Assist. Prof. Dr. Ameer Mezher Hadi

Lecture. 6

Second Stage

Evaluation Lecturer

Al-Mustaqbal University

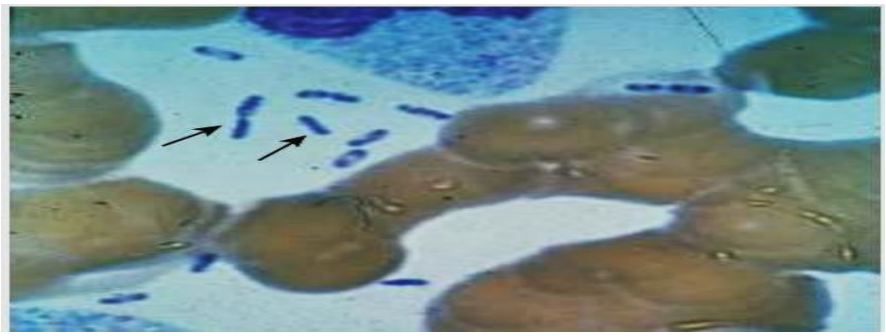
College of Health and Medical Techniques

Department of Medical Laboratory Technique

YERSINIA

Yersinia pestis

short, pleomorphic, Gram-negative rods that often exhibit **bipolar staining (A bipolar stain is a particular staining pattern that colors only the two opposite poles of the microorganism in question, leaving the rest of the bacterium unstained or a lighter color)** with special stains such as Wright, Giemsa, Wayson, or methylene blue, appear as single cells or as pairs or short chains in clinical material. They are catalase positive and microaerophilic or facultatively anaerobic.



Cultural and Biochemical Characteristics

It is non-motile, grows as a facultative anaerobe on many bacteriologic media, and can be readily isolated when **sterile** specimens such as **blood** or **lymph node aspirates** are plated onto **sheep blood agar**. Growth is more rapid when agar plates are incubated at **28°C**. In cultures on sheep blood agar incubated at 37°C, colonies may be smaller when compared to colonies from agar plates incubated at 28°C. Colonies of *Y. pestis* are typically **gray** to **white**, sometimes **opaque**, and are 1–1.5 mm in diameter with **irregular edges**; the

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organism does not produce **hemolysis**.

Antigenic Structure

All Yersinia possess

1-lipopolysaccharides that have endotoxic activity when released.

2-*Y. pestis* and *Y. enterocolitica* also produce antigens and toxins that act as virulence factors.

3-They have type III secretion systems that consist of a membrane-spanning complex that allows the bacteria to inject proteins directly into cytoplasm of the host cells.

4-The virulent yersiniae produce V and W antigens.

Clinical Findings

5-The clinical manifestations of **plague** depend on the **route** of **exposure**, and three forms of the disease have been described:

A-bubonic plague, (the most common, incubation period of 2–7 days, sudden onset of high fever and development of painful lymphadenopathy, **tender lymph nodes (buboes)** in the neck, groin, or axillae).

B-pneumonic plague, commonly with greatly enlarged

C-septicemic plague. (occur spontaneously or as a complication of untreated bubonic plague, *Y. pestis* multiplies intravascularly, can be seen in blood smears)

6-Patients typically present with a sudden onset of high fever, chills, and weakness, progressing rapidly to septic shock with associated disseminated intravascular coagulation, hypotension (septic shock),

7-Altered mental status, and renal and cardiac failure.

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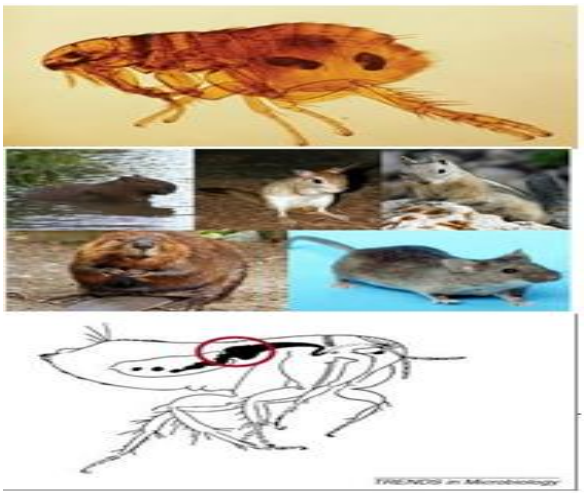
8-Bleeding into skin and organs can also occur. Vomiting and diarrhea may develop during the early stages of septicemic plague. Terminally,

9-signs of pneumonia and meningitis can appear.

Pathogenesis and Pathology

When a flea feeds on a rodent infected with Y. pestis, the ingested organisms multiply in the gut of the flea and, helped by the coagulase, block its proventriculus so that no food can pass through. Subsequently, the "blocked" and hungry flea bites ferociously, and the aspirated blood, contaminated with Y. pestis from the flea, is vomited into the bite wound. The inoculated organisms may be phagocytosed by polymorphonuclear cells and macrophages.

The Y. pestis organisms are killed by the polymorphonuclear cells but multiply in the macrophages; because the bacteria are multiplying at 37°C, they produce the antiphagocytic protein and subsequently are able to resist phagocytosis. The pathogens rapidly reach the lymphatics, and an intense hemorrhagic inflammation develops in the enlarged lymph nodes, which may undergo necrosis and become fluctuant.



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Diagnostic Laboratory Tests

A.Specimens

Blood is taken for culture and aspirates of enlarged lymph nodes for smear and culture. Acute and convalescent sera be examined for antibody levels. In pneumonia, sputum is cultured; in possible meningitis, cerebrospinal fluid is taken for smear and culture.

B.Smears

Wright, Giemsa, or Wayson stains may be more useful when staining material from a suspected buboes or a positive blood culture result because of the striking bipolar appearance (safety pin shape) of the organism using these stains that is not evident on a direct Gram-stain. More specific direct staining methods include the use of fluorescent antibody stains targeting the capsular F1 antigen.

C.Culture

All materials are cultured on blood, chocolate, and MacConkey agar plates and in brain–heart infusion broth. Growth on solid media may be slow, requiring more than 48 hours, but blood culture results are often positive in 24 hours. Y. pestis produces non-lactose-fermenting colonies on MacConkey agar, and it grows better at 28°C than at 37°C.

The organism is

- ✓ catalase positive;
- ✓ indole, oxidase, and urease negative;
- ✓ Non-motile.

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- ✓ Definite identification of cultures is best done by immunofluorescence or by lysis by a specific Y. pestis bacteriophage. All cultures are highly infectious and must be handled with extreme caution inside a biological safety cabinet.