Food Microbiology

4th year Biology

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Brucellosis:

It is term used as a convenient description for all phases of the disease caused by bacteria called *Brucella*. Many names have been applied to it as (Malta fever, Mediterranean fever, rock fever, Undulant fever).

Brucellosis transmitted from animal hosts to humans (i.e., zoonotic) is highly contagious, but is rarely transmitted from human to human. Contact occurs most commonly through occupational exposure or ingestion of animal products (e.g., raw milk and soft cheeses made with unpasteurized goat or cow milk). Among the rare instances of human-to human transmission are those that have included exposure through reproduction and breast-feeding.

The disease is caused by Gram negative bacteria of the genus *Brucella*, which are facultative intracellular coccobacilli that belong to the α 2-Proteobacteriacea family. It grows optimally around 37 ^{0}C and is killed by heating at 63 ^{0}C for 30 min. When shed in the milk of an infected animal it can survive for many days.

Brucella is comprised of six species, namely *B. melitensis, B. abortus, B. suis, B. canis, B. ovis* and *B. neotomae*. All except *B. ovis* and *B. neotomae* are known to be infectious to humans. Veterinarians and farm workers are at particular risk of infection, due to occupational exposure to tissues of aborted animal fetuses, which may contain millions of organisms.

Route of entry:

Oral*;** e.g., through ingestion of contaminated raw milk or milk products. ***Inhalation; e.g., by laboratory personnel in the clinical setting. Via ***skin wounds***; e.g., in slaughterhouse workers and veterinarians. In rare instances, human-to-human transmission may occur through, e.g., reproduction or breast-feeding. In addition to depending on the type of *Brucella* strain, the severity of the illness depends on host factors and dose. The common sources of infection for humans are unpasteurized milk, milk products, and cheese, and occupational contact (eg, farmers, veterinarians, and slaughterhouse workers) with infected animals.

Symptoms:

Incubation period: may not develop for up to 2 months from time of exposure.

-***Acute phase***: is < 8 weeks from onset with non-specific "flu like" symptoms and intermittent fever

-***Advanced disease***: is the undulant form, <1 year from onset. Symptoms are undulant fever, arthritis and epididymo-orchitis in males.

-Chronic disease: (>1 year from onset) can mimic miliary tuberculosis with suppurative lesions in the liver, spleen, and bone. The patient may have recurrent fever, arthritis, depression, and chronic fatigue syndrome.

Patients who develop complications may show symptoms of endocarditis or myocarditis, such as shortness of breath, arrhythmia, edema, or chest pain; meningo-encephalitis, such as severe headache, stiff neck, confusion, or back pain. With appropriate antibacterial therapy, it is possible to see resolution of disease in only a few weeks; however, even with treatment, symptoms may reappear and last for months or even years.

Pathogenesis:

The pathogenic potential of *Brucella* spp. is highly dependent on its ability to enter and survive within host cells. *Brucella* does not have classic virulence factors such as exotoxins, capsule, or endotoxic lipopolysaccharide (LPS). The major virulence mechanisms of *Brucella* already identified are those required for host cell invasion and intracellular survival or replication within phagocytic cells as well as in non-phagocytic cells such as trophoblasts. This ability involves a temporary fusion of the *Brucella*-containing vacuole with the lysosome, and subsequent exclusion of the lysosomal proteins.

Following this process, the *Brucella*-containing vacuole becomes associated with the endoplasmic reticulum. These endoplasmic reticulum-associated compartments are the niche for intracellular replication of *Brucella* in macrophages, epithelial cell lines and placental trophoblasts. These macrophages transport the bacteria to the lymph nodes and on to systemic sites (the bacteria can establish chronic infection).

Prevention

- Prevention of human brucellosis depends on: Control and elimination of Brucellosis in domestic animals.
- Effective attenuated live bacterial vaccines exist for:

    - *B. abortus* (Strain 19).
    - *B. melitensis* (Strain Rev-1).
    - No vaccines for *B. suis* and *B. canis*.

- On rare occasions, accidents with 19 and Rev-1 caused human brucellosis.

Treatment:

Brucellosis is rarely fatal if treated; in untreated persons, estimates of the case fatality rate vary from less than 2% to 5%. Antibiotics are usually the mainstay of treatment; long-term treatment may be required. Some forms of localized disease, such as endocarditis, may require surgery. Deaths are usually caused by endocarditis or meningitis. Although recovery is common, disability is often pronounced depending on the localization of infection and response to treatment. Approximately 5% of treated cases will relapse weeks to months after therapy has ended due to the failure to complete the treatment regimen or infection that

requires surgical drainage. Antibiotic resistant strains of *Brucella* have been reported, but the clinical importance of that fact is not well understood. *Brucellae* may be susceptible to tetracyclines or ampicillin. Symptomatic relief may occur within a few days after treatment with these drugs is begun. However, because of their intracellular location, the organisms are not readily eradicated completely from the host. For best results, treatment must be prolonged. Combined treatment with a tetracycline (such as doxycycline) and either streptomycin for 2–3 weeks or rifampin for 6 weeks is recommended.

Listeriosis:

Listeriosis, a serious infection usually caused by eating food contaminated with the bacterium *Listeria monocytogenes* .The disease primarily affects older adults, pregnant women, newborns, and adults with weakened immune systems. However, rarely, people without these risk factors can also be affected.

Listeria species are Gram-positive, rod-shaped, motile bacterium, classified in the Family Listeriaceae and there are six species of *Listeria* within this phylogeny; it is a facultative intracellular bacterium that has a propensity for central nervous system infection in humans and domesticated mammals. On the basis of somatic (O) and flagellar (H) antigens, 17 serovars have been described. *Listeria monocytogenes* has an unusual characteristic of surviving in temperatures from -7°C to 45°C. Its optimum growing temperature is around 37°C and it is able to grow, albeit slowly, at temperature as low as 0°C. As a result, it can multiply in properly refrigerated food after contamination. Nevertheless, it can be easily destroyed under normal cooking temperatures. *Listeria monocytogenes* and grow over a wide range of environmental conditions such as low pH and high salt concentration. Therefore, it is able to overcome food preservation and safety barriers making it an important food-borne pathogen. The infective dose of *Listeria monocytogenes* is unknown and may vary with the strain and susceptibility of the host.

How do you get listeriosis??

- *Listeria Monocytogenes* is widely dispersed in the natural environment, including soil, water and decaying vegetation.

- Transmission of bacterium is principally via the faecal-oral route through the consumption of contaminated food. Raw or contaminated milk, vegetables and ready-to-eat meat have been implicated in overseas outbreaks. It can multiply in contaminated refrigerated food (soft cheese).

- In neonatal infection, the pathogen is transmitted from the infected mother to her fetus transplacentally following maternal bacteraemia. Other routes of transmission, e.g. outbreaks attributed to contaminated equipment or materials in delivery room and hospital have also been reported.

- Common animal reservoirs include domestic and wild mammals such as cattle, sheep and fowls.

Listeriosis forms of disease

** ***Febrile gastroenteritis***

- High infectious dose.

- Flu-like symptoms.

- Bacteria shed for weeks or months in feces.

** ***Invasive systemic disease***

- Infectious dose of 100-1000.

- Passes through intestines into body; can affect liver, brain, placenta.

Symptoms:

- Fever.
- Muscle ache.
- GI : Nausea, diarrhea
- Pregnant women: mild flu-like , miscarriage, stillbirth, premature delivery, or infected newborn.
- Lethargy.
- Irritability.
- If infection spreads to the nervous system: headache, stiff neck, confusion, loss of balance, or convulsions.
- Listeria can cause Pneumonia, Meningitis, and Sepsis.

Pathogenesis :

L. monocytogenes enters the body through the gastrointestinal tract after ingestion of contaminated foods. The organism has several adhesin proteins (Ami, Fbp A, and flagellin proteins) that facilitate bacterial binding to the host cells and that contribute to virulence. It has a cell wall surface protein called internalin A that interacts with E-cadherin, a receptor on epithelial cells (specifically present on epithelial cells in intestine, placenta and blood brain barrier), promoting phagocytosis into the epithelial cells. After phagocytosis, the bacterium is enclosed in a phagolysosome, where the low pH activates the bacterium to produce listeriolysin O. This enzyme lyses the membrane of the phagolysosome and allows the listeriae to escape into the cytoplasm of the epithelial cell. *L monocytogenes* can move from cell to cell without being exposed to antibodies, complement, or polymorphonuclear cells.

Prevention:

- Thoroughly cook raw food from animal sources.
- Wash raw vegetables thoroughly before eating.
- Separate uncooked meats from vegetables, cooked foods and ready-to-eat foods.
- Avoid unpasteurized milk or food.
- Wash hands, knives, and cutting boards with hot soapy water for at least 20 sec after handling uncooked foods.
- Observe all expiration dates on food items.
- Consume perishable and ready-to-eat foods as soon as possible.
- Do not eat soft cheeses: feta, brier, camembert, blue-veined, or Mexican-style etc.
- Do not eat refrigerated meat spreads, smoked salmon, smoked seafood; canned or shelf-stable smoked seafood may be eaten.
- *Listeria monocytogenes* is killed by cooking or by heating methods, including pasteurization.

Treatment:

- Listeriosis is a serious disease requiring hospitalization.
- A combination of antibiotics is given intravenously .
- When infection occurs during pregnancy, antibiotics must be given promptly to the mother to prevent infection of the fetus or newborn.
- Babies with Listeriosis receive the same antibiotics as adults.
- The duration of antibiotic treatment is at least 2 weeks.
- Even with prompt treatment, some infections result in death.