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Unraveling Rabies: Insights into Epidemiology, Transmission, and Control Strategies

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Abstract

When it comes to infectious diseases, rabies has one of the highest case-fatality ratios and is nearly always lethal due to lyssavirus infection. After the rabies virus enters the central nervous system, generally in the spinal cord, it is linked to neuronal dysfunction. The biting pathway is still thought to be the primary mode of transmission. Dogs and cats are considered as the most common ways that humans are exposed to rabies, even though wild animals are thought to be a host. The most severely impacted areas are the tropical nations of Africa, Asia, and South America, which have inadequate resources for treatment, diagnosis, control, surveillance, and the development and production of vaccines. Therefore, methods like the polymerase chain reaction, direct fluorescent antibody test, and mouse inoculation technique are used for confirmatory diagnosis. Since rabies is a disease that can be fatal, this study reviews the transmission, pathophysiology, control, prevention, and treatment of this virus.

Keywords: Rabies, Lethal, Transmission, Diagnosis, Control.

INTRODUCTION

RABV genotype 1 is the primary cause of rabies, making it one of the most frequent and fatal diseases in the world. According to **Walde *et al*., (2013),** it is mostly connected to dog bites in Europe, Asia, and Africa, as well as bat bites in the Americas. The Lyssa virus genus, which is a member of the Rhabdoviridae family, is the cause of rabies. The virus has a bullet-like form and a genome made of single-stranded RNA **(Moges, 2015).** The ultraviolet light can harm the lyssavirus. When exposed to air, sunshine, or dried blood with secretions, it quickly becomes inactive **(Tojinbara *et al*., 2016**). All mammals have been affected, including agricultural animals, humans, cats, dogs, and wildlife. Three forms are mentioned for animals: prodromal, excitation (fierce), and paralysis (dumb). The virus is found in the saliva of infected animals, and bites, scratches, or licks to broken skin or mucous membranes are the most common ways that it can infect people **(Jackson, 2010).** When an animal bites, scratches, or licks an open wound or mucosal membrane, it can transfer the virus to other people **(Nilsson, 2014).**

Human rabies infection continues to be a serious global public health concern. An estimated 35,000 people die from rabies annually, primarily in Africa, Asia, and Latin America. According to the **World Health Organisation (WHO),** rabies is a disease that is often ignored and is most prevalent in places that are struggling with poverty and a lack of financial resources. According to **Permpalung *et al*., (2013),** the most significant vector of human exposure is the domestic dog. It is feasible to shield an exposed individual from getting rabies by neutralising the virus with antibodies prior to the virus invading the nerve tissue. This is accomplished through immunoglobulin use and/or immunisation, a procedure known as post-exposure prophylaxis (PEP) **(Wilde *et al*., 2013).** The prevention of rabies in humans is proposed to involve raising public awareness and increasing understanding about the disease, providing first aid after dog bites, learning more about dog behaviour, and learning how to avoid being bitten by dogs **(Depani *et al*., 2012).** Thus, this paper's primary goal is to review the resources that are available for rabies prevention and control.

PATHOGENESIS

Saliva containing the virus is introduced into a bite site to allow the rabies virus to infect a new host. Saliva contamination of the mucous membranes in the mouth, eyes, and nasal passages is another way to obtain entry. Intact skin is impervious to the virus **(Klingen *et al*., 2008).** Local viral proliferation in non-neural tissue may occur at the point of entrance, after which the virus attaches to nerve cell receptors and enters peripheral nerve endings **(Charlton, 1994).** The virus moves by afferent axons until it reaches the central nervous system, where it multiplies and then spreads widely throughout the brain and spinal cord. Salivary gland infection results from centrifugal transport via efferent cranial neurons, which also releases virus particles into the saliva. Brain infections frequently cause behavioural abnormalities that prompt the host to bite other animals, which spreads the virus. The clinical picture might vary greatly throughout species, among members of the same species, and even during the course of a given individual's disease. Death from a widespread central nervous system infection nearly always results from subsequent circulatory, metabolic, or viral processes, as well as respiratory paralysis **(Ugolini, 2011).** The amount of virus that is transmitted, the virus strain, the position of inoculation (bite closer to the head has a shorter incubation period), host immunity, and the type of lesion all affect the incubation period. The incubation period in dogs and cats is 10 days to 6 months; most cases show symptoms between 2 weeks and 3 months **(Bishop *et al*., 2010).**

MODE OF TRANSMISSION

The majority neurotropic rabies virus quickly kills its host as it enters the neurones. The virus enters the salivary glands prior to death and is released into the saliva. When simple licking or contamination is sufficient, the saliva enters another host through a pre-existing skin break; alternatively, the rabies virus enters by a mechanical skin breach caused by the bite of the rabid animal **(Radostits *et al*., 2007).** The transmission of rabies occurs through animal bites in 99.8% of cases. Rabies can occasionally be contracted through aerosol transmission and corneal or other organ transplants from undiagnosed donors **(Hendekli, 2005).**

DIAGNOSIS

The only way to diagnose this disease is after the symptoms appear **(WHO, 2013).** According to **Consales and Bolzan, (2007),** the diagnosis of rabies is made either in vivo or through autopsy. Ante-mortem diagnosis of lyssavirus infection is a challenging task. Although hydrophobia is a very suggestive condition, there are no clinical indications of infection that are indicative of this disease. Since several laboratory-based tests have been established for infection confirmation due to short sensitivity, the historical dependence on the detection of accumulated Negri-bodies is no longer deemed adequate in support of the diagnostic evaluation **(Abera *et al*., 2015).** A sample of tissue from the suspected animal's brain is used to diagnose the rabies virus. However, samples from the cerebellum and brain stem are typically obtained for confirmatory diagnosis **(Yousaf *et al*., 2012).** The fluorescent antibody test (FAT), which is intended to work with both human and animal samples, is used to detect virus antigen in brain smears. The direct FAT is advised as a confirmatory diagnostic test for the majority of animals. Table 1 lists additional techniques for identifying this virus.

Table 1: Techniques used for diagnosis of virus along with advantages and disadvantages

Techniques	Samples used	Advantage/Disadvantage	Reference
PCR (Polymerase Chain Reaction**)**	body fluids, saliva, urine, cerebrospinal fluid	Applicable in all tissue conditions but, requires experienced technicians	Yousaf *et al*. (2012)
DFA (Direct Fluorescent Antibody Technique**)**	liver, brain, salivary glands, spleen and pancreas are the most appropriate sample	Applicable with most tissue sources. Not applicable in decomposed tissues.	Yousaf *et al*. (2012)
MIT (Mouse Inoculation Technique**)**	liver, brain, salivary glands, spleen and pancreas are the most appropriate sample	For an accurate result use only fresh tissues	Yousaf *et al*. (2012)
TCIT (Tissue Culture Infection technique**)**	liver, brain, salivary glands, spleen and pancreas are the most appropriate sample	Have to only use fresh tissues	Yousaf *et al*. (2012)

PREVENTION AND CONTROL

Before Louis Pasteur and Emile Roux developed the rabies vaccine in 1885, almost all instances of rabies in humans were fatal. Rabbits that were infected created the innovative vaccine. In this process, the virus within the rabbits' nervous system was harmed by allowing them to become severely dehydrated for a period of five to ten days **(Geison, 1978).** Additionally, in 1967 the human diploid cell rabies vaccine was discovered. However, inexpensive vaccinations made from chicken embryo cells are now accessible **(Ly *et al*., 2009).** In order to prevent outbreaks in wild animals, France, Belgium, Germany, and the United States utilise a different recombinant vaccination called Raboral V-RG **(Reece *et al*., 2006).** According to **Tojinbara *et al*. (2016),** human rabies can be prevented by providing appropriate rabies pre-exposure prophylaxis, prompt local treatment of infected lesions, and appropriate rabies post-revelation prophylaxis **(Chernet and Nejash, 2016).**

TREATMENT

Post-exposure prophylaxis entails administering human rabies immunoglobulin and rabies vaccination after promptly cleaning and disinfecting the wound. If a person has received a previous vaccination, then the fewer doses and no rabies immunoglobulin are used. If post exposure prophylaxis is started immediately after exposure, it is quite effective. Once symptoms start to appear, there is no cure. Previous attempts to treat rabies virus infection included vaccinations, antiviral medications including ribavirin and interferon-alpha, passive administration of anti-rabies virus antibodies (human immunoglobulin or monoclonal antibodies), ketamine; nevertheless, these treatments were typically unsuccessful **(McDermid *et al*., 2008).**

CONCLUSION

This virus-caused disease is called rabies, and it can kill both unvaccinated humans and animals. In both agricultural animals and pets, it can be managed with appropriate knowledge and lyssavirus vaccination. Because prevention is better than cure, rabies can be avoided by avoiding close contact with the rabid animal, its mucous membranes, and wounds. Veterinary professionals, wildlife workers, animal handlers, and laboratory personnel can also benefit from good training in rabies prevention. It is essential to educate the public on the causes, symptoms, and methods of rabies prevention and control. Establishing rules for managing stray dogs is a good idea. Stray dogs should be closely supervised, and rabies vaccinations should be required.

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