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Review Article

Review on Epidemiology of Peste des Petits Ruminants

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Abstract

Peste des petits ruminants is an acute, contagious, and highly fatal viral disease that affects different animal species which is caused by *Morbillivirus* in the family *Paramyxoviridae*. The genome contains six transcription units encoding in sequential order, the Nucleocapsid (N) protein, the Phospho (P) protein, the Matrix (M) protein, the Fusion (F) protein, the Hemagglutinin (H) protein and the Large (L) protein. The virus exists as a single serotype but the genetic level is divided into four distinct lineages (I-IV) based on the Fusion (F) protein gene sequence. The disease occurs in Africa, in most of the Middle East, Arabian Peninsula, Europe and in parts of Asia including much of the Indian subcontinent. The disease is transmitted by the aerosol route during close contact between animals. The disease is characterized by high fever, ocular and nasal discharge, pneumonia and necrosis. Diagnosis can be made based on case history, geographical distribution, clinical signs, post-mortem lesions and laboratory confirmation by using various serological and molecular techniques. It has a significant economic impact on food security and livelihoods. There is no specific treatment for the disease. Control and prevention can be done through quarantine, movement control, cleaning and disinfection of infected premises and vaccination.

Keywords: Peste des petits ruminants; Virus; Contagious; Review; Epidemiology

Introduction

A Peste des petits ruminants is an acute, contagious, and frequently fatal disease of Small ruminants, caused by a *Morbillivirus* of the family *Paramyxoviridae* [1,2]. Peste des Petits Ruminants (PPR) spreads quickly in susceptible ruminant species, and the highest number of outbreaks occurs in sheep and goats. Cattle, camels, pigs and several wild ruminants have been infected occasionally; however, there is no evidence to show that the disease is maintained in these populations without concurrent infection in sheep or goats [3]. Peste des Petits Ruminants Virus (PPRV) was first identified in Côte d'Ivoire, West Africa, in 1942, and it is currently believed to be endemic across much of West, Central, North and East Africa, the Middle East and Central, South and East Asia [4]. Four genetic lineages (Lineages I-IV) and a number of viral strains have been identified. Geographically, lineages I and II have been found predominantly in West and Central Africa, and lineage III has been found predominantly in East Africa and the Middle East [1]. Lineage IV is the main lineage found in Asia [5].

In small ruminants, infection by Peste des petits ruminants virus is characterized by sudden depression, fever, pneumonia, nasal and ocular discharge, diarrhoea with high morbidity and mortality rates which can be approaches up to 100% that threatens the food security and sustainable livelihood of the communities [6,7]. PPR is transmitted by close contact, and confinement favors outbreaks. Secretions and excretions of sick animals are the sources of infection. Transmission can occur during the incubation period [1,8]. PPR is tentatively diagnosed by clinical observations, characteristic symptoms, epidemiology, post-mortem lesions and laboratory confirmation by using various serological and molecular techniques such as Competitive Enzyme-Linked Immunosorbent Assay (C-ELISA), Agar Gel Immunodiffusion (AGID), Virus Neutralization Test (VNT), Reverse Transcriptase Polymerase Chain Reaction (RT-PCR) and others [9,10]. For the proper control of PPR, there is need of strong support of diagnostic methods and proper, timely vaccination of the susceptible population [11].

The disease causes annual economic losses of up to USD 2.1 billion. Looking beyond this figure, 300 million families are at risk of losing their livelihoods, food security, and employment opportunities. Moreover, small ruminants and their products are internationally traded commodities, particularly in Africa and the Middle East. PPR considerably affects export earnings and creates supply shortages. The inability of families, communities, and institutions to anticipate, absorb, or recover from PPR can compromise national and regional development efforts, and reverse decades of progress [12]. Therefore, the aim of this review is to give overview of Peste des petits ruminants in sheep and goats.

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Epidemiology of Peste des Petits Ruminants

Etiology

Peste-des-Petits Ruminantis Virus (PPRV) belongs to the genus *Morbillivirus* of the family *Paramyxoviridae* and is an envelope, single-stranded RNA virus with genomes 15–16 kb in length and 200 nm in diameter [1,2,13]. The major site of this virus propagation is lymphoid tissue and acute diseases are usually accompanied by profound lymphopenia and immunosuppression, leading to the host susceptible for secondary and opportunistic infections. The PPRV genome is 15,948 nucleotides nearly 16 kb in length, although a variant virus with an additional six nucleotides has been detected in the recent Chinese epizootic. The genome contains six transcription units encoding in sequential order, the Nucleocapsid (N) protein, the Phospho (P) protein, the Matrix (M) protein, the Fusion (F) protein, the Hemagglutinin (H) protein and the Large (L) protein which together with the P protein forms the viral RNA-dependent RNA polymerase [13,14]. The virus exists as a single serotype but the genetic level is divided into four distinct lineages (I-IV) based on the Fusion (F) protein gene sequence [1].

Geographical Distribution

Peste-des-Petits Ruminantis was long considered to be confined to West Africa but later it has expanded to cover large regions of Africa, the Middle East, Arabian Peninsula, Europe and Asia [15]. In Africa, PPR endemic zones include the countries located between the Sahara and the Equator, from the Atlantic Ocean to the Red Sea. The disease is widespread in western, central, eastern and northern Africa [1,16]. The diseases are generally cover around 70 countries of the world and suspected as another 50 countries are at high risk of getting the diseases. Out of these infected countries, more than 60% are in Africa whereas the remaining is in Asia (South East Asia, China, South Asia and Central Asia/ West Eurasia including Turkey) and the Middle East [17]. Based on the sequencing of F and N gene, Peste-des-Petits Ruminantis virus is classified into four genetically distinct lineages [18]. The lineages are generally correlated with geographical distribution of the virus. PPR viruses belonging to lineages I and II have been isolated exclusively from west and central African countries. Lineage III has been isolated from eastern Africa and Arabian Peninsula, lineage IV has been isolated in Asia, Middle East and in northern Africa [19].

Host Affected and Transmission

Sheep and goats are the primary hosts for Peste-des-Petits Ruminantis virus although many other species have been reported to be infected [20]. Infection of other large ruminants like (cattle and buffalo) and pigs has been reported although infection is generally subclinical in these species [21,22]. Camels are susceptible to infection and can display signs of clinical disease [23]. PPRV is most effectively transmitted between animals by direct contact, often through the inhalation of infective droplets. However, the virus is known to be excreted in eye and nasal discharge as well as, to a lesser extent, in urine and faecal matter. The Ultra Violate liability and temperature sensitivity of the virus reduce the likelihood of transmission via routes other than droplet spread. Transmission via infected bedding, water, feed troughs and other inanimate objects (fomites) is possible but is thought to occur at a very low level [24,25].

Clinical Signs

The incubation period of peste-des-petits ruminantis virus ranges from 2 to 6 days with the clinical signs begins with a clear discharge from the nostrils that becomes grey and sticky. The discharge from the nostrils may gradually change into exudates that crust over, blocking the nostrils causing respiratory distress. The nasal mucous membranes may develop small areas of erosion. The conjunctiva may be congested with matted eyelids. The mucous membranes in the mouth may also be eroded. Concurrently, animals will most likely have profuse, non-hemorrhagic diarrhea resulting in severe dehydration, which may progress to emaciation and difficulty in breathing [26-28]. Bronchopneumonia with coughing is common late in the disease. The disease occurs as per acute, acute and sub-acute form and most cases of peste-des-petits ruminantis is occur in the acute form [29].

Diagnosis

Peste-des-petits ruminantis virus is tentatively diagnosed based on case history, geographical distribution, clinical signs, post-mortem lesions and laboratory confirmation by using various serological and molecular techniques including PPRV detection by specific antibody in serum detection of viral antigens [30]. Serological tests that are routinely used include Virus Neutralization (VN) test and the Competitive Enzyme –Linked Immunosorbnt Assay (ELISA). In most countries PPR is a notifiable disease in domestic sheep and goats and the authorities require to be informed if the infection is suspected but not when infection occurs in other species. Differential diagnosis of Peste-des-petits ruminantis includes a number of diseases such as rinderpest, contagious caprinepleuropneumonia, bluetongue, Pasteurellosis, contagious ecthyma, foot and mouth disease, heartwater, coccidiosis, Nairobi sheep disease and mineral poisonings [31-33].

Prevention and Control

Peste-des-petits ruminantis virus is a short-lived virus in the environment, and it is usually spread by direct contact, and introduced by infected animals. Import controls, movement restrictions, testing, and quarantine are used to exclude the virus from non-endemic areas. There is no specific treatment against the disease, although a broad spectrum of antibiotics can be administered against secondary bacteria that could aggravate the disease condition because of the animal's compromised immune status. Control of PPR outbreaks can do through movement control (quarantine) combined with the use of focused ring vaccination and prophylactic immunization in high-risk populations. The PPR vaccine seed is available through the Pan African Veterinary Vaccine Centre (PANVAC) at Debre-Zeit, Ethiopia, for African countries. The structural composition of the virus paste des petits ruminants are surface glycoproteins hemagglutinin and fusion protein. This induces the immunity and morbilliviruses are highly immunogenic and produce protective immunity. When these viruses attack host, the immune response particularly cell-mediated induces immunity and is a crucial role in the protection of the host from these agents [34].

Conclusion and Recommendation

Conclusively peste des petits ruminant is a serious viral disease that has a great economic impact throughout small ruminant production areas. This is recognized as an essential disease of sheep and goats worldwide. In Ethiopia peste des petits ruminant is the main constraint to sheep and goats production system. This disease is widely distributed in almost all parts of the country imposes great losses on the economic de-

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References

1. Banyard AC, Parida S, Batten C, Oura C, Kwiatek O, Libeau G. Global distribution of peste des petits ruminants' virus and prospects for improved diagnosis and control. J Gen Virol. 2010; 91: 2885-97.
2. Parida S, Muniraju M, Mahapatra M, Muthuchelvan D, Buczkowski H, Banyard AC. Peste des petits ruminants. Vet Microbiol. 2015; 181: 90-106.
3. Lembo T, Oura C, Parida S, Hoare R, Frost L, Fyumagwa R, et al. Peste des petits ruminants infection among cattle and wildlife in northern Tanzania. Emerg Infect Dis. 2013; 19: 2037-40.
4. Clarke BD, Islam MR, Yusuf MA, Mahapatra M, Parida S. Molecular detection, isolation and characterization of Peste-des-petits ruminants virus from goat milk from outbreaks in Bangladesh and its implication for eradication strategy. Transbound Emerg Dis. 2018; 65: 1597-604..
5. Liu F, Li J, Li L, Liu Y, Wu X, Wang Z. Peste des petits ruminants in China since its first outbreak in 2007: A 10-year review. Transbound Emerg Dis. 2018; 65: 638-48.
6. Afera B, Hussien D, Amsalu K. Seroprevalence of peste des petits ruminants in goats of southern parts of Tigray region. Glob Vet. 2014; 12: 512-6.
7. Mdetele DP, Komba E, Seth MD, Misinzo G, Kock R, Jones BA. Review of peste des petits ruminants occurrence and spread in Tanzania. Animals (Basel). 2021; 11: 1698.
8. Madboli AA, Ali SM. Histopathological and immunohistochemical studies on the female genital system and some visceral organs in sheep and goat naturally infected by Peste des Petits Ruminants virus. Glob Vet. 2012; 9: 752-60.
9. Forsyth MA, Barrett T. Evaluation of polymerase chain reaction for the detection and characterization of rinderpest and peste des petits ruminants' viruses for epidemiological studies. Virus Res. 1995; 39: 151-63.
10. Anderson J, Corteyn M, Libeau G. Diagnosis of rinderpest and peste des petits ruminants virus. In: Rinderpest and peste des petits ruminant: virus plagues of large and small ruminants. Academic Press. 2006; 63-84.
11. Worrall EE, Litamoi JK, Seck BM, Ayelet G. and Xerovac. An ultrarapid method for the dehydration and preservation of live attenuated rinderpest and peste des petits ruminants vaccines. Vaccine. 2000; 19: 834-9.
12. FAO. Peste des petits ruminants: the disease and its impact. Food and Agriculture Organization of the United Nations (FAO). 2020.
13. Rajko-Nenow PZ, Cunliffe TG, Flannery JT, Ropiak HM, Avaliani L, Donduashvili M, et al. Complete genome sequence of pestedes petits ruminants virus from Georgia. Genome Announc. 2017; 5: 1091-17.
14. Baron MD, Diallo A, Lancelot R, Libeau G. Peste des petits ruminants virus. Adv Virus Res. 2016; 95: 1-42.
15. Khan HA, Siddique M, Abubakar M, Arshad MJ, Hussain M. Prevalence and distribution of peste des petits ruminants virus infection in small ruminants. Small Rumin Res. 2008; 79: 152-7.
16. OIE world animal health information database (WAHID); 2011a. -. Version: 1.4.
17. OIE and FAO Global control and eradication of peste des petits ruminants: investing in veterinary systems, food security and poverty alleviation. 2015; 1-28.
18. Couacy-Hymann E, Roger F, Hurard C, Guillou JP, Libeau G, Diallo A. Rapid and sensitive detection of peste des petits ruminants virus by a polymerase chain reaction assay. J Virol Methods. 2002; 100: 17-25.
19. Shahriari R, Khodakaram-Tafti A, Mohammadi A. Molecular characterization of Peste des Petits ruminants virus isolated from four outbreaks occurred in southern Iran. BMC Vet Res. 2019; 15: 177.
20. Truong T, Boshra H, Embury-Hyatt C, Nfon C, Gerdts V, Tikoo S, et al. Peste des petits ruminants virus tissue tropism and pathogenesis in sheep and goats following experimental infection. PLOS ONE. 2014; 9: e87145.
21. Sen A, Saravanan P, Balamurugan V, Bhanuprakash V, Venkatesan G, Sarkar J, et al. Detection of subclinical Peste des petits ruminants virus infection in experimental cattle. Virusdisease. 2014; 25: 408-11.
22. Mahapatra M, Sayalel K, Muniraju M, Eblate E, Fyumagwa R, Shilinde L, et al. Spillover of Peste des petits ruminants virus from domestic to wild ruminants in the Serengeti ecosystem, Tanzania. Emerg Infect Dis. 2015; 21: 2230-4.
23. Fakri FZ, Bamouh Z, Jazouli M, Omari Tadlaoui K, Elharrak M. Experimental infection of dromedary camels with virulent virus of peste des petits ruminants. Vet Microbiol. 2019; 235: 195-8.
24. EFSA Panel on Animal Health and Welfare (AHAW). Scientific Opinion on peste des petits ruminants. EFSA J. 2015; 13: 3985.
25. de Vries RD, Duprex WP, de Swart RL. Morbillivirus infections: an introduction. Viruses. 2015; 7: 699-706.
26. Roeder PL, Obi TU. Recognizing peste des petites ruminants: A field manual, FAO Animal Health Manual. 1999; 5: 28.
27. Radostits OM, Gay CC, Hinchcliff KW, Constable PD. Veterinary medicine: a textbook of the diseases of cattle, horses, sheep, pigs and goats. 10th ed. London: Saunders Elsevier. 2006; 1242-4.
28. Kumar P, Tripathi BN, Sharma AK, Kumar R, Sreenivasa BP, Singh RP, et al. Pathological and immune-histochemical study of experimental peste des petits ruminants virus infection in goats. J Vet Med B. 2004; 51: 153-9.

29. Abubakar M, Jamal SM, Khan MA, Ali Q. Peste des petits ruminants outbreak in small ruminants of Northern Areas of Pakistan. Res J Vet Sci. 2008; 1: 56-61.

30. Brüning-Richardson A, Akerblom L, Klingeborn B, Anderson J. Improvement and development of rapid chromatographic strip-tests for the diagnosis of RPV and PPRV. J Virol Methods. 2011; 174: 42-6.

31. Malik YS, Singh D, Chandrashekar KM, Shukla S, Sharma K, Vaid N, et al. Occurrence of dual infection of peste des-petits-ruminants and goatpox in indigenous goats of central India. Transbound Emerg Dis. 2011; 58: 268-73.

32. Mondal B, Sen A, Chand K, Biswas SK, De A, Rajak KK, et al. Evidence of mixed infection of peste des petits ruminants virus and bluetongue virus in a flock of goats as confirmed by detection of antigen, antibody and nucleic acid of both the viruses. Trop Anim Health Prod. 2009; 41: 1661-7.

33. Saravanan P, Balamurugan V, Sen A, Sarkar J, Sahay B, Razak KK, et al. A mixed infection of peste des petits ruminants and Orf in a goat farm. India: Shahjhahanpur. Vet rec. 2007; 160: 410–2.

34. Gibbs EP, Taylor WP, Lawman MJ, Bryant J. Classification of peste des petits ruminant virus as the fourth member of the genus Morbillivirus. Intervirology. 1979; 11: 268-74.