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Rabies: A Global Health Challenge

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Introduction:

Rabies is zoonotic encephalitis caused by the rabies virus. The virus belongs to the Lyssavirus of the family Rhabdoviridae. The primary way that rabies is transmitted is by animal bite. It can directly penetrate the peripheral nerve system and move towards the brain. It can also spread within muscle tissue, where the host's immune system cannot harm it. It then passes through the neuromuscular connections and into the nervous system. The deadly zoonotic illness rabies severely paralyses the central nervous system. The infection is nearly always fatal, resulting in approximately 59,000 deaths worldwide each year. Rabies is prevalent in over 150 countries worldwide, and India alone accounts for one-third of the global rabies cases, resulting in approximately 20,000 deaths annually. The government of India introduced its National Action Plan for the Elimination of Dog-mediated Rabies (NAPRE) in 2021. This is aligned with the global objective of eliminating human deaths caused by dog-mediated rabies by 2030.

Etiology: The genus Lyssavirus, which belongs to the Rhabdoviridae family of bullet-shaped viruses with a single-stranded RNA genome, is the causal agent of rabies [10,15]. The genus Lyssavirus includes the rabies virus as well as viruses that are closely related, such as the Australian bat Lyssavirus, the European bat viruses 1 and 2, the Mokola virus, the Lagos bat virus, and the Duvenhage virus from Africa. It is believed that any of these viruses can infect humans and animals with a condition similar to rabies [15].

Transmission: Any bite, scratch, or another incident in which saliva, CSF fluid, tears, or nerve tissue from a suspected or confirmed rabid animal or human contacts the mucous membranes of another animal or person, gets into an open wound or is transplanted into another animal or person is considered a rabies exposure. Rarely, in caverns home to millions of bats or laboratories using live rabies virus, humans have contracted rabies from inhaling airborne virus. The most common ways for humans to contact rabies are through animal bites or contact with virus-infected saliva that gets into wounds from scratches. [13]

Pathophysiology: The rabies virus enters the body through contact with mucosal surfaces or wounds. It can't pass through skin that is still intact. To join the central nervous system, the rabies virus multiplies locally in non-neural tissue after biting a muscle and attaches itself to motor endplates and axons [17]. Transport vesicles carry

the virions, which are only transported to the central nervous system (CNS) by fast retrograde transport via motor axons [8,9]. Neither sensory endings nor sympathetic endings can absorb the virions. Salivary gland infection results from centrifugal transport via efferent cranial neurons, releasing virus particles into the saliva. Brain infections frequently cause behavioural abnormalities that prompt the host to bite other animals, which spreads the virus. Death from a widespread central nervous system infection almost always results from subsequent circulatory, metabolic, or viral processes, as well as respiratory paralysis [2,6]. Viral penetrations through penetrating injuries can potentially directly penetrate motor axons in peripheral nerves. Depending on the amount of virus in the inoculum, the density of motor endplates at the wound site, and the proximity of virus entry to the central nervous system, the incubation period can range from five days to several years (typically 2-4 months; rarely more than 1 year) [16]. If the patient is bitten on the head or neck, or if several bites, deep wounds, or massive wounds transfer a heavy inoculum, the incubation period is fewer than 50 days. If someone gets a scratch on their hand, it could take them longer to have rabies symptoms than if they get bitten in the head. The incubation period in dogs and cats is 10 days to 6 months; most cases show symptoms between 2 weeks and 3 months. There have been reports of an incubation period for rabies spread by vampire bats in cattle ranging from 25 days to over 5 months. The incubation period in humans can range from a few days to several years. Most instances show symptoms after one to three months [17].

Clinical Indicators:

Within a species, between individuals within the same species, and even during a given individual's sickness, the clinical picture might vary greatly. Whenever the illness worsens, Rabies-infected animals may exhibit odd behaviour. Any clinical indication of rabies needs to be verified by investigation in a lab [3]. The earliest clinical symptoms can include anxiety, restlessness, anorexia, or an increase in hunger, diarrhoea, vomiting, a mild temperature, pupil dilating, hypersensitivity to stimuli, and severe salivation. Lameness in the leg that received the vaccination is typically the initial symptom of post-vaccinal rabies.

Excitement (Furious) phase: The prodromal stage eventually gives way to a time of extreme agitation and aggression. The animal frequently bites through anything. For example, a characteristic high barking sound during intense rabies may develop in rabid canines. Convulsions may result in death even in the absence of the disease's paralytic stage [20]. The restless, roaming, howling, polypnea, drooling, and attacks on humans, other animals, or inanimate objects are the hallmarks of the furious form. Animals that are affected frequently ingest foreign things like sticks and stones. Oftentimes, wild creatures lose their fear of people and turn on them, attacking people or other animals that they would ordinarily avoid (like porcupines). It's possible to see nocturnal animals during the day.

The phase of paralysis (dumb): Progressive paralysis is a characteristic of the "dumb" form of rabies. In this condition, the animal may not be able to swallow and may exhibit excessive salivation due to paralysis of the masseter and throat muscles. Changes in vocalization, such as an unusual bellow in cattle or a raspy howl in dogs, can result from laryngeal paralysis. Additionally, the lower jaw may drop or there may be facial paralysis. Separation from the herd might cause ruminants to become drowsy or melancholic. You might give up ruminating. Additionally observed are ataxia, incoordination, and progressive spinal paresis or paralysis [20]. The difficulty in swallowing is what defines this stage, and foamy saliva around the mouth is a common symptom. Certain animals may experience paralysis

that starts in the rear limbs. Eventually, complete paralysis is followed by death [18].

Diagnosis:

Since the majority of rabies virus diagnostic procedures in animals require brain tissue for detection, they are sometimes only feasible after death [1]. Any portion of the afflicted brain can be used to diagnose rabies in animals. However, the test needs to include tissues from the brain stem and cerebellum, which are the two areas of the brain from which rabies must be ruled out. Numerous diagnostic techniques exist for the identification of rabies in animals, including polymerase chain reaction, mouse inoculation technique, tissue culture infection technique, direct fluorescent antibody [12]. The easiest way to obtain brain samples is to open the skull and collect a direct sample. To detect virus antigens in both human and animal samples, the fluorescent antibody test (FAT) uses brain smears or touch impressions. The direct fluorescent antibody test, or dFAT, is the suggested diagnostic procedure for animals. The purpose of this test is to identify rabies antigens in brain tissue. Additional diagnostic methods consist of serological testing (quick pres fluorescence focus inhibition test, fluorescent antibody neutralization test), reverse transcription polymerase chain reaction (RT-PCR), and direct rapid neurohistochemistry test (dRIT). The preferred test for rabies in humans is dFAT on brain tissue. dRIT and RT-PCR are further diagnostic tests that have been employed [5].

Prevention:

The rabies vaccination is more effective if administered in advance of potential exposure to a rabid animal, but it is typically administered later. The Pre-exposure immunization plus post-exposure booster has shown to be 100% effective.

Pre-exposure vaccination for animals: Several inactivated, thermostable, very effective vaccinations for veterinary usage have been produced recently. The granted immunity lasts somewhere between one and three years. Most veterinary vaccines are only authorized for use in particular species—dogs, for example. Set potency standards must be met by any rabies vaccinations authorized for use in humans and animals. It is required that each dose have a minimum antigenic potency of 2.5 IU [18]. Young puppies may receive the vaccinations, but they need to be supplemented at three months of age and once more in the year that follows. After that, vaccinations have to be administered every three years. Depending on the recommendations of the vaccine producer, sheep and cattle may receive vaccinations every three or two years or once a year. Regardless of the duration of the first vaccination's protection period, all dogs and cats should have a second vaccination 12 months after the first one. It is imperative to have a booster vaccination as soon as possible after coming into contact with a rabid animal to provide sufficient defence against the virus [14].

Treatment for animals after exposure: Results from research by Hanlon et al. (2002) indicated that a previously unvaccinated animal exposed to rabies may be protected by five doses of the canine rabies vaccination given on days 0, 3, 14, 21, and 35 in addition to murine anti-rabies antibody on day 0. A booster shot should be given a year after the original vaccine, regardless of the animal's age at that time [3]. If the animal exhibits symptoms suggestive of rabies, such as paralysis, convulsions, etc., the animal should be put down and the head sent for examination [7].

Final Verdicts and Advice:

A deadly viral zoonotic illness, rabies poses a significant threat to public health. Despite being widespread, it is particularly significant in underdeveloped nations like Ethiopia. This is a result of the abundance of stray dogs

that are present everywhere. This virus poses a hazard to the African wild dog (Lycaon pictus) and Ethiopian wolf (Canis simensis). It can only spread when the virus gets into a bite wound or mucous membrane. Although avoidable, the condition is incurable. The two main methods of preventing rabies in animals are vaccination and avoiding contact with diseased animals. By educating people on the routes by which rabies is spread and avoiding contact with wildlife, most animal and human rabies exposures can be avoided. It is possible to convey the recommendations that follow in light of the conclusions mentioned above. It is crucial to educate the public on the causes, symptoms, and methods of rabies prevention and control. utilizing international law to aid in the prevention and treatment of communicable illnesses. Adopting rules for managing stray dogs is a good idea. Dogs that are allowed to roam freely should be closely supervised, and rabies vaccinations should be required.

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