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Review Article

Review of Sheep Pox Disease in Sheep

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Abstract

Sheep and Goat Pox is a highly contagious viral disease of sheep and goats and in sheep, it is considered to be economically the most important in the tanning sector due to its slow and permanent scar formation. The causative agents, the capripox viruses (CaPV) are considered to be very host-specific and sheep and goat poxviruses are pathogenic exclusively for the ovine and caprine species respectively. The systemic signs include fever, conjunctivitis, rhinitis, lymphadenopathy, anorexia and depression. The skin lesions follow a typical pox virus development from a macule to papule and appear as small red patches usually around the mouth, on the head, under the tail and between the legs. The mucous membranes of the eyes, nose, mouth, vulva and prepuce may be necrotic ulcerated and all the body lymph nodes are swollen and enlarged. The disease causes low mortality in indigenous breeds in enzootic areas as compared to exotic breeds but severe outbreaks occur in naïve sheep introduced in these areas, if there are intensive rearing practices or concurrent infections. Heavy economic losses in sheep pox outbreaks are due to the high mortality, abortions and loss of market value of the affected animals. In many countries where Sheep and Goat pox are enzootic, vaccination and bio-security are the only two main control measures. Therefore, it is essential to vaccinate sheep flocks regularly, on an annual basis, with a safe and efficient vaccine, for the control of this serious and economically important disease in endemic regions. Enhanced awareness on appropriate bio-security measures to be undertaken by livestock keepers can greatly reduce the impact of this disease on pastoral livelihoods

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ABBREVIATIONS

SGP: Sheep and Goat Pox; CaPV: Capripox Viruses

INTRODUCTION

Sheep and Goat Pox (SGP) is one of the most important diseases of sheep and goats in Africa following Peste des Petits Ruminants (PPR) and Contagious Caprine Pleuropneumonia (CCPP). Sheep and Goat Pox is a highly contagious viral disease of sheep and goats. Among infectious diseases affecting sheep, sheep pox is considered to be economically the most important in the tanning sector due to its slow and permanent scar formation [1]. Heavy economic losses in sheep pox outbreaks are due to the high mortality, abortions and loss of market value of the affected animals [2]. Morbidity and mortality vary with the breed of the animal, its immunity to Capri pox viruses, and the strain of the viruses. It is an OIE list A disease. Pox infections can limit trade, export, and development of intensive livestock production [OIE 2008]. Mortality may be up to 50% in a fully susceptible flock and as high as 100% in young animals [3,2]. Mild infections are common in indigenous breeds. However, symptoms may be more severe in lambs, stressed animals, animals that have concurrent infections or animals that come from areas where pox is not endemic [4-6].

The causative virus

Sheep and Goat Pox diseases are caused by infection by viruses in the Poxviridae family, Chordopaxvirinae subfamily and Capripox virus genus [7]. These are large (170-260 nm by 300-450 nm), double stranded, DNA and enveloped viruses [8]. In general, capripoxviruses (CaPV) are considered to be very host-specific [9]. In natural conditions, sheep and goat poxviruses are pathogenic exclusively for the ovine and caprine species respectively. In addition to the isolate Kenya Sheep and Goat Pox virus(KSGPV O-240, only a few other Sheep pox virus(SPPV) and Goat Pox Virus(GTPV) strains have been known to affect both sheep and goats [10,11]. The major difference between the African and the Middle Eastern and Indian SPP and GTP strains seems to be the wider host range of the African isolates [12]. The Kenya sheep-1 (KS-1) strain is derived from the attenuated KSGP O-240 vaccine strain [12,13]. In general, SGP viruses will be inactivated at 56^{0}C within 2h, or at 65^{0}C within half an hour. They can survive at a pH between 6.6 and 8.6. These viruses are susceptible to highly acidic or alkaline pH and as an example, 2% Hydrochloric acid (HCL) or Sulphuric acid (H_2SO_4) can completely destroy the virus within 15 min. The CaPV are considered as stable in the environment. They are susceptible to sunlight but may survive in a dark and cool environment for upto 6 months. The SGP are

included in the OIE list as one of the notifiable diseases and OIE should be notified within 24h of confirming the disease [14].

Geographic and seasonal distribution

Sheep pox was likely present in Asia and Europe as early as the second century AD. Its infectious nature was recognized in the mid-18th century. Today, sheep pox and goat pox are found in central and north Africa, central Asia, the Middle East, and parts of the Indian subcontinent. Sheep pox is enzootic in Africa north of the Equator, the Middle East, Turkey, Iran, Iraq, Afghanistan, Pakistan, India, Nepal, parts of the People's Republic of China, Bangladesh. Sporadic outbreaks occur in Southern Europe and other parts in the World [6,15,16]. The most recent outbreaks occurred in Vietnam in 2005, Mongolia in 2008 and 2009, and Azerbaijan in 2009. The first outbreak in Chinese Taipei occurred in 2008 and was eradicated by stamping out and movement control [2]. Sheep pox virus is considered exotic to the EU and is classified in the notifiable disease list of the OIE. The virus has been absent from the countries of central and Western Europe for many years, but considering the outbreak of sheep and goat pox virus in Southern Europe, there is potential for further spread of these viruses to Europe [5].

Outbreaks of SP occur during all months of the year but are more frequent during the cold or wet seasons. During the cold season, sheep are exposed to low temperatures exerting stress which could suppress the immune system, and ultimately the sheep become vulnerable to infection. The seasonality of SP observed could be explained either by the capability of the virus to survive for many months in the wet and cold weather, by associating with the lambing season, or by the poor physiological conditions of flocks in the autumn [3,17,18]

Economic importance

Sheep pox causes considerable economic loss due to its high morbidity, mortality, reduced milk and meat production, abortion, depreciation of wool and skin quality and as a result of trade restrictions [17]. Economic investigations have indicated that some variables such as number of adult animals affected, number of days of illness and flock sizes, significantly influence the economic losses due to SP [19,20].

Economic losses result from decreased milk production, damage to the quality of skins and wool, and other production losses. The skin lesions heal slowly and the scars are permanent. The existence of the disease affects trade of animals and products and can hinder efforts to improve local sheep and goats through importation of improved breeds. The hides and skins that are processed by salting treatment or drying only from SP enzootic countries may pose a risk for re-introduction to SP free regions or countries like the EU [21].

Morbidity and mortality

Capripoxviruse infections of small ruminants cause severe pox diseases of domestic animals. In susceptible herds, morbidity can reach 75-100% and case fatality, depending on the virulence of the virus, is between 10-85% in the outbreaks. Mortality in older animals can reach up to 90% when capripox is superimposed on another viral condition such as peste des petits ruminants (PPR). Breeds of sheep and goats originated from Europe are very susceptible to capripox, and mortality may reach up to 100% [22,15]. Mondal et al. (2004) [23], reported that Sheep of the Rambouillet breed was highly susceptible to infection as compared to Australian cross and American Merino breeds [23]. The disease causes low mortality in indigenous breeds in enzootic areas as compared to exotic breeds. The indigenous breeds come down with disease in areas where it has been absent for a long time and then intensive rearing methods are introduced or other complicating infections Peste des Petits Ruminants or Foot and Mouth disease arise. Sheep and Goat Pox is a major constraint to the introduction of exotic breeds of sheep and goats and to the development of intensive livestock production.

Transmission

Transmission of sheep pox between and among flocks occurs from the movement of sheep [3,2]. Although all age groups can be affected, the disease is more severe in young animals than in adults [3]. The systemic signs include fever, conjunctivitis, rhinitis, lymphadenopathy, anorexia and depression [24,25,1]. The mucous membranes can become necrotic and animals may develop a mucopurulent nasal or ocular discharge [14]. Transmission of SGP occurs by the respiratory route when there is close contact between sick and healthy animals. The disease causing virus may also enter the body through other mucous membranes or skin abrasions produced either iatrogenically or by insects. Intra-uterine infection can occur and in that event, lambs can be born with developed lesions. Viruses are shed in secretions and excretions of infected animals, but it is believed that they are not important sources of transmission during outbreaks, because it is difficult to recover live virus on tissue culture from scab materials. Movement of infected animals acts as the main cause of spreading the sheep pox virus [26,15]. Indirect transmission of the disease occurs by contaminated litter, fodder and other objects while transmission by insects and via mechanical vectors has been reported. The virus can remain infectious for up to six months in animal pens.

Clinical signs

The incubation period varies from four to twenty-one days, but is usually one to two weeks. The disease is more severe in lambs and kids than in adult animals. Some very young lambs and kids may die before exhibiting signs of the disease.

Most affected animals become weak with no appetite. They may exhibit a high fever for short time. The skin lesions follow a typical pox virus development from a macule to papule. Skin lesions appear as small red patches usually around the mouth, on the head, under the tail and between the legs. The centers of the patches become depressed and turn grayish in color due to necrosis (Figure 1). These patches form blisters that break becoming open sores that soon develop scabs. The ruptured lesions often form a hard, black, scab. These skin lesions render infected sheep prone to fly strike and the scabs may persist for several weeks. Kitching (2007) [27] considered that the clinical signs of severe sheep pox are pathognomic. Animals often have labored breathing due to blisters inside the respiratory tract and lungs. Lesions in the mouth, nose and eyes can cause discharge and excessive salivation. Affected mucous membranes may

Figure 1 Sheep affected by sheep pox virus
Courtesy: Reter Roeder; Empres

become necrotic and ulcerate. Nodules in the intestines can cause diarrhea. Depression and emaciation may be seen in some animals. Abortions may also occur.

Lesions can take several weeks to heal, and may leave permanent scars on the skin. During healing, animals are susceptible to fly strike. Secondary bacterial infections, including pneumonia are common and death can occur at any stage of the disease. Recovery can be slow if the animal was severely affected.

Pathology

The skin contains congested bloody, swollen and necrotic lesions. The most striking clinic-pathologic feature is generalized cutaneous eruptions. Each of these occupies the full thickness of the skin. Often centers become necrotic and ulcerated, resulting in a "sitfast". A high percentage of affected animals may develop pneumonia, which grossly appears as multiple foci of sub-pleural consolidation and edema. In addition, pox lesions can sometimes be found on many serosal surfaces.

The mucous membranes of the eyes, nose, mouth, vulva and prepuce may be necrotic ulcerated and all the body lymph nodes are swollen and enlarged. Lymph nodes draining infected areas are enlarged upto eight times normal size, swollen with body fluids and may be congested and haemorhhagic. Kitching (2007) [27] commented that 'the large number of hard, pale, sometimes haemorrhagic lesions found throughout the lobes (Figure 2) of the lung are usually the most obvious and the most likely cause of death.' Some authors have however; found the lesions to be soft rather than hard [28].

At necropsy, affected sheep would show widely dispersed discrete, generally circular, slightly raised, firm 1-2 cm papules on the lung surface, occasionally in the mucosa of the rumen (Figure 3,4) and abomasums (Figure 5) and rarely, small (2-5 mm) lesions in the renal cortex (Figure 6) and liver [27].

Histologically, the skin lesions are characterized by dermal edema and cellularity with variable numbers of "sheep pox cells" - histiocytic-like cells with large vacuolated nuclei and poorly-defined eosinophilic cytoplasmic inclusions (Figure 7,8). In the lung there can be a necrotizing and proliferative bronchiolitis, often with "sheep pox cells" scattered throughout the proliferative zone.

Diagnosis

Sheep or goat pox should be suspected in animals with the characteristic full-thickness skin lesions, fever, and lymphadenitis. Laboratory procedures for the diagnosis of sheep and goat pox include observation of the virus by electron microscopy (morphology is characteristic) and virus isolation (identification is by immune fluorescence or immune peroxidase staining). A PCR assay is also available [25]. Viral antigens can

Figure 2 Lung of sheep pox case (Courtesy: photograph Colin Scrivener).

Figure 3 Pox lesions in the omentum and wall of the rumen (Courtesy: photograph Colin Scrivener).

Figure 4 Pox lesions in rumen wall (Courtesy: photograph Colin Scrivener).

Figure 5 Sheep pox lesions in the wall of the abomasum (Courtesy: photograph Colin Scrivener).

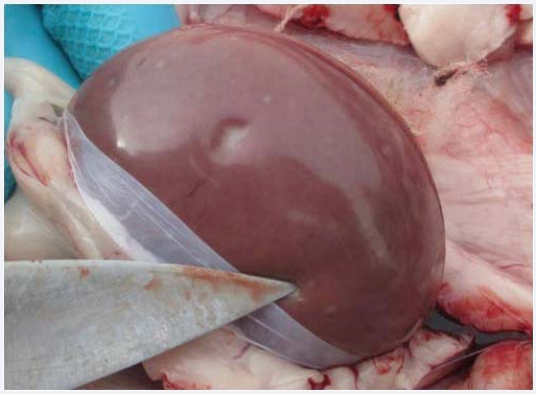

Figure 6 Sheep pox lesions in the renal cortex (Courtesy: photograph Colin Scrivener).

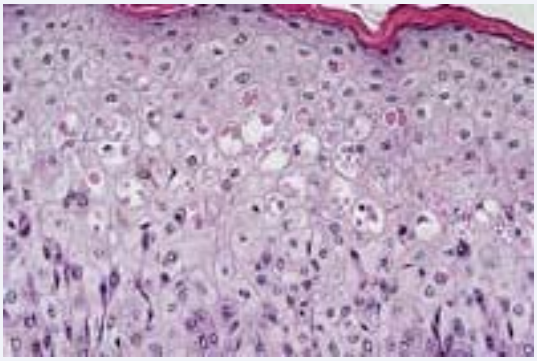

Figure 7 Skin. Note ballooning degeneration of hyperplastic keratinocytes with eosinophilic pox inclusions in the cytoplasm. 20X
Courtesy: International Veterinary Pathology Slide Bank. Laser disc frame #12492-12503

be detected by agar gel immune diffusion (AGID) or enzyme-linked immune sorbent assay (ELISA). However, cross-reactions occur in the AGID test with parapoxvirus. Serology is also useful; antibodies can be found one week after the skin lesions appear. Serologic tests include virus neutralization, AGID, indirect immune fluorescence, ELISA, and immune blotting (Western blotting). Virus neutralization is the most specific serological test, but is not sensitive enough to detect infections in all animals. Cross-reactions with other viruses are seen in the AGID and indirect immune fluorescence tests. Histopathologic lesions are also characteristic

Control

Immunity induced by pox viruses or vaccines is strong enough and may persist long time as compared to some other pathogens. Pox viruses cause to produce both cellular and humoral immune responses. Maternal immunity provides protection from SGP virus for up to 3 months. The animals that are recovered from SGP infection contained lifelong immunity. So, the virus can only survive by constant transmission from infected to susceptible animals, and therefore requires a certain minimum size of susceptible population. The size of this population depends on the strain of the virus, the susceptibility of the host population, and on the basic reproductive number (R_0), i.e., the number of susceptible animals infected, on average, by a single diseased animal [26,29-31]. Active mass vaccination to SGP may induce strong herd immunity that can effectively control the disease. Single vaccination is considered as enough for providing lifelong strong immunity [31].

Control of the disease, once it has entered, is usually by early detection and notification, prompt movement restriction of animals, culling affected and in-contact animals, and ring vaccination with a vaccine [22]. Routine control measures include the cleaning and disinfection of depopulated premises and establishment of protection and surveillance zones, with a radius of 3 and 10 km, respectively, around the outbreak [5]. As noted earlier, uncontrolled movement of infected animals in SGP-endemic areas poses serious difficulties in efficient control of the disease. Therefore, it is essential to vaccinate sheep flocks regularly, on an annual basis, with a safe and efficient vaccine, for the control of this serious and economically important disease in endemic regions [17].

The main factors that favor control of SPV in enzootic countries include easy detection of the disease or virus, high economic impact of the disease, absence of reservoir hosts other than domestic ruminants, induction of solid immunity after vaccination, nonexistence of a carrier state, and relatively

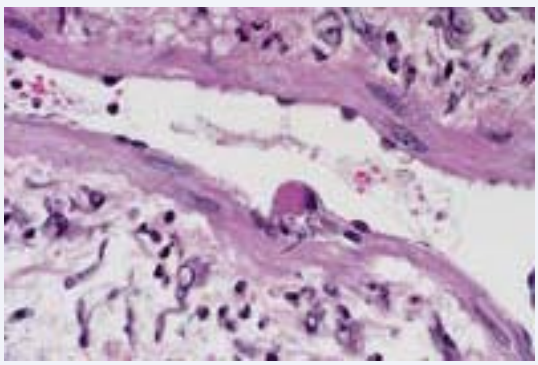

Figure 8 Skin. Note within the vessel, an endothelial cell bearing a large cytoplasmic pox inclusion. 40X
Courtesy: International Veterinary Pathology Slide Bank
Laser disc frame #21928-21932.

low annual turnover rate of animals in flocks. In contrast, the factors which may impede control are prolonged stability of the virus on wool, long incubation period of the disease, and unregulated introduction of livestock through importation or illegal importation [31].

CONCLUSION

Among infectious diseases affecting sheep, sheep pox is considered to be economically the most important in the tanning sector due to its slow and permanent scar formation. The disease causes low mortality in indigenous breeds in enzootic areas as compared to exotic breeds. A severe disease develops in naïve animals introduced among these enzootic environments, or in indigenous animals where intensive practices are introduced or concurrent infections arise. Therefore, it is essential to vaccinate sheep flocks regularly, on an annual basis, with a safe and efficient vaccine, for the control of this serious and economically important disease in endemic regions.

REFERENCES

1. Ozmen O, Kale M, Haligur M, Yavru S. Pathological, serological, and virological findings in sheep infected simultaneously with Bluetongue, Peste-des-petits-ruminants, and Sheep pox viruses. Tropic Anim Hlth Prod. 2009; 41: 951-958.
2. OIE (Office International des Epizooties). Sheep and goat pox. In: Terrestrial Animal Health Code. World Organization for Animal Health, Paris, France. 2008.
3. Bhanuprakash V, Moorthy ARS, Krishnapa G, Sirinivasa GRN, Indrani BK. An epidemiological study of sheep pox infection in Karanataka State, India. Rev Sci tech. 2005; 24: 909-920.
4. Beard PM, Sugar S, Bazarragchaa A. Description of two out breaks of capripox viruse disease in Mongolia. Vet Microbiol. 2010; 142: 427-431.
5. Mangana O, Kottaridi C Nomikou K. The epidemiology of sheep pox in Greece from 1987 to 2007. Rev Scient Tech. 2008; 27: 899-905.
6. Rao TVS, Bandyopadhyay SK. A comprehensive review of Goatpox and Sheeppox and their diagnosis. Anim Hlth Res Rev. 2000; 1: 127-132.
7. Buller RM, Arif BM, Black DN. Poxviridae in Virus Taxonomy: Eighth Report of the International Committee on the Taxonomy of viruses. Elselvier Academic Press. Oxford. 2005; 117.
8. Tullman ER, Afonso CL, LuZ. The Genomes of Sheeppox and Goatpox viruses. J Virol. 2002; 76: 6054-6061.
9. Babiuk S, Bowden TR, Parkyn G, Dalman B, Hoa DM, Long NT, et al. Yemen and Vietnam capripoxviruses demonstrate a distinct host preference for goats compared with sheep. J Gen Virol. 2009; 90: 105-114.
10. Asagba MO, Nawathe D R. Evidence of sheep pox in Nigeria. Trop Anim Hlth Prod. 1980; 13: 61.
11. Yan XM, Chu YF, Wu GH, Zhao ZX, Li J, Zhu HX, et al. An outbreak of sheep pox associated with goat poxvirus in Gansu province of China. Vet Microbiol. 2012; 156: 425-428.
12. Davies FG. Characteristics of a virus causing a pox disease in sheep and goats in Kenya, with observations on the epidemiology and control. J Hyg Camb. 1976; 76: 163-171.
13. Gershon PD, Black DN. The nucleotide sequence around the capripoxvirus thymidine kinase gene reveals a gene shared specifically with leporipoxvirus. J Gen Virol. 1989; 70: 525-533.
14. OIE (Office International des Epizooties). Sheep and Goat Pox-Technical disease card. Paris OIE. 2014.
15. Radostits OM Gay CCHinch cliff KW. 2006; Veterinary medicine 10th Edition SAUNDERS 1430-1431.
16. OIE (Office International des Epizooties). Manual of Diagnostic Tests and Vaccines for Terrestrial Animals, Chapter 2.4.14, Lumpy Skin Disease. Paris: OIE. 2010.
17. Yeruham I, Yadin H, Van Ham M. Economic and epidemiological aspects of an outbreak of sheeppox in a dairy sheep flock. Vet Rec. 2007; 160: 236-237.
18. Zangana. Epidemiological, Clinical and histo-pathological studies of lamb and kid pox in Duhok, Iraq. Bulgarian. J Vet Med. 2013; 16: 133-138.
19. Garner MG, Sawarkar SD, Brett EK. The extent and Impact of Sheep pox in the State of Marahashtra, India. Trop Anim Health Prod. 2000; 31: 205-223.
20. Senthilkumar V, Thirunavukkrasu M. Economic losses due to sheep pox in sheep farms in Tamil Nadu. Tamil Nadu Journal of Veterinary and Animal Science. 2010; 6: 88-94.
21. EFSA Panel on Animal Health and Welfare. 2014.
22. Kitching RP. The Control of Sheep and goat pox. Rev Sci Tech off Epiz. 1986; 5: 503-511.
23. Mondal B, Hosamani M, Dutta TK. An outbreak of Sheep pox on a sheep breeding farm in Jammu, India. Rev Sci Tech. 2004; 23: 943-949.
24. Balinsky CA, Delhon G, AfonsoCL, Risatti GR, Borca MV, French RA, et al. Sheep pox virus kelch-like gene SPPV-019 affects virus virulence. J Gen Virol. 2007; 81: 11392-11401.
25. Balinsky CA, Delhon G, Simoliga G, Prarat M, French RA, Geary SJ, et al. Rapid preclinical detection of Sheep pox virus by Real -Time PCR Assay. J Clin Microbiol. 2008; 46: 438-442.
26. Kitching RP. Sheep pox and goat pox. In: Infectious Diseases of Livestock, Coetzer JAW, 2ndEdn. Capetown: Oxford University Press Southern Africa. 2004; 1277-1281.
27. Kitching RP. Diseases of Sheep, Fourth Edition. 2007; 302-306.
28. Watt B, Scrivener C. Sheep and Goat Pox: Skirting the Issues, The Official Newsletter of the Australian Sheep Veterinarians. Autumn. 2014; 6-9.
29. Panchanathan V, Chaudhri G, Karupiah G. Correlates of protective immunity in poxvirus infection: where does antibody stand?. Immunol Cell Biol. 2008; 86: 80-86.
30. Sadri R, Fallahi R. A new approach to develop a vaccine against capripox infection in sheep and goats using a new strain of sheep pox virus in Iran. Iran J Vet Med. 2010; 4: 221-224.
31. Bhanuprakash V. Prospects of control and eradication of capripox from the Indian subcontinent: A perspective. Antiviral Res. 2011; 91: 225-232.

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