PLAGUE

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INTRODUCTION

- Plague is one of the oldest diseases known to man.
- It is primarily a zoonotic disease that exists in nature between small mammals, usually wild rodents, and the fleas that they harbour.
- It is widely distributed in the tropics and subtropics and in warmer areas of temperate countries.
- Untreated plague can be a very serious disease with case fatality rates between 30% and 60%

- Plague has been known as a dreaded killer from times immemorial.
- **First plague pandemic:**
  - Also called the *Justinian plague*
  - Took place in the sixth century and
  - Killed nearly a hundred million victims.

- **Second plague pandemic:**
  - Known as the “Black Death” of the fourteenth century
  - Caused 50 million deaths.
  - A quarter of the population of Europe is said to have been wiped out by this pandemic.

- **Third Plague pandemic:**
  - Began in Hong Kong in 1894.
  - Within 10 years this pandemic had spread to all the continents.
  - Resulted in 13 million deaths in India.
  - During the third pandemic, the causal agent, *Yersinia pestis* was discovered in 1894.

GLOBAL MAGNITUDE

- Plague exists in natural enzootic cycles involving wild rodents and their fleas in several parts of the world.
- These natural cycles are usually hidden with no transmission to humans.
- Epidemics of plague occasionally occur when the disease spreads from wild rodents to rats that live in close proximity of human habitation.

- Plague is endemic in many countries in Africa, the former Soviet Union, the Americas and Asia.
- The distribution of plague coincides with the geographical distribution of the rodents it infects, which are found in all continents except Australia, within a broad belt in tropical, subtropical and warmer temperate climates.
- Plague epidemics have occurred in Africa, Asia, and South America but since the 1990s, most human cases have occurred in Africa.
- The 3 most endemic countries are Madagascar, the Democratic Republic of Congo and Peru.

- Between 1989 and 2003, 38, 310 cases with 2845 deaths were recorded.
- In 2013 there were 783 cases reported worldwide, including 126 deaths.
- Three geographical areas experienced outbreaks of human plague after silent periods of about 30 - 50 years :
  - India in 1994,
  - Indonesia in 1997 and
  - Algeria in 2003.

INDIAN SCENARIO

- Very large number of deaths during the third Plague pandemic.
- Plague outbreaks continued to occur, but with decreasing frequency during the first half of the 20th century.
- This is often attributed to the collateral benefit from the extensive insecticide spraying done as a part of the National Malaria Programme.
- India remained plague free for almost 30 years after the last human case was reported from Karnataka in1966.

- In August - October 1994 human plague was reported in India.
- 876 cases with 54 deaths.
- Most cases were reported from Maharashtra (596), 151 from Gujarat, 68 from Delhi, 50 from Karnataka, 12 from Madhya Pradesh, and 10 from Uttar Pradesh.
- Almost all the deaths were reported from Gujarat.
- Several reasons have been put forth to explain this outbreak.

- **Rat - fall** was first reported from Mamla village in the Beed district of Maharashtra on 5 August 1994.
- This was followed by reports of **flea nuisance**.
- Ecological changes created by the **earthquake** in September 1993 and large scale storage of foodgrains probably contributed to a gradual growth of the rat population.
- The resurgence of plague in Surat, Gujarat, was related to a record **high rainfall** during the September monsoon.
- **Floods** in the Tapti river resulted in inundation of large areas.
- Many rodents were found dead when the water floods receded.

- In February 2002, an outbreak of pneumonic plague occurred in Hat Koti village, Shimla district, Himachal Pradesh.
- 16 cases, 4 deaths were reported.
- The outbreak is believed to have started after a person acquired the infection in the forest, which then spread to others through person - to - person contact

AGENT

- *Yersinia pestis*
- a gram - negative coccobacillus.
- small (1.0 to 2.0 mcm x 0.5 mcm), pleomorphic and is seen as single cells or short chains in direct smears.
- nonmotile, nonsporulating, non - lactose fermenting facultative anaerobes
- formerly classified in the family *Pasteurellaceae*, but has been now reclassified as members of the *Enterobacteriaceae* family.
- there are 11 species in the genus Yersinia, only three are considered important human pathogens.

VECTOR

- There are more than 1, 500 flea species, of which about 30 are known to be vectors for *Yersinia pestis*. The major flea vectors include:

a) *Xenopsylla cheopis* (the oriental rat flea; nearly worldwide in moderate climates)
b) *Oropsylla montanus* (United States)
c) *Nosopsyllus fasciatus* (nearly worldwide in temperate climates)
d) *Xenopsylla brasiliensis* (Africa, India, South America)
e) *Xenopsylla astia* (Indonesia and Southeast Asia)
f) *Xenopsylla vexabilis* (Pacific Islands)

- *Pulex irritans*, the human flea may be responsible for human to human transmission of Plague

HOST

- The animal hosts of plague are classified as:
- **Enzootic (maintenance) hosts**
  - Enzootic hosts are characterized by relatively mild illness, and low mortality rates.
  - Voles and mice have been suggested as maintenance hosts.

- **Epizootic (amplification) hosts**
  - Epizootic rodents are associated with susceptibility and high mortality.
  - Mice, rats, voles, gerbils, ground squirrels and marmots. Rats have historically been a primary carrier of plague

TRANSMISSION

- The most common mode of transmission of *Yersinia pestis* to humans is by the bite of infectious fleas.

- Other, less common modes of transmission include:
  - direct contact with infectious body fluids or tissues while handling an infected animal
  - inhaling infectious respiratory droplets.

- The mode of entry of the organism has marked clinical significance.

CLINICAL FEATURES

- “Flu-like” symptoms after an incubation period of 3-7 days.
- Typical symptoms are the sudden onset of fever, chills, head and body-aches and weakness, vomiting and nausea.
- There are 3 forms of plague infection, depending on the route of infection:
  - Bubonic,
  - Septicaemic and
  - Pneumonic.

Bubonic plague:

- Known in mediaeval Europe as the ‘Black Death’
- The most common form of plague
- Caused by the bite of an infected flea.
- Plague bacillus, *Y. pestis*, enters at the bite and travels through the lymphatic system to the nearest lymph node where it replicates itself.
- The lymph node then becomes inflamed, tense and painful, and is called a "bubo".
- At advanced stages of the infection the inflamed lymph nodes can turn into suppurating open sores.

Septicaemic plague:

- Occurs when infection spreads directly through the bloodstream without forming a “bubo".
- Septicaemic plague may result from flea bites and from direct contact with infective materials through cracks in the skin.
- Advanced stages of the bubonic form of plague will also lead to direct spread of *Y. pestis* in the blood.

Pneumonic plague

- Lung-based plague
- the most virulent and least common form of plague.
- Typically, the pneumonic form is caused by spread to the lungs from advanced bubonic plague.
- However, a person with secondary pneumonic plague may form aerosolized infective droplets and transmit plague via droplets to other humans.
- Untreated pneumonic plague has a very high case-fatality ratio.

DIAGNOSIS

- Plague is diagnosed clinically based on exposure history and the symptoms of the patient.
- The diagnosis of plague is confirmed by the culture of *Yersinia pestis* from body fluids or tissues.
- Serological tests : ELISA, HAI.

- In the recent past rapid diagnosis of plague has become available using the F1 antigen diagnostic assays based on dipsticks.
- These tests make a bedside diagnosis available within 15 minutes using bubo aspirate, serum and urine specimens

TREATMENT

- All patients suspected of having bubonic plague should be placed in isolation until 2 days after starting antibiotic treatment.
- Suspect plague patients with evidence of pneumonia should be placed in isolation and managed under respiratory droplet precautions.
- Streptomycin (I/M) : 30 mg/kg/day X 10 days.
- Chloramphenicol (Oral or Parenteral) : 50 mg/kg/day X 10 days.
- Tetracycline, Ciprofloxacin.

- Tetracycline and chloramphenicol are the antibiotics of choice for prophylaxis.

PREVENTION AND CONTROL

- **Control of transmission is directed at controlling the rodent reservoirs and flea vectors of the disease.**
- Trying to eliminate fleas and wild rodents from the natural environment in plague - infected areas are impractical.
- However, controlling rodents and their fleas around places where they are in close proximity of human beings is very important.
- Environmental sanitation and public health education are effective means of achieving these ends.

SURVEILLANCE

- An effective surveillance system to provide early warning can abort epidemics.
- Surveillance must include:
  - reporting of human cases,
  - ecological and environmental observations, and
  - surveillance of rodent populations.

VACCINATION

- Plague vaccines were once widely used but have not been shown to be very effective against plague.
- Vaccines are currently not recommended during outbreaks but are still used for high-risk groups (e.g. laboratory personnel who are constantly exposed to the risk of contamination).

LEPTOSPIROSIS

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INTRODUCTION

- Leptospirosis is an infectious disease caused by bacteria belonging to the genus Leptospira.
- Leptospirosis occurs worldwide, but is most prevalent in tropical and subtropical regions.
- Outbreaks can occur following excessive rainfall or flooding.
- The disease is found wherever humans come into contact with the urine of infected animals.

- Most human infections are asymptomatic and the disease presentation can vary from extremely mild illness to fatal illness.
- The severe form of the disease was first described by Adolf Weil as a disease entity in four men who had fever, haemorrhage and severe jaundice in 1886 in Heidelberg.
- His name is still attached to a serious form of Leptospirosis called Weil’s disease.
- Inada and Ido identified the causal organism in 1916 in Japan.

GLOBAL MAGNITUDE

- The number of human cases worldwide is not known precisely.
- The incidence ranges from approximately 0.1 - 1 per 1,00,000 per year in temperate climates to 10 - 100 per 1,00,000 in the humid tropics.
- During outbreaks and in high - exposure risk groups, disease incidence may reach over 100 per 1,00,000.
- Increased awareness of the disease has led to increased recognition

INDIA

- Though Leptospirosis is widespread in India, the true extent of the disease is not known
  - no large scale serological surveys have been carried out.
- A number of studies have reported outbreaks in different parts of the country since 1930.
- Several epidemics of Leptospirosis have occurred in Andaman and Nicobar islands and in southern and western parts of India during the past century.
- Large outbreaks have occurred following the monsoon flooding in the city.

AGENT

- *Leptospira icterohaemorrhagiae* is the causal organism for Leptospirosis.
  - a slender, closely wound, very actively motile spirochete varying in length from 6μ to 20μ.

- Before 1989, the genus Leptospira was divided into two species.
  - *Leptospira interrogans* which were the pathogenic strains
  - *Leptospira biflexa* which were the saprophytic strains in the environment.

HOST

- Virtually all wild and domestic mammals can harbour the bacteria and act as source of infection to humans and other animals.
- **Rodents**
  - the first recognized carriers of leptospirosis
  - primary source of infection to human beings.

- Cattle, buffaloes, horses, sheep, goat, pigs and dogs
  - are also considered common reservoirs of the bacteria that causes leptospirosis.
- Humans are a “dead end” for Leptospires as they do not form an infection reservoir.

PEOPLE "AT RISK"

- The risk of infection depends on exposure.
- A high risk of exposure because of their occupation, the environment they live in or their lifestyle.
- The main occupational groups at risk include:
  - farm and agricultural workers, pet shop workers,
  - Veterinarians, sewer workers,
  - abattoir workers, meat handlers,
  - military personnel,
  - survivors of natural disasters (e.g., flooding),
  - people engaging in recreational water sports (swimming, etc).
- **Male > Female**
- Often considered to be a **rural** disease, people living in **cities** may also be at risk, because of exposure to infected

ENVIRONMENT

- The pathogenic organisms can survive for weeks in soil and water contaminated with urine and faeces of reservoir animals.

- Poor housing, improper sewage disposal and unsafe water supply increase the risk of transmission.

- Warm, humid conditions are ideal for survival of the Leptospires and consequently the disease shows a seasonal variation in India.

TRANSMISSION

- Human leptospiral infections result primarily from:
  - direct contact with urine or tissue of infected animals or
  - indirect contact through soil, water or vegetation that is contaminated with animal urine.

- Occasionally enter the human body via the inhalation of droplets of urine or via drinking - water.
- They can be transmitted from human to human by sexual intercourse, transplacentally from the mother to the fetus and via breast milk to a child.
- The urine from a patient suffering from Leptospirosis should be considered infectious

CLINICAL FEATURES

- Incubation period: between 5 - 14 days (range from 2 to 30 days).
- The clinical presentation of the disease can be extremely variable.
- Most cases present with symptoms of sudden headaches, fevers, nausea and bodyache.
- Less than 10% of patients suffer from Icteric Leptospirosis or Weil's disease.
- The presentation includes fever, jaundice, renal failure and haemorrhage.
- Other organ systems (pulmonary, cardiac, central nervous) also are involved frequently.
- Weil's disease carries a mortality rate of 5 to 30%.

- Despite the possibility of severe complications, the disease is mostly self - limited and nonfatal.

DIAGNOSIS

- Direct visualization, culture and serology have all been used to confirm the diagnosis of Leptospirosis.
- Samples for culture from blood, CSF or peritoneal fluid.
- Cultures take very long, and hence are not a practical.

- The most reliable serological test is the Microscopic Agglutination Test (MAT).
- Other tests include an indirect haemgglutination test and ELISA for specific IgM antibodies.
- PCR may be used for molecular diagnosis for epidemiological studies.

TREATMENT

- Treatment with antibiotics is most effective when started as soon as possible.
- Do not wait for the results of laboratory tests.
- Severe cases of Leptospirosis: Intravenous penicillin.
- Less severe cases: Oral antibiotics such as amoxycillin, ampicillin, doxycycline or erythromycin, ceftriaxone and cefotaxime.
- Aggressive supportive care with strict attention to fluid and electrolyte balance is essential.
- Peritoneal or haemodialysis is indicated in renal failure.
- Doxycycline 200mg orally once a week has been used for chemoprophylaxis.

CONTROL

- Wearing protective clothing (boots, gloves, spectacles, aprons, masks).
- Covering skin lesions with waterproof dressings.
- Preventing access to, or giving adequate warning about water bodies known or suspected to be contaminated (pools, ponds).
- Try to avoid wading or swimming in potentially contaminated water.
- Washing or showering after exposure to urine splashes or contaminated soil or water.
- Strictly maintaining hygienic measures during care or handling all animals.
- Where feasible, disinfecting contaminated areas (scrubbing floors in stables, butcheries, abattoirs, etc.).
- Consuming clean drinking-water