

Lymphocytic Choriomeningitis (LCM)

Lymphocytic choriomeningitis, or LCM, is a rodent-borne viral infectious disease caused by lymphocytic choriomeningitis virus (LCMV), a member of the family *Arenaviridae*, that was initially isolated in 1933.

The primary host of LCMV is the common house mouse, *Mus musculus*. Infection in house mouse populations may vary by geographic location, though it is estimated that 5% of house mice throughout the United States carry LCMV and are able to transmit virus for the duration of their lives without showing any sign of illness. Other types of rodents, such as hamsters, are not the natural reservoirs but can become infected with LCMV from wild mice at the breeder, in the pet store, or home environment. Humans are more likely to contract LCMV from house mice, but infections from pet rodents have also been reported.

LCMV infections have been reported in Europe, the Americas, Australia, and Japan, and may occur wherever infected rodent hosts of the virus are found. The disease has historically been underreported, often making it difficult to determine incidence rates or estimates of prevalence by geographic region. Several serologic studies conducted in urban areas have shown that the prevalence of LCMV antibodies in human populations range from 2% to 5%.

Additionally, pregnancy-related infection has been associated with congenital hydrocephalus, chorioretinitis, and mental retardation.

Transmission

LCMV infections can occur after exposure to fresh urine, droppings, saliva, or nesting materials from infected rodents. Transmission may also occur when these materials are directly introduced into broken skin, the nose, the eyes, or the mouth, or presumably, via the bite of an infected rodent. Person-to-person transmission has not been reported, with the exception of vertical transmission from infected mother to fetus, and rarely, through organ transplantation.

Signs and Symptoms

LCMV is most commonly recognized as causing neurological disease, as its name implies, though infection without symptoms or mild febrile illnesses are more common clinical manifestations.

For infected persons who do become ill, onset of symptoms usually occurs 8-13 days after exposure to the virus as part of a biphasic febrile illness. This initial phase, which may last as long as a week, typically begins with any or all of the following symptoms: fever, malaise, lack of appetite, muscle aches, headache, nausea, and vomiting. Other symptoms appearing less frequently include sore throat, cough, joint pain, chest pain, testicular pain, and parotid (salivary gland) pain.

Following a few days of recovery, a second phase of illness may occur. Symptoms may consist of meningitis (fever, headache, stiff neck, etc.), encephalitis (drowsiness, confusion, sensory disturbances, and/or motor abnormalities, such as paralysis), or meningoencephalitis (inflammation of both the brain and meninges). LCMV has also been known to cause acute hydrocephalus (increased fluid on the brain), which often requires surgical shunting to relieve increased intracranial pressure. In rare instances, infection results in myelitis (inflammation of the spinal cord) and presents with symptoms such as muscle weakness, paralysis, or changes in body sensation. An association between LCMV infection and myocarditis (inflammation of the heart muscles) has been suggested.

Previous observations show that most patients who develop aseptic meningitis or encephalitis due to LCMV survive. No chronic infection has been described in humans, and after the acute phase of illness, the virus is cleared from the body. However, as in all infections of the central nervous system, particularly encephalitis, temporary or permanent neurological damage is possible. Nerve deafness and arthritis have been reported.

Women who become infected with LCMV during pregnancy may pass the infection on to the fetus. Infections occurring during the first trimester may result in fetal death and pregnancy termination, while in the second and third trimesters, birth defects can develop. Infants infected *In utero* can have many serious and permanent birth defects, including vision problems, mental retardation, and hydrocephaly (water on the brain). Pregnant women may recall a flu-like illness during pregnancy, or may not recall any illness.

LCM is usually not fatal. In general, mortality is less than 1%.

Risk of Exposure

Individuals of all ages who come into contact with urine, feces, saliva, or blood of wild mice are potentially at risk for infection. Owners of pet mice or hamsters may be at risk for infection if these animals originate from colonies that were contaminated with LCMV, or if their animals are infected from other wild mice. Human fetuses are at risk of acquiring infection vertically from an infected mother.

Laboratory workers who work with the virus or handle infected animals are also at risk. However, this risk can be minimized by utilizing animals from sources that regularly test for the virus, wearing proper protective laboratory gear, and following appropriate safety precautions.

Diagnosis

During the first phase of the disease, the most common laboratory abnormalities are a low white blood cell count (leukopenia) and a low platelet count (thrombocytopenia). Liver enzymes in the serum may also be mildly elevated. After the onset of neurological disease during the second phase, an increase in protein levels, an increase in the number of white blood cells or a decrease in the glucose levels in the cerebrospinal fluid (CSF) is usually found.

Laboratory diagnosis is usually made by detecting IgM and IgG antibodies in the CSF and serum. Virus can be detected by PCR or virus isolation in the CSF at during the acute stage of illness.

Treatment

Aseptic meningitis, encephalitis, or meningoencephalitis requires hospitalization and supportive treatment based on severity. Anti-inflammatory drugs, such as corticosteroids, may be considered under specific circumstances. Although studies have shown that ribavirin, a drug used to treat several other viral diseases, is effective against LCMV in vitro, there is no established evidence to support its routine use for treatment of LCM in humans.

Prevention

LCMV infection can be prevented by avoiding contact with wild mice and taking precautions when handling pet rodents (i.e. mice, hamsters, or guinea pigs).

Rarely, pet rodents may become infected with LCMV from wild rodents. Breeders, pet stores, and pet owners should take measures to prevent infestations of wild rodents. Pet rodents should not come into contact with wild rodents. If you have a pet rodent, wash your

hands with soap and water (or waterless alcohol-based hand rubs when soap is not available and hands are not visibly soiled) after handling rodents or their cages and bedding.

If you have a rodent infestation in and around your home, take the following precautions to reduce the risk of LCMV infection:

- Seal up rodent entry holes or gaps with steel wool, lath metal, or caulk.
- Trap rats and mice by using an appropriate snap trap.
- Clean up rodent food sources and nesting sites and take precautions when cleaning rodent-infested areas: ◦Use cross-ventilation when entering a previously unventilated enclosed room or dwelling prior to cleanup.
 - Put on rubber, latex, vinyl or nitrile gloves.
 - Do not stir up dust by vacuuming, sweeping, or any other means.
 - Thoroughly wet contaminated areas with a bleach solution or household disinfectant.
 - Hypochlorite (bleach) solution: Mix 1 and 1/2 cups of household bleach in 1 gallon of water.
 - Once everything is wet, take up contaminated materials with damp towel and then mop or sponge the area with bleach solution or household disinfectant.
 - Spray dead rodents with disinfectant and then double-bag along with all cleaning materials and throw bag out in an appropriate waste disposal system.
 - Remove the gloves and thoroughly wash your hands with soap and water (or waterless alcohol-based hand rubs when soap is not available and hands are not visibly soiled).

The geographic distributions of the rodent hosts are widespread both domestically and abroad. However, infrequent recognition and diagnosis, and historic underreporting of LCM, have limited scientists' ability to estimate incidence rates and prevalence of disease among humans. Understanding the epidemiology of LCM and LCMV infections will help to further delineate risk factors for infection and develop effective preventive strategies. Increasing physician awareness will improve disease recognition and reporting, which may lead to better characterization of the natural history and the underlying immunopathological mechanisms of disease, and stimulate future therapeutic research and development.

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