



The Big Blue Bacillus: *Listeria Monocytogenes*

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Listeria monocytogenes is an often forgotten, large, gram-positive bacillus acquired from exposure to the environment. It is associated with a number of ailments, affecting those who are immunocompromised or those at the extremes of age. This important, but often neglected, microorganism is our **Bug of the Month**.

What is *L. monocytogenes*?

Listeria monocytogenes is a gram positive, aerobic, facultatively anaerobic, motile, non-spore forming rod. This bacterium is a common environmental microorganism that can grow over a wide range of salt concentrations, pH levels and temperatures. *L. monocytogenes* has been isolated from:

- soil,
- sewage,
- domestic and wild animal manure,
- animal feed,
- refrigerated processed food,
- unpasteurized dairy products
- water and
- seafood.

Table 1

Risk groups for *L. monocytogenes* infection

- Pregnant women
- Individuals who are at the extremes of age
- Organ transplant recipients
- Individuals who are suffering from oncologic or a hematologic disease
- Alcoholics
- Individuals with a hepatic disease
- Diabetics
- Individuals with HIV
- Patients with iron overload
- Patients on glucocorticosteroids or immunosuppressive medications

L. monocytogenes is a facultatively intracellular parasite. Cell-mediated immunity is required for human resistance to this pathogen. Infection with *L. monocytogenes* is an uncommon cause of illness in the general population, but it can be life threatening to:

- neonates,
- pregnant women,
- the elderly,
- immunosuppressed patients and
- others with impaired cell-mediated immunity (Table 1).

L. monocytogenes is a common cause of bacterial meningitis in patients with underlying neoplastic disease, organ transplants or in patients who are receiving corticosteroids. The most common causes of bacterial meningitis are shown in Table 2.

What is listeriosis?

Listeriosis is an animal and food borne disease that is caused by *Listeria spp.*, which can cause both animal and human disease. In humans, listeriosis has two forms:

- 1) mild non-invasive focal infection or GI illness with fever, vomiting and diarrhea, or
- 2) an invasive disease characterized by septicemia or neuropathic disease, seen most commonly in those with underlying immunosuppression.

Specific conditions associated with *Listeria spp.* include:

- **Infection in pregnancy:** This usually occurs in the third trimester and is

characterized by:

- fever,
- myalgia,
- nausea,
- diarrhea
- malaise,
- headache and
- vomiting.

Listeria spp. may cross the placenta causing chorioamnionitis, premature labour or stillbirth. Vertical transmission to the fetus may also occur.

- **Infection in neonates:** Infection occurring in newborns < 10-days-old causes:

- sepsis,
- respiratory distress,
- skin lesions and
- granulomatosis infantis septicum (disseminated abscesses).

Neonates who develop infection after 10 days of age typically develop meningitis.

- **Infection in adults:** Septic presentation of *L. monocytogenes* is characterized by:

- fever,
- malaise,
- fatigue and
- abdominal pain.

Central nervous system (CNS) invasion may cause:

- fever,
- headache,
- ataxia,
- seizures and
- altered mental status.

Listeria spp. can cause:

- meningitis,
- encephalitis,

- meningoencephalitis,
- rhomboencephalitis (brain stem infection) or cerebritis and
- abscesses.

A high index of clinical suspicion is required for performing a lumbar puncture as *Listeria spp.* meningitis is usually subacute and only occasionally presents with the neck stiffness that is typical of meningitis due to other organisms.

How does infection occur?

The usual route of entry is through the GI tract (via contaminated food). The bacteria invades intestinal epithelia, are taken up by macrophages and are transported to the liver and the spleen. Due to the high blood flow of these organs, *Listeria spp.* may then hematogenously seed other organs and the CNS. *L. monocytogenes* contains many cell surface proteins (such as listeriolysin O) which enhance its entry into and between cells, promotes growth and protects the bacterium from intracellular digestion (e.g., by phagosomes) and

immunological detection. Infection by *L. monocytogenes* is countered by non-specific macrophages, complement and CD8 + T lymphocytes.

How is listeriosis prevented?

Because most *Listeria spp.* infections are food-borne, preventative measures typically deal with food safety. Food safety recommendations are as follows:

- Proper washing of raw vegetables
- Avoiding unpasteurized dairy products
- Keeping uncooked meats away from fruits and vegetables
- Proper hand washing
- Keeping knives, cutting boards and counters clean
- High-risk individuals should avoid soft cheeses and they should properly cook left-over or ready-to-eat foods.

It is important to note that approximately 15% to 70% of hot dogs are reported to be contaminated with *Listeria spp.*

How do we diagnose infection with *L. monocytogenes*?

The diagnosis of infection with *L. monocytogenes* is based on blood culture and cerebral spinal fluid (CSF), gram stain and culture. Cultures are required because of symptom overlap with other infectious agents, especially in meningitis. It is also important to culture CSF because *Listeria spp.* may be mistaken for gram variable or contaminating diphtheroids on gram stain. CSF analysis may appear aseptic, although commonly, the fluid is purulent with a predominance of neutrophils and can show pleocytosis, increased protein and normal glucose levels. Blood cultures usually reveal the organism before CSF culture becomes positive.

Serologic testing for anti-listeriolysin O may also aid in the diagnosis.

What is the treatment of listeriosis?

Diagnosis of infection with *L. monocytogenes* is very important in CNS infection because standard empiric treatment for meningitis with third generation cephalosporins is ineffective against *L. monocytogenes*.

It is generally recommended to treat listeriosis with high-dose parenteral ampicillin. The β -lactam antibiotics are particularly useful, but it is also recommended that an aminoglycoside be added for synergy in serious infections, such as meningitis. Gentamicin is frequently used in this regard. In penicillin-allergic patients, trimethoprim-sulfamethoxazole (TMP/SMX) is the treatment of choice. TMP/SMX has bactericidal activity against *L. monocytogenes*, it achieves adequate concentrations in serum and CSF and it has documented clinical efficacy. Therapeutic regimens without aminoglycosides are preferable for patients who are pregnant, have impaired renal function, or who are taking other nephrotoxic drugs.

Optimal duration of therapy is unknown and varies with the patient and the type of infection. Treatment is generally given for a minimum of 14 days, but should be prolonged in immunocompromised patients to prevent relapses. The response to therapy is monitored by blood and CSF culture and therapy is continued until cultures are negative and the patient is clinically asymptomatic.

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Table 2

Most common causes of bacterial meningitis by age group

Neonates

- *Escherichia coli*
- Group B *Streptococcus*
- *Listeria monocytogenes*

Children (>1 month of age) and adults

- *Streptococcus pneumoniae*
- *Haemophilus influenzae*
- *Neisseria meningitidis*

Alcoholics, the immunocompromised and individuals > 50 years of age

- *Streptococcus pneumoniae*
- *Listeria monocytogenes*
- Gram negative bacilli