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Rabies in Animals: Etiology, Pathogenesis, and Preventive Strategies

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Introduction:

Rabies also called as Hydrophobia, Lyssa and mad dog disease is an acute, progressive, and almost invariably fatal viral encephalomyelitis that affects all warm-blooded animals, including humans. It is caused by the virus belonging to the genus *Lyssavirus* within the family *Rhabdoviridae* (Jackson, 2023). The family *Rhabdoviridae* contains four genera that contain animal viruses: the genera Lyssa virus, Vesiculovirus, Ephemerovirus, and Novirhabdovirus. The Genus Lyssa virus (*Greek lyssa Rage or fury*) includes rabies virus and closely related viruses including Mokola, Lagos bat, Duvenhage, European bat lyssaviruses 1 and 2, and Australian bat lyssa virus (Dietzgen et al., 2017). Each of these viruses is capable of causing rabies-like disease in animals and humans. Bats are potential reservoirs of both reservoirs of both rabies and rabies-like viruses. Rabies virus and related lyssaviruses-present in saliva; transmitted by biting carnivores and bats and cause encephalitis in mammals which is invariably fatal.

Pathogenesis:

Incubation period: the incubation period is both prolonged and variable. Most cases in dogs occur within 21-80 days after exposure, but the incubation period may be shorter or considerably longer.

Mortality: rabies is a fatal infection and once symptoms are exhibited animals will certainly die.

Following introduction into the tissues, (The main mode of RABV transmission is through exposure of broken skin to the saliva of an infected animal) virus enters peripheral nerve endings. The proportion of the animals that develop rabies after exposure depends on the location and severity of the bite and the species of animal involved (foxes can carry up to 10^6 infectious units of virus per millilitre of saliva). The bite of a rabid animal usually delivers virus deep into striated muscles and connective tissue, but infection can also occur, albeit with less certainty, after superficial abrasion of the skin. From its entry site, virus must gain entry into peripheral nerves; recent evidences indicate that this may happen directly, but in many instances, virus is amplified by first replicating in muscle cells (Rupprecht et al., 2020).

Immunity:

Although rabies proteins are highly immunogenic, neither humoral nor cell-mediated responses can be detected during the stage of movement of virus from the site of bite to the central nervous system, probably because very little antigen is delivered to the immune system- most is sequestered in the muscle tissue or within nerve axons. However, this early stage of

infection is accessible to antibody, hence the efficacy in exposed humans of the classical Pasteurian post exposure vaccination, especially when combined with the administration of hyper immunoglobulin. Immunological intervention is effective for some time during the long incubation period because of the delay between the initial viral replication between the muscle cells and the entry of virus into the protected environment of the nervous system.

Clinical Signs:

Once the brain is affected, clinical signs such as aggression, paralysis, excessive salivation, difficulty swallowing, and abnormal behaviour appear. Death usually occurs within 5–10 days after the onset of clinical signs, due to respiratory failure or paralysis. The cattle with furious rabies are dangerous, attacking and pursuing man and other animals. Lactation ceases abruptly in dairy cattle. Instead of the usual placid expression, there is alertness. The eyes and ears follow sounds and movement. A common clinical sign is a characteristic abnormal bellowing, which may continue intermittently until shortly before death. Horses and mules frequently show evidence of distress and extreme agitation. These signs, especially when accompanied by rolling, may be interpreted as evidence of colic. As with other species, horses may bite or strike viscously and, because of size and strength, become unmanageable in a few hours. Such animals frequently suffer self-inflicted wounds (Fooks et al., 2017).

Prevention:

Vaccination remains the most effective tool against rabies, with dogs and cats vaccinated at three months of age and given annual boosters, while in high-risk areas livestock such as cattle, goats, sheep, and horses should also be protected (WHO, 2023). If an animal is bitten by a suspected rabid animal, the wound must be washed with soap and water for at least 15 minutes, antiseptic applied, and veterinary advice sought for post-exposure vaccination (Tordo et al., 2017). Exposed unvaccinated animals require quarantine, while vaccinated ones need a booster, and suspected cases must be isolated (OIE, 2021). Responsible pet ownership, mass vaccination, and public awareness are essential.

Conclusion:

Rabies continues to be one of the most feared zoonotic diseases due to its almost 100% fatality once clinical signs appear. Despite this, it is also one of the most preventable diseases in animals and humans through timely vaccination and awareness. Understanding the etiology and pathogenesis of rabies provides valuable insights into its progression and highlights the critical window of intervention before the virus reaches the nervous system. Early wound care, vaccination of companion animals and livestock, responsible pet ownership, and community-based control of stray dog populations are essential for breaking the cycle of transmission. Since no treatment exists once symptoms develop, prevention through vaccination and awareness remains the cornerstone of rabies control

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