

*Yersinia , Pasteurella and
Francisella*

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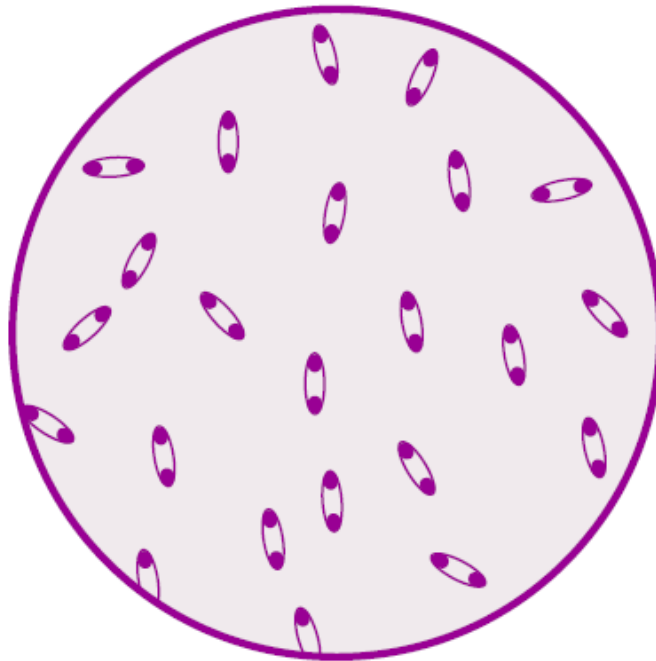
TRIBE YERSINIAE

- Genus: *Yersinia*
- Yersin (1894) and Kitasato (1894) –
Y. pestis – *Pasteurella pestis*
- 1944 – *Yersinia* genus – *Y. pestis* – plague
Y. pseudotuberculosis | mesenteric
Y. enterocolitica | lymphadenitis
- Septicemia – immunocompromised children

Y. pestis

- Morphology – Gram–negative coccobacilli, 1.5 x 0.7 μm , single, pairs, chains, non–sporing, non–motile, capsulated – exudates, cultures – 37°C
- Methylene blue; bipolar staining (safety pin appearance)
- Pleomorphism – 3% NaCl – unfavourable media – club–shaped, coccoid cells, filaments

Y. pestis



Smear of *Y.pestis* with bipolar staining

CULTURAL CHARACTERS

- Aerobe / Facultative anerobe
- pH 7.2, temperature 2–45°C
- NA – transparent, minute, pin point, opaque – 5 days
- BA – dark brown – absorption – hemin pigment
- MA – non–lactose fermentors

- Broth – granular deposit/surface pellicle
- Stalactite growth; drop of oil– surface inoculated broth – growth hangs down into broth from oil drop – stalactites

BIOCHEMICAL REACTIONS

- Catalase +ve, indole -ve, MR +ve, VP and citrate -ve, urease and gelatin liquefaction -ve

ANTIGENIC STRUCTURE

- Months – soil, rodent burrows
- Antigens – 20 antigens
- F1 /Fraction 1 – heat labile (100°C) protein envelope Ag – cultures 37°C; function – inhibits phagocytosis, stimulates immunity protection/humans and mice
- V and W proteins – virulent strains – *Y. pestis* 37°C/low calcium concentration
- Inhibit phagocytosis and intracellular killing

VIRULENCE FACTORS

- Plague toxin; two classes of toxin
- Endotoxin – lipopolysaccharide
- Murine toxin – protein

PATHOGENICITY DETERMINANTS

- Virulent strains – bacteriocin – pesticin1, coagulase and fibrinolysin
- Ability to synthesise purines; production of pigmented colonies hemin-containing media

PATHOGENESIS

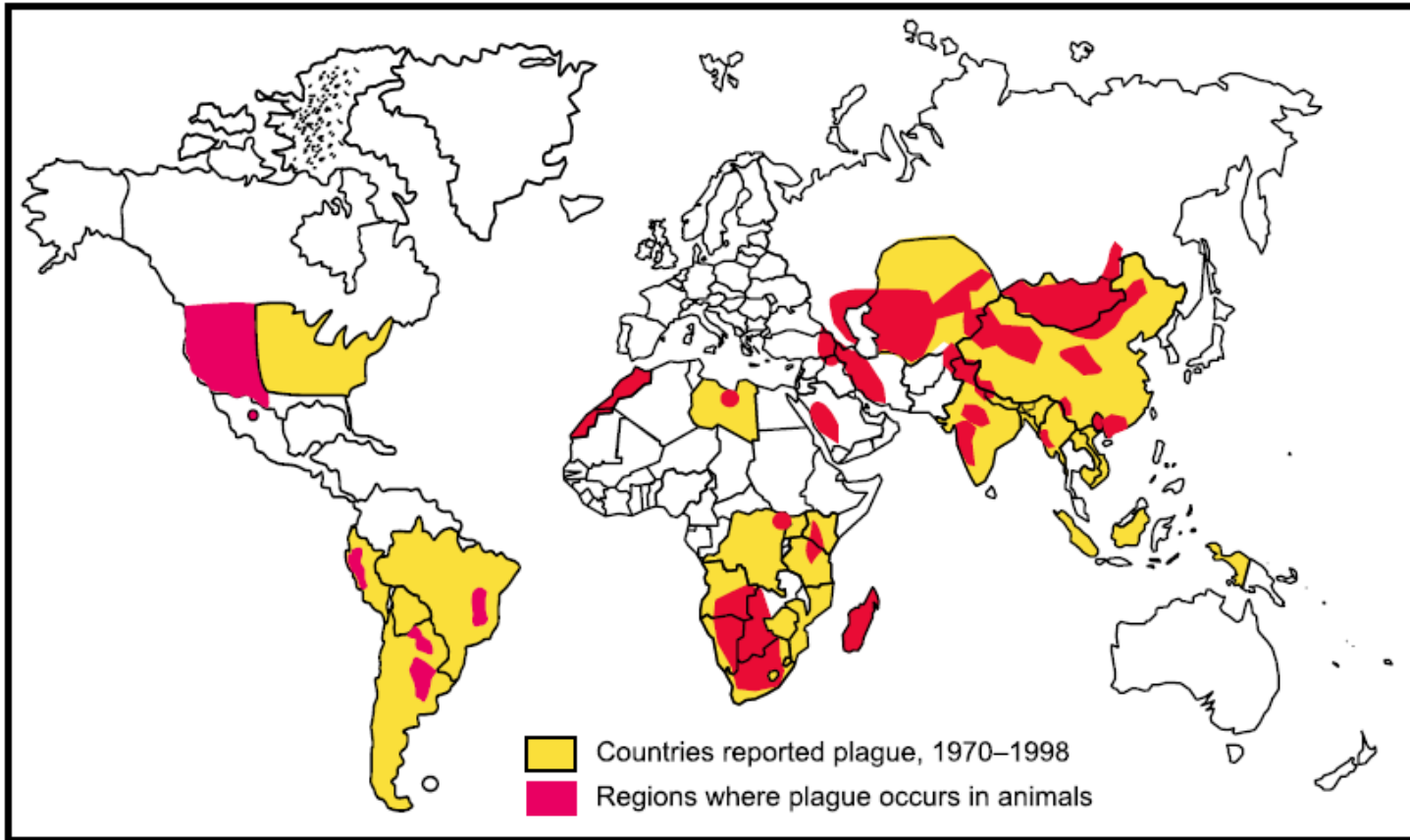
- Zoonotic disease, natural pathogen – rodents
- Mode of infection – *Xenopsylla cheopis*
– rat flea (bite), droplet pneumonic plague

- Flea bite (diseased rat) – sucks 0.5 ml of blood (5000–50,000 bacilli) – multiply in stomach – proventriculus lumen blocked – flea bites another rodent – blood cannot enter – hungry flea bites vigorously – regurgitation of bacteria to bite – transmission diseased rat – death – flea leaves, bites human – bubonic plague

CLINICAL FEATURES

- Three forms
 - Bubonic plague: Incubation period 2–5 days, inguinal nodes enlarged, suppurate, fever, chills, nausea and malaise, bacteremia
 - Septicemic plague: Massive blood vessel involvement – hemorrhages – skin and mucosa – black death

- Pneumonic plague: Bacterial emboli–trapped lungs, pneumonia, fever 104°F, cyanosis/circulatory failure
- Death rate – bubonic plague 50–75%, pneumonic plague 100%; with treatment 5–30%

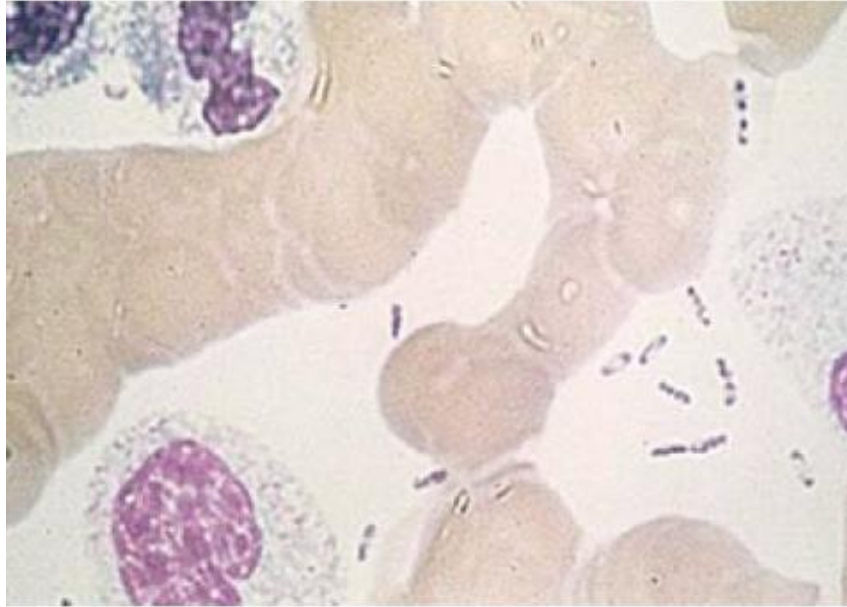


World distribution of plague, 1998

LABORATORY DIAGNOSIS

- Specimen: Exudate bubo, sputum – pneumonia, blood – septicemia
- Bubonic plague: Bubo – punctured – hypodermic syringe
- Microscopy: Gram stain/methylene blue
- Isolation: BA – 27°C, biochemical tests
- Animal experiment – guinea pigs; animal death 2–5 days, postmortem – local inflammation, necrosis and edema, regional lymph nodes – enlarged and congested greyish white patches – tissues

BUBO SMEARS – WAYSON STAIN



Bubo smears in Wayson stain

- Convalescent stage – serology; ELISA – F1 Ag
- PCR – primers – F1 gene sequences
- *Pneumonic plague*: Sputum – Gram stain and methylene blue
- Isolation – BA + BA – sodium azide 7 microgram/ml
- Animal experiment: Guinea pigs – sputum – nasal mucosa/shaved area of skin

DIAGNOSIS

- Diagnosis – rats – dead animals immerse
– disinfectant – kill fleas
- Autopsy – lymph node enlargement
 - pleural effusion
 - splenic enlargement
 - liver congested and mottled,
hemorrhages | skin and
mucosa
 - heart blood culture

PROPHYLAXIS

- Control – fleas and rodents
- Insecticide – rodent burrows
- Rat poison – after killing fleas
- Treatment – streptomycin, doxycycline, chloramphenicol
- Long-term control – good sanitation and waste disposal

VACCINES

- Killed vaccines, Haffkine Institute, Mumbai – whole culture vaccine
- Live vaccines; avirulent strains – *Y. pestis*,
- Disadvantages – difficult to prepare, unacceptable reactions
- Killed vaccine recommended

Yersinia pseudotuberculosis

- Yersiniosis – other than *Y. pestis*, zoonosis
- Morphology – ovoid, bipolar stained, GN bacillus NS, NC, slightly acid fast
- Isolation – poor growth MA, motility at 22°C not at 37°C, urease +ve, rhamnose and melobiose – fermented

PSEUDOTUBERCULOSISa

- Zoonosis, animals – mode of infection – GIT, guinea pigs – liver, spleen and lungs – multiple nodules resembling tuberculous lesions – name pseudotuberculosis
- Humans – mode of infection; skin contact – contaminated water, vegetables
- Clinically – mesenteric lymphadenitis (resembling appendicitis) – acute, subacute, erythema nodosum

LABORATORY DIAGNOSIS

- Excised mesenteric lymph node, blood
- Mesenteric lymphadenitis self-limiting
- *Yersinia enterocolytica* resembles *Y. pseudotuberculosis*, motile at 22°C; sucrose and cellobiose fermented, rhamnose and melobiose – negative, ornithine – decarboxylates; VP +ve and indole +ve

- Six biotypes – cultural and biochemical characters
- 60 ‘O’ serotypes
- Human isolates – 03, 08 and 09
- Clinically – gastroenteritis/enterocolitis – young children
- Mesenteric adenitis and terminal ileitis/older children
- Systemic disease – adults – bacteremia, meningitis, arthralgia

Pasteurella multocida

- Zoonoses
- Non-motile, Gram negative - oxidase +ve , indole +ve
- Cannot grow on MacConkey's agar
- Commensal - human respiratory tract
- Mode of infection - animal bites/trauma
- Local suppuration - wound infection, cellulitis, abscess, osteomyelitis
- Meningitis (head injury)

- Respiratory tract infection
(pneumonia, bronchitis, sinusitis)
- Appendicitis and appendicial abscess
- Rx: Tetracycline, Streptomycin,
Penicillin

Francisella tularensis
(*Pasteurella tularensis*, *Brucella tularensis*)

- Tularemia – rabbits, rodents – Tulare County, California.
- Mode of infection – ticks, arthropod vectors
- Contact – infected rabbits; ingestion (meat or water)
- Inhalation – water borne – excreta infected rodents

MORPHOLOGY

- Minute, capsulated, non-motile, Gram negative
- Resembles *Mycoplasma* – filterable multiplying – filament formation and budding
- Isolation – fastidious, Francis blood dextrose cystine agar, 3–5 days transparent colonies

TULAREMIA

- Clinically, local ulceration, lymphadenitis, typhoid-like fever – glandular enlargement, influenza-like respiratory infection
- Diagnosis – culture
 - animal inoculation – guinea pig/mice
 - serology – antibodies
- Prevention – attenuated vaccine, scarification – high-risk persons

Thank you