APCRI Journal
Volume 27, Issue 1- 2025, Pg. No. 35-39
Peer Reviewed & Open Access Journal

Case Report

Epidemiological Factors Contributing to an Outbreak of Rabies in Domesticated Mules and Effectiveness of Control Measures in Prevention of Spread of Disease to Animal Handlers: A Longitudinal Descriptive Study

Shubhralok Sinha[1], Navneet Kaur Sandhu[2]

[1]Senior Advisor and Professor, Department of Community Medicine, Colonel Health, Northern Command, Udhampur, Jammu, India
[2]Officer Commanding, Station Health Organisation, Pathankot, India
DOI: https://doi.org/10.24321/0973.5038.202501

I N F O

Corresponding Author:
Navneet Kaur Sandhu, Station Health Organisation, Pathankot, India
E-mail Id:
drnavneetkaur86@gmail.com
Orcid Id:
https://orcid.org/0000-0001-8910-1059
How to cite this article:
Sinha S, Sandhu N K. Epidemiological Factors Contributing to an Outbreak of Rabies in Domesticated Mules and Effectiveness of Control Measures in Prevention of Spread of Disease to Animal Handlers: A Longitudinal Descriptive Study. APCRI J. 2025; 27(1): 35-39.

Date of Submission: 2025-03-10
Date of Acceptance: 2025-05-20

A B S T R A C T

Introduction: Rabies is responsible for an estimated 59,000 human deaths and over 3.7 million disability-adjusted life years (DALYs) lost every year. India accounts for 59.9% of rabies deaths in Asia and 35% of deaths globally. Rabies deaths in humans are 100% preventable through prompt and appropriate medical care.

Objectives: To study the epidemiological factors comprising host, agent, and environment in the onset of rabies in domesticated mules and determine the effectiveness of control measures such as awareness-raising health talks and immunization in the prevention of the spread of disease to the animal handlers.

Methods: A rabies outbreak was reported by the local veterinary authorities among domesticated mules on a farm located in the Binnaguri District of West Bengal. An epidemiological investigation was carried out to find out the source of infection among mules and animal handlers at risk and to institute containment measures to prevent the spread of disease among animals and animal handlers.

Results: The source of infection in mules was stray animals such as wild foxes and wild dogs, which acted as reservoirs of the infection. Risk assessment among the animal handlers indicated that the majority had Category I exposure. Isolation and containment measures were instituted for all animals at the farm, and the animal handlers were immunized with anti-rabies vaccine and immunoglobulins based on their risk profile.

Conclusion: The best way of reducing mortality due to rabies is its prevention. Immediate vaccination coupled with health education to improve KAP of animal handlers forms the cornerstone for prevention of the disease in humans.

Keywords: Rabies, Immunization, Risk Assessment, Domesticated Mules, Animal Handlers

Introduction

Rabies is a vaccine-preventable viral disease that occurs in more than 150 countries and territories. The rabies virus causes encephalomyelitis in virtually all warm-blooded animals, including man. The causative agent is found in domestic and wild animals and is transmitted to other animals and humans through close contact with their saliva (bites, scratches, licks on broken skin, and mucous membranes).[1]

Rabies is responsible for an estimated 59,000 human deaths and over 3.7 million disability-adjusted life years (DALYs) lost every year globally.[2] The Asian subcontinent is a major contributor to mortality due to rabies, with an estimated 35,172 human deaths per year. India accounts for 17.4 million animal bites in a year, resulting in 20,565 human rabies deaths.[3] Rabies has terrified man since antiquity. The fear is by no means unfounded since the disease is invariably fatal and perhaps the most painful and dreadful of all communicable diseases, in which the sick person is tormented at the same time with thirst and fear of water (hydrophobia). Fortunately, development of rabies can be prevented to a large extent if animal bites are managed appropriately and in time. In this regard, the post-exposure treatment of animal bite cases is of prime importance.[4]

Although all age groups are susceptible, rabies is most common in children below 15 years. Ninety-six percent of mortality and morbidity is associated with dog bites. Cats, mongooses, and rodents are other important reservoirs of rabies in India.[5] Whereas previous studies have demonstrated mass dog vaccination and post-exposure prophylaxis (PEP) as the most effective control strategies, successful rabies elimination has yet to be realized as these recognized effective interventions continue to face challenges of limited accessibility.[6] One of the most important strategies to improve accessibility is to increase awareness among the general population regarding the importance of timely PEP and vaccination of pet dogs. This can be achieved through mass education programs catered specifically for high-risk population groups such as school-going children and their parents/guardians.[7]

This research work was undertaken to study the epidemiological factors responsible for the onset of rabies in domesticated mules and determine the effectiveness of control measures such as awareness-raising health talks and immunization in the prevention of the spread of disease to the animal handlers.

Epidemiological Investigation

Overview

The animal farm where the study was conducted was located in an isolated rural area in close proximity to the Modhuban forest of Binnaguri. The rearing of mules was done as confinement farming, and the purpose of rearing was for transport on difficult and hilly terrain. The farm was surrounded by a picket fence, but the risk of exposure to wild foxes and stray dogs was high when animals were taken out for physical activity.

The first case of rabies in the domesticated mules at the farm was reported on 29 October 2022. The affected mule showed symptoms of neurological hyperactivity, such as aggression and restlessness. After a week of the onset of symptoms, there was ataxia and drooling associated with paralysis of the limbs. The mule died ten days after the onset of the first symptoms. The diagnosis was confirmed by examination of brain samples collected during autopsy of the mules conducted by the district veterinary authorities located at Siliguri.

The epidemiological investigation to assess the source of infection and the risk of transmission was started on 31 October 2022. However, during the investigation, three more mules developed the infection. The last case was reported on 04 December 2022, and the mule died on 20 December 2022. The investigation ended on 15 January 2023 (6 weeks after the last reported case, based on the incubation period of rabies, which varies from 2 to 6 weeks).

It is important to note that the investigation was divided into two parts, i.e., determining the source of infection in mules, preventing its further spread to other mules, and protecting the animal handlers based on their risk profile.

Case Finding and Data Collection

Case Definitions

- **Clinical case definition:** A person presenting with an acute neurological syndrome (encephalitis) dominated by forms of hyperactivity (furious rabies) or paralytic symptoms (dumb rabies) progressing towards coma and death, usually by respiratory failure, within 7-10 days after the first symptoms, if no intensive care is instituted.
- **Definition of contacts:** The following categories describe the risk of a rabies virus exposure according to the type of contact with the animal suspected of having rabies. The category of exposure determines the indicated PEP procedure.

1. **Category I:** Touching or feeding animals, animal licks on intact skin (no exposure).
2. **Category II:** Nibbling of uncovered skin, minor scratches, or abrasions without bleeding (exposure).
3. **Category III:** Single or multiple transdermal bites or scratches, contamination of mucous membrane or broken skin with saliva from animal licks, exposures due to direct contact with bats (severe exposure).

ISSN: 0973-5038
DOI: https://doi.org/10.24321/0973.5038.202501

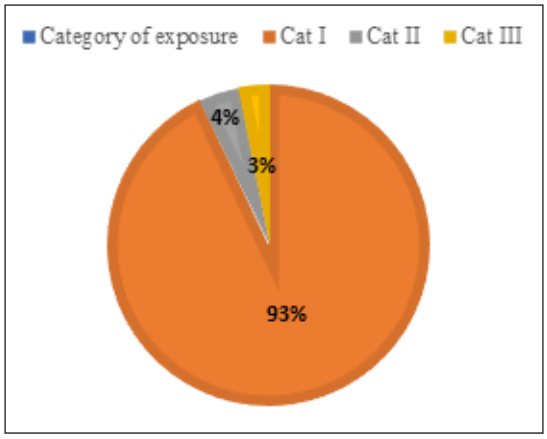

Figure 1. The percentage-wise distribution of animal handlers that were found to be in contact with the rabid mules with respect to their category of exposure

Data Collection Technique

The data was collected with the help of a pre-validated questionnaire. Information with respect to travel history of mules, symptomology, and risk assessment of mules as well as animal handlers was collected by the public health specialist and team of veterinary doctors from Siliguri District.

Analysis of Data

Epidemiological data with respect to the occurrence of rabies in mules

- Movement of animals (in the past 6 months) The first and fourth mules that succumbed to the illness (on 29 Oct 2022 and 04 Dec 2022, respectively) had a history of movement to East Sikkim from 16 Jun 2022 to 13 Aug 2022. No other movement of animals had been documented in the past 6 months.
- **Source of infection:** A detailed epidemiological investigation was carried out by the team detailed from Siliguri district, including postmortem analysis of brain samples of mules to confirm the diagnosis of rabies. The likely source of infection were the wild foxes and dogs, which was estimated based on the history of contact of animals with wild animals acting as hosts of circulating rabies virus.
- **Period of infectivity:** Once an animal becomes infected with the rabies virus, the incubation period lasts from 2 to 6 weeks. However, it can range from as little as nine days to as long as several years in some rare cases.
- **Factors influencing transmission:** As the rabies virus is spread from one animal to another by means of licks/bites, close-proximity of animals in the mule lines as well as the general habit of biting (to establish dominance) may have led to the transmission of disease from one mule to another.
- **Data regarding animal handlers:** Figure 1 illustrates the risk profile of the animal handlers who reported to have come in contact with the rabid mules. It was found that 3% of the animal handlers had category III exposure followed by 4% who had Cat II exposure and 93% who had Category I exposure. All animal handlers were given post-exposure prophylaxis depending on their category of exposure. Other personnel employed on the farm but not in contact with the animals (n=22) were administered pre-exposure prophylaxis.

Preventive measures with regard to animals were instituted immediately on detection of the first case

1. Immediate segregation of affected animals.
2. Early reporting and proper disposal of the animal carcasses.
3. Strict disinfection measures in the farm premises.
4. Daily inspection of mules for any bites/wounds.
5. The mule lines and farm premises were protected by proper fencing and picketing to prevent the entry of stray animals.
6. Anti-rabies vaccination of all animals was conducted in accordance with recommended policy.
7. No movement of affected animals in close contact with the diseased for at least a duration of 2 incubation periods (6 months).

Preventive measures with respect to animal handlers instituted immediately on detection of first case

1. All animal handlers were educated regarding the importance of personal protective measures and the importance of safe handling of animals as a preventive measure to spread rabies.
2. No mixing of animal handlers was allowed. (Proper teams were allotted to a particular animal, especially when sick.).
3. PrEP of all personnel was carried out with immediate effect.

Discussion

Rabies outbreaks have been reported previously among mules domesticated at the study site.

(Animal Farm) located in Binnaguri, West Bengal. As highlighted in Figure 2, one case each was reported in the years from 1985 to 1990, 1991 to 1995, 2001 to 2005, and 2016-2020. However, a sharp rise in the number of cases was observed during the current outbreak, where four cases of rabies were detected in a span of 3 months. (October to December 2022)

On comparison of the epidemiological pattern of the current outbreak with the previous ones, there is a difference in terms of the high morbidity and mortality rate only affecting young mules of age between 5 and 7 years and the rapid progression of the disease.

ISSN: 0973-5038
DOI: https://doi.org/10.24321/0973.5038.202501

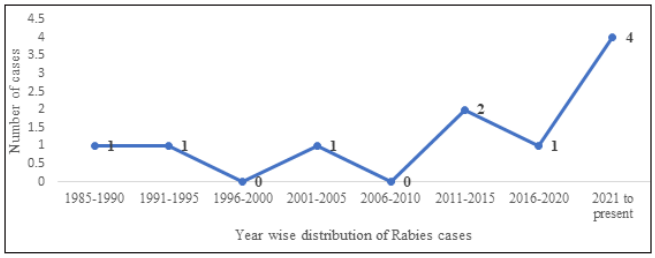

Figure 2.The number of cases of rabies detected among domesticated mules on the animal farm (study site) from the year 1985 to 2022. The line diagram denotes the number of cases of rabies that were detected at the animal farm

This study highlights the importance of awareness regarding rabies infection and its prevention.

The study was divided into two parts. One was to determine the source of infection among mules diagnosed with the infection to prevent its spread to other mules, and the other part was focused on the protection of animal handlers through immunization.

As per a study done by Rebecca Jessica Falcao Camara et al., animals belonging to the class Equidae (horses, mules, and donkeys) are the most susceptible to rabies infection. The primary mode of transmission to these animals is through the bite of infected carnivorous animals (e.g., dogs, jackals, hyenas, foxes) or blood-sucking bats.[8]

A similar trend is found in our study, where the mule that first showed the signs and symptoms of rabies had a travel history to a neighbouring state. However, taking into consideration a holistic view of infection transmission, spread of infection through bites of wild dogs and jackals cannot be ruled out.

Once the diagnosis of rabies in mules was confirmed through virological analysis of brain and CSF, the focus of the epidemiological investigation was on prevention of further spread of disease among mules and to prevent spread to the animal handlers.

The preventive measures employed for the protection of the animal handlers were increased awareness and vaccination.

As per a study done by Harish Kumar Tiwari et al. on Knowledge, Attitude, and Practices (KAP) towards rabies and free-roaming dogs (FRD) in Shirsuphal village in Western India[9], the lack of awareness about animal bite-related rabies in the rural population of developing countries, including India, is a major impediment to controlling the incidence of disease in humans. Hence, all the animal handlers were educated regarding important preventive measures and precautions to be taken during animal feeding and other routine activities.

As vaccination is considered the most effective strategy for disease prevention, a massive vaccination was carried out, through which 100% vaccination of the animal handlers as well as the mules was achieved.

Conclusion

Rabies is primarily a disease of animals, and once infected, the disease is almost always fatal. Hence, the best way of reducing mortality due to rabies is its prevention. Continuous and strict surveillance of fresh cases is of paramount importance. Also, special emphasis needs to be paid to the disposal of infected carcasses. As suggested by the epidemiology of the disease, any animal can act as a host for the rabies virus. Hence, timely vaccination of all animals in addition to protection from surrounding wildlife will form an important strategy for prevention of such occurrences in the future. Immediate vaccination coupled with health education to improve KAP of animal handlers forms the cornerstone for prevention of the disease in humans.

Limitation of the Study

The study was mainly focused on prevention of the spread of the disease among animal handlers. While preventive strategies in the form of vaccination of all mules on the farm were carried out, specific studies to pinpoint the exact source of infection in mules could not be carried out due to a paucity of resources and trained manpower.

Recommendations

Protective strategies for domestic animals, such as building picket fences and their timely immunization, would go a long way in the prevention of rabies. In addition, improvement in KAP (knowledge, awareness, and practice) regarding rabies and its prevention among animal handlers would form an important strategy in containment of the spread of the disease.

Conflict of Interest: None

Source of Funding: None

Declaration of Generative AI and AI-Assisted Technologies in the Writing Process: None

Authors' Contribution: SS- Plan of study and literature review; NKS- Planning and execution of methodology, statistical analysis, and discussion writing.

References

1. Park JE, Park K. Textbook of preventive and social medicine. (No Title). 1983. [Google Scholar]
2. Shukla R, Singhal A, Shaw SC, Manthene M, Sharma R, Soman KP, Singhal A. Knowledge, Attitude, and Practice of Rabies Postexposure Prophylaxis among

Young Doctors. Journal of Marine Medical Society. 2023 Jul 1;25(2):121-4. [Google Scholar]

3. Rubeshkumar P, Majella MG, Jahan N, Sakthivel M, Krishnamoorthy Y. Secular trends of rabies in India, 2005–2020: importance of surveillance and implications for elimination strategies. The Lancet Regional Health-Southeast Asia. 2024 Jan 1;20. [Google Scholar] [Pubmed]
4. Chowdhury R, Mukherjee A, Naskar S, Lahiri SK. A study on knowledge of animal bite management and rabies immunization among interns of a government medical college in Kolkata. Int J Med Public Health. 2013 Jan 13;3(1):17-20. [Google Scholar]
5. Taylor LH, Wallace RM, Balaram D, Lindenmayer JM, Eckery DC, Mutonono-Watkiss B, Parravani E, Nel LH. The role of dog population management in rabies elimination—a review of current approaches and future opportunities. Frontiers in veterinary science. 2017 Jul 10;4:109. [Google Scholar] [Pubmed]
6. Auplish A, Clarke AS, Van Zanten T, Abel K, Tham C, Bhutia TN, Wilks CR, Stevenson MA, Firestone SM. Estimating the intra-cluster correlation coefficient for evaluating an educational intervention program to improve rabies awareness and dog bite prevention among children in Sikkim, India: A pilot study. Acta tropica. 2017 May 1;169:62-8. [Google Scholar] [Pubmed]
7. Jordana L Burdon Bailey, Luke Gamble, Andrew D Gibson, Barend M deC Bronsvoort, Ian G Handel, Richard J Mellanby et al. A rabies lesson improves rabies knowledge amongst primary school children in Zomba, Malawi. PLoS Negl Trop Dis. 2018 Mar 9;12(3):e0006293. [Google Scholar] [Pubmed]
8. Câmara RJ, Bueno BL, Resende CF, Balasuriya UB, Sakamoto SM, Reis JK. Viral diseases that affect donkeys and mules. Animals. 2020 Nov 25;10(12):2203. [Google Scholar] [Pubmed]
9. Tiwari HK, O'Dea M, Robertson ID, Vanak AT. Knowledge, attitudes and practices (KAP) towards rabies and free-roaming dogs (FRD) in Shirsuphal village in western India: A community based cross-sectional study. PLoS Negl Trop Dis. 2019 Jan 25;13(1):e0007120. [Google Scholar] [Pubmed]

ISSN: 0973-5038
DOI: https://doi.org/10.24321/0973.5038.202501