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Abstract

Rabies And Its Zoonotic Potential

Ghanshyam Sahu, Lalhmangaihzuali, Shikha Bishnoi

Ph.D. Scholar -Animal Biochemistry Division Indian Veterinary Research Institute
Izatnagar, Bareilly-243122

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Abstract

Rabies is a fatal viral disease that can be transmitted from animals to humans. Domestic dogs are responsible for rabies virus transmission to humans in most of the cases. The disease is caused by a neurotropic virus called the Lyssavirus under the Rhabdoviridae family. The virus reaches the brain and undergoes replication and then declines along the facial nerve and enters the salivary glands. Therefore, the virus spreads from a bite via the saliva of the animal as the saliva consists of the large quantity of the virus. All warm-blooded animals including humans can get the infection from different domestic as well as wild animals and transmit to human and animals. The virus has a genome that encodes five proteins which are related to the ribonucleoprotein (RNP) complex or the viral envelope and responsible for the pathogenesis of the virus. The disease can be prevented by proper care and management of domestic animals including regular preexposure vaccination. Post-exposure vaccination can also prevent in development of the disease even after the bite.

Introduction

The saying goes “dogs are the man’s best friend”, which is quite true as the canines are good companion for the humans. But these animals that we love and care so much can be a cause of deadly disease and havoc to mankind and other animals. The dogs if not cared for properly and regularly, could be carriers to many diseases but if proper care is taken, they could be the best thing for a man. One of the most dangerous diseases that a dog can transmit to human and other animals is the rabies. According to World Health Organization, “rabies is a viral zoonotic disease which is vaccine-preventable, in which the clinical symptoms once appear, is virtually 100% fatal and in up to 99% of cases, domestic dogs are responsible for rabies virus transmission to humans”.

The disease is caused by a neurotropic virus that infect the central nervous system through the peripheral nerves, called the Lyssavirus under Rhabdoviridae family. This virus family consists of



more than hundred negative-sense, single stranded, rod-shaped virus that can cause diseases in a wide range of hosts – animals. The rabies virus (lyssavirus) can infect both domestic and wild animals as well as humans which spreads via the bites of infected animals.

Clinical Manifestations

Once the virus infects the body, it can replicate itself in the connective tissues on the site of the bite and then enter the peripheral nervous system. It manifests itself in five stages – incubation, prodrome, acute neurological period, coma and death or rarely recovery (Rupprecht, 1996). The incubation period can range from 5 days to more than 2 years from the day of exposure. Clinical symptoms can be seen during the prodromal which can be from 2 to 10 days or more with non-specific symptoms including general malaise, fever and fatigue which may be accompanied by symptoms of respiratory system, gastrointestinal system or central nervous system. The most outstanding symptoms are distress, hydrophobia, photophobia, nightmares and depression.

The virus enters the CNS via the peripheral nervous system and can cause two forms of the disease viz furious and paralytic forms. As the name suggests, in the furious form, there is hyperactivity, hydrophobia, excitable behaviour and death due to cardio-respiratory arrest. While in paralytic form, the muscles undergo gradual paralysis from the site of the bite or scratch leading to comatose and eventually death.

The virus reaches the brain and undergo replication in the brain. After replication and multiplication in the brain, it declines along the facial nerve and enter the salivary glands (Boonsriroj, 2016). Therefore, the virus spreads from a bite via the saliva of the animal as the saliva consists of large quantity of the virus.

Fig: Schematic diagram of pathogenesis of rabies. (Jackson & Fu, 2013)

Zoonotic Cycle

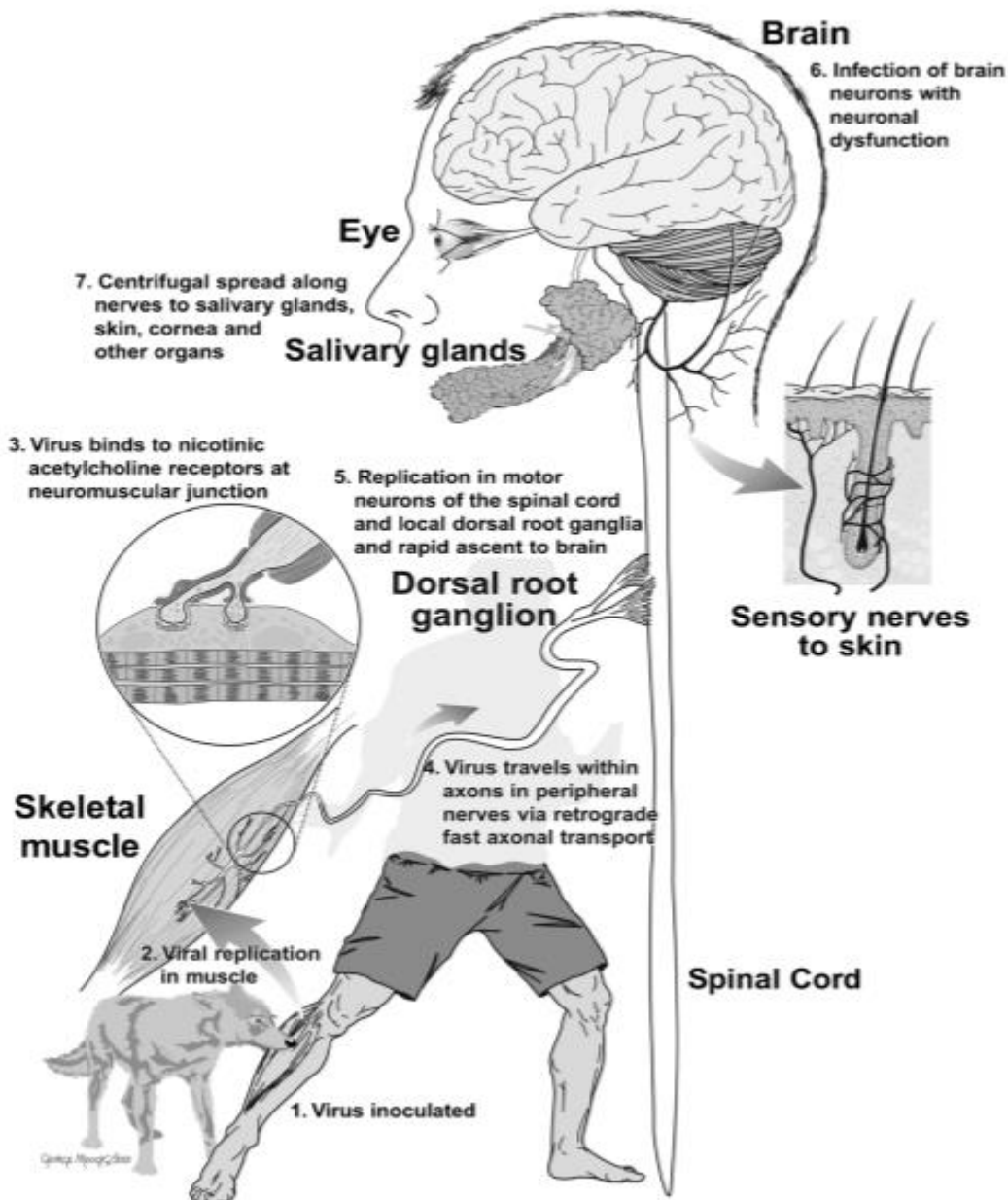
All warm-blooded animals including humans can get the infection from different domestic as well as wild animals and transmit to human and animals. Dogs are the most common source of infection and transmission world-wide. The virus may also be transmitted by bats, monkeys, racoons, foxes, skunks, cattle, wolves, coyotes, cats, mongoose (Taylor, 1993), infected bears, groundhogs, weasels, domestic animals and wild carnivores (CDC, 2010).

The virus has a genome that encodes five proteins which are related to the ribonucleoprotein (RNP) complex or the viral envelope viz. L (polymerase), N (nucleoprotein), P (phosphorylated) protein, matrix protein (M) and external surface glycoprotein (G). The N, P and L proteins constitute the ribonucleoprotein (RNP). Factors determining the virulence of the virus include virus uptake, cell-



to-cell spread, expression of vital glycoprotein (G) and rate of replication of virus. Viral glycoprotein (G) is the main factor contributing to the pathogenicity of the virus, it enables quick viral entry and regulates the rate of replication of virus. (Dietzschold *et al.* 2008).

Virus infects muscle cells adjacent to the wound site and replicate there or it can enter the peripheral nervous system via the acetylcholine receptors in the neuromuscular junction and moves centripetally



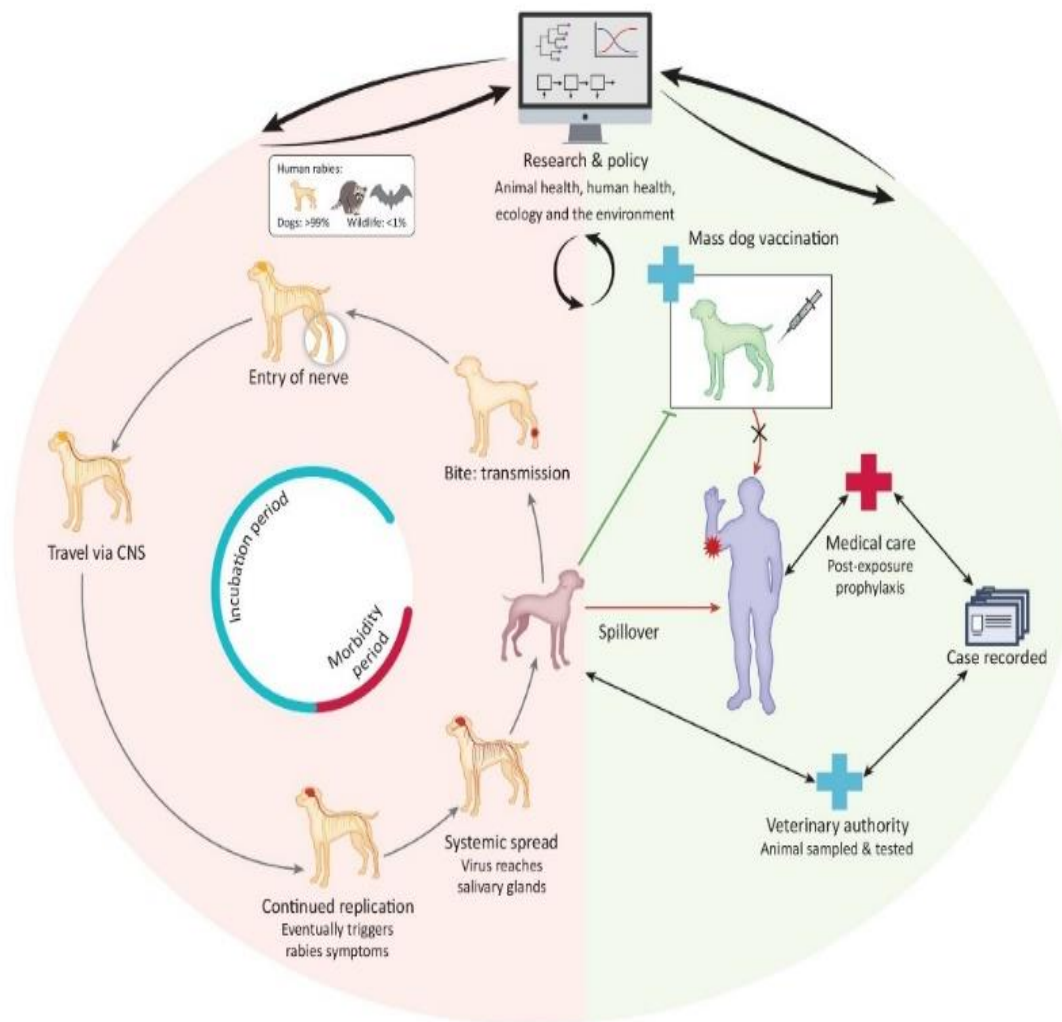
to the CNS where it replicates causing the symptoms. Then the virus moves centrifugally to other parts of the body especially the salivary gland to be transmitted to the next host. The virus can replicate in the tissues and cells of humans and animals and cause fatal infection; therefore, it has



high zoonotic importance.

Fig: Diagrammatic representation of zoonotic life cycle of rabies virus (Brunker & Mollentze, 2018)

Conclusion



Trends in Microbiology

Risk assessment is important to prevent the disease and should focus on species of animals involved, prevalence of rabies in the specific place, extent of the injury, condition of the animal and accessibility of diagnostic tests. When bitten by animals, thoroughly washing of the wound with normal saline, ringer’s lactate or water and soap, then applying povidone-iodine or alcohol can decrease the rate of infection. Post exposure treatment should be done for the wound with proper line of treatment including antibiotic injections, regular dressing, etc. Prevention of rabies can be done using vaccination for human including pre-exposure and post exposure vaccinations; preexposure



vaccination should be done at 0, 7, 21 or 28 days which will limit post exposure vaccination to 0 and 3 days only. But if only post exposure vaccination is to be given, it should be on 0, 3, 7 and 14 days from the day of bite. The domesticated animals should also be given preexposure vaccination regularly from 3 months old onwards with another dose once every year. If any exposure to animal's saliva by bites or deposits in exposed wounds, the exposed person should be kept in confinement for 10 days and during that time, if the animal develops any signs of rabies, the exposed person is in risk of the disease and should be tested; while the animal should be euthanized and the brain should be submitted for diagnosis of rabies. Care should be taken to not expose oneself and domestic animals to wild animals as the wild animals can be carrier of the virus.

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