

RIFT VALLEY FEVER

(Infectious enzootic hepatitis of sheep and cattle)

- [Definition](#)
- [Etiology](#)
- [Host Range](#)
- [Geographic Distribution](#)
- [Transmission](#)
- [Incubation Period](#)
- [Clinical Signs](#)
- [Gross Lesions](#)
- [Morbidity and Mortality](#)
- [Diagnosis](#)
- [Field Diagnosis](#)
- [Specimens for the Laboratory](#)
- [Differential Diagnosis](#)
- [Vaccination](#)
- [Control and Eradication](#)
- [Public Health](#)
- [References](#)
- [FAD Table of Contents](#)

Definition [top](#)

Rift Valley fever (RVF) is an arthropod-borne (primarily mosquito), acute, febrile, viral disease of sheep, cattle, and goats (4). The disease in these species is characterized by high abortion rates, high mortality in neonates, and hepatic necrosis (6). Humans are highly susceptible. Symptoms in humans in most cases are those of an acute undifferentiated febrile disease; severe cases (about 1 percent) resemble a dengue-like disease (18) accompanied by hemorrhage, meningoencephalitis, retinopathy, and sometimes death (10).

Etiology [top](#)

Rift Valley fever is caused by a three-stranded RNA virus in the *Phlebovirus* genus of the family Bunyaviridae (11). All isolates are serologically similar. Detection of differences between isolates requires RNA fingerprinting.

Rift Valley fever virus is inactivated by lipid solvents, detergents, and low pH. At

neutral or alkaline pH in the presence of protein such as serum, the virus can remain viable for up to 4 months at 4° C. Specimens stored below 0° C will retain infectivity for 8 years (6). Rift Valley fever virus in aerosols has a half-life in excess of 77 minutes at 25° C and 30 percent relative humidity (9). Humans have been infected by aerosols generated during the slaughtering procedure, by handling aborted fetuses, performing necropsies, and conducting laboratory procedures.

Contaminated surfaces should be washed to remove large amounts of organic matter and disinfected using strong solutions of sodium or calcium hypochlorite; residual chlorine should exceed 5,000 ppm. Solutions having a pH of 6.2 (acetic acid) or lower are also effective.

Host Range [top](#)

Rift Valley fever virus infects many species of animals and humans (table 1). Neonatal lambs, kids, calves, and puppies are highly susceptible and have a high mortality. Sheep and cattle are the primary species affected and the primary amplifiers of the virus. Humans are highly susceptible to RVF virus infection and are readily infected by mosquitoes and aerosols. Humans develop a sufficient viremia to be a source of infection for mosquitoes and thus could introduce the disease into uninfected areas.

TABLE 1. Rift Valley fever host range and disease severity (6, modified)

Mortality ~100%

Lambs
 Calves
 Kids
 Puppies
 Kittens
 White mice
 Hamster
 Field mice
 Door mice

Field voles

Severe illness, Abortion, Mortality

Sheep

Cattle

Goats

Water buffalo

Humans

Severe illness, Viremia, Abortion

Monkeys

Camels

Rats

Gray squirrels

Infection, Viremia

Horses

Cats

Dogs

Monkeys

Refractive to infection

Guinea pigs

Rabbits

Pigs

Hedgehogs

Tortoises

Frogs

Chickens

Canaries

Pigeons

Parakeets

Geographic Distribution [top](#)

Rift Valley fever has been found to occur in most of Africa.

Transmission [top](#)

Historically, explosive outbreaks of the disease have occurred simultaneously over a wide area of Africa at 5 to 15 year intervals. The outbreaks have generally occurred in otherwise dry areas following periods of heavy rainfall. The long interval between outbreaks in animals allows for the development of a susceptible population. For many years, the reservoir during the interepidemic periods was unknown. Then researchers found RVF virus to be present in dormant eggs of the mosquito *Aedes lineatopinnis* located in the soil of grassland depressions known as dambos (5). When these depressions become full of water, the eggs hatch, and infected mosquitoes develop. These mosquitoes infect an amplifying host (ruminant), which serves as a source of infection for many other genera of mosquitos that rapidly spread the disease. If the area of infected mosquitoes extends into areas of susceptible animals, there are many clinical cases. In contrast, in most areas of Africa the disease is enzootic and best monitored by the use of sentinel animals.

In Africa, many of the species of mosquitoes in the genera *Aedes*, *Anopheles*, *Culex*, *Eretmapoites*, and *Mansonia* can transmit RFV. In North America, mosquitoes in the genera *Aedes*, *Anopheles*, and *Culex* experimentally are capable vectors of RFV (8). Experimentally, *Culex pipiens*, an important vector in Egypt, was shown to feed preferentially on febrile rather than normal sheep. Experimentally, vector competence of *Culex pipiens* also increased with increasing holding temperature (17).

Incubation Period [top](#)

Experimentally, the incubation period in newborn lambs, kids, calves, and puppies, is about 12 hours. In adult sheep, cattle, goats, and dogs the incubation period

may be as long as 3 days. In humans, the incubation period is 4 to 6 days.

Clinical Signs [top](#)

Clinical signs depend on the species affected and physiologic conditions such as age and pregnancy. Lambs develop a fever of 104-107° F (40-42° C) accompanied by anorexia and become weak and die about 36 hours after inoculation. Mortality in lambs under 1 week of age exceeds 90 percent. Mortality in lambs over a week old is greater than 20 percent. Adult sheep develop a fever of 104-106° F (40-41° C), along with a mucopurulent nasal discharge, and they may vomit. If animals are pregnant, abortion will be the most prominent sign. Mortality, particularly in ewes that abort, may reach 20 to 30 percent. Calves develop a fever of 104-106° F (40-41.1° C)

and become depressed. Mortality can range from 10 to 70 percent. Adult cattle develop a fever of 104-106° F (40-41.1° C), have excessive salivation, anorexia, and weakness; some may develop a fetid diarrhea. If animals are pregnant, abortion will be the most prominent sign (Fig. 90). Mortality is usually less than 10 percent.

Humans develop influenza-like symptoms with fever of 100-104° F (37.8-40° C), headache, muscular pain, weakness, and nausea plus epigastric discomfort and photophobia. Most people recover in 4 to 7 days; however, a small percentage of infected individuals will develop complications. Some may develop a hemorrhagic syndrome of jaundice, hematemesis, melena, and petechiae 2 to 4 days after becoming febrile and die. Others will develop a meningoencephalitis, and a third group a retinopathy 5 to 15 days after becoming febrile.

Gross Lesions [top](#)

The primary lesion in RVF is hepatic necrosis. In aborted fetuses and in neonatal animals, particularly lambs and calves, hepatic necrosis can be massive. The liver may be enlarged and yellowish, have petechial hemorrhages, and be friable (Fig. 91). Older animals may have a focal hepatic necrosis; this may be visible as small pale foci in the parenchyma or be seen only by histopathologic examination. In both neonatal and older animals that die, there may be widespread cutaneous hemorrhages, petechial to ecchymotic hemorrhages on parietal and visceral serosal membranes, and a hemorrhagic enteritis.

Morbidity and Mortality [top](#)

Rift Valley fever causes a high mortality in young lambs, calves, and kids. Mortality in adult sheep is about 20 percent and in adult cattle about 10 percent. A high percentage of pregnant animals may abort.

Diagnosis [top](#)

Field Diagnosis [top](#)

Rift Valley fever should be considered in the differential diagnosis whenever the following observations are made in a disease outbreak:

1. High abortion rates (possibly approaching 100 percent) in ewes, cows, and bitches but lower rates in goats and in other ruminants,
2. High mortality (possibly approaching 100 percent) in lambs and calves less than 7 days of age and lower rates of disease and mortality in older animals,
3. Extensive liver lesions in aborted fetuses and neonatal animals,
4. An influenza-like disease in man — particularly in individuals associated with livestock,
5. Occurrence of the disease during a period of high insect activity, and
6. Rapid spread.

Although this scenario may appear to make the suspicion of RVF rather obvious, unfortunately, a lack of communication may result in a delay in recognizing the pattern.

Specimens for the Laboratory [top](#)

If RVF is suspected, extra precautions should be taken in the collection and shipment of specimens because of the potential for human infection. Samples for virus isolation should be collected from aborted fetuses or febrile animals, or both. Specimens for virus isolation should include liver, spleen, heparinized blood, serum, and brain. For serologic confirmation of the disease, febrile animals should be permanently identified, a serum sample collected, and a second serum sample collected a minimum of 30 days later.

Differential Diagnosis [top](#)

In animals, RVF could be misdiagnosed as bluetongue, Wesselsbron, ephemeral fever, enterotoxemia of sheep, brucellosis, vibriosis, trichomoniasis, Nairobi sheep disease, heartwater, or ovine enzootic abortion.

Vaccination [top](#)

Several vaccines have been used to protect against RVF infection. Rift Valley fever virus was first attenuated by serial intracerebral inoculation of mice (Smithburn strain) (18). One inoculation of this vaccine produced protection in 6 to 7 days and immunity that lasted at least 3 years. However, when administered to pregnant ewes, it caused abortion, and the vaccine was pathogenic for man. Because of these problems with the attenuated vaccine, inactivated vaccines produced from cell-culture-propagated virus were developed. These vaccines protected; however, they had the disadvantages of requiring two inoculations for protection, annual vaccination, and large amounts of antigen (17). When the epizootic occurred in Egypt, enough inactivated vaccine could be produced to vaccinate only the more valuable breeding stock. Recently a mutagen-attenuated Vero-cell-propagated vaccine has been developed for use in people (2). The vaccine has also been tested in sheep and cattle. The vaccine causes no adverse effect in neonatal lambs, calves, or pregnant sheep or cattle. Bovine fetuses inoculated with the vaccine via a laparotomy continued a normal development and were seropositive when born. This vaccine also has the advantage that one inoculation induces rapid immunity, and as few as 10 plaque-forming units of the virus induce protection (12,13). Thus, many doses of vaccine can be produced quickly.

Attenuated vaccines induce a higher and more persistent serum antibody neutralizing titer than inactivated vaccines. Animals and people vaccinated with inactivated vaccine should have their RVF neutralizing antibody titer determined annually or be revaccinated. A serum neutralization titer of 20 or greater is protective (18). Lambs and calves that receive colostrum from a convalescent dam or dam vaccinated with an attenuated virus are passively protected for about 3 months.

Control and Eradication [top](#)

In RVF enzootic areas, vaccination is the only practical method of preventing low-level losses. Movement of animals from an enzootic area to RVF-free areas during the period of virus activity should be discouraged to prevent an epizootic. Mosquito control during an epizootic is logical but not practical for large areas; it could be used to reduce human exposure in limited areas. Slaughter of sick animals is not recommended because of the risk of human infection from aerosols

of blood and body fluids. In an epizootic, widespread vaccination of all susceptible animals to prevent infection of amplifying hosts and thus infection of vectors is the only way to prevent infection of animals and man.

Public Health [top](#)

Humans are highly susceptible to infection. In an enzootic or epizootic area, protective measures should be taken to prevent infection by mosquitoes. Of even more importance, protective measures should be taken to prevent infection by aerosols produced during the handling of infected fetuses and tissues and in laboratory procedures. People who could be exposed to the virus should be vaccinated.

GUIDE TO THE LITERATURE [top](#)

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C. A Mebus, DVM, PhD, USDA, APHIS (retired), Southold, NY 11971
