IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

One Health Approach In Rabies Elimination: Human, Animal, And Environmental Perspective

1)Ms.Komal Khushalrao Tambe, 2)Miss.Mayuri Balu Mokal, 3)Mr.D.K.Vir
4)Ms.Darshana Panjabrao Theng 5) Mr.Ritesh Sachin Dound
1)Author 2) Associate Professor 3) Principle 4)Co-Author 5)Co-Author
Department of Pharmaceutical Science and Technology
Shree Goraksha College of Pharmacy and research Center Khamgaon,Chhatrapati Sambhaji Nagar,India

❖ **Abstract**

Rabies is one of the oldest known infectious diseases, with historical records tracing back violent symptoms seen in infected individuals. In ancient Greece, it was also referred to as lyssa, which means frenzy.Rabies is a zoonotic viral infection capable of affecting humans as well as all mammals, including domestic pets, livestock, and wild animals.Louis Pasteur (1885) A major breakthrough came when Louis Pasteur developed the first rabies vaccine using an attenuated virus. The first successful treatment was given to Joseph Meister, a boy bitten by a rabid dog, marking a milestone in medical history.Rabies is a zoonotic infection that can be prevented through vaccination and still causes considerable deaths across the globe. The rabies virus, like other members of the Lyssavirus genus, is primarily transmitted through the bite of an infected animal.The World Health Organization (WHO) considers rabies a preventable yet neglected zoonotic disease that continues to cause tens of thousands of deaths each year, mainly in Asia and Africa. WHO emphasizes that rabies can be eliminated through a “One Health” approach, which integrates mass dog vaccination, improved human post-exposure prophylaxis, public awareness, and stronger health systems.The organization, together with global partners, has set the target of achieving ."Zero human deaths from dog-mediated rabies by 2030."

❖ **Keywords :**Rabies,Dog, Human,vaccine, Lyssaviruses, Wild animals

❖ Introduction

Rabies is considered one of the most ancient illnesses recognized in humans and remains a highly lethal viral infection of the central nervous system, capable of affecting all warm-blooded species [1].

Rabies is an age-old zoonotic illness, produced by viruses belonging to the order Mononegavirales, the family Rhabdoviridae, and the genus Lyssavirus[2].

Rabies, historically referred to as hydrophobia due to the intense fear of water sometimes seen in patients, is primarily spread through the bite of an infected animal, most often a dog carrying the virus. The disease has been recognized for thousands of years, with some of the earliest accounts traced back to the fourth century BCE[3].

Vaccination stands as one of the most remarkable achievements of human innovation, scientific progress, and the joint commitment of global public and veterinary health sectors[4].

The term rabies is believed to have originated from the ancient Sanskrit word Rabhas, used around 3,000 years ago, which translates to “to do violence.” The disease is transmitted primarily through the bite of an infected or carrier animal, introducing the virus directly into the wound[5].

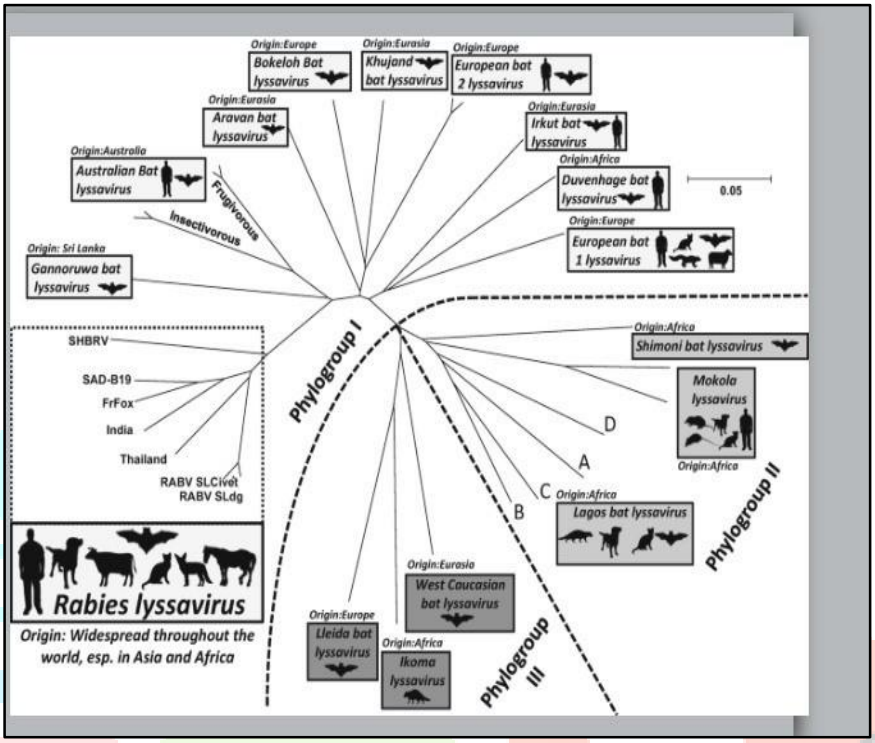

Fig no 1.global member of the lyssavirus genus

3.Rabies History

In 1885, Louis Pasteur, along with Emile Roux and their associates, successfully developed the first effective vaccine against rabies[6],[7]

that ancestral rhabdoviruses may have diversified in parallel with the evolutionary progression of invertebrates, plants, and vertebrates—most notably among mammals. The existence of rabies-like viruses before the rise of mammals cannot be entirely ruled out, given the traits that favor a rabies reservoir: a developed central nervous system, warm-blooded nature, social interactions, sharp teeth suited for biting, functional salivary glands, mobility, wide ecological distribution, and large populations. Many ancient and existing animal groups display these attributes. Hence, it is plausible that some dinosaur species could have been vulnerable to rabies-like pathogens, as it seems unlikely that primitive lyssaviruses would have bypassed such plentiful potential hosts. Nevertheless, the exact evolutionary timeline and emergence of lyssaviruses— particularly within bat lineages (Chiroptera)—remain subjects of ongoing scientific discussion[8],[9].

4.Epidemiology

The rabies virus (RABV) maintains a broad natural reservoir, as it can infect a wide range of mammalian species—likely due to its potential binding with receptors such as the nicotinic acetylcholine receptor (nAChR), neural cell adhesion molecule (NCAM/CD56), and the low-affinity neurotrophin receptor[10].

According to the WHO Global Vaccines Research Forum, dog-mediated rabies places more than 3 billion individuals at risk worldwide, with Asia alone reporting over 30,000 deaths each year—equating to one

death every 15 minutes. Tragically, around 15% of these rabies-related fatalities occur in children below 15 years of age [11].

From an epidemiological perspective, a major challenge in understanding lyssavirus dynamics lies in the worldwide variation of its species distribution. The rabies virus occurs broadly among terrestrial carnivores across the globe, whereas bat-associated infections are primarily confined to the Americas, where transmission cycles are observed among insecteating, fruit-eating, and blood-feeding bat populations[12].

In Europe, widespread dog vaccination efforts led to a shift from the urban to the sylvatic form of rabies around the mid20th century. The sylvatic form was subsequently managed through oral vaccination programs targeting wild species, especially red foxes. Since the late 1980s, all European nations have implemented oral rabies vaccination campaigns, which continue today due to the need for regular immunization of wild animal populations, typically conducted twice a year[13].

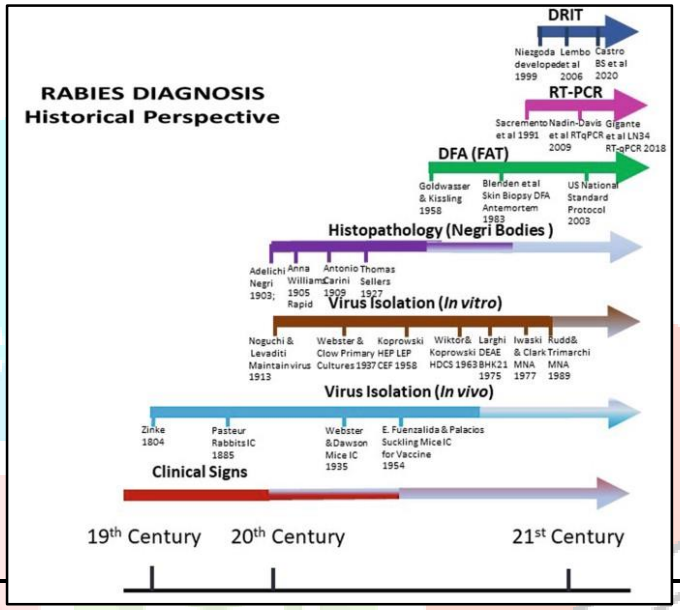

Fig no 2.Historical Perspective of Rabies Diagnosis

5.Pathogenesis of rabies

Death in rabies cases is primarily attributed to cardiac failure; however, extensive viral replication in the brain may lead to failure of multiple organ systems. The disease process of rabies has been clearly described in both humans and animals, though no single clinical sign is unique to it. Therefore, laboratory testing is essential to confirm the involvement of a lyssavirus. In regions lacking advanced diagnostic facilities, such infections may be mistakenly attributed to other pathogens[14]. During the clinical phase of rabies infection or postmortem examination, viral antigens can be identified in the central nervous system (CNS), particularly within the brainstem, which is one of the major target regions. The virus spreads from the CNS to peripheral organs through neural pathways, enabling the detection of viral particles even before death. Transmission may also occur when scavenging mammals feed on carcasses of infected animals, contributing to the continued circulation of the virus within wildlife populations [15].

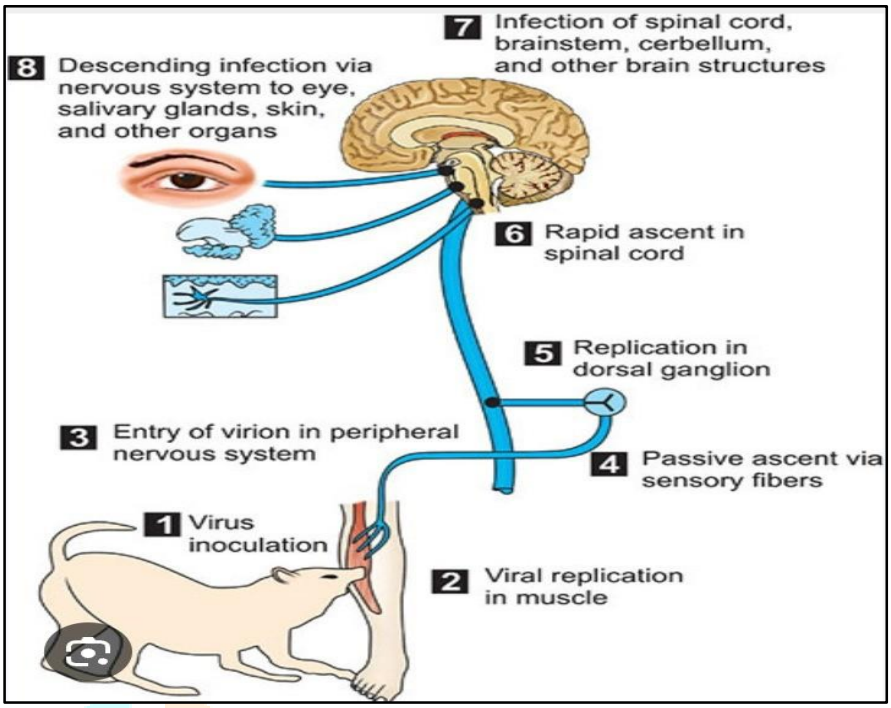

Fig no 3.Organisms differ in their susceptibility to various physical and chemical agents

6.The virus and genome organisation

The rabies virus is an enveloped, bullet-shaped infectious particle measuring approximately 180 × 75 nm. It contains a single-stranded, negative-sense RNA genome of about 12 kb and is classified under the genus Lyssavirus within the family Rhabdoviridae and the order Mononegavirales (ICTV, 9th Report). The rabies virus (RABV) cannot survive for long outside the host and is easily destroyed by exposure to sunlight, elevated temperatures, and drying conditions[16].

The rabies virus was first identified in South Africa through the isolation of a virus from a mongoose, marking a significant milestone in the study of lyssaviruses. This discovery contributed to a better understanding of the epidemiology and classification of rabies-related viruses across different regions of Africa and globally[17]. The amino acid composition within the G ectodomain region of lyssaviruses exhibits high similarity among viruses belonging to the same phylogroup. This close resemblance is responsible for their serological cross-reactivity within the group. In contrast, viruses from different phylogroups show minimal or no cross-neutralization. Phylogenetic studies have demonstrated that the antigenic relationship among lyssaviruses is generally consistent with their genetic similarity, indicating that viruses sharing closer genetic sequences display stronger cross-reactivity in the G protein domain[18].

7.Mode of transmission of rabies virus

After invading the central nervous system (CNS), the rabies virus (RABV) migrates centrifugally to peripheral organs, including the salivary glands, through cranial nerves such as the facial and glossopharyngeal nerves. Once it reaches the salivary glands, the virus is secreted into the saliva, enabling transmission to a new host. The most prevalent route of rabies transmission, accounting for approximately 90% of human cases, is through the bite of infected animals such as dogs and cats. This high rate of transmission is attributed to the close association of these animals with humans in both domestic and community environments[19],[20].

9.Diagnosis

The diagnosis of rabies demands a high index of clinical suspicion, particularly in individuals with a relevant history of animal exposure and epidemiological risk factors. Once such criteria are established, specific diagnostic investigations can be initiated. A definitive ante-mortem confirmation of rabies is achieved through the detection of the virus or its antigens in clinical specimens such as saliva, serum, cerebrospinal fluid (CSF), or skin biopsies obtained from hair follicles located at the nape of the neck. The Direct Fluorescent Antibody (DFA) test is widely recognized as the gold standard for confirming rabies infection. In recent years, the Direct Rapid Immunohistochemical Test (dRIT) has emerged as a cost-effective, reliable, and equally sensitive alternative to DFA, with the added advantage of easier interpretation and lower technical requirements[21]. Diagnosis of rabies in both humans and animals primarily relies on the observation of characteristic clinical symptoms along with laboratory confirmation through virus detection methods. The rabies virus can be isolated using albino mice or specific cell culture systems such as Neuro2a (CCL 131), BHK-21/C13, Vero, and McCoy cell lines. Among these, the mouse inoculation test remains one of the most sensitive diagnostic techniques. Additionally, the presence of Negri bodies in the brain tissue can be demonstrated through Seller's and Mann's staining methods[5].

10.Treatment of rabies virus

Rabies is a highly fatal infectious disease, with an almost 100% mortality rate once clinical symptoms appear. However, there have been rare exceptions, with six documented cases of survival worldwide. Among these, five individuals had received partial post-exposure prophylaxis (PEP), and only two recovered with normal neurological function. The first recorded instance of survival without any PEP was reported in a 15-year-old American teenager who contracted rabies from a bat bite, marking a historic milestone in medical literature[22].

❖ Conclusion

Rabies continues to be one of the most lethal zoonotic infections known to humanity, despite centuries of scientific advancement and the availability of highly effective vaccines. Its persistence across Asia and Africa—particularly in underserved rural regions—highlights the gaps in public health infrastructure, surveillance, mass dog vaccination, and access to timely post-exposure prophylaxis. The historical development of rabies prevention, from Pasteur's attenuated vaccine to modern cell-culture and recombinant vaccines, has significantly strengthened global control strategies. A strengthened One Health approach—which integrates veterinary, medical, environmental, and community sectors—is crucial to achieving global targets such as "Zero human deaths from dog-mediated rabies by 2030." Continued improvements in diagnostic technologies, expansion of oral vaccination in wildlife, development of novel vaccine platforms, and sustainable dog immunization programs are essential for long-term control. With coordinated national and international efforts, robust surveillance, and accessible preventive measures, rabies can shift from a neglected tropical threat to a preventable disease nearing global elimination.

❖ Reference

1.Albertini AA, Ruigrok RW and Blondel D (2011). Rabies virus transcription and replication. Advances in Virus

2.Fooks AR, Banyard AC, Horton DL, Johnson N, McElhinney LM, Jackson AC. Current status of rabies and prospects for elimination. Lancet. 2014;384(9951):1389–99.

3.Neville J. Rabies in the ancient world. In: King AA, Fooks AR, Aubert M, editors. Historical perspective of rabies in Europe and the Mediterranean Basin. Paris: OIE; 2004. p. 1–12.

4.Stobart CC, Moore ML. RNA virus reverse genetics and vaccine design. Viruses. 2014;6:2531–50

5.Diksha Kandpal1, R.S. Chauhan2*, M. Saminathan3, Kuldeep Dhama4 and Yashpal Singh Malik5*

6..Destruction of Life by Snakes, Hydrophobia etc. in Western India, by an Ex-Commissioner; WH Allen and Co.: London, UK, 1880; p. 120.

7.Rabies vaccines: WHO position paper—April 2018. WHO Wkly. Epidemiol. Rec. 2018, 93, 201–220.

8.Rupprecht C, Kuzmin I, Meslin F. Lyssaviruses and rabies: current conundrums, concerns, contradictions and controversies. F1000Res. 2017 Feb 23;6:184.

9.Hayman DT, Fooks AR, Marston DA, Garcia-R JC. The global phylogeography of lyssaviruses—challenging the 'Out of Africa' hypothesis. PLoS Negl Trop Dis. 2016;10: e0005266.

10.Fisher CR, Streicker DG, Schnell MJ. The spread and evolution of rabies virus: conquering new frontiers HHS Public Access. Nat Rev Microbiol 2018;16:241–55. https://doi.org/10.1038/nrmicro.2018.11.

11.Yousaf MZ, Qasim M, Zia S, Khan Mu, Ashfaq UA, Khan S. 2012. Rabies molecular virology, diagnosis, prevention and treatment. Virol J. 9:50.

12.Banyard AC, Hayman DTS, Freuling CF, Mueller T, Fooks AR, Johnson N. Bat rabies. In: Jackson AC, editor. Rabies: scientific basis of the disease and its management. 3rd ed. Oxford: Elsevier Academic Press; 2013.

13.Baker L, Matthiopoulos J, Müller T, Freuling C, Hampson K. Local rabies transmission and regional spatial coupling in European foxes. PLoS One 2020;15. https://doi.org/10.1371/journal.pone.0220592.

14.Tsiodras S, Dougas G, Baka A, Billinis C, Doudounakis S, Balaska A, et al. Re- emergence of animal rabies in northern Greece and subsequent human exposure, October 2012 - March 2013. Eurosurveillance 2013;18:20474. https://doi.org/
10.2807/ese.18.18.20474-en.

15.Baer GM. Vampire bat and bovine paralytic rabies. In: Baer GM, editor. The natural history of rabies, 2nd edition. Boca Raton (FL): CRC Press; 1991:390–406.

16.Liu J, Hamrouni A, Wolowiec D, Coiteux V, Kuliczkowski K, Hetuin D, Saudemont A, Quesnel B. 2007. Plasma cells from multiple myeloma patients express B7-H1 (PD-L1) and increase expression after stimulation with IFN{gamma} and TLR ligands via a MyD88-, TRAF6-, and MEKdependent pathway. Blood. 110(1):296–304.

17.Schneider LG. Antigenic variants of rabies virus. Comparative Immunology, Microbiology and Infectious Diseases. 1982; 5:101–107.

18.Badrane H, Bahloul C, Perrin P, Tordo N. Evidence of two lyssavirus phylogroups with distinct pathogenicity and immunogenicity. Journal of Virology. 2001; 75:3268–3276.

19.Baer GM, editor. 1991. The natural history of rabies. Boca Raton (FL): CRC Press.

20.Chhabra M, Ichhpujani RL. 2003. Animal bites: the current management guidelines. Indian J Pediatr. 70(1):S11–S16.

21Madhusudana SN, Subha S, Thankappan U, Ashwin YB. Evaluation of a direct rapid immunohistochemical test (dRIT) for rapid diagnosis of rabies in animals and humans. Virol Sin 2012;27:299–302. https://doi.org/10.1007/s12250-012-3265- 6.

22.Willoughby RE Jr, Tieves KS, Hoffman GM, et al. Survival after treatment of rabies with induction of coma. N Engl J Med 2005; 352: 2508-14.