



ANIMAL HEALTH DISEASE CARDS

Sheep and Goat Pox

Names

Pathogen(s)

Preferred Name : Goat poxvirus ICTV

Common Names :

English: Goat-pox virus
 English: Goat-pox virus

Acronyms
 English: GPV

Disease/Parasitosis
 Preferred Name : Goat pox

English:
 GPV infection
 Indian goat dermatitis
 Caprine variola
 Capripox
 Goat-pox
 Goat-specific pox
 Goatpox
 Sheep and goat pox
 Stone pox
 Variola of goats

Overview

Goat pox, which is listed in Group A diseases of the OIE (World Animal Health, 1997), is a highly contagious viral disease of goats, characterized by fever, ocular and nasal discharges. Pox lesions appear on the skin and on the respiratory and gastrointestinal mucosae. The disease was described in detail about 200 AD in ancient veterinary medical texts, and has been widespread since early times. Hansen reported goat pox in 1879 from Norway (Rafyi and Ramyar, 1959). Later on it was observed during the First World War in Macedonia and became enzootic during 1926 with a mortality rate of 15% (Blanc et al., 1929). The disease is caused mainly by goat poxvirus (GPV) and occasionally by sheep poxvirus (SPV), which are enveloped double stranded DNA viruses, classified in the genus Capripoxvirus of the family Poxviridae (Murphy et al., 1995). The disease inflicts substantial losses in terms of reduced productivity and lower quality of wool and leather. It poses a major obstacle in the intensive rearing of goats and also greatly hampers international trade. Goat pox is the most important of all pox diseases of domestic animals causing high mortality in kids and significant economic losses (Upton, 1980; Agriculture Western Australia, 1999).

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Related Links

-  World Organisation for Animal Health (OIE)



Subjects

Animal Health

Disease Cards

- Bluetongue
- Contagious bovine pleuropneumonia (CBPP)
- Contagious caprine pleuropneumonia (CCPP)
- **Sheep and goat pox (SGP)**
- Zoonotic Diseases
- Anthrax
- Avian Influenza
- Botulism
- Bovine Spongiform Encephalopathy - BSE [Spanish only]
- Brucellosis, bovine
- Brucellosis, ovine/caprine
- Cysticercosis (bovine)
- Cysticercosis (porcine)
- Escherichia coli [Spanish only]
- Hydatid disease
- Leptospirosis
- Listeria monocytogenes [Spanish only]
- Q fever
- Rabies
- Rift valley fever (RVF)
- Sarcocystosis
- Toxoplasmosis
- Trichinosis
- Tuberculosis

Capripoxviruses infect only ungulates, and most strains of virus tend to cause clinical disease in only one species. Under natural conditions, GPV is highly host specific infecting only goats, but host specificity varies from isolate to isolate. Kenyan and Yemen isolates as well as an Oman sheep isolate infect sheep and goats equally (Davies, 1976; Kitching and Taylor, 1985b). Usually, Middle East and Indian isolates are host specific and do not infect sheep (Bakos and Brag, 1957; Sharma and Dhanda, 1972; Tantawi et al., 1980; Kitching, 1983; Soman et al., 1985; Datta and Soman, 1991). It is possible that the host preference shown by different strains is due to their adaptation to either goats or sheep in a restricted geographical area. However, it is envisaged that when sufficient isolates have been examined biochemically, no clear distinction will be possible between goat and sheep isolates, but rather a spectrum will emerge in which some strains have clear host preferences while others will be less defined and will naturally infect whichever host they come into contact with (Kitching, 1994). Exceptionally, it is observed that a few strains of GPV with pathogenicity for human beings (Bakos and Brag, 1957; Sawhney et al., 1972) may also produce lesions in rabbits and reindeer (Nandi and Rao, 1997).

Goat pox affects goats of all ages, sex and breeds but the disease is more common and severe in younger animals, lactating females and older animals. European breeds are particularly susceptible. High mortality is seen in animals, particularly if the infection is in association with other diseases such as peste des petits ruminants, or bad management. There is no clear seasonality to outbreaks of goat pox.

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Epidemiology

The distribution of disease in goat pox enzootic areas is frequently a reflection of the distribution of traditional forms of husbandry (Kitching, 1994). It is not exactly known what critical number of animals is required to maintain GPV within a single population. Disease in a village is usually only seen following the introduction of new animals, typically from market, and generally affects animals of all age groups. The disease spreads through the village, usually within 3-6 months, and then disappears in the absence of more susceptible animals. Animals exported from countries that are free of GPV may suffer from goat pox when they arrive in enzootic areas. The severity of outbreaks depends on the size of the susceptible population, the virulence of the strain of GPV and the breed affected. Generally, an epidemic in a susceptible flock can affect over 75% of goats, with mortality as high as 50%; case fatality rates in young stock may approach 100%.

The virus commonly infects its host's respiratory tract and therefore, transmission of disease frequently occurs by aerosols during direct or intimate contact between infected and susceptible animals. Transmission by fomites is probably not of major importance (Kitching and Taylor, 1985a). Biting flies have been shown experimentally to transmit the virus between sheep and goats (Kitching and Mellor, 1986), although insects do not seem to be important epidemiological agents. Experimentally, the disease can also be transmitted by intradermal, intravenous and subcutaneous inoculation as well as by artificially produced virus aerosols.

Animals are most infectious soon after the appearance of papules, during the 10-day period before the development of significant levels of protective antibody. High titres of virus are present in papules, and those on the mucous membranes quickly ulcerate and release virus in nasal, oral and lachrymal secretions, and into milk, urine and semen, which all constitute important sources of virus dissemination. Animals that develop generalized lesions produce considerable quantities of virus and are highly infectious. The virus is very resistant and remains viable for long periods, on or off the animal host; for example, they may persist for up to 6 months in shaded animal pens, and for at least 3 months in dry scabs on the fleece, skin and hair from infected animals. There is no evidence for the existence of animals persistently infected with GPV (i.e. there is no carrier state).

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Distribution Table

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Distribution

Goat pox is currently prevalent throughout Southwestern Asia, the Indian subcontinent and North and Central Africa: the disease occurs particularly where small ruminants play an important role in the agricultural economy. It was eradicated from the UK in 1866, but only recently from continental Europe. Sporadic outbreaks still occur in Eastern European Mediterranean islands, probably originating from imported animals (House, 1992).

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Disease Systems

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Disease Course

There exists considerable variation in the pathogenicity of strains of GPV. Usually, the incubation period of GPV is about 1 or 2 weeks. Fever generally occurs at 4-7 days post-infection. Twenty-four hours after the development of pyrexia of between 40 and 41°C, macules (2-3 cm diameter areas of congested skin) can be seen on the white skin of goats, particularly under the tail. After a further 24 hours the macules swell to become hard papules. Disease may appear more rapidly in goats than in sheep. In the generalized form of goat pox, papules cover the body, being concentrated particularly on the head and neck, axilla, groin, perineum, and external mucous membranes of the eyes, prepuce, vulva, anus and nose. The papules on the mucous membranes quickly ulcerate, and the secretions of rhinitis and conjunctivitis become mucopurulent. All the superficial lymph nodes, particularly the prescapular, are enlarged. Some virus strains produce a vesicular stage in which fluid exudes from the lesion. The papules become necrotic, and if the animal survives the acute stage of the disease, they change to scabs over a 5-10 day period from the first appearance of papules. Scabs can persist for up to a month. The course of the disease from first signs until resolution of skin lesions may last 1-2 months.

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Pathology

The lesions of goat pox are not restricted to the skin, but also may affect any of the internal organs, in particular the gastrointestinal tract from the mouth and tongue to the anus, and the respiratory tract. Necropsy reveals skin lesions that may involve the full depth of the epidermis, dermis and adjacent muscle. Postmortem lesions usually include tracheal congestion, lentil-sized bullet-shaped nodules and white patches on lungs, inflamed spleen and lymph nodes with greying white necrotic lesions and increased quantity of blood-tinged pleural fluid. In some animals, lesions develop in the lungs as multiple consolidated areas (Kitching and Taylor, 1985b; Isloor et al., 1991).

Microscopically, the affected skin reveals an initial epithelial hyperplasia followed by coagulation necrosis as thrombi develop in the blood vessels supplying the papules. Histiocytes accumulate in the areas of the papules and the chromatin of the nuclei of infected cell marginates. The cells appear stellate as their boundaries become poorly defined, and many undergo hydropic degeneration with the formation of microvesicles. Intracytoplasmic inclusion bodies are present in infected cells of the dermis and also in the columnar epithelial cells of the trachea (Kitching, 1994). Furthermore, affected lung tissue is characterized by congestion, red hepatisation, and exudation, coagulative necrosis surrounded by marked zone of inflammatory reaction and thickening of interlobular septae. Depletion of lymphocyte population in paracortical regions and absence of germinal centres in spleen and lymph nodes are also observed (Isloor et al., 1991; Saha et al., 1991).

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Diagnosis

Introduction

Goat pox is usually identified by the clinical signs that constitute the skin lesions, the gross pathology of the disease and the host species affected. Specimens to submit for laboratory diagnosis (virus isolation) can include biopsy tissue material, but necropsy specimens collected from one or two severely affected acute cases are preferable. Biopsy specimens should include samples from two or three lesions at the papular or vesicular stage. Skin lesions should be clipped, and cleansed with a non-disinfectant soap and rinsed with water. Blood (with added anticoagulant) should be collected aseptically from early febrile cases. Necropsy specimens should include lesions from skin, turbinates, trachea, lungs and enlarged lymph nodes. Specimens that will arrive at the testing laboratory within 24 hours of shipment can be shipped with wet ice; if more than 1 day will elapse, then specimens should be shipped in dry ice. For pathology, preserve portions of the collected tissues in 10% buffered formalin and forward to the laboratory unfrozen. For serology, collect serum from at least three 'early' and three chronic cases. Collect a convalescent serum from the same 'early' cases 14-21 days later (House, 1992).

Clinical diagnosis

Clinical cases vary from mild to severe

- Fever, depression, off feed, arched back
- Cutaneous eruption beginning with erythematous areas (macules) especially noticeable in hair or wool-free parts of the body
- Lesions evolve into papules

Papulo-vesicular form

- Papules desiccate and form crusts that are easy to remove
- Rarely, papules may transform into vesicles. After rupture of vesicles, a thick crust covers the lesions

Nodular form ('stone pox')

- Papules give rise to nodules involving all the layers of the skin and the subcutaneous tissue
- Necrosis and sloughing of the nodules leaves a hairless scar

Lesions

- Skin lesions: congestion, haemorrhage, oedema, vasculitis and necrosis
- Lymph nodes draining infected areas: enlargement (up to eight times normal size) and lymphoid proliferation
- Pox lesions: on mucous membranes of the eyes, mouth, nose, pharynx, epiglottis, trachea, on the rumenal and abomasal mucosae, and on the muzzle, nares, in the vulva, prepuce, testicles, udder, and teats
- Lung lesions: severe and extensive pox lesions, focal and uniformly distributed throughout the lungs

Differential diagnosis

- Bluetongue
- Peste des petits ruminants
- Contagious ecthyma
- Photosensitization
- Dermatophilosis
- Insect bites
- Parasitic pneumonia
- Caseous lymphadenitis
- Mange (scabies)

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Laboratory diagnosis

The laboratory diagnosis of goat pox is carried out by a wide variety of tests. Initially, laboratory testing was mainly confined to agar gel immunodiffusion for which conventionally raised antiserum against infectious GPV suspension was commonly used. Subsequently, a soluble antigen fraction, which is not infectious, effectively replaced the infectious virus in various serological tests (Rao and Negi, 1997; Singh et al., 1998). Its use in various tests can avoid the risk of spread of virus from the laboratory; it helps in the safe handling and supply of diagnostic reagents to various destinations. A number of tests have recently evolved which employ the soluble antigen fraction and its antiserum for the diagnosis of goat pox. The detection of GPV or its antigens may be performed by virus isolation and neutralization in cell culture (lamb/kid testis/kidney cells), fluorescent antibody or electron microscopy.

Nevertheless, the diagnosis of goat pox by classical virological or serological techniques dependent on live viruses is not suitable in countries where the virus is exotic and live viruses are not

available. Hence, the latest molecular biology tools such as polymerase chain reaction (PCR)-based diagnostic methods are extremely useful for the detection of the viral nucleic acid of GPV in those countries. The following tests can be routinely employed for the diagnosis of goat pox in field samples.

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Agar Gel Immunodiffusion (AGID) Test

A gel diffusion technique for diagnosis of goat pox was applied as early as the 1960s (Bhambani and Krishnamurthy, 1963). Subsequently, use of [³⁵S]methionine-labeled antigen preparations considerably improved the sensitivity of AGID for capripoxvirus antibody detection (Kitching et al., 1986b). AGID is very simple and can be applied anywhere in the remote regions as it requires bare minimum laboratory facilities. Although cheaper, it is relatively insensitive (Rao and Negi, 1997).

Counter immunoelectrophoresis (CIE) test

The CIE test is more sensitive and rapid than AGID in the diagnosis of goat pox (Sharma et al., 1988a). Normal saline solution may exceptionally be used as an alternative to barbitone buffer (Rao et al., 1999). It is a simple and economical test.

Latex agglutination test

Latex agglutination assays have been successfully used in the detection of various antigen-antibody systems and have proved to be rapid, simple-to-perform, and need no expensive equipment (Rao et al., 1997c). The test is comparable in sensitivity to the CIE test for the diagnosis of goat pox in field samples (Rao et al., 1996b) and can be applied at farm level.

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Reverse phase passive haemagglutination (RPHA) test

Capripoxviruses are non-haemagglutinating (Matthews, 1982). Therefore, indirect haemagglutination tests like RPHA using sensitized sheep erythrocytes are useful in the laboratory diagnosis of goat pox and the RPHA is more sensitive than AGID and CIE tests (Tiwari et al., 1995; Rao and Negi, 1997). Other agglutination tests that include coagglutination (Joshi et al., 1989) and spot agglutination (Tiwari et al., 1996) are also available for the simple and rapid diagnosis of goat pox.

Single radial haemolysis (SRH) test

The test is simple and has been successfully employed to diagnose goat pox (Tiwari and Negi, 1996a).

Enzyme-linked immunosorbent assays (ELISAs)

ELISA is now widely used to detect antibodies and antigens in a variety of test systems and is more sensitive than a virus neutralization test (Carn et al., 1994a). Different methods of ELISA are available to diagnose goat pox, but a considerable background reaction (Sharma et al., 1988b) or the need for special reagents such as recombinant proteins (Carn, 1995) may limit their use as routine screening tests. Alternatively, an immunocapture ELISA can be regarded as a relatively simple assay for the detection of GPV antigens in scab suspensions (Rao et al., 1997d), but this assay too has limitations as it is best utilized only in combination with a CIE test for accurate and confirmative diagnosis.

A dot-ELISA, which is carried out on nitrocellulose strips or paper, is a valuable addition to the battery of diagnostics for goat pox and is more sensitive than SRH (Tiwari and Negi, 1996b) and CIE tests (Sedhukhan et al., 1998). Avidin-biotin ELISA for the detection of antibodies to GPV in goat sera uses an isolated fraction of the soluble antigens, which substantially minimizes the background reaction in the assay (Rao et al., 1999). This is a reliable test that may be used to assess immunity to goat pox (and possibly sheep pox), and can be used in epidemiological studies. Though efficient diagnostic tools, all ELISAs are relatively expensive and also demand technical expertise to handle the assays.

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Polymerase chain reaction (PCR)

Although sensitive, ELISA and virus isolation in cell culture fail to detect virus particles that are bound to neutralizing antibody (Ireland and Binopal, 1998), and the sensitivity of a precipitation or an agglutination test is usually low. Hence, the highly sensitive molecular biology techniques based on PCR are now routinely employed for the identification of capripoxviruses in skin biopsies and cell cultures (Ireland and Binopal, 1998; Mangana-Vougiouka et al., 1999). The PCR method using two primers viz.

5'TTTCCTGATTTTCTACTAT3' (21mer) and

5'AAAATTATACGTAAATAAC3' (20mer) for the gene encoding viral attachment protein is exceptionally effective for the diagnosis of GPV in suspected skin samples (Nandi and Rao, 2000).

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Immunology of the disease

Infection with poxviruses evokes both humoral and cell-mediated immune responses (Pandey et al., 1969; Negi et al., 1988; Deshmukh and Gujar, 1992). The relative importance of circulating antibodies versus cytotoxic T-lymphocytes in the suppression of the infection is not fully understood. However, it is quite clear that on the appearance of circulating anti-viral antibodies, infection subsides in hosts (Cho and Wenner, 1973). Circulating antibody derived through natural infection or vaccination may limit spread of virus in the animal, but it is the cell-mediated immune response that eliminates infection (Carn, 1993). Nonetheless, the immune status of a previously infected or vaccinated animal cannot be related to serum levels of neutralizing antibody (Kitching, 1986), and current serological tests are unable to distinguish reliably between susceptible and immune animals.

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Disease Prevention and Control

Immunization and Vaccines

In enzootic areas, both live attenuated and inactivated vaccines are useful in the prevention and control of goat pox, but inactivated vaccines give only short-term immunity (Prasad and Datt, 1973; Yadav et al., 1986; Pal and Soman, 1992). Live attenuated vaccines are highly immunogenic but have a limitation of setting up a 'pock' reaction and/or mortality in some of the vaccinated animals due to proliferation of disease. Usually, homologous vaccinations incorporating locally prevalent strains of GPV are quite successful in protecting goats against goat pox.

Therefore, in different countries and sometimes within a country, various live attenuated vaccines have existed from time to time for goat pox with varying degrees of protective efficacy (Ramyar et al., 1974; Dubey and Sawhney, 1978; El-Zein et al., 1983; Davies and Mbugwa, 1985; Guo et al., 1986; Wang and Jiang, 1988a; Mahmood et al., 1989, 1993). A subunit vaccine also appears to be of some use in the control of disease as revealed by higher neutralization indices in immunized goats (Carn et al., 1994b). Moreover, a single vaccine prepared from a strain of capripoxvirus that infects sheep and goats equally is effective in controlling both goat pox and sheep pox for at least 12 months (Kitching et al., 1987b; Carn, 1993).

Nevertheless, reports of cross-protection of sheep and goats against goat pox and sheep pox and other related diseases such as CPD are often contradictory and inconclusive (Ergin et al., 1988; Wang and Jiang, 1988b); attempts to protect either goats with SPV vaccines or sheep with GPV vaccines are largely unsuccessful (Prasad and Datt, 1973; Agrawal and Soman, 1997). It is normally recommended that homologous vaccines should be used to protect goats effectively against goat pox.

Husbandry Methods and Good Practice

In enzootic areas, annual vaccination of susceptible animals with a live vaccine will control the disease. Although maternal antibody will inactivate the vaccine, it is advisable to vaccinate all stock over 10 days old. Ring vaccination is frequently practiced during outbreaks in enzootic areas, but usually only the species that are clinically affected are vaccinated. The following points are extremely useful for sanitary prophylaxis.

- Isolation of infected herds and sick animals for at least 45 days after recovery
- Slaughtering of infected herd (as far as possible)
- Proper disposal of cadavers and products
- Stringent disinfection

- Quarantine before introduction into herds
- Animal and vehicle movement controls within infected areas

Local Control

Capripox-free countries maintain their disease-free status by the restriction of imports of livestock and animal products from affected areas. In the case of countries remote from enzootic areas the swift implementation of a radical slaughter policy and severe movement restrictions, coupled with a ring vaccination of radius 25-50 km, should result in elimination of disease (Carn, 1993).

Clinical Management

All infected goats should be placed in a clean, well-ventilated house and fed on a good and balanced diet. Animals reluctant to feed should be given 10% glucose saline parenterally. All diseased animals should be given antibiotic coverage to restrict secondary bacterial infections. To relieve respiratory-related signs, nostrils should be cleaned and washed with a weak solution of potassium permanganate (1:10,000). Respiration should be stimulated with oleum eucalyptus inhalations or coramine. Antibiotic ointment or powder should be applied topically to skin lesions (Nandi et al., 1999).

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Zoonoses and Food Safety

Human infections during the handling of infected animals are rare except for the development of a mild localized reaction limited to the skin, with only 2 isolated cases reported to date (Bakos and Brag, 1957; Sawhney et al., 1972). There have been no reports of human health hazards caused by consuming meat and meat products of goats from goat pox enzootic areas.

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