Animal- and arthropod-transmitted diseases

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Ch. 27
Galán and Wolf-Watz review
Plague

- Infectious disease of animals and humans
- *Caused by a bacterium named* *Yersinia pestis*
- People usually get plague from being bitten by a rodent flea that is carrying the plague bacterium
- Antibiotics are effective against plague, but if an infected person is not treated promptly, the disease is likely to cause illness or death
Epidemiology

• Wild rodents in certain areas are infected with plague
• Outbreaks usually associated with infected rats and rat fleas (*Xenopsylla cheopis*)
• Globally, the WHO reports 1,000 to 3,000 cases of plague each year

http://www.cdc.gov/ncidod/dvbid/plague
History of plague

• First pandemic spread from Egypt to Europe, Africa, and Asia 542-600

• Second pandemic known as the Black Death spread from Asia to Europe in the 1300s

http://bubonicplague.quickseek.com/
Natural history

• Epidemics usually involve rats
• Last rat-borne epidemic in the US occurred in Los Angeles in 1924-25
• Since then, all human cases in the U.S. have been sporadic cases acquired from wild rodents
• Rock squirrels and their fleas are the most frequent sources of human infection in the southwestern states

Courtesy of Diliff.

www.mammalogy.org
Geographic distribution

- Averages about 18 cases per year in US
- Mostly in people < 20 years of age
- About 1 in 7 persons will die
- Epidemic plague occurs Africa, Asia, & South America associated with domestic rats
Forms of disease

• Bubonic plague
  - enlarged, tender lymph nodes, fever, chills and prostration

• Septicemic plague
  - fever, chills, prostration, abdominal pain, shock and bleeding into skin and other organs

• Pneumonic plague
  - fever, chills, cough and difficulty breathing; rapid shock and death if not treated early

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Diagnosis of plague

- Painful, swollen lymph node, called a bubo
- Onset usually 2-6 days after exposure
- Disease progresses rapidly and bacteria invade the bloodstream, producing severe illness, called plague septicemia
- Progression leads to lung infection or plague pneumonia
- Incubation period of primary pneumonic plague is 1-3 days
  - Characterized by overwhelming pneumonia with high fever, cough, bloody sputum, and chills
  - Mortality rate > 50%
Treatment

• As soon as a diagnosis of suspected plague is made, the patient should be isolated, and local and state health departments should be notified

• The drugs of choice are streptomycin or gentamicin, but a number of other antibiotics are also effective

• Those individuals closely associated with the patient, particularly in cases with pneumonia, should be traced, identified, and evaluated
Prevention

• Epidemic plague is best prevented by controlling rat populations in both urban and rural areas

• In regions where plague is widespread in wild rodents, the greatest threat is to people living, working, or playing in areas where the infection is active
  - Eliminate food and shelter for rodents
  - Surveillance in wild rodent populations
  - Use of appropriate insecticides to kill fleas
The bacterium

• **Gram negative facultative anaerobe**
• Formerly classified in the family *Pasteurellaceae*, but based on DNA-DNA hybridization member of the *Enterobacteriaceae* family
• 11 named species, but only 3 are human pathogens
  - *Y. pestis*, the etiologic agent of plague
  - *Y. pseudotuberculosis* and *Y. enterocolitica*
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Invasion

- Enteropathogenic *Yersinia* species invade cultured mammalian cells
- Mediated by *inv* gene product invasin
- Outer membrane protein binds $\beta_1$ integrins

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Transposase

IS100

ColE1 replicon

Pesticin immunity protein

Pesticin activator

Plasminogen activator

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