is most common in the western United States and Southeast and Central Asia [12]. The outbreaks of plague are recorded from India, Uganda and Congo [1]. In this context, Runfolo and co-investigators [13] reported an outbreak of human pneumonic plague with dog-to-human and possible human-to-human transmission. The natural infection due to *Y.pestis* has been documented in about 230 species of wild rodents [2]. Besides humans, rodents, non-human primates, wild and domestic felids, wild and domestic canids, wild and domestic lagomorphs, Black-footed ferrets, American badgers, goats, camels, sheep, bat, kangaroo, Cervids, and Pronghorn antelope are common definitive hosts; while flies are the disease's vectors [2,4]. Where there is risk factor exposure to the insect vector and rodent host in an area where the disease is active, the plague is present [12].

Infected flea bites, direct contact with infectious bodily fluids or contaminated materials of infected animals or humans, and inhalation of infected respiratory droplets from a patient with pneu-

monic plague are all ways for plague to transmit between animals and humans [14]. Person-to-person transmission of pneumonic plague necessitates intimate contact, usually with a patient who is towards the late stage of the infection and coughing up copious amounts of bloody sputum [15]. Accidental laboratory hazard during handling of the infected materials has also been noticed [2]. It is pertinent to mention that direct transmission of infection can occur from diseased cat to humans through the abrasion, scratch, and bite [2].

Clinical disease features

- **Bubonic plague:** The most common form of plague is bubonic plague, which is spread by infected flea bites. The bacteria grow and infect the lymph nodes nearest to the point of entry into the human body. The bacteria can spread to other parts of the body if the patient is not treated with the necessary medications. Fever, headache, chills, weakness, and one or more enlarged, sensitive, and painful lymph nodes appear suddenly in patients (called buboes). If untreated, the mortality rate of bubonic plague is believed to be 50%-90% [14].
- **Septicemic plague:** Septicemic plague can arise from untreated bubonic plague or as the initial symptoms of plague. This kind is caused by infected flea bites or handling an infected animal. Septicemic plague may have or has lower mortality, at approximately 22% [3].
- **Pneumonic plague:** Pneumonic plague is the most severe form of the disease and the only type of plague that can spread by infected droplets from one person to another. Fever, headache, weakness, and a fast growing pneumonia with shortness of breath, chest pain, cough, and bloody or watery mucus are all symptoms that patients experience. Incubation can be as short as 24 hours [14].

Diagnosis

Clinical symptoms and signs should always be accompanied by typical epidemiological aspects, such as travel to or residence in a plague-endemic area within 10 days after commencement of symptoms and signs, exposure to plague patients or infected animals, and/or a history of flea bites [3]. Symptoms of patient may be frequently non specific not identifying with plague infections and laboratory testing is required to definitively diagnose plague. Both a microscopic study of stained smears obtained from peripheral blood, mucus or swollen lymph node aspirate and microbiological

culture can be used to identify *Yersinia pestis*. By detecting the presence of bacterial genes, such as the *pla* gene (plasmogen activator) and the *caf1* gene (F1 capsule antigen), PCR can also be used to diagnose plague [15]. Serology is occasionally helpful. Serological tests include ELISAs, passive hemagglutination, hemagglutination-inhibition, latex agglutination and complement fixation [16]. The organisms can also be demonstrated in the lymph node aspirate by fluorescent antibody technique [2].

Treatment

Treatment is determined by a patient's age, medical history, underlying health issues, and allergies, among other factors. Streptomycin is considered as the antibiotic of choice. Gentamicin, which is regarded safer than streptomycin for usage in pregnant women and children, can also be utilized. Those who are allergic to aminoglycosides or tetracycline should take doxycycline instead. The treatment should last 10-14 days [17]. Fluoroquinolones have also been suggested as an alternative for treating plague in mass casualty situations [18].

Prevention and control

Informing people when zoonotic plague is present in their surroundings, as well as urging them to avoid flea bites and not handle animal carcasses, are all preventive actions. People should be encouraged to stay away from infected body fluids and tissues in general. Standard precautions should be used when handling possibly contaminated patients and collecting specimens. Patients with pneumonic plague, whether proven or suspected, should be isolated to avoid infecting others through air droplets. Pneumonic plague patients should wear masks. Follow up with close contacts of pneumonic plague patients by identifying, informing, and monitoring them, as well as providing them with a seven-day chemoprophylaxis. To effectively and efficiently manage plague outbreaks, it is critical to have well-informed health-care workers and a community that can quickly diagnose and treat infected patients, identify risk factors, conduct ongoing surveillance, control vectors and hosts, confirm diagnosis with laboratory tests, and communicate findings to appropriate authorities [16,17]. Except for high-risk groups, such as laboratory personnel, who are frequently exposed to the risk of contamination and health-care workers, WHO does not recommend vaccination [14].

Conclusion and Recommendations

Plague is a highly contagious bacterial zoonosis that spreads by infectious flea bites, direct contact with diseased animals, or inhalation of infectious respiratory droplets. The bacterium is found in lymph node fluid, blood, or sputum for diagnosis. To lower the risk of complications and death, prompt identification and treatment are critical. Vaccination is suggested for those who are at a very high risk of exposure, as well as those who live in places where plague is endemic. The following recommendations are made based on the foregoing conclusion:

- Further research should focus on a thorough understanding of pathophysiology of the disease.
- Public health implications and more effective disease prevention strategies are advocated.
- A good flea management program should be created, and fleas should be kept away from affected humans and animals.
- The role of cat and dog in the transmission of *Y.pestis* infection to humans should be further investigated.

Acknowledgements

The authors are very thankful to Prof. Dr. R. K. Narayan for his suggestions during the preparation of manuscript. The help of Anubha Priyabandhu in computers is also highly appreciated. This paper is dedicated to the scientists who did pioneer work in the field of plague.

Author's Contribution

All the authors contributed equally. They read the final version, and approved it for the publication.

Conflict of Interest

The authors declare that they do not have conflict of interest.

Source of Financial Grant

There was no financial support for this manuscript.

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Volume 4 Issue 11 November 2021

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