



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.

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1. 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* (Banyard *et al.*; 2010; Parida *et al.*; 2015). 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 (Lembo *et al.*; 2013). 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 (Clarke *et al.*; 2018). 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 (Banyard *et al.*; 2010). Lineage IV is the main lineage found in Asia (Liu *et al.*; 2018).

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 (Afera *et al.*; 2014; Mdetele *et al.*; 2021). 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 (Banyard *et al.*; 2010; Madboli and Ali, 2015). 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 (Forsyth and Barrett, 1995; Anderson *et al.*; 2006). For the proper control of PPR, there is need of strong support of diagnostic methods and proper, timely vaccination of the susceptible population (Worrall *et al.*; 2000).

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 (FAO, 2020). Therefore, the aim of this review is to give overview of Peste des petits ruminants in sheep and goats.

2. Epidemiology of peste des petits ruminants

2.1. Etiology

Peste-des-Petits Ruminantis virus (PPRV) belongs to the genus *Morbillivirus* of the family *Paramyxoviridae* and is an enveloped, single-stranded RNA virus with genomes 15–16 kb in length and 200 nm in diameter (Banyard *et al.*; 2010; Parida *et al.*; 2015; Rajko-Nenow *et al.*; 2017). 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 (Rajko-Nenow *et al.*; 2017, Baron *et al.*; 2016). 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 (Banyard *et al.*; 2010).

2.2. 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 (Khan *et al.*; 2008). 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 (Banyard *et al.*; 2010; OIE, 2011a). The diseases is 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 (OIE and FAO, 2015). Based on the sequencing of F and N gene, Peste-des-Petits Ruminantis virus is classified into four genetically distinct lineages (Couacy-Hymann *et al.*; 2002). 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 (Shahriari *et al.*; 2002).

2.3. 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 (Truong *et al.*; 2014). Infection of other large ruminants like (cattle and buffalo) and pigs has been reported although infection is generally subclinical in these species (Sen *et al.*; 2014; Mahapatra *et al.*; 2015). Camels are susceptible to infection and can display signs of clinical disease (Fakri *et al.*; 2019). 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 (EFSA, 2015; de Vries *et al.*; 2015).

3. 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 (Roeder and Obi, 1999; Radostits *et al.*; 2006; Kumar *et al.*; 2004). 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 (Abubakar *et al.*; 2008).

4. 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 (Bruning-Richardson, *et al.*; 2011). Serological tests that are routinely used include virus neutralization (VN) test and the Competitive enzyme-linked immunosorbent 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 caprine pleuropneumonia, bluetongue, Pasteurellosis, contagious ecthyma, foot and mouth disease, heartwater, coccidiosis, Nairobi sheep disease and mineral poisonings (Malik *et al.*; 2011; Mondal *et al.*; 2009; Saravanan *et al.*; 2007).

5. 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 peste 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 (Gibbs *et al.*; 1979).

6. Conclusion and recommendation

Peste des petits ruminant is a viral disease that affects the animal health and its production. The disease is mainly distributed in Africa, Middle East, Arabian Peninsula, Europe and Asia. It can be transmitted through direct and indirect contact. The disease has significant economic impact due to its highly contagious nature. The best control and prevention mechanism of the disease is through movement control (quarantine) combined with the use of focused ring vaccination.

7. References

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