PLAGUE

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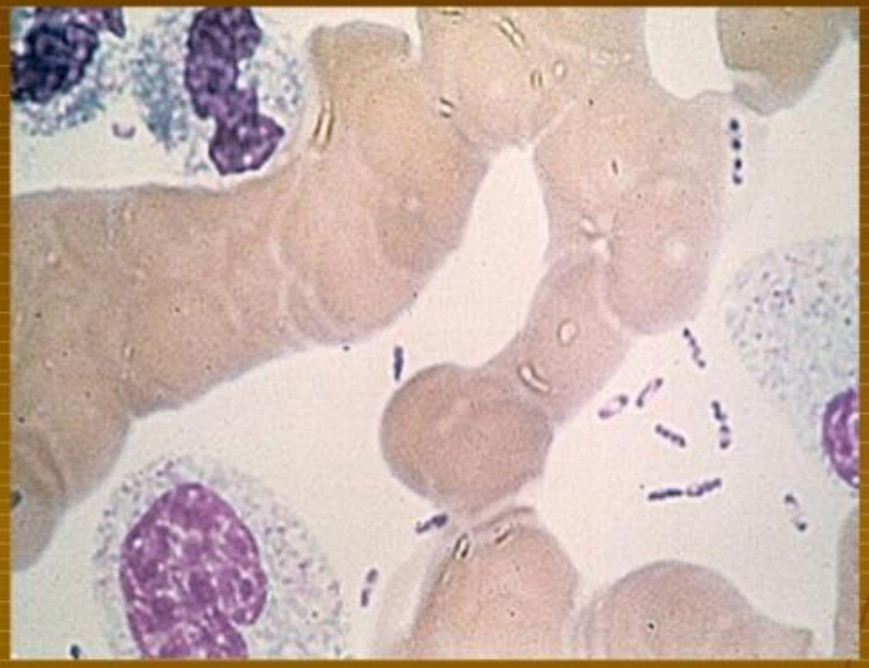
Definition

Plague is an acute, contagious, febrile illness transmitted to humans by the bite of an infected rat flea. The cause is the plague bacillus, a rod-shaped bacteria referred to as Yersinia pestis. Yersinia is named in honor of Alexander Yersin, who successfully isolated the bacteria in 1894 during the pandemic that began in China in the 1860s.

History

Plague has caused large-scale epidemics, thereby changing the course of history in many nations. The first pandemic was believed to have started in Africa and killed 100 million people over a span of 60 years. In the Middle Ages, plague killed approximately one fourth of Europe's population. The pandemic that began in China in the 1860s spread to Hong Kong in the 1890s and was subsequently spread to Africa, Asia, and South America. In the early twentieth century, plague epidemics accounted for about 10 million deaths in India.

Etiology



Wayson stain showing the characteristic "safety pin" appearance of *Yersinia pestis,* the plague bacillus. Image courtesy of Centers for Disease Control and Prevention (CDC), Atlanta, Ga.

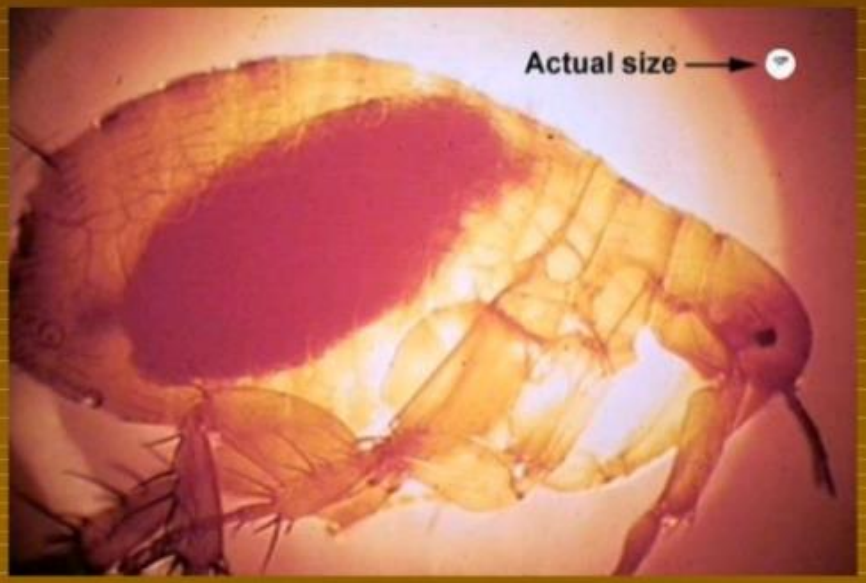
Y. pestis is a nonmotile, non-spore-forming, pleomorphic, gram-negative coccobacillus. The bacteria elaborate a lipopolysaccharide endotoxin, coagulase, and a fibrinolysin, which are the principal factors in the pathogenesis of this disease.

Epidemiology

The prairie dog is a burrowing rodent of the genus *Cynomys.* It can harbor fleas infected with *Yersinia pestis,* the plague bacillus. Image courtesy of the Centers for Disease Control and Prevention (CDC), Atlanta, Ga.

Domestic and urban rats are the most important reservoirs for the plague bacillus, but field mice, cats, camels, prairie dogs, rabbits, and squirrels can be important animal reservoirs as well.

Epidemiology



Oriental rat flea (*Xenopsylla cheopis*), the primary vector of plague, engorged with blood. Image courtesy of Centers for Disease Control and Prevention (CDC), Atlanta, Ga.

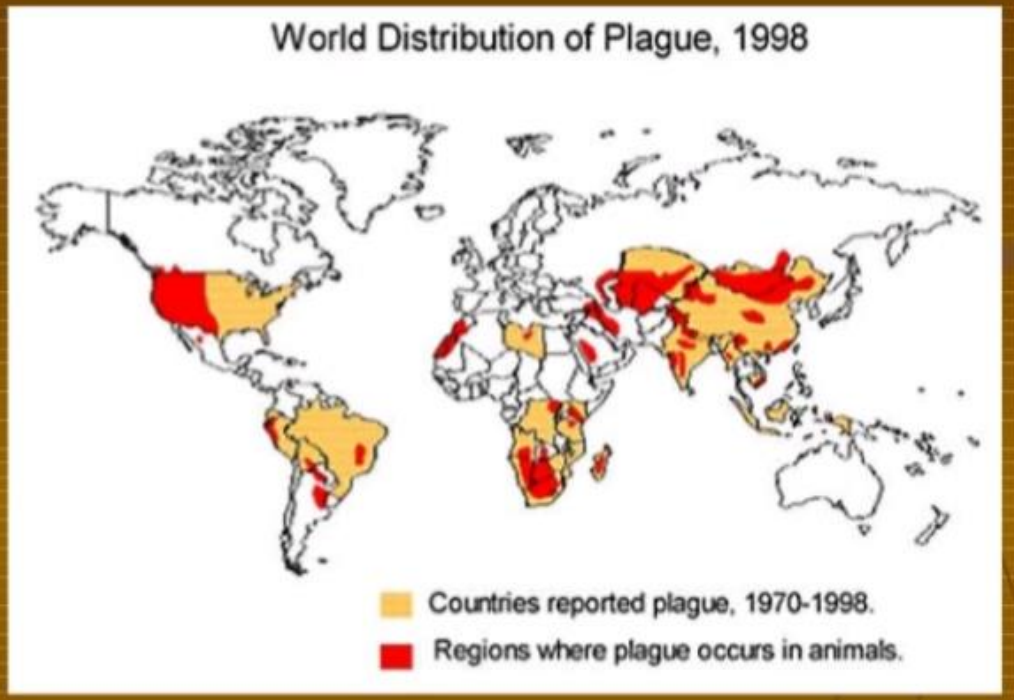
- The most important vector for transmission of plague is the rat flea, *Xenopsylla cheopis*. Ticks and human lice have been identified as possible vectors. Humans are accidental hosts in the natural cycle of this disease.
- Human-to-human transmission is rare except during epidemics of pneumonic plague.

Epidemiology

Risk factors

- Flea bite
- Contact with a patient or a potential host
- Contact with sick animals or rodents
- Residence in an endemic area of plague
- Presence of a food source for rodents in the immediate vicinity of the home
- Camping, hiking, hunting, or fishing
- Occupational exposure
- Direct handling or inhalation of contaminated tissue or tissue fluids

Epidemiology



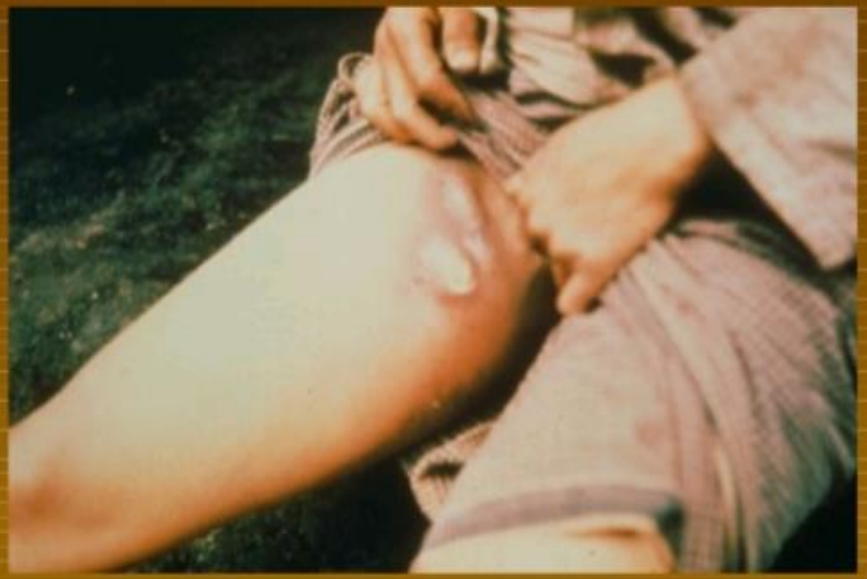
Plague is worldwide in distribution, with most of the human cases reported from developing countries.

1998 world distribution of plague. Image courtesy of the Centers for Disease Control and Prevention (CDC), Atlanta, Ga.

Pathophysiology

When a rat flea ingests a blood meal from an animal infected with *Y. pestis,* the coagulase of the bacteria causes the blood to clot. The bacilli multiply in the blood clot, and the flea inoculates thousands of these bacilli into a host's skin during subsequent blood meals. The bacilli migrate to the regional lymph nodes, are phagocytosed by the polymorphonuclear cells and mononuclear phagocytes, and multiply intracellularly. Involved lymph nodes show dense concentrations of plague bacilli, destruction of the normal architecture, and medullary necrosis. With subsequent lysis of the phagocytes, bacteremia can occur and may lead to invasion of distant organs in the absence of specific therapy.

Clinical

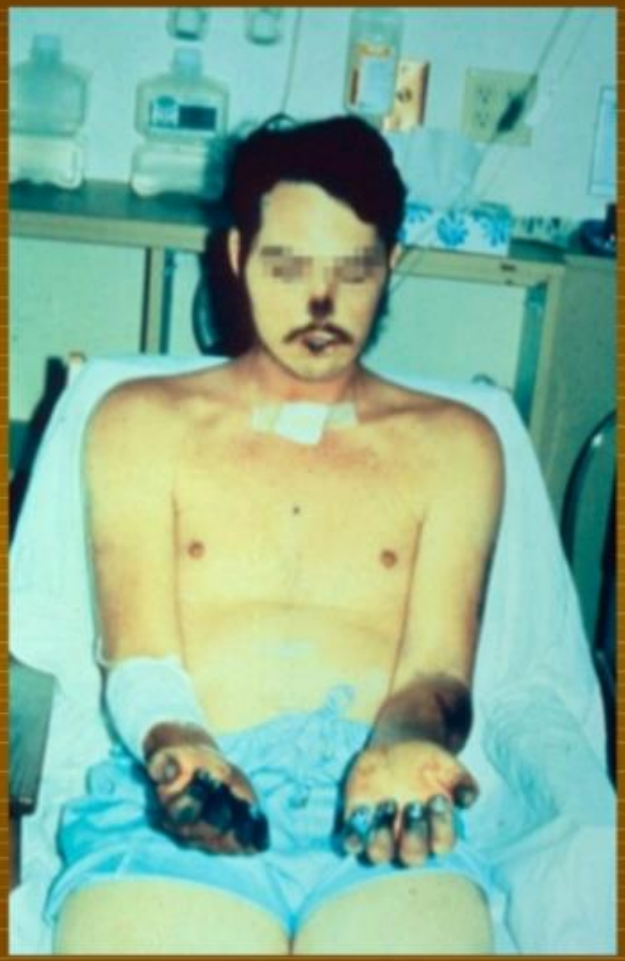


Swollen lymph glands, termed buboes, are a hallmark finding in bubonic plague. Image courtesy of Centers for Disease Control and Prevention (CDC), Atlanta, Ga.

Bubonic plague

- This is the most common presentation of plague.
- The incubation period varies but usually ranges 2-6 days.
- There is a sudden onset of high fever, chills, and headache.

Clinical

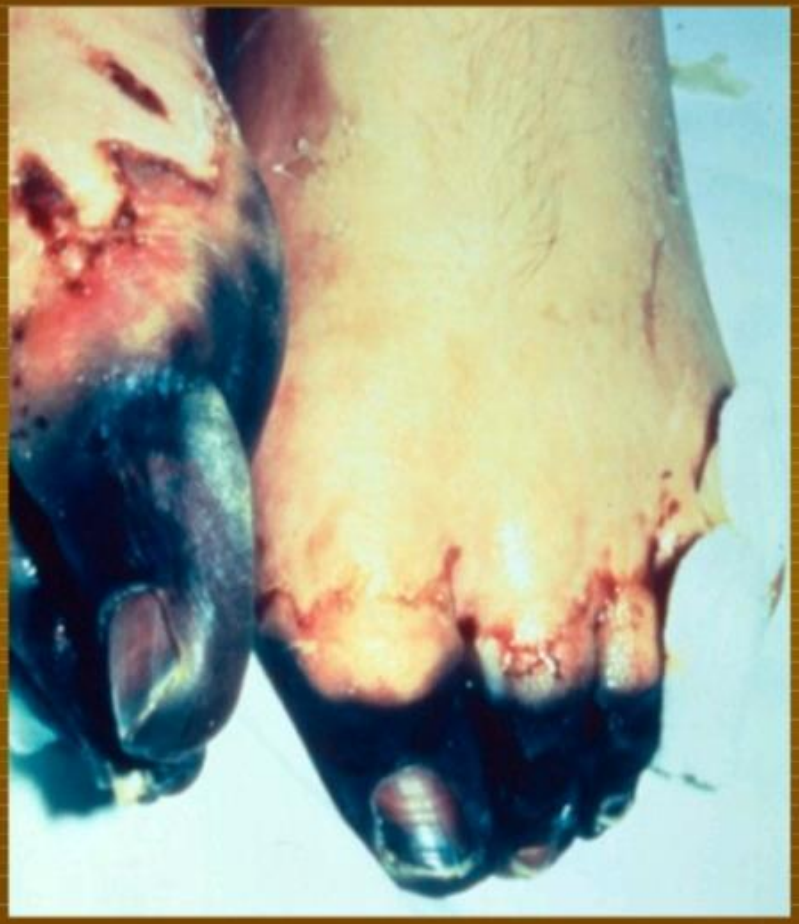


Acral necrosis of the nose, the lips, and the fingers

Bubonic plague

- Patients with this type also experience body aches, weakness, abdominal pain, and/or diarrhea.
- Painful, swollen lymph glands (buboes) arise, usually in the groin (most common site), axilla, or neck.

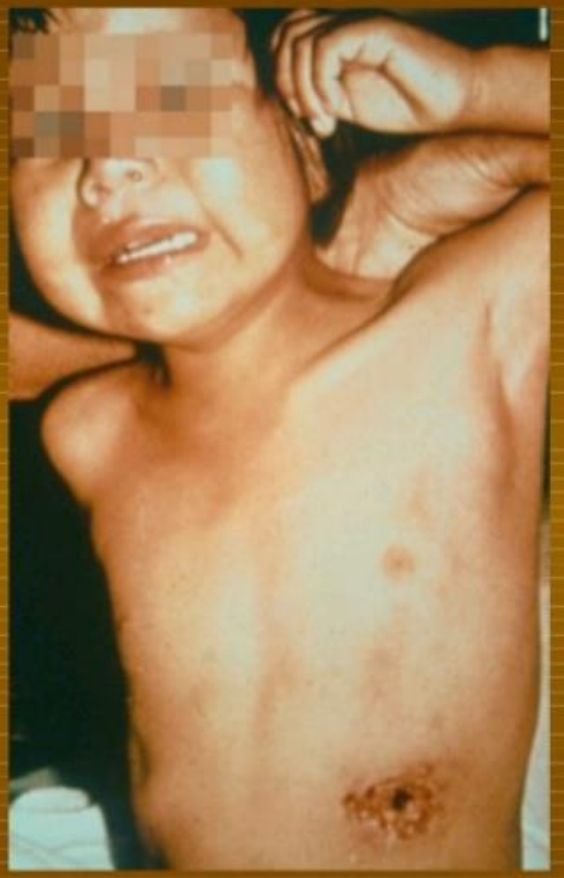
Clinical



Acral necrosis of the toes

- Axillary, and cervical buboes are almost always seen in cat-associated plague.
- Without intervention, this stage may lead to secondary pneumonic plague or meningitis or may disseminate and manifest as a sepsis picture.

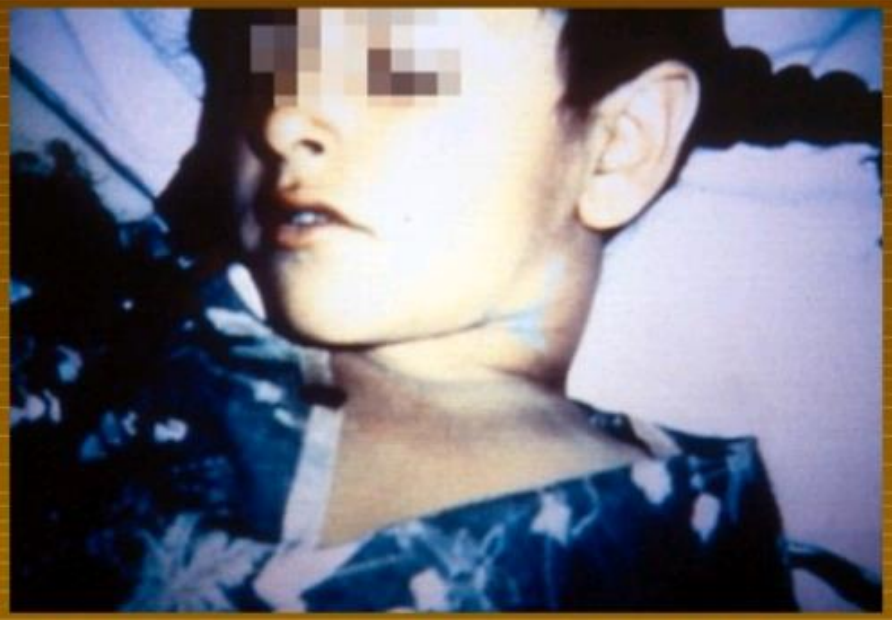
Clinical



Erythematous, eroded, crusting, necrotic ulcer at the primary inoculation site

- Meningeal plague is characterized by fever, headache, and nuchal rigidity.
- Buboes are common in meningeal plague.
- Axillary buboes are associated with an increased incidence of the meningeal form.

Clinical



Ecchymoses at the base of the neck in a girl with plague. The bandage is over the site of a prior bubo aspirate. These lesions are probably the source of the line from the children's nursery rhyme, "ring around the rosy." Courtesy of Jack Poland, PhD, Centers for Disease Control and Prevention (CDC), Fort Collins, Colo.

- Pharyngeal plague results from ingestion of the plague bacilli.
- Patients experience sore throat, fever, and painful cervical lymph nodes.

Pneumonic plague

- Pneumonic plague is highly contagious and transmitted by aerosol droplets.
- This is often secondary to bubonic or septicemic plague. However, primary pneumonic plague may be seen in laboratory workers, individuals exposed to an infected person, or those who have been exposed to a cat with pneumonic plague.
- There is an abrupt onset of fever and chills, accompanied by cough, chest pain, dyspnea, purulent sputum, or hemoptysis.
- Buboes may or may not be associated with pneumonic plague.
- The ability for plague to be spread by aerosols makes Y. pestis a potential agent of bioterrorism.

Septicemic plague

- Septicemic plague is observed in elderly patients and causes a rapid onset of symptoms.
- Patients experience nausea, vomiting, abdominal pain, and diarrhea.
- Patients exhibit a toxic appearance.
- Buboes are uncommon in septicemic plague.
- Septicemic plague carries a high mortality rate and is associated with disseminated intravascular coagulation (DIC), multiorgan failure, and profound hypotension.
- Plague initially occurred as a flea-borne septicemic disease. However, over its evolutionary course, it acquired the plasminogen activator gene, giving rise to the bubonic form of disease.

Laboratory Studies

- Blood culture results are often positive for *Y. pestis* in patients with bubonic plague and septicemic plague. *Y. pestis* may be observed on a peripheral blood smear.
- Lymph node aspirates often demonstrate *Y. pestis*. In patients with pharyngeal plague, *Y. pestis* is cultured from throat swabs.
- Gram stain of sputum often reveals *Y. pestis*.

Other Tests

- Direct immunofluorescence testing of fluid or cultures may aid in rapid diagnosis.
- A passive hemagglutination test (performed on serum from a patient in acute or convalescent stages) with a 4-fold or greater increase in titer suggests plague infection.

PREVENTION AND CONTROL

- CONTROL OF CASES

a) Early Diagnosis

b) Notification

c) Isolation

d) Treatment

Treatment

Streptomycin sulfate – Dosing: 1 g IV/IM q12h for 7-14 d or continue for 5-7 d once patient is afebrile; not to exceed 2 g/d.

Gentamicin – Dosing: 2 mg/kg IV loading dose with normal renal function; then, 1.7 mg/kg IV q8h for 10 d.

Doxycycline – Dosing: 100 mg PO/IV q12h.

Chloramphenicol - Dosing: 500 mg PO/IV q6h.

Control of fleas

- The most effective method to break the chain of transmission is the destruction of rat fleas by proper application of an insecticide.
- In general DDT and BHC should be used as dusts containing 10 percent and 3 percent of the active ingredient respectively.

CONTROL OF RODENTS

- Continuous mass destruction of rodents is an important plague-preventive measure. The long term policy for the control of rodents should be based on improvement of general sanitation, improvement of housing and quality of life.

VACCINATION

- The vaccine is given subcutaneously in two doses of 0.5 and 1ml at an interval of 7 and 14 days.
- Immunity starts 5-7 days after inoculation and remains for 6 months.
- Booster doses are recommended for people who are at constant risk of infection.

CHEMOPROPHYLAXIS

- Should be offered to all plague contacts, nursing, medical and health personnel exposed to the risk of infection.
- The drug of choice is tetracycline. For adults, the dose is 500mg 6 hourly for 5 days.

SURVEILLANCE

- In areas where natural foci exist or there is history of past infection, surveillance is essential.
- It should cover all aspects of rodent and human plague e.g microbiology, serology, entomology, mammology, epidemiology and ecology. On the basis of information provided, control measures should be established.

HEALTH EDUCATION

- Health education is an essential part of any plague control programme. Education should aim at providing the public with the facts about plague and enlisting their cooperation. Emphasis must be placed on the need for prompt reporting of dead rats and suspected human cases so that preventive measures can be taken.
- Epidemiological investigation
- Reporting of cases and outbreaks of plague

Complications

- Acute respiratory distress syndrome
- Chronic lymphedema from lymphatic scarring
- Disseminated intravascular coagulation
- Septic shock
- Superinfections of the buboes by *Staphylococcus* and *Pseudomonas* species

Differential Diagnoses

- Acute Renal Failure
- Bacterial Pharyngitis
- Anthrax
- Bacterial Pneumonia
- Brucellosis
- Catscratch Disease
- Rocky Mountain Spotted Fever
- Cellulitis
- Bacterial Sepsis
- Disseminated Intravascular Coagulation
- Systemic Inflammatory Response Syndrome
- Tularemia
- B-Cell lymphoma
- Typhus
- Malaria
- Septic Shock

Prognosis

Untreated patients with plague have a mortality rate of approximately 50%; however, with appropriate therapy, the mortality rate drops to approximately 5%.


Thank you for
your attention!