

# Epidemiology of Rabies

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**R**abies is probably the most feared of all human diseases. It is one of the most ancient diseases of man and animals. The acute viral infection is characterised by inflammation of the central nervous system.

Rabies has plagued man since ancient times. The ancient oriental physicians describe a disease resembling rabies, in dogs and man as far back as 3000 years BC. Rabies in animals has also been described in detail by Democritus around 500 BC and Celsus during first century.

## **Etiology**

The rabies virus is a small (150 x 75nm) RNA containing bullet shaped virus belonging to the genus *Lyssa* virus and family *Rhabdoviridae*. Each particle contain a helical nucleocapsid surrounded by a lipid bilayer. The outer surface is covered with spike-like projections, 10 nm in length, anchored in a lipid bilayer. Five proteins have been identified following disruption of rabies virus with sodium dodecyl sulfate. The ribo-nucleoprotein contains the genomic RNA associated with three internal proteins, the transcriptase (L) ( $M_1 = 1,90,000$ ), the nucleoprotein (N) ( $M_1 = 55,000$ ), and a phosphoprotein (NS) ( $M_1 = 38,000$ ). These proteins, together with the RNA, forms an active RNA complex, which controls both transcription and replication. The other structural proteins are the matrix protein (M) ( $M_1 = 26,000$ ), which is located on the inner side of the virus envelope, and the glycoproteins (G) ( $M_1 = 67,000$ ), which forms the surface projection. The G protein is the only viral antigen that induces virus neutralising anti-

bodies. It is also a target for virus immune T helper cells and cytotoxic T cells. The N protein has been shown to be a major antigen, capable of inducing T helper cells that cross react between different rabies and related viruses. Since the G and N proteins are the major antigens capable of inducing immunity against lethal rabies infection both should be included in the genetically engineered vaccines.

The virus is highly resistant against cold, dryness decay etc. It can remain infectious for weeks in cadavers, if it is refrigerated. It is inactivated by formaldehyde, sunlight, lipid solvents and various antiseptics.

## **Geographical distributions**

Rabies occurs in all continents except Australia and Antarctica. About 59 countries are free of this disease, which includes Great Britain, Spain, Portugal in Europe, Jamaica, Uruguay in South America, Japan and Qatar in Asia etc. (Singh and Batia, 1993). Islands of Pacific and Oceania such as Fiji and Papua New Guinea are historically free from rabies. Certain Asian countries like Malaysia, Singapore, Taiwan etc. have become free of it by adoption of rigorous control programme.

## **Incidence in India**

In India rabies is endemic except in the Lakshadweep, Andaman and Nicobar, which are free of it. States like Manipur, Meghalaya, Sikkim, Arunachal Pradesh, Mizoram, Nagaland and Dadra and Diu have reported occasional cases of hydrophobia while substantial death have been reported in Maharashtra, Tamil Nadu, Uttar Pradesh, West Bengal and Andhra Pradesh.

Dog continues to be the main reservoir of infections and is responsible for over 97% of rabies in man and animals. In a few

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countries in Europe cats attack more people than dogs. The wild animals remain as reservoir hosts and act as a source of infection for dogs which in turn spread the disease to man and other animals. Stray dogs play a crucial role as vectors in the spread of rabies in India. It is estimated that dog population in India is about 30 million and dog to human ratio is 1:35. The dog densities are higher in densely populated areas inhabited by lower income group.

Of the total known rabies cases in the world, 47.1% occurs in the tropics, with 96% of cases in dogs in urban areas. Of the total estimated and reported human deaths from rabies, 99.9% were in the tropics, while 89.5% of post-exposure treatment was administered to persons living in the tropics (Anbumani, 1993).

The problem of human rabies in countries of tropics is basically urban in nature, where there is a close physical and spatial relationship between dogs and people. In areas where dog rabies predominates cases have been reported in other domestic animals such as cattle, buffaloes, sheep, goat, swine and horses.

Wild animals like fox, jackal, mongoose can spread the disease by biting to dogs and other domestic animals besides propagating among wild animals. Study at Central Research Institute, Kasauli has shown that 3% of bandicoots harboured rabies virus in their brain. Among wild animals, the reservoir hosts of rabies in different countries are as follows:

Europe	: Foxes, Roe deer, Badgers, Martins
Asia	: Wolves, Jackals, Bats, Mongoose
North America	: Foxes, Skunks, Coyotes, Bats
Central America & South America	: Vampire bats

In most of the northern hemisphere, rabies is primarily a disease of wild life. The most important residual focus of rabies infection in these region are the foxes, wolves, skunks, jackal, racoons and coyotes. In these

regions not only these are the most prevalent form of rabies but also the most difficult to control because mass immunisation of these animals or reduction in their population is difficult to achieve. Whereas in the southern hemisphere it affects pet animals and man.

Though vampire and insectivorous bats do transmit rabies abroad, especially in American countries, bat transmitted rabies in India is yet to be established, though one case of bat rabies was reported at Srikakulam in the year 1954 (Patnaik, 1995).

### Transmission

In 1804, Zinke demonstrated the infectious nature of saliva of rabid animals.

Rabies is transmitted mainly by the contamination of bite wound with the saliva from infected animals. Until the 1960s, bite-inoculation of saliva was considered the only natural means of rabies transmission. It was demonstrated that aerosol transmission to humans and other animals occur under special condition in some bat caves (Constantine, 1962).

The virus is excreted in saliva, urine, milk and tears. Hence contamination of wound with above materials can lead to infection, though rare. Consumption of raw milk and meat from infected animals can lead to infection and act as a method of transmission in animals.

Corneal transplantation from infected patients has led to rabies.

The significance of transplacental infection in natural rabies transmission is uncertain. Howard (1989) demonstrated rabies virus in the uterus, ovaries and embryo of a dead pregnant skunk. Transplacental rabies infection in a cow and in bats have also been reported (Green, 1980).

### Incubation Period

The average incubation period is 4 days to 90 days in human beings but variations do occur. This varies according to the site of bite, the amount of virus infected, virulence of the virus and the immunological status of the patient (Patnaik, 1995).

