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Peste Des Petits Ruminants (PPR) of small ruminants in Iraq (A review)

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Abstract
Peste des petits ruminants (PPR) is a highly contagious viral disease of sheep and goats with high morbidity and mortality rate. The disease is of considerable economic importance in all countries, where small ruminant products are more important. This review will highlight the importance of the disease in Iraq and its possible epidemiological criteria with suggested control measures advised, the causative virus PPRV has been registered in most of Iraq, However, The diagnosis concentrated on the clinical manifestations encountered by diseased animals, post mortem lesions shown by dead animals as well as the molecular identification of the virus, Moreover, Risk factors which include age, sex, species, and close contact of animals from different farms and localities. Unfortunately, no vaccines are available yet meaning low vaccine coverage, uncared disease surveillance, and uncontrolled animal movements could be the major problems for control efforts for PPR in Iraq. Furthermore, a collaborative attempt to increase and develop the control and eradication plans are needed, On the other hand, The establishment of a national reference laboratory for PPR, conduct of surveillance, the development of high-quality vaccines, as well as fulfillment of a carefully planned national vaccination campaign may be the key to the control and subsequent eradication of the disease in Iraq.

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I. Introduction

Peste des petits ruminants (PPR) is a highly contagious and acute viral disease of sheep and goats, with a possible sub-clinical manifestation in cattle, pigs, and camels. The disease has also been reported in some wildlife species including Dorcas gazelles (*Gazella dorcas*) , Nubian ibex (*Capra nubiana*), Laristan sheep (*Ovis vignei laristanica*), and gemsbok (*Oryx gazelle*) (1). The disease is characterized by fever, anorexia, nasal and ocular discharges, sores in the mouth, pneumonia, profuse diarrhea, and often death, However, Reported morbidity and mortality rates have varied between 90–100% and 50–100%, respectively (2). PPR has also been associated with a high rate of abortion in infected goats. Consequently, PPR is a major constraint to small ruminant production in Africa and is thus of high economic importance, especially in areas with a high reliance on small ruminant products (3).

PPR is caused by peste des petits ruminants virus (PPRV), species *Small ruminant morbillivirus* (SRMV), a member of the genus *Morbillivirus*, in the family *Paramyxoviridae* (4). It is closely related to other members of the genus, including the rinderpest virus, measles virus, and canine distemper virus (1). The virus is highly contagious and easily transmitted by direct contact of healthy animals with the secretions and/or excretions from infected animals, or by contact with infected fomites (2). PPRV exists as one serotype, but sequence analysis of the nucleoprotein (N) gene and the fusion protein (F) gene has revealed four genetically distinct lineages, However, Lineages I and II are mainly found in West and Central Africa; lineage III is found mainly in East Africa, Yemen, and Oman; and lineage IV is found across the Arabian Peninsula, the Middle East, southern Asia and recently, in several African territories (5).

The geographical spread of PPR is wide. The disease was first identified in West Africa in the 1940s and has since been observed in North and Central Africa, the Middle East, parts of East Africa and Asia, and Europe (6). In East Africa, PPRV was first isolated in Ethiopia in 1991, although sick goat herds in the Afar region of Ethiopia were suspected to have PPR much earlier in 1977, Moreover, In Tanzania, PPR was officially confirmed in 2008 (7)

Currently, a global initiative driven by the Food and Agriculture Organization of the United Nations (FAO) and the World Organisation for Animal Health (OIE) exists to eradicate PPR by 2030 (8). For this to be attainable, it is important to understand the specific epidemiological features of the disease and identify the socio-economic factors that must be considered to stop the transmission of the disease.

History of the disease:

The disease is widespread in western, central, eastern, and northern Africa (9), and the four genetic lineages are all present in different regions of the continent. In northern Africa, only Libya has not reported the disease to date. Several countries have started national PPR control programs, such as the Kingdom of Saudi Arabia, India, Pakistan, and China. In March 2015, OIE and FAO officially launched a new program to eradicate PPR and presented a global control and eradication strategy (10).

Peste des petits ruminants was first described in 1942 in the Republic of Cote-d'Ivoire in West Africa (11). At the time of first PPRV recognition, it was considered a variant of the rinderpest virus. However, demonstrated, based on the biological and physicochemical characteristics, that PPRV is distinct enough to be considered a new member of the genus Morbilliviruses (12).

The disease has been confirmed in most countries in West Africa, such as Nigeria, Senegal, Togo, and Benin, while by 1982 the disease had been diagnosed in Sudan, an eastern African country (9).

The disease has recently been reported for the first time in China, Nepal, Vietnam, and Tajikistan, while in Africa PPRV has now expanded south of the Equator to Gabon (1996), Kenya (2006), the Congo (2006), Uganda (2007) and Tanzania (2008), and also to the north of the Sahara into Morocco (2007). Algeria, Tunisia, and Libya are now known to have experienced infection (13).

It was documented that the Iraqi Ministry of Agriculture confirmed officially the first outbreak of PPR in Iraq in September 1998(14). Another outbreak occurred in 2000 in which the virus caused high morbidity and low mortality rates among small ruminants (15). Outbreaks of PPR are now known to be common in India, Nepal, Bangladesh, Pakistan, and Afghanistan (5). In Asia, the virus spread to China in 2007 and again in 2013, spreading rapidly throughout 22 provinces (6) and from 2013 to 2014, PPR was also reported in countries surrounding China such as India, Vietnam, and Pakistan where a high level of antibody to PPRV was detected in small domestic ruminants and wildlife (10). Peste des petits ruminants (PPR) is an acute, contagious, and frequently fatal disease of sheep and goats, caused by a morbillivirus related to the viruses that cause rinderpest in cattle, measles in humans, and distemper in dogs. The severity of clinical signs, the morbidity rate, and the case fatality rate can vary depending on the virulence of the virus strain, the species, and breed of the host, concurrent infection, and previous exposure of the population to PPR virus (PPRV) (5).

The disease is characterized by fever, congestion, and discharge from, the eyes and nose, respiratory problems, erosive sores in the mouth, lesions around the outside of the mouth, possibly swelling of the lips, and diarrhea, although not all signs are seen in all infected animals (16). It is an acute and highly contagious viral disease of primarily sheep and goats and is currently emerging to cause infection in camels and clinically manifested by high fever, discharges from eyes and nasal orifices, oral necrotizing, and erosive ulcers, stomatitis, gastroenteritis, diarrhea and bronchopneumonia (2). This transboundary nature of the disease is one of the foremost constraints in enhancing the productivity of the small ruminants in enzootic countries in Africa, the Arabian Peninsula, the Middle East, and Central and Southeast Asia. PPR has a massive potential to cause huge economic losses and it significantly impacts the livestock sector economy and food security of the enzootic countries (17).

The disease in Iraq:

In September 1998, Iraq reported an outbreak of peste des petits ruminants (PPR) in its northern governorates to OIE and FAO. Although this disease had been suspected in the central and northern governorates for several years and was known to be present in neighboring countries, this was the first official report of PPR in the country and caused great concern(15). PPR is a serious disease economically, and its transboundary nature could compromise control programs for both PPR and rinderpest in neighboring countries. Owing to the international sanctions imposed on Iraq, the Iraqi veterinary authorities had few resources to cope with this highly contagious disease of small ruminants (18).

The Iraqi Ministry of Agriculture requested FAO's assistance in controlling PPR. In 1999, an FAO TCP project was implemented to help eliminate the disease through focused vaccination, establish and strengthen laboratory-assisted surveillance, enhance the diagnostic capacity of field veterinary staff, and to form a national network for surveillance and early warning systems against transboundary animal diseases. Vaccines, laboratory equipment, and other materials were supplied, and two consultants, Dr. Samir Hafez and Dr. Adama Diallo traveled to Iraq to assist in these tasks in late 1999. The consultants conducted workshops on laboratory methods in Baghdad, and PPR recognition and control in 12 governorates(19).

The extent of PPR in Iraq was not well defined before the project, and still needs more investigation. However, information exchange during the consultancies has led to awareness building and an increased understanding of the situation.

During the last few years, PPR was seen clinically in sheep and goats in Irbil and Dahuk Governorates and has been suspected clinically in Mosul, As-Sulaimaniyah, and Ta'amim, all of which are in the north of the country, Moreover, recently PPR was also registered as a common outbreak in the south part of Iraq(20). Being

a disease that is easily confused with rinderpest in small ruminants or various infections leading to pneumonic signs, as well as being an exotic disease until recently, insufficient capacity to recognize PPR may have caused underreporting of the disease(6).

Diagnosis of PPR:

This situation would be alleviated to some extent if a diagnosis could be made in the field at the pen side. For PPRV, the currently available diagnostic tests are agarose gel immunodiffusion (AGID), enzyme-linked immunosorbent assay (ELISA), and reverse transcription-polymerase chain reaction (RT-PCR), either gel-based or real-time or loop-mediated isothermal amplification (LAMP) (19). Detection of antibodies to PPRV is generally carried out using ELISA techniques. Currently, the OIE recommends the use of the competitive PPRV-specific anti-H monoclonal-based and virus neutralization tests. However, several alternatives exist (21) including the indirect N ELISA, immunofiltration, a novel sandwich ELISA, haemagglutination tests, and latex agglutination tests, For molecular detection, standard RT-PCR has been superseded by real-time RT-PCR assays specific for PPRV (22). Laboratory confirmation by using various serological and molecular techniques, However, specific diagnosis of PPRV infection can be achieved by cDNA hybridization. (3,5,17).

The control of the disease:

Different control and preventive strategies can be used for PPR in animals. In the very first stage separate the infected animals from healthy animals to minimize the chance of transmission of the PPR virus from infected animals to healthy animals. Secondly slaughtering of apparent diseases animals and seropositive animals, moreover proper disposal of all infected material, and decontamination of items of infected sheep/goat flock is crucial for control/ eradication of PPR (23).

For the proper control of PPR, there is a need for strong support of diagnostic methods and proper, timely vaccination of the susceptible population upon understanding. the epidemiology of the disease is imperative. Hence, the availability of attenuated cell culture vaccines and various diagnostic techniques/kits (24). The standard disease control measures consist of quarantine, movement control, and sanitary slaughter and disinfection. A modified live vaccine is used in endemic areas (25).

In the past, an attenuated heterologous vaccine (Tissue culture rinderpest vaccine), which is consist of live rinderpest was used, but with current efforts to eradicate rinderpest worldwide, it's no longer an acceptable method, because interferes with the eradication of global schedule (24). Gilbert and Monnier 1962 showed cytopathic effects of PPRV in sheep hepatocytes and PPRV adaptation in cell culture. There is no treatment for PPR but it helps to give broad-spectrum antibiotics to stop secondary bacterial complications (26).

The controls of PPR require an effective vaccine and for this purpose, several vaccines including both homologous and recombinant vaccines have been developed (27). Nowadays, efficient live attenuated PPR vaccines are available that can induce lifelong protective immunity in vaccinated animals, And in general, the control of the disease is more effective by applying measures such as the slaughter of the infected herd, correct disinfection, and adequate disposal of carcasses, movement control, emergency vaccination and quarantine (10). It has been shown that The Live-Attenuated PPR Vaccines, is an immunosuppressants is a consequence not only of the direct effects of virus multiplication in lymphoid cells but also of the different strategies developed by morbilliviruses to overcome the host protective response, such as interference with both the innate and induced immune responses. However, this immunosuppressive effect is transient and recovery from the disease is usually accompanied by the establishment of a strong, specific, and long-term protective immune response (S25,28). Attenuated morbillivirus vaccines seem to have less immune suppression capacity compared to wild-type viruses, but still induce a strong protective immunity (10, 24). Following this first success, other PPRV strains were successfully attenuated by serial passage in cell culture (29).

The PPR vaccine with an improved freeze-dried method and stabilizers can be maintained at 37 °C for up to 24 h without any significant effect on the protective efficacy. although the reconstituted vaccine must be administered to the animals within 2 h (30). Moreover, Subunit vaccines for morbilliviruses have been developed for several species. Initial work carried out with Capripox virus strains expressing F and H proteins of Rinderpest virus was shown to protect goats against Peste des petits ruminants virus (28,29). On the other hand, Capripox virus strains expressing the homologous to Peste des petits ruminants virus proteins H or F have also been shown to protect goats or sheep against infection by Peste des petits ruminants virus(31,32,33,34,35).

II. Conclusion:

It has been concluded that Peste des petits ruminants (PPR) is a highly contagious disease that may cause many deaths among sick animals (sheep and goats). Therefore, it has become necessary to monitor the disease extensively and try to detect it and diagnose it faster and more accurately to develop adequate and

strategic plans to limit its spread among animals and reduce the economic losses resulting from the death of many sick animals

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