Medical Bacteriology- Lecture 14

Gram negative coccobacilli

Zoonosis

Brucella

Yersinia

Francesiella

Zoonosis: A disease, primarily of animals, which is transmitted to humans as a result of direct or indirect contact with the infected animal population

Brucella

Small gram-negative coccobacilli
Aerobic growth on chocolate agar and blood agar
Oxidase positive
Non haemolytic
Non motile, non-spore forming
strongly positive to urease
Not grow on MacConkey or EMB agar
Grow slowly (7 days) at 37C
Causes Brucellosis (undulant fever) or (Malta fever) ; primarily a disease of animal facultative intracellular
Brucella can go through intact skin

Major human pathogenic species

• Species	Primary animal host
•***B. abortus***	**Cattle**
•***B. melitensis***	**Goat / Sheep/ camel**
•*B.canis*	Dogs (pathogenic to humans with immunodeficiency)
•*Brucella ovis*	Sheep

Brucellosis (Undulant fever) is a zoonotic disease transmitted to human who work with unvaccinated animals by direct contact with infected animal skin and mucus membrane, inhalation, or ingestion of unpasteurized dairy products.

***Brucella* human symptoms:** chills, fever (undulant) sweats, weakens, myalgia and headache.

• **Complication:** Brucella spondylitis (Vertebral brucellosis)
- **no vaccine to humans.**

Mechanism of pathogenesis

Skin , contaminated milk and cheese, Aerosols to the mucosa of (nose, mouth & conjunctiva)
↓
Local multiplication
(Slight ulceration of mucosa, PMN phagocytize but *Brucella* multiply in them)
↓
Lymphatic system (local lymph nodes)
↓
Reticulo-endothelial system
(Liver, spleen, and bone marrow)
chronic inflammation (granulomas → abscesses)
↓
Septicemia
↓
Generalized infections
(Meningitis, L-forms in bone marrow)

Fracncisella

•***Francisella tularensis***

Small gram negative coccobacillus
facutative intracellular
low infectious dose
aerobic
slow growing (48hrs) at 37C
fastidious (grow in blood-cysteine agar, grow on chocolate agar)
non motile
encapsulated
not grow on MacConkey or EMB
urea negative
capsule protect from complete killing

Tularemia (Rabbit Fever) is a **zoonotic** disease and transmitted to human by

- **1- biting (rabbit)**
- **2- direct contact with infected animal tissue**
- **3- inhalation of aerosols**
- **4- ingestion of contaminated food and water.**
- **5- by fly or Ticks**

Tularemia types

• **Ulcerglandular tularemia**: Ulceration of arms and hands with lymphadenitis after tick bite or direct contact of broken skin with infected tissue or blood

• **Oculoglandular tularemia:** Accidental contamination of conjunctiva with infected droplets/aerosols

• **Pneumonic tularemia:** Contracted through contaminated aerosols

• **Typhoidal tularemia:** Following ingestion of inadequately cooked food, bacteremia (fever, chills, sore throat, headache, myalgias)

Mechanism of pathogenesis

Site of intery
↓
Ulcerating papule
↓
Lymphatics
↓
Regional lymph nodes
(Enlarged, tender, may suppurate),
(Survival for long times in the monocytes)
↓
Blood (transitory bacteremia)
↓
Lungs
Liver

Yersinia

•Short, pleomorphic gram negative coccbacillus
microaerophilic or facultative anaerobic
facultative intracellular
non motile
non lactose fermenter

• **Three species of facultative intracellular** bacteria that are pathogenic for humans

***Y. pestis* (Pneumonic, bubonic and septicemic plague)**
Y. pseudotuberculosis
Y. enterocolitica

These are primarily animal pathogens, and humans are accidental hosts for infection.

Y. pestis

Causes plaque
Natural disease of rodents
Fleas that live on rodents transmit bacteria to human, in the bubonic form
optimal growth at 28C
Non motile
Urease and oxidase negative

Three forms of clinical plaque illness

Bubonic Plaque (black Plaque): cutaneous, bites- characterized by high fever- infected lymph nodes, painful and enlarged lymph nodes called buboes- 80% can be septic- 60 % mortality if untreated

Pneumonic Plaque: transmitted via aerosols or from septicemic spread to lungs- rapidly- infection of lungs- High mortality rate (95-100%) during 24-36hrs of untreated - painful in muscles- high fever- enlarged liver and spleen- bloody sputum

Septicemic plaque: blood- borne organism, primary or secondary from bubonic or pneumonic- 100% mortality of untreated,

Inoculum dose: 10^8-10^9 organism

Incubation period (IP) =5-10 days

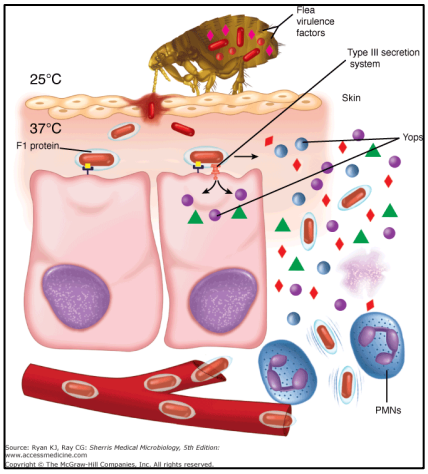
•Diagnosis and treatment must be rapid due to the fast progression and deadliness of the plague

Phage typing
Flourescent antibody

Virulence Factors

- virulence is up regulated at 37C
- Antigenic change at 37c
- antiphagocytic capsule
- protein (V) and Lipoprotein (W) (overwhelming septicemia)

- Calcium dependence at 37C
- **Yersinia outer membranes (Yops);** 11 different proteins, cytotoxic, inhibit phagocyte migration, engulfment and intracellular killing, inhibit platelets aggregation
- Hemolysin,
- Coagulase, produce at 28 C but not at 32C (causes clotting and microthrombi formation)
- Fibrinolysin (promotes dissemination) .



Mechanism of pathogenesis

Dogs and cats
Rodent→ Rodent
↓ Fleas ↓
↓ ↓ ↓
Septicemic plague ←←← **Man**
↓ ↓ 1-6 days
↓ Small pustule (or no local lesion)
↓ ↓
↓ Phagocytosis
↓ Bacteria survive, macrophage killed,
↓ Cal+ determinant or VWa+
↓ ↓
↓ Enlarged lymph nodes (buboes)-**Bubonic plague**
↓ ↓
↓ Lymphatic system
↓ ↓
→ Septicemia (endotoxin, Schwartzman reaction)
↓ ↓
Pneumonia (**Pneumonic plague**) Meningitis

Treatment and Prevention

Streptomycin or tetracycline
Strict isolation
Minimize domestic rat population
Control flea population

Y. enterocolitica and *Y. pseudotuberculosis*

Non-lactose fermenting
Urease positive
Oxidase negative
motile, the flagella are produced during growth at 22 but not at 37c
Isolated from rodents, farm animals, cat and dogs
Human acquire infection via fecal- oral route
Symptoms: abdominal pain, diarrhea, sever arthritis

•*Y. enterocolitica*:

Animal pathogen

Human infection **(Gastroenteritis)**; occurs by contaminated food and drinks from domestic animals or rodents

•Causes diarrhea, fever, abdominal pain, arthritis, internal lesions in liver and spleen and lymph nodes, inflammation of the intestinal tract

• antibiotic therapy recommended

•More virulent and prevalent than *Y. pseudotuberculosis*, more likely cause infection on the skin and to cause food poisoning.

Y. enterocolitica: Mechanism of pathogenesis

similar with *Y. pseudotuberculosis* plus (more likely than in *Y. pseudotuberculosis*)

Local skin lesion
↓
Red, spreading necrosis
↓
Local lymph nodes
↓
Lymphatic system
↓
Septicemia
↓
See *Y. pseudotuberculosis*

•*Y. pseudotuberculosis*:

Human infection results from ingestion of food and drinks contaminated by animal feces

Y. pseudotuberculosis: Mechanism of pathogenesis

Ingestion (simple gastroenteritis)
↓
Invasion of epithelium, ulcerations
↓
Lymphatic tissue (pyeres patches), ulcerations
↓
Lymph nodes (spreads as mesenteric lymphadenitis,symptoms like appendicitis)
↓
Septicemia
↓
Meninges, Joints, Spleen, Liver

Review Question

What is the meaning of zoonosis diseases, Brucellosis?

What is major characteristics of Brucella?

What is the causative agent of: Brucellosis (Undulant fever)- plaque?

How can undulant fever disease transmits?

What are types of tularemia diseases. How can transmitted to human?

Plague is a deadly infections that is caused by *Y. pestis*. Primarily carried by rodents and spread to humans via fleas or rodent. The Plague can be bubonic or pneumonic. Explain? Give three examples of virulence factors?