

RABIES IN CAMELS





Definition

Rabies is an acute, progressive viral encephalomyelitis that principally affects carnivores and bats, although any mammal including Camel can be affected. The disease is fatal once clinical signs appear. Rabies is found throughout the world, but a few countries claim to be free of the disease because of either successful elimination programs or their island status and enforcement of rigorous quarantine regulations. Globally, the dog is the most important reservoir, particularly in developing countries.

Etiology

Rabies is caused by lyssaviruses in the Rhabdovirus family. Lyssaviruses are usually confined to one major reservoir species in a given geographic area, although spillover to other species is common. Identification of different virus variants by laboratory procedures such as monoclonal antibody analysis or genetic sequencing has greatly enhanced understanding of rabies epidemiology. Generally, each virus variant is responsible for virus transmission between members of the same species in a given geographic area. To date, >15 different lyssaviruses have been described. Globally, rabies virus is the most important member of the genus. The rabies virus is enveloped and has a cylindrical morphology (bullet shaped) having a single stranded [RNA](#) genome with [negative-sense](#). The genetic information is packaged as a [ribonucleoprotein](#) complex in which RNA is tightly bound by the viral nucleoprotein. The RNA genome of the virus encodes five genes whose order is highly conserved. These genes code for nucleoprotein (N), phosphoprotein (P), matrix protein (M), glycoprotein (G) and the viral RNA polymerase (L).



Epidemiology

From an epidemiologic perspective, the name of the mammalian species acting as the reservoir and vector is used as an adjective to describe involvement in the infection process. For example, rabies maintained by dog-to-dog transmission is termed canine rabies, whereas rabies in a dog as a result of infection with a variant from a different reservoir mammal, eg, skunk (or raccoon or fox), would be referred to as skunk (or raccoon or fox, etc) rabies in a dog.

Rabies is a public health problem of significant importance in the majority of Southern and Eastern Mediterranean and Middle Eastern countries. In some of these countries, there is a considerable death rate due to rabies. Dogs are the main source of human infection, while cats constitute the second most important group of domestic animals followed by cattle, sheep, goats, camels, donkeys and then wild animals. There are around 300 reported human cases in these regions annually, with several hundred thousand post-exposure treatments. Laboratory confirmation of rabies cases is not always performed. In most countries, there is one central rabies diagnosis laboratory with trained staff and the diagnosis capability of district laboratories is weak. Animal rabies control consists of the vaccination of dogs and cats, the elimination of stray animals, health education for the public, etc. The effective coverage rate of mass vaccination of dogs and cats is not exactly known. The elimination of stray dogs and other animals by shooting and poisoning is still implemented in certain countries, however, this has a minimal effect on rabies transmission. Certain countries of the Middle East region are facing increasing problems due to wildlife rabies, including Saudi Arabia, Oman, Yemen, Israel, Iran and Turkey. The red fox (*Vulpes vulpes*) and golden jackal (*Canis aureus*) are usually involved. Coordinated actions to confront the serious rabies public health and economic problems should be undertaken by affected countries, with the assistance of international organisations, under conditions that are suitable for each country.



Clinical signs

Transmission almost always occurs via introduction of virus-laden saliva into tissues, usually by the bite of a rabid animal. Most rabies cases in dogs develop within 21–80 days after exposure, but the incubation period may be shorter or considerably longer. Rabid animals of all species usually exhibit typical signs of CNS disturbance, with minor variations among species. The most reliable signs, regardless of species, are acute behavioral changes and unexplained progressive paralysis. Behavioral changes may include sudden anorexia, signs of apprehension or nervousness, irritability, and hyperexcitability (including priapism). The animal may seek solitude. Ataxia, altered phonation, and changes in temperament are apparent. Uncharacteristic aggressiveness may develop—a normally docile animal may suddenly become vicious. According to a study in the [Sudan Journal of Veterinary Research](#), symptoms of rabies in dromedary camels are hyper-excitability, attacking inanimate objects, self-biting of forelimbs, salivation sternal recumbency, paralysis of hind legs, and death within 3-7 days.

In a study regarding incidence of rabies in Saudi Arabia, the disease was transmitted in about 70% of cases by bites from rabid wild dogs and in 17% of cases from bites of rabid foxes. The source of infection was not found in about 13% of cases. Camels were bitten when they defend their neonates from attacking predators. The usual sites of the bite were either on fore or hind limbs. The disease was mainly of the silent or dumb type (67% of cases). The male camel was especially dangerous when showing the furious form of the disease, attacking and biting nearby objects and mutilating its own body. The clinical signs of the disease were restlessness, salivation and rotation of head and neck in all directions. These signs were soon followed by paralysis, recumbent and death. Results also showed that camels did not transmit rabies to humans. A rabid camel is usually segregated from the herd and left to die in the desert, or destroyed when aggressive. The clinical course may be divided into three general phases—prodromal, acute excitative, and paralytic/end stage. During the prodromal period, which lasts ~1–3 days, animals show only vague nonspecific signs, which intensify rapidly. The disease progresses rapidly after the onset of paralysis, and death is virtually certain a few days thereafter. Some animals die rapidly without marked clinical signs.



The term “furious rabies” refers to animals in which aggression (the acute neural excitative phase) is pronounced. “Dumb or paralytic rabies” refers to animals in which the behavioral changes are minimal, and the disease is manifest principally by paralysis.

Furious Form:

This is the classic “mad-dog syndrome,” although it may be seen in all species. There is rarely evidence of paralysis during this stage. The animal becomes irritable and, with the slightest provocation, may viciously and aggressively use its teeth, claws, horns, or hooves. The posture and expression is one of alertness and anxiety, with pupils dilated. Noise may invite attack. Such animals lose caution and fear of people and other animals. As the disease progresses, muscular incoordination and seizures are common. Death results from progressive paralysis.

Paralytic Form:

This is manifest by ataxia and paralysis of the throat and masseter muscles, often with profuse salivation and the inability to swallow. These animals may not be vicious and rarely attempt to bite. The paralysis progresses rapidly to all parts of the body, and coma and death follow in a few hours.

In general, rabies should be suspected in terrestrial wildlife acting abnormally. The same is true of bats that can be seen flying in the daytime, resting on the ground, paralyzed and unable to fly, attacking people or other animals, or fighting.

Rodents and lagomorphs rarely constitute a risk of exposure to rabies virus. However, each incident should be evaluated individually. Reports of laboratory-confirmed rabies in woodchucks are not uncommon in association with the raccoon rabies epizootic in the eastern USA.



DIAGNOSIS

Clinical diagnosis is difficult, especially in areas where rabies is uncommon, and should not be relied on when making public health decisions. In the early stages, rabies can easily be confused with other diseases or with normal aggressive tendencies. Therefore, when rabies is suspected and definitive diagnosis is required, laboratory confirmation is indicated. Suspect animals should be euthanized, and the head removed for laboratory shipment.

Antigen detection

1. Fluorescent antibody (FA) test

A quick and easy procedure for the diagnosis of rabies is the use of a suitable dye for the detection of Negri bodies. Histopathological techniques have, however, been replaced in most laboratories by the fluorescent antibody (FA) test. The FA technique is a highly sensitive method for detecting rabies antigen in fresh specimens. It is recommended that fresh tissue be examined where possible. When specimens are received in 50% glycerol-saline, it is imperative that the tissue be washed several times in saline before staining.

2. Cell-culture isolation techniques

Fixed rabies viruses can grow in a wide variety of cells. Successful in vitro cultivation of rabies virus was first reported in 1936. Tests for the isolation of street rabies in cell culture were first carried out in the mid 1970s using baby hamster kidney cells, line 21 (BHK-21), and chick embryo-related (CER) and neuroblastoma cells. These studies demonstrated that rabies infection could be detected by immunofluorescence from as early as 4-5 hours up to 5 days following inoculation.



3. Enzyme-linked immunosorbent assay (ELISA)

ELISA called rapid rabies enzyme immunodiagnosis (RREID), is based upon the detection of rabies virus nucleocapsid antigen in brain tissue. In this test, microplates are coated with purified IgG and an IgG-peroxidase conjugate is used to react with immunocaptured antigen.

RREID is a simple and relatively cheap technique, which can be especially useful for epidemiological surveys. It may be used to examine partially decomposed tissue specimens for evidence of rabies infection, but it cannot be used with specimens that have been fixed in formalin. Since the antigen can be visualized with the naked eye, the test can be carried out in laboratories that do not have the necessary equipment for FA tests.

4. Virus identification using monoclonal antibodies

Monoclonal antibodies are produced by hybridomas of fused mouse myeloma cells and splenocytes from mice immunized with either the rabies virus or rabies-related viruses. These hybridomas secreted monoclonal antibodies directed against the glycoprotein (G protein) or nucleocapsid of rabies virus. Although monoclonal antibodies are mainly used for epidemiological investigations, they were found to be very useful for rabies diagnosis in certain circumstances, such as imported cases of human rabies and rabies associated with uncertain exposure, and also routinely in countries where large-scale programmes for oral vaccination of foxes are under way to establish that no infections are caused by the vaccine strain.

5. Intra vitam diagnosis

In addition to the brain and spinal cord, rabies virus antigen can be detected by FA in the peripheral nerves, salivary glands, saliva, and also in the cornea and skin during the final stages of the disease.



Prevention and Control

Comprehensive guidelines for control in dogs have been prepared internationally by the World Health Organization. They include the following: 1) notification of suspected cases, and euthanasia of dogs with clinical signs and dogs bitten by a suspected rabid animal; 2) reduction of contact rates between susceptible dogs by leash laws, dog movement control, and quarantine; 3) mass immunization of dogs by campaigns and by continuing vaccination of young dogs; 4) stray dog control and euthanasia of unvaccinated dogs with low levels of dependency on, or restriction by, people; and 5) dog registration.

Many effective vaccines, such as modified-live virus, recombinant, and inactivated types, are available for use throughout the world. Recommended vaccination frequency is every 3 years after an initial series of two vaccines 1 year apart. Vaccines available for use in cattle and sheep can be used in Camels also.

Management of Suspected Rabies Cases

Where terrestrial wildlife or bat rabies is known to occur, any animal bitten or otherwise exposed by a wild, carnivorous mammal (or a bat) not available for testing should be regarded as having been exposed to rabies. It is recommended that any unvaccinated dog, cat, or ferret exposed to rabies be euthanized immediately. If the owner is unwilling to do this, the animal should be placed in strict isolation (ie, no human or animal contact) for 6 months and vaccinated against rabies 1 month before release. If an exposed domestic animal is currently vaccinated, it should be revaccinated immediately and closely observed for 45 days.



Zoonotic Risk

Rabies has the highest case fatality of any infectious disease. When a person is exposed to an animal suspected of having rabies, the risk of rabies virus transmission should be evaluated carefully. Risk assessment should include consideration of the species of animal involved, the prevalence of rabies in the area, whether exposure sufficient to transmit rabies virus occurred, and the current status of the animal and its availability for diagnostic testing.

Any healthy domestic dog, cat, or ferret, whether vaccinated against rabies or not, that exposes (bites or deposits saliva in a fresh wound or on a mucous membrane) a person should be confined for 10 days; if the animal develops any signs of rabies during that period, it should be euthanized and its brain promptly submitted for rabies diagnosis. If the dog, cat, or ferret responsible for the exposure is stray or unwanted, it may be euthanized as soon as possible and submitted for rabies diagnosis.

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