Current Perspective of Diagnostic and Treatment of Rabies

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Abstract

Background. Rabies is a zoonotic disease caused by the rabies virus (RABV) from the Lyssavirus genus. Transmitted through saliva, typically via bites or scratches, it causes fatal neurological disorders if untreated. Annually, rabies claims 59,000 lives, with most cases in rural Africa and Asia, where dogs are the primary reservoirs. Despite available vaccines, low coverage in resource-limited settings makes rabies a persistent public health issue. Effective prevention requires vaccination programs, public awareness, and animal population control.

Methods. This study was conducted through a literature review using PubMed and Google Scholar as primary sources. Relevant peer-reviewed articles and research papers on rabies epidemiology, clinical features, pathophysiology, and management published in the last five years (2019–2024) were selected. Keywords such as "rabies," "Lyssavirus," and "vaccination" guided the search.

Discussion. Rabies is a deadly disease with a high fatality rate once symptoms appear, making prevention through vaccination critical. Early post-exposure treatment, such as wound cleaning and immunoglobulin administration, reduces infection risks. Despite advancements in diagnostics and cost-effective vaccination methods, challenges remain in controlling rabies transmission, particularly from dogs and bats. Public awareness, improved vaccine access, and effective animal control are essential to eliminating rabies.

Conclusion. Rabies is a fatal zoonotic disease with almost no chance of survival once symptoms appear. Prevention through vaccination and post-exposure treatment, including wound cleaning and immunoglobulins, is crucial. Efforts to control rabies require increased

vaccination coverage, public education, and better management of animal reservoirs, especially dogs.

Keywords : Rabies, Zoonoses, Rabies, Lyssavirus, Symptoms, Vaccination

Introduction

Rabies is a zoonotic disease that can be prevented through vaccines and transmitted from animals to humans[1]. Rabies virus (RABV) is a member of the genus Lyssavirus containing more than 16 species, this virus causes acute and progressive neurological disease in susceptible species[2]. Other lyssaviruses also cause fatal diseases that are indistinguishable from those caused by (RABV), (RABV) Usually transmitted through the saliva of an infected host through a bite, this virus is highly neurotropic and causes death through encephalomyelitis. Rabies kills about 59,000 people each year, many of them children. In rural Africa and Asia, where most human cases occur, dogs are the main reservoirs, responsible for up to 99% of rabies transmission to humans.[3] The distribution pattern of canine rabies virus (RABV) exhibits a geographically focused pattern with minimal genetic variation within local populations. The spread of the virus is strongly influenced by human activities, such as migration and trade, which allowed RABV to be introduced into new regions, including North America in the 17th century by European colonists. In addition, RABV's rapid infection dynamics and high fatality rate reduce the likelihood of coinfection, resulting in a more focused distribution pattern of dominant strains. Regional differences in dog population density and public health policies also contribute to this variation in distribution patterns, creating a complex interplay of biological and human historical factors.[1]

Methods

This research was conducted through a literature review using PubMed and Google Scholar as primary sources. Relevant peer-reviewed articles and research papers on rabies epidemiology, clinical features, pathophysiology, and management published in the last five years (2019–2024) were selected. Keywords such as "rabies," "Lyssavirus," and "vaccination" guided the search.

Discussion

Clinical Symptoms

The incubation period is usually 4-8 weeks, but it can vary from 5 days to 7 years. Bites on the face, neck, and head that are close to the central nervous system have a shorter incubation period. There could be two types:[4]

• Encephalitis type (malignant rabies) — found in most cases

- **Prodromal (Early Symptoms):** Early symptoms can include fever, headache, anxiety, insomnia, and muscle aches. Paresthesia or itching around the bite wound can also occur.
- **Advanced Symptoms**:[4]

  After a few days, symptoms may progress to

  - Hydrophobia (fear of water) caused by muscle spasms whn trying to swallow.
  - Agitation, confusion, and hallucinations.e
  - Muscle spasms and spasms.
  - Death usually occurs within a week of symptoms appearing.

• Paralytic type (mute rabies) — found in about 20% of cases

- These symptoms are rarer and usually occur in cases of bat-borne rabies or in individuals who have been partially vaccinated.
- **Symptoms**:[4]
  - Diffuse paralysis that can spread from the bite site.
  - Fever and excessive sweating.
  - There is no level of excitement as in encephalitic rabies.
  - Death can occur after a few days to weeks.

Phatophysiology

The rabies virus is the prototype of the genus Lyssavirus in the Rhabdoviridae family. The virus is bullet-shaped and contains RNA bound to nucleoprotein proteins that form a helical coil. The virus is quickly deactivated by heat; at 56°C, its half-life is less than 1 minute. Humans are infected through the inoculation of saliva containing the virus, usually through the bite of an infected animal. The virus can also enter through contact with abraded skin or mucosal membranes. The virus cannot enter through intact skin. After exposure, the rabies virus travels through the nervous system. The virus is carried centripetally by the flow of the axoplasma towards the dorsal root ganglion, where the virus multiplies and causes prodromal symptoms such as paresthesia at the site of the bite. From the ganglion, the virus then moves to the brain, where massive virus replication occurs. After replication in the brain, the virus spreads through

the efferent nerves to almost all organs, including the adrenal glands, cornea, pancreas, and salivary glands, causing the virus to be released into saliva. In autopsies, extensive infections are usually found in the brain, especially in the brainstem, hippocampus, and basal ganglia. There is also vascular congestion in the central nervous system and petechial hemorrhages in the pia-arachnoid. Histological examination shows perivascular cellular infiltration. Negri bodies, which are round or oval eosinophilic inclusions, can be detected in the cytoplasm of nerve cells, especially in the hippocampus and Purkinje cells of the cerebellum. Negri bodies are found in the brains of more than 95% of rabies animals.[4]

Differential Diagnosis

Differentiation Diagnosis of similar diseases

- Pseudorabies Histeris
- Guillain–Barré Syndrome
- Encephalitis or Bulbar Paralysis
- Sepsis or Blood Poisoning

Treatment

Early and accurate diagnosis is essential for the successful treatment of rabies. Advances in molecular techniques, such as PCR, allow for faster diagnosis. Earlier therapeutic interventions can be made possible thanks to a quick diagnosis.[5]

1. **Palliative Medicine**: Once symptoms appear, only palliative treatment is possible. These include:[4]
    - **Seizure Control**: Seizure must be controlled with heavy sedation. Diazepam (10 mg) can be given every six hours, and chlorpromazine (50 mg) can be added if needed.
    - **Maintenance of Fluid and Nutrient Balance**: This should be done through the intravenous route.
    - **Airway Maintenance and Oxygenation**: It is important to ensure the patient gets enough oxygen.
    - **Coma Induction (Milwaukee Protocol):** The Milwaukee Protocol, which involves coma induction, has been found useful in some cases, although it is a rare and not always successful approach.
2. **Vaccination and Immunoglobulins**

- **Anti-Rabies Vaccine**: The anti-rabies vaccine is used for prophylaxis before and after exposure. Intramuscular (IM) regimens are being replaced by intradermal (ID) vaccines because they are more economical.
- **Rabies Immunoglobulin (RIG):** For bleeding bites, RIG administration is required at the same time as vaccination. For small scratches without bleeding, only vaccination may be required.

Prognosis

The possibility of treatment is very poor, with almost all cases ending fatal after symptoms appear. The high mortality rate is due to the aggressive nature of the disease, where death usually occurs within a short period of time.[4] Rapid initial treatment, such as wound cleaning and post-exposure vaccination, can reduce the risk of developing rabies from 50% to less than 5%. The highest risk of developing this disease occurs after a bite in the head area. Although there are few reports of patients who survive, they often experience neurological sequelae. Overall, rabies is a deadly disease, so prevention through proper vaccination and treatment is essential.[4] In 2004, there were patients who survived rabies despite not receiving the vaccine before clinical symptoms appeared, suggesting that there may be exceptional circumstances in which recovery can occur.[6] Rabies continues to be a significant public health concern, with its pathophysiology involving retrograde transport through the nervous system. The study emphasizes the ability of pathogenic lyssavirus strains to evade immune responses, which contributes to the severity of the disease.[7] Highlights the complexities of controlling rabies in wildlife reservoirs, particularly in bats. Their study showed that reactive culling could paradoxically accelerate viral spread due to increased dispersal of infected bats, questioning the effectiveness of traditional intervention strategies.[8] Developed an ELISA-based approach for evaluating rabies vaccine efficacy in dogs, which offers a cost-effective and high-throughput alternative to traditional methods. This innovation could play a crucial role in improving rabies vaccination coverage in resource-limited settings.[9]

Conclusion

Rabies is a zoonotic disease that is almost always fatal if clinical symptoms appear. The initial symptoms resemble the flu, followed by neurological disorders such as hydrophobia and paralysis. Its pathophysiology involves the replication of the virus in muscle tissue before attacking the central nervous system, causing encephalitis. The diagnosis should be differentiated from other conditions such as viral encephalitis and Guillain-Barré syndrome.

Treatment is effective only in the post-exposure stage through wound cleaning, immunoglobulins, and vaccinations. Once symptoms develop, the prognosis is very poor, so prevention through vaccination and education is essential.

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