

Rabies Overview

Rabies is a viral infection transmitted in the saliva of infected mammals. The virus enters the central nervous system of the host with resulting inflammation that is almost always fatal. Rabies is currently present in all states, except for Hawaii. Although all mammals are susceptible to rabies virus infection, only a few species are reservoirs for the disease in nature. In the United States, several distinct rabies virus variants have been identified in populations of raccoons, skunks, foxes, and coyotes. In addition to the terrestrial reservoirs for rabies, several species of insectivorous bats also serve as reservoirs for the disease. Raccoons and bats are the major reservoirs for wildlife rabies in Alabama. Foxes and other wild carnivores can be infected by raccoons and often test positive with the raccoon variant of the rabies virus.

The epidemiology of the positive rabies cases in Alabama has changed drastically over the past 60 years. In 1948, dogs and cats comprised 70% of the 358 positive rabies tests. In the 1960s, due to the public health programs initiating mandatory animal vaccinations, there was a dramatic decrease in rabies in dogs and cats. However, another dynamic of positive rabies cases was beginning to surface in the mid-1970s. During this period, the number of skunks and raccoons that tested positive for rabies sharply increased. Although skunk positives have waned significantly in recent decades, raccoons remain as the most common wild terrestrial animal with rabies in Alabama. The raccoon variant of the rabies virus is believed to have originated in Florida and has steadily spread northward and eastward through natural movement and illegal translocation of raccoons incubating the rabies virus. Currently, the southeastern part of the state is endemic with the raccoon variant of rabies. The region generally to the south and east of the Alabama and Coosa River system accounts for the vast majority of positive animal tests. However, sporadic positive may be found outside of the endemic area.

For most Alabamians, the most common connection to rabid animals is through their pets. Reducing the risk of rabies in domestic animals is central to the prevention of human rabies. Vaccinating and removing stray animals that are at risk of exposure to rabid wildlife is the basic element of a rabies control program. Alabama law (Code of Alabama 1975 §3-7A-2) requires that all owned dogs, cats, and ferrets be vaccinated against rabies by a licensed veterinarian with an approved vaccine.

Nationally, indigenously acquired rabies among humans has declined markedly in recent years. In the last century the average number of human rabies cases has dropped from around a hundred per year to 2 or 3 cases per year. This reduction further signifies the importance of advances made in human rabies vaccine and rabies control programs.

The most recent case of human rabies in Alabama was in 1994, as a result of the bat variant. All human cases in the United States since 1990 known to have contracted rabies while stateside have been from a bat variant. Human rabies cases from other variants since 1990 were acquired while traveling abroad. Whether this is due to increased human exposure to bats or to an increase in the percentage bats harboring rabies is debatable. Bites from bats are also particularly concerning because of their difficulty to recognize which may result in an unknown exposure.

Since rabies is a statistically 100% fatal disease, the focus is to prevent human rabies by administering rabies post-exposure prophylaxis if exposure occurs. Additional efforts should be made to prevent additional human exposure through rabies education, animal quarantine and animal vaccination.

Biology, Transmission, and Pathogenesis

Rabies Virus

The rabies virus belongs to the order Mononegavirales, viruses with a nonsegmented, negative-stranded RNA genome. Within this group, viruses with a distinct “bullet” shape are classified in the Rhabdoviridae family, which includes at least three genera of animal viruses, Lyssavirus, Ephemerovirus, and Vesiculovirus. The genus Lyssavirus includes rabies virus, Lagos bat virus, Mokola virus, Duvenhage virus, European bat virus 1 & 2, and Australian bat virus. The most common is the rabies virus. The rabies virus is only cause of rabies in the US. The virus can be further classified by slight variation within species that it infects, such as the raccoon variant, canine variant, and bat variant of the rabies virus.

Although the rabies virus can infect a variety of cell types, it primarily targets neurons. The cycle of viral infection is depicted in Figure 1: Transmission of Rabies Through the CNS, on page 9. The virus spreads by retrograde axonal transport from the peripheral nerves to the neuronal cell body. After replication in the cell body of the primary neuron, infection proceeds via retrograde axonal transport and transsynaptic spread through several neurons. Transsynaptic spread is the ability of the virus to use synaptic junctions to propagate within the CNS. Neuronal infection by the rabies virus causes abnormalities in the function of neurotransmitters affecting serotonin, GABA, and muscarinic acetylcholine transmission. Cells of the salivary gland are infected next, which in turn shed virus into the oral cavity. This accounts for the presence of the virus in saliva.

Susceptibility

ALL mammals (animals that are warm-blooded, have hair, fur, or mammary glands) are susceptible to rabies, but there are varying degrees of susceptibility. Birds and reptiles cannot be infected with the rabies virus.

Table 1 Levels of Rabies Susceptibility

Level of Susceptibility	Animals
Most Susceptible	Foxes, coyotes, jackals, and wolves
Highly Susceptible	Skunks, raccoons, bats, ferrets, and cattle
Moderately Susceptible	Dogs and cats (domesticated), sheep, goats, horses, and subhuman primates

Opossums are relatively resistant to rabies and considered a low risk for infection. Experiments have shown that the viral exposure dose required to infect opossums is 80,000 times that needed to infect a fox. Rodents and rabbits are also a relatively low risk for transmitting the rabies virus and seem somewhat refractory to rabies infection. Experimentally infected rodents generally