



YERSINIA

26.1 INTRODUCTION

Genus *Yersinia* belongs to tribe *Yersinieae* of the family *Enterobacteriaceae*. *Yersinia* are Gram-negative rod shaped bacteria and are facultative anaerobes. Important human pathogens are *Yersinia pestis*, *Y. enterocolitica* and *Y. pseudotuberculosis*.



OBJECTIVES

After reading this lesson, you will be able to:

- differentiate characteristics between various species of *Yersinia*.
- describe diseases caused by *Yersinia* species.
- discuss the laboratory diagnosis of plague.

26.2 YERSINIA PESTIS

Yersinia Pestis: Causative agent of plague.

26.2.1 General characteristics

Gram negative bacilli or coccobacilli, with rounded ends, convex or parallel sides. Non motile.

Capsule present when grown at 37°C. Bipolar staining (safety pin appearance) with methylene blue or giemsa stain.

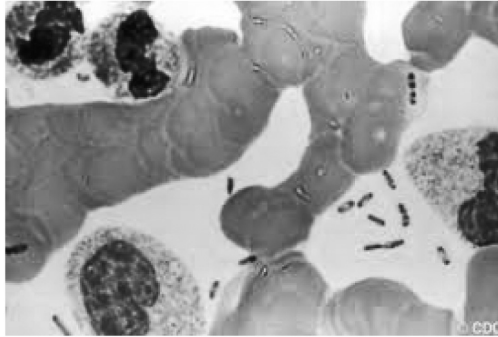


Fig. 26.1: Bipolar staining (safety pin appearance)

Pleomorphic when grown in unfavourable conditions (nutrient agar with 3% sodium chloride).

Grow on ordinary media. Colonies are dark brown on blood agar because of absorption of haemin. On Macconkey agar NLF colonies are produced. Optimum temperature 27°C

Liquid media- granular deposit and surface pellicle. Shows stalactite growth if a drop of sterile oil/gheebroth is allowed to float on broth and the medium is not disturbed growth hangs down from oil/ghee into the liquid medium which looks like stalactites.

Catalase: Positive

Oxidase, Urease, and Indole: Negative

26.2.2 Antigen, toxins and other virulence factors

- Fraction-1 or F1: heat labile protein envelope antigen ⇒ antiphagocytic
- V and W antigens: always produced together ⇒inhibits phagocytosis and intracellular killing,
- Pesticin 1 (bacteriocin), fibrinolysin ,coagulase : inhibits strains of *Y. enterocolitica* and *Y. Pseudotuberculosis* and *E.coli*
- Plague toxin (endotoxin -LPS and Murinetoxin)
- Ability to synthesize-purine



INTEXT QUESTIONS 26.1

1. Yersinia is gram bacilli.
2. Yersinia are catalase
3. appearance is seen with methylene blue stain.
4. Yersinia are culturally facultative



Notes

26.2.3. Pathogenesis

Causative agent of plague. It is a zoonotic disease. Rodents are the natural reservoirs. It is transmitted through a bite of an infected rat flea (*Xenopsylla species*), but can also be transmitted by air (especially during pandemics of the disease).

Rat fleas become infected after taking blood meals from septicemic animals. *Y. pestis* grows in the midgut and eventually blocks the proventriculus, starving the flea for blood. The insects attempt to feed more often but end up giving back infected blood into the wound. Rat flea can't fly. It jumps to a height of <2 feet, usually biting on the legs of humans.



Notes

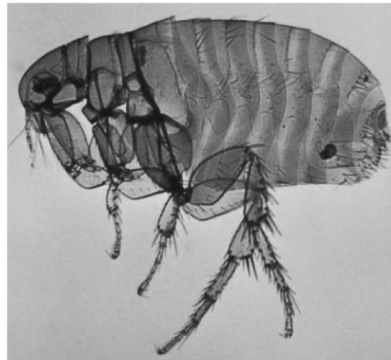


Fig. 26.2: Rat flea

Plague can occur in 3 forms:

- (a) **Bubonic plague:** Incubation period of 2–6 days. General malaise, fever, headache and chills occur suddenly at the end of the incubation period. Swelling of lymph nodes resulting in buboes, the classic sign of bubonic plague. The inguinal nodes are most frequently affected (“boubon” is Greek for “groin.”)



Fig. 26.3: Bubonic plague showing bubos on wrist.

- (b) **Pneumonic plague:** Spread person to person by droplet infection as the bacilli spread through the lungs producing haemorrhagic pneumonia. The bloody mucoid sputum that is coughed out contain enormous number of bacilli. Fever, chills, cough, chest pain, dyspnea, hemoptysis, hypotension and shock. This type is highly infectious.
- (c) **Septicemic plague:** End stage of bubonic or pneumonic plague but may occur primarily also. Hypotension, fever, hepato-splenomegaly, delirium, seizures in children and shock. Symptoms of bubonic or pneumonic plague are not always present. Patient may die before any symptoms appear.

Also called as 'Black death'.

26.2.4 Laboratory diagnosis

Specimen

- For pneumonic plague Sputum /Bronchial wash/ tracheal aspirate,
- For septicemic plague - blood.
- For bubonic plague - Aspirate or biopsy of bubo.

Microscopy: Exudates/ sputum/ other specimens can be stained by gram stain and methylene blue to look for characteristic safety pin morphology.

Culture: Exudates/other specimen cultured on blood agar. Perform biochemical testing for identification of the isolate. Blood culture can be done in septicemic cases.

Biochemical reactions

- GNB, non motile, NLF
- Catalase +ve, oxidase -ve,
- Ferments glucose, maltose, sucrose, and mannitol anaerogenically.
- MR +ve,
- Indole, VP, urease, and Citrate -ve,
- Gelatin is not liquefied.

Animal pathogenicity: Guinea pigs or white rats. Diagnosis in rats: rat is immersed in disinfectant like 3% Lysol and necropsy is performed to look for following characteristic features-

- Enlarged lymph nodes especially cervical.
- Subcutaneous injection
- Pleural effusion



Notes



Notes

- Granular congested liver
- Enlarged spleen with some white areas
- Microscopy and culture of heart blood, spleen and liver also done.

26.2.5. Prevention

Control of rat flea and rats using pesticides and rat poison.

Vaccines:

1. Killed vaccine containing 2000 million bacteria/ ml. Protects for about 6 months after 3 doses. This is used in India.
2. Live vaccine using avirulent strains of *Y. Pestis* is no longer recommended.

26.2.6. Treatment

Aminoglycosides such as streptomycin and gentamicin, tetracyclines and fluoroquinolones can be given.

26.3 YERSINIA ENTEROCOLITICA

Causative agent of gastroenteritis, mesenteric lymphadenitis and septicaemia. Laboratory diagnosis is by isolation of organism from blood, lymph node, feces, food or soil or by serology using tube agglutination test. Cold enrichment often helps.

The organism is motile at 25°C but non motile at 37°C.

26.4 YERSINIA PSEUDOTUBERCULOSIS

Causative agent of pseudotuberculosis (a zoonosis).

Causes mesenteric lymphadenitis and erythema nodosum especially in young males. Diagnosis is by serology using tube agglutination test (for antibody detection).

This organism is motile at 25°C but non motile at 37°C and hydrolyses urea and has relatively poor growth on MaConkey agar.



INTEXT QUESTIONS 26.2

1. Yersinia causes in human.
2. are the natural reservoirs of yersinia.
3. Septicemic plague is also called as
4. agglutination test is used to diagnosis serology.



WHAT YOU HAVE LEARNT

- This chapter deals with various *Yersinia* species i.e *Y.pestis*, *Y. enterocolitica* and *Y. pseudotuberculosis* their pathogenesis and laboratory diagnosis. The organisms are gram negative bacilli, some of them showing pleomorphism or involution forms. Bipolar staining is characteristic with methylene blue stain. *Y. enterocolitica* and *Y. pseudotuberculosis* are motile at 22°C but non motile at 37°C while *Y.pestis* is non motile.



Notes



TERMINAL QUESTIONS

1. Name the causative agent of plague and its mode of transmission.
2. Describe morphological characteristics of *Y. pestis*.
3. How *Y. pestis* can be identified in the laboratory.
4. How is *Y.pestis* different biochemically from *Y.enterocolitica*?



ANSWERS TO INTEXT QUESTIONS

26.1

1. Negative
2. Positive
3. Safety pin
4. Anaerobes

26.2

1. Plague
2. Rodents
3. Black death
4. Tube