Transmission Dynamics of Rabies Virus

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ABSTRACT

Rabies, a viral disease that can be transmitted between animals and humans, has a complex transmission pattern involving its natural hosts, carriers, and vulnerable individuals. The rabies virus, part of the Lyssavirus genus, is mainly found in the nerve tissue of mammals, such as bats, raccoons, skunks, foxes, and mongooses, who carry the virus without showing symptoms and act as reservoir hosts. The transmission process starts with an infected animal biting a host, allowing the virus, which is present in saliva, to enter the body and attack muscle cells near the entry point. After entering the body, the virus travels through peripheral nerves using retrograde axonal transport to reach the central nervous system (CNS), which includes the spinal cord and brain. The centrifugal expansion in the nervous system causes quick duplication and resulting inflammation, resulting in distinct clinical signs. As the virus progresses, it invades the salivary glands, increasing its presence in saliva and making the infected person highly contagious. The virus causes changes in behavior, like increased aggression and restlessness, which make it more likely for aggressive interactions to occur and lead to the virus spreading through bites. While the virus is kept in check in wildlife by natural reservoirs, there is a significant threat of transmission between different species. Domestic animals and humans are at risk of contracting rabies from bites or saliva of infected wild animals. Successful prevention relies on the use of vaccines, which are a key component of thorough initiatives that aim to protect both domestic and wild animals. Post-exposure prophylaxis (PEP) is crucial for reducing the impact of potential exposure by using a series of rabies vaccinations. Public health efforts and educational programs are essential for increasing understanding and encouraging responsible pet ownership, which ultimately helps control and prevent the spread of this deadly virus. It is essential to have a deep understanding of the complex transmission patterns of the rabies virus in order to take proactive steps to protect both humans and animals.

Keyword: Rabies virus; Transmission dynamics; Zoonotic disease; Centripetal spread; Post-exposure prophylaxis

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1. INTRODUCTION

Rabies is a viral zoonotic disease that affects the central nervous system. It can be prevented by proper vaccination. Rabies virus is prevalent in more than 150 countries and territories. Every year it causes millions of deaths across the world mostly in Asian and African regions. Mostly it harms the children below 15 years which is 40% of the total cases. The foremost cause of human deaths by rabies virus are stray dogs that contribute about 99% of total rabies spreads in individuals. Rabies virus can also be found in desolate faunae like flaps, raccoons, pigs, and bamboozles (Chhabra and Ichhpujani 2003).

Rabies affects practically all homothermic animals and people and results in severe central nervous system damage (Paweska et al. 2006). About 99% of the human cases in rabies occur in underdeveloped nations in Asia and Africa (Knobel et al. 2005). Several hundred people died from rabies each year between 2015 and 2018 in China, making it a significant public health concern. Rabid dogs are responsible for more than 95% of human rabies cases (Meng et al. 2011).

When clinical signs start, rabies is always deadly in addition to uncalculated psychological trauma for individuals and communities. Worldwide, rabies is thought to cost $8.6 billion annually. Except for Antarctica, all continents have rabies, with Asia and Africa accounting for more than 95% of all fatalities. However, rabies cases are infrequently recorded, and the registered numbers are far lower than the burden estimate. Both domestic and wild animals can are affected by rabies virus (Monroe et al. 2016).

The estimated annual death toll from canine rabies is 59,000 persons globally. Asia is undoubtedly grappling with a significant rabies problem since there are more rabies-related fatalities among humans there than everywhere else in the globe. The Americas account for fewer than 0.05% of all human rabies deaths, with the bulk of rabies-related fatalities occurring in Asia (59.6%), followed by Africa (36.4%). Additionally, India is responsible for 35% of all human rabies fatalities worldwide. The estimated annual cost of postexposure prophylaxis (PEP) for canine rabies in Asia is up to US$1.5 billion and 2.2 million disability-adjusted life years (Organization 2018).

Rabies is completely avoidable in both animals and people with immunization. WHO has suggested pre-exposure prophylaxis for people of those regions where the risk of exposure to rabies virus is high and more frequent (for example, veterinarians and animal handlers). If a wild or rabid animal bite a person, post-exposure prophylaxis (PEP) is acclaimed for the treatment measures as recommended by WHO which includes rapid wound care, immunization and administration of a single dose of Human rabies immunoglobulin (HRIG) and rabies vaccine and then a single dose of vaccine again on 3rd, 7th and 14th days respectively. Nonetheless, canine vaccination is often regarded as the supreme gainful method of averting rabies in people (Ganasegeran and Abdulrahman 2021).

The average cost of rabies post-exposure prophylaxis (PEP) (travel expenses and income loss) is presently estimated to be US$ 108. Managing a rabies exposure can be a crippling financial burden for afflicted households, whose typical daily income may be as low as US$ 1-2 per person. Following a probable rabies exposure, a person should seek immediate medical assistance since the virus can cause damage to the brain that ultimately results in death. By vaccinating pets, staying away from animals, and getting medical help right away after suspected exposures before symptoms occur, rabies can be prevented. A One Health strategy ensures that many sectors and local communities are involved in raising awareness and conducting mass dog vaccination programs (Hemachudha et al. 2013).

2. HOW IS RABIES TRANSMITTED?

Rabies virus can be directly transmitted from the saliva or brain/nervous system tissue of a diseased animal (for example, through injured skin or mucous membranes in the eyes, nose, or mouth). The biting of a rabid animal is the most common way for rabies spread. Scratches, abrasions or open wounds exposed to saliva or other potentially infectious material from a rabid animal can result in non-bite exposure to rabies. Other interactions such as petting a rabid animal or touching its blood, urine or faeces, do not increase the chance of contracting the disease and are not regarded as rabies exposure (Aghahowa and Ogbevoen 2010).

Although transmission is typically local (within one km), rabies can produce fitful and unpredictable behavior with diseased dogs which are capable of running more than 15 kilometers, much beyond the average range of healthiest dogs. As a result, secondary cases are more prevalent due to disease-mediated invasions disseminated from neighboring populations (e.g., nearby human towns within rabid dog movement range). Furthermore, long-distance human-mediated intrusions of incubating dogs can result in spreading of epidemic from previously disconnected communities (Fooks et al. 2014).

According to extensive study on dogs, cats, and ferrets it has been noted that rabies virus may be identified in the saliva of infected animals several days before infection reveals. Before and after the onset of clinical symptoms, viral expulsion might be erratic and the quantity of virus ejected may change significantly over time. The length of time between exposure and the onset of sickness can vary widely depending on a number of circumstances, including the environment in which the exposure occurred, the kind of rabies virus that was present and any immunity present in the affected animal or person (CDC 2017).

3. LIFE CYCLE OF THE LYSSAVIRUS

Non-segmented negative-strand RNA viruses known as lyssaviruses have small genomes of 11–12 kilobases that only include five genes, which are encoded in the conserved gene order of the nucleoprotein (N), phosphoprotein (P), matrix proteins (M), glycoprotein (G) and large polymerase protein (L). A maximum divergence of 60% may be found across the lyssavirus genome, suggesting significant nucleotide conservation throughout (Finke and Conzelmann 2005).

The essential replication process of all the non-segmented negative strand viruses follows a similar theme. Gene sizes and intergenic regions are highly conserved. Completely encapsulated RNA fragments known as genome RNAs are protected from the hazardous intracellular environment by N-protein encapsulation. Messenger RNAs are created by a transcriptase complex that includes the N, P and L proteins along with the RNA. It uses the negative-strand RNA genomes as a template. The simplest viral replicative unit is the ribonucleoprotein complex (RNP), which is a complex of RNA encased in N and linked to P and L proteins (Rupprecht et al. 2002).

Viral proteins are produced via viral mRNA transcription, which is followed by mRNA translation on ribosomes in the host cell. The polymerase produces full-length positive-sense genome strands of RNA that are co-transcriptionally encapsulated as a result of the increase in viral proteins in the cell, which contributes to the change from transcriptive to replicative activity. Following their formation, these replicative intermediates act as templates for the development of nascent genomic negative-sense RNA, which is encapsulated and released from the cell as nascent infectious virions (Miranda and Miranda 2020).

The neurotropic virus prototype known as the rabies virus infects both people and animals and can be fatal. This virus attacks peripheral body parts of the hosts, enters in motor nerves or sensory neurons

and then moves to the central nervous system (CNS) by axonal transference. Later, critical exodus ports like the salivary glands experience centrifugal supper. The behavioral abnormalities caused by the CNS illness enable transmission to additional hosts. The successful completion of the viral infectious cycle is dependent on many virus activities and specific virus proteins. Rabies virus appears to be very crucial for sneaking inside the host without creating obvious host reactions and preservation (Ugolini and Hemachudha 2018).

The advent of reverse genetic technologies for producing engineered recombinant RV has enabled tools for a more complete examination of viral activities relevant to normal RV pathogenesis. Tracking of live fluorescent RV, for example, is expanding the possibilities for determining RV pathogenicity variables. Many elements of RV molecular biology are important to pathogenesis such as precise regulation of RV transcription, gene expression and replication (Finke and Conzelmann 2005).

4. TRANSMISSION DYNAMICS

The transmission dynamics of rabies involve the spread of the virus within populations of animals and in some cases from animals to humans. Severity of disease is dependent on different aspects like species involved, geographical locality, and control measures in place (Yousaf et al. 2012).

Here are some key aspects of the transmission dynamics of rabies:

4.1. RESERVOIR/HOSTS

Certain animal species, known as reservoir hosts are the main reason to affect the spread and transmission of the virus in the certain geographic region. Domestic dogs, for example, are the principal reservoir host for rabies in many regions of the world and contribute to the transmission cycle (Coetzer et al. 2019).

4.2. WILDLIFE RESERVOIRS

Wildlife such as bats, raccoons, foxes and skunks act as reservoir hosts for rabies in many areas. Transmission among wildlife populations can happen through bites but it can also happen through other means, such as contact with infected surfaces or inhalation of aerosolized virus in bat roosts (Lembo et al. 2008).

4.3. TRANSMISSION IN ANIMALS

Rabies is typically transmitted to animals through the bite of an infected animal. The virus can be transferred if a rabies infested animal bites another vulnerable animal. This transmission can occur within a species or across species (Lushasi et al., 2021).

4.4. HUMAN TRANSMISSION

Although it is uncommon but human-to-human rabies transmission can occur by organ donation from infected donors or through extremely intimate contact, such as bites or exposure to contaminated saliva (Lembo et al. 2008).

4.5. INCUBATION PERIOD

Following transmission, the virus replicates within the host's body and transfers to the nervous system from the peripheral parts. The time frame and the duration of the incubation period can vary from several weeks to months (Rupprecht et al. 2017).

4.6. VIRUS SHEDDING

Infected animals can shed the rabies virus in their saliva before clinical indications appear, allowing them to spread the infection to others. This shedding is more common in the latter stages of the illness, when neurological symptoms appear (Hemachudha et al. 2013).
Controlling the transmission of rabies involves measures such as animal vaccination campaigns, responsible pet ownership, surveillance and reporting of cases and timely availability of treatments for persons who have acquired the virus and show the symptoms of the disease. These efforts aim to interrupt the transmission cycle and reduce the incidence of rabies in both animal and human populations (Miranda and Miranda 2020).
The scheme of transmission of rabies infection is shown in Fig. 1.

5. TYPES OF EXPOSURES

Only exposed skin wounds and other mucous membranes like the mouth and eyes can transmit the rabies virus. When assessing a potential rabies exposure, it's also important to take into account the local natural history and current health of the animal that bites the person (such as anomalous behavior or illness symptoms) and the possibility that the animal had previously been exposed to a rabid affected animal. The type and intensity of the exposure affect how likely it is that someone may get rabies (CDC 2017).
There are typically two forms of exposure: bites and non-bite exposure.

6. EXPOSURE WITH BITE

A bite exposure occurs when teeth penetrate the skin. No matter where the bite occurs on the body, there is a chance that rabies might spread. However, the hazard differs depending on the type of animal that bite the victim, where the bite occurred anatomically and how severe the wound was. Some animal bites, like those from bats, might only cause minor damage and are therefore difficult to identify. It’s also important to note that "Was the attack that led to the bite triggered or malicious?” Bites that a person receives while handling or trying to feed a seemingly healthy animal should be regarded as provoked. It is possible that the animal is affected by rabies virus if the attack was uninvited (Acharya Anita et al. 2012).

7. NON-BITE EXPOSURE

Contagion of open lesions, scrapes and other skin tissues that are infested by contagious material from a diseased animal is defined as non-bite exposure. This acquaintance to terrestrial animals seldom results in rabies. However, rabies transmission through these types of exposures suggests that these kinds of exposures should be investigated for prospective post-exposure prophylactic medication. Other types of contact, such as touching a rabid animal's blood, urine, or feces, do not constitute exposure and do not grounds for post-exposure vaccination (Bharadva et al. 2015).

8. OTHER MEANS OF RABIES VIRUS (RV) SPREAD

Injury cases are rare, with the exception of bites and scrapes. One potential non-bite exposure method is inhaling rabies virus through aerosol route. Mostly lab staff comes into contact with rabies virus aerosol. Rabies transmission through corneal and solid organ transplants is extremely uncommon. Only two solid organ donors with rabies are known to have existed in the United States since 2008. It has been claimed that rabies can be acquired through the transplant of infected organs or through the

inhalation of virus-containing aerosols. Transmission from sick animals to humans through raw meat or milk is also possible. There is no link between increased risk of infection by touching a rabies infected individual or coming into contact with urine, blood or other non-infectious fluid or tissue. Contact with a person who has received rabies vaccination does not result in rabies exposure, illness or the need for post-exposure prophylaxis. The rabies virus loses its contagiousness when it is exposed to sunshine and dries out. This virus can be inactivated if the reservoir of the virus is dry and it becomes non-infectious (Gadre et al. 2010).

9. PATHOPHYSIOLOGY OF THE RABIES VIRUS

Rabies virus belongs to the Rhabdoviridae family. The pathophysiology of rabies involves a complex interplay between viral replication, neuronal dysfunction, inflammation and immune responses. It is important to note that rabies virus is highly toxic and it can leads to death. Appearance of clinical signs highlights the urgent need for preventive measures, such as vaccination and prompt medical intervention following exposure (Miranda and Miranda 2020).
The pathophysiology of rabies involves several stages and processes:

9.1. TRANSMISSION

When a rabies infected animal like dogs, bats, foxes, skunks or raccoons bites a human, rabies virus is transmitted. The virus is present in the saliva of the infected animal and enters the body through broken skin (Lembo et al. 2008).

9.2. PERIPHERAL REPLICATION

When the virus enters in the body it starts replication in the peripheral parts and muscle cells at the site of infection, then it travels to the CNS through the peripheral nerves. Time from the start of infection to the onset of symptoms is called the incubation period of the virus that can vary from some days to many years in different individuals (Mazarakis et al. 2001).

9.3. NEUROINVASION

The virus reaches the CNS by traveling along the peripheral nerves. It can enter the nerve endings and spreads to the spinal cord, brainstem and other regions of the brain area. The virus can also enter the CNS directly through mucous membranes or open wounds (Lushasi et al. 2021).

9.4. VIRAL REPLICATION IN THE CNS

Once inside the CNS, the virus starts to replicate rapidly, primarily in the gray matter of the brain, including the limbic system, hypothalamus and brainstem. This leads to inflammation and destruction of neural tissue (Finke and Conzelmann 2005).

9.5. INFLAMMATORY RESPONSE

The presence of the virus in the CNS triggers an immune response, leading to inflammation. This inflammatory response contributes to the clinical manifestations of rabies, including neurological symptoms (Brunker and Mollentze 2018).

9.6. NEURONAL DYSFUNCTION AND ENCEPHALITIS

The rabies virus primarily targets and damages neurons in the CNS. It disrupts normal neuronal function, leading to the development of encephalitis. The affected neurons undergo degeneration and death, causing various neurological symptoms (Jogai et al. 2000).

9.7. ASCENDING PARALYSIS

As the virus spreads within the CNS, it affects motor neurons, leading to muscle weakness and paralysis. This paralysis typically starts at the point of wounds or the bite of the rabid animal or/and progresses towards the head, neck and extremities (Yousaf et al. 2012).

9.8. AUTONOMIC DYSFUNCTION

Rabies can also affect the autonomic nervous system, resulting in abnormalities in heart rate, blood pressure and temperature regulation. This can lead to fluctuations in blood pressure, excessive sweating and salivation (Lembo et al. 2008).

9.9. HYDROPHOBIA AND AEROPHOBIA

One of the characteristic features of rabies is that patient feels fear of water and air and often develops hydrophobia and aerophobia like symptoms. This occurs due to the involvement of the limbic system and brainstem, which control emotions and sensory responses (Brunker and Mollentze 2018).

9.10. COMA AND DEATH

As the disease progresses, individuals with rabies may enter a comatose state due to extensive damage to the CNS. When the infection spreads in the whole body and symptoms of rabies have appeared, mostly it leads to death of the patients within a few weeks because of the cardiovascular arrest and disturbances in central nervous system (Paweska et al. 2006).

10. THE CONTAGIOUS PATH OF VIRUS

Rabies virus passes through different stages:

10.1. INCUBATION PERIOD

After the initial spread of rabies virus by the bite and scratch of a diseased animal, there is an incubation period that typically ranges from weeks to several months. In this phase, the virus duplicates at the site of entry without causing any noticeable symptoms. The rabies virus must move to the brain after exposure before it may cause symptoms. The incubation period is the interval between exposure and the emergence of symptoms. The incubation time for rabies is normally 2-3 months, but can range from 1 week to 1 year depending on factors such as the site of virus entrance and viral burden. It might remain for weeks or months (Hemachudha et al. 2002).
The incubation period may differ depending on the following factors:

- the location of the exposure site (how far away it is from the brain)
- the kind of rabies virus
- Existing immunity (Brunker and Mollentze 2018)

10.2. PRODROMAL PHASE

This stage lasts for 2 to 10 days and is considered by the symptoms that are similar to flu, fever, headache, discontent and gastrointestinal disturbances. The virus starts to invade peripheral nerves and spreads toward the CNS (Colombi et al. 2020).

10.3. NEUROLOGIC PHASE

Once the virus reaches the CNS, it begins to spread rapidly along nerve fibers towards central nervous system (CNS). It is believed that the virus travels within the peripheral nerves using a retrograde axonal transport mechanism. The rabies virus invades peripheral nerves before reaching into the central nervous system (CNS). Viral amplification causes the virus to spread quickly in the rostral grey matter of the spinal cord after the virus has infected the ventral horn of the spinal cord or the dorsal root ganglia. Exoplasmic transport is used to advance material to the brain along a number of ascending and descending fibers where it is first placed in the brainstem and then diffuses into the rest of the brain. In contrast to necrosis or apoptosis, the resulting neurologic symptoms are thought to be predominantly the result of nerve cell malfunction; however, the precise functional impairment involved is unknown (Singh et al. 2017)
This phase is associated with two distinct clinical presentations:

10.3.1. FURIOUS RABIES

This kind accounts for over 80% of cases and is distinguished by hyperactivity, agitation, hallucinations, and unpredictable behavior. Hydrophobia (fear of water) may develop in patients as a result of severe throat spasms and difficult swallowing. As the illness advances, muscle spasms, convulsions and paralysis may occour (Laothamatas et al. 2008).

10.3.2. PARALYTIC (DUMB) RABIES

This variety occurs in around 20% of cases. It is distinguished by muscular weakness, paralysis, and the absence of usual angry signs. The paralysis usually starts in the bitten limb and progresses to other muscle groups gradually. Virus can also move from brain to peripheral parts and other body tissues and also moves out from the body and targets a new host and infect the new host. Following infection of the brainstem nuclei, the facial and glossopharyngeal cranial nerves send the virus to the salivary glands through the ganglia that are connected to them. Viral shedding into salivary secretions is considerable following the infection of glandular epithelia (Mitrabhakdi et al. 2005).
The cornea and retina, as well as the liver, heart and kidneys which are supported by the parasympathetic and sympathetic nervous systems, receive virus transmissions. Additionally, rabies has frequently been spread through corneal transplants. The virus often accumulates in the free sensory nerve endings of nuchal tactile hair, hence a skin tissues biopsy sample taken from this region is used as a routine diagnostic test (Fooks et al. 2014).
The terminal phase is characterized by severe neurologic impairment, which leads to coma, respiratory failure, and death. The autonomic nerve system is disrupted and it can lead to change in heart rates, blood pressure in arteries and temperature of the body can also be increased (Lembo et al. 2008).
The pathophysiology of rabies is mostly linked to the virus's direct effects on neurons and the immune system of the host. Rabies virus can infect and reproduce within neurons, resulting in neuronal damage which causes death. Furthermore, the host’s immune system when tries to manage the infection, causes an inflammatory reaction inside the CNS, which contributes to tissue destruction (Finke and Conzelmann 2005).
The infectious pathways of rabies infection is shown in Fig. 2.

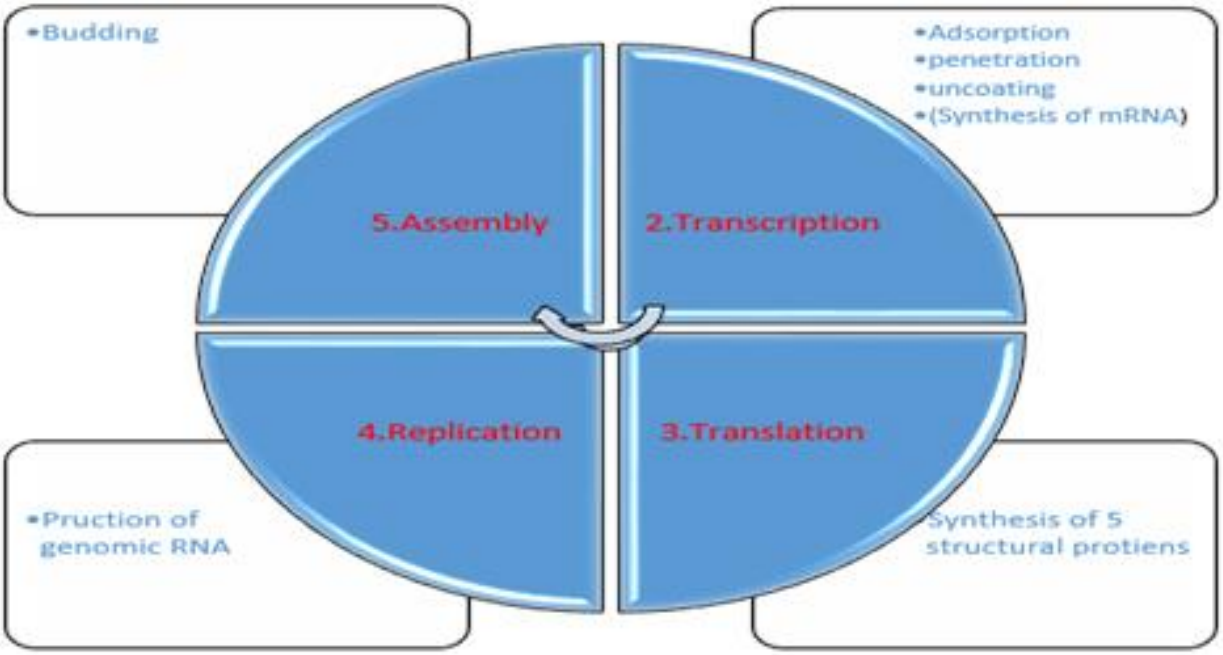

Fig. 2: The Infectious Pathway of the Rabies Virus.

11. SIGNS AND SYMPTOMS OF RABIES

Rabies symptoms, indications and outcomes in animals might vary. Animal symptoms are frequently comparable to human symptoms. These include vague early signs, acute neurologic symptoms and eventually death. Typical rabies symptoms include fever, discomfort, and odd or inexplicable itchy, stabbing or scorching ambiences at cuts or biting sites. When the virus spreads to the brain area or CNS, it causes deadly soreness in brain and spinal cord. Clinically rabies in humans is treatable but rarely cured, and only with significant neurological abnormalities. The initial crests of the disease are common symptoms of fever like flu, body pain, weakness or headache etc (Lushasi K et al. 2021).

Soreness or burning sensations at the location of infection or wound is mostly detected. All these indicators may remain for several days or weeks. The symptoms lead to intellectual damage, nervousness, confusion and distress. The patient may feel hallucination, madness, hydrophobia (fright of water) and sleeplessness as virus spreads in body and the condition worsens (Lembo et al. 2008).

Initial stage of the disease typically remains 2-10 days. When irrefutable indications of rabies ascend, the condition is mostly deadly, and the management is frequently helpful to the patients. Mostly rabies leads to death and chances of survival is very low as only 20 examples of human endurance are reported. Only a few individuals had no prior or postexposure prophylactic history (Susilawathi et al. 2012).

12. DIAGNOSIS OF RABIES

Current diagnostic methods are ineffectual for recognizing the infection before quantifiable illness develops. Mostly rabies is diagnosed by the most prevalent indications of hydrophobia or exposure of the person with a doubted or confirmed rabies affected animal. Different diagnostic techniques are being used to recognize the whole viral genome, antigens in viruses or nucleic acids in septic tissues like saliva, brain tissues or skin tissues that can ratify rabies virus in post- mortem (CDC 2017).

13. RABIES POSTEXPOSURE PROPHYLAXIS (PEP)

The immediate treatment to rabies exposure is post-exposure prophylaxis (PEP). As a result, the virus cannot be able to enter the central nervous system and kill the host. Included in this are a series of rabies vaccinations, an urgent 15-minute soap-and-water wound wash, and, if necessary, the administration of rabies immunoglobulin or monoclonal antibodies, which can save their lives. Every year, PEP is given to about 29 million patients all over the world (Fooks et al. 2014).

Due to the disruption of dog-mediated transmission in the USA, hematophagous bats are currently the main reason of rabies fatality in human. In Australia and Europe, rabies that is caused by bats is also becoming a public health problem. While rabies is regarded as a neglected tropical disease, the cost to human life and the expense of post-exposure preventative resources demand that it should be given high priority. This goal is a part of the Millennium Development Goals, which aim to reduce poverty and preventable deaths of children from transmissible diseases in resource-limited regions of the world (Abela-Ridder et al. 2016).

Following Post-exposure Prophylactic measures should be taken after exposure;

- Comprehensive cleaning with water and soap for at least 15 minutes after a suspected exposure, followed by a local wound care as soon as possible.
- A series of WHO-approved rabies vaccinations that are powerful and effective.
- If required, the wound may be injected with monoclonal antibodies or rabies immunoglobulin (Colombi et al. 2020).

Human rabies immune globulin (HRIG) and rabies vaccination are given as part of PEP on the day following rabies exposure, and then doses of the vaccine are given on days 3, 7 and 14. The administration of both HRIG and the rabies vaccine should always be a part of post-exposure prophylaxis (PEP) for people who have never received rabies vaccination (Yamada et al. 2016).

For bite and non-bite exposures, HRIG in conjunction with immunization is suggested regardless of the interval between exposure and treatment. The only people who should receive the vaccination are those who have already had it or are undergoing pre-exposure immunization for rabies. It is unusual for immune globulin with the rabies vaccine to cause negative reactions. Nowadays, more recent vaccines on the market cause fewer adverse reactions than previous vaccines. The rabies vaccine has been associated with mild local reactions, such as discomfort, redness, swelling, or itching at the injection site (Banyard et al. 2019).

Rarely, reports of symptoms like headaches, nausea, stomachaches, aches in the muscles and dizziness have been reported. Local discomfort and a low-grade fever may appear after receiving rabies immune globulin injection. Unless they are already infected with the illness, people cannot spread rabies to others. Because of the protection by PEP, a person can do his normal activities in an innocuous environment (Prosniak et al. 2003).

14. EXPOSURE RISK AND INDICATIONS FOR PROPHYLAXIS

As rabies is regarded as an ignored tropical malady, the encumbrance on hominid life expectancy and the high cost of post exposure preventative (PEP) resources require it to be a high priority. Administration of a complete PEP course is suggested according to the severity of the suspected rabid animal contact as mentioned in Table 1.

15. CONCLUSION

Rabies is a deserted oppressive ailment that mostly distresses disadvantaged, underprivileged, and susceptible populations. It is transmitted to human and animals when these are bite off or scratched by

Table 1: Types of interactions and suggested prophylaxis measures

Types of interaction with suspicious animal	Post-exposure prophylaxis measures
Type 1: feeding or petting animals; exposure to animal licks on unbroken skin (Exposed)	Only wash the infected skin site and no use of PEP
Type 2: exposed skin pecking, tiny scrapes or scratches without hemorrhage (Exposed)	Instant vaccination and wound washing
Type 3: Saliva of the animal that have contaminated broken skin or mucous membranes, single or many transdermal bites or scratches, and exposures from coming into contact with bats directly (Rigorously exposed)	Vaccination in a right away, application of rabies immunoglobulin and monoclonal antibodies, and wound cleaning

a rabid animal. Because stray dogs and other pets are mostly unvaccinated, it causes increase in rabies prevalence. Other reasons may include occupational menaces, inaccessibility of the proper vaccinations in developing countries and mostly in rural areas. Unawareness about the prominence of getting proper treatment after the animal's bite and unavailability of health facilities can lead to an increase in rate of rabies infection worldwide, predominantly in Asia and Africa. Post-exposure prophylaxis (PEP) is projected to protect human health in millions from rabies every year. Even if Vaccination and protective medicines are available for the prevention of human rabies mostly caused by dogs and other wild animals but these are not always conveniently reachable to the needy people.

Regardless of the accessibility of suggestion and recommendations for rabies prevention and treatment, Southeast Asian states still have difficulties in controlling the disease including a lack of political obligation, insufficient capitals, a privation of strategy agreement, feeble harmonization in different sectors, unresponsive investigation arrangements, restricted access to proper vaccines supply and a lack of community consciousness and collaboration. The large predicted rabies affliction supports the requirement to highlight rabies prevention and control. Different organizations are working to end up the rabies by 2030. These include Food and Agriculture Organization (FAO), World Health Organization (WHO) and Organization for Animal Health (OIE). These all organizations are working for a common objective to decrease scarcity and avertible demises of children by transmissible diseases in under developed countries in the world.

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