When dermatologic diseases are devastating: differentiating common endemic conditions in the United States from sheep and goat pox

Katharine M. Simpson, DVM, MS, DACVIM1,*; Sarah M. Depenbrock, DVM, MS, DACVIM2; Rachel E. Oman, DVM, MS, DACVIM1; Christie E. Mayo, DVM, PhD3

1Livestock Medicine and Surgery Service, Department of Clinical Sciences, College of Veterinary Medicine and Biological Sciences, Colorado State University, Fort Collins, CO
2Department of Medicine and Epidemiology, School of Veterinary Medicine, University of California-Davis, Davis, CA
3Department of Microbiology, Immunology, and Pathology, College of Veterinary Medicine and Biological Sciences, Colorado State University, Fort Collins, CO

*Corresponding author: Dr. Simpson (simpson1@colostate.edu)

Received December 11, 2022
Accepted February 14, 2023
doi.org/10.2460/javma.22.12.0553

ABSTRACT

This article provides information to help US-based practitioners develop differential diagnoses for, and recognize foreign animal diseases associated with, dermatologic lesions in small ruminants. Sheep and goat pox are currently considered foreign animal diseases (in the United States) and may cause lesions similar to other endemic diseases of small ruminants including orf, ulcerative dermatosis, bluetongue, and dermatophilosis. Any cases involving unusual dermatologic lesions associated with high morbidity and/or mortality warrant reporting to governmental authorities including USDA APHIS or state regulatory veterinarians for herd or flock investigations. Vigilance on the part of livestock veterinarians and small ruminant producers is of paramount importance in preventing the entry and spread of economically devastating foreign animal diseases.

Dermatologic conditions associated with foreign animal diseases (FAD) likely conjure up images of mass livestock depopulation events like those that occurred with foot and mouth disease in the United Kingdom. However, it is important to recognize other insidious FADs such as sheep pox and goat pox that affect only small ruminants but have potentially high morbidity and mortality rates. Sheep pox and goat pox are caused by Capripoxviruses in the Poxvirus family. Currently, the viral agents associated with sheep and goat pox are found in Africa, the Middle East, Europe, and Asia.1,2 They have not been identified in North America3 in a very long time.4 These viruses limit the productivity of small ruminant farming in endemic countries and have detrimental economic consequences.1,2 Capripoxviruses may be host specific, but some strains have the ability to affect both sheep and goats2,5 and will be referred to in this article collectively as sheep and goat pox (SGP). Vigilance and awareness of SGP on the part of livestock veterinarians and small ruminant producers could help prevent the spread of this virus to other regions of the world including the United States. Sheep pox and goat pox are currently foreign animal diseases in the United States and are thus reportable to the State Veterinarian and the USDA APHIS Veterinary Service Area Veterinarian in Charge (please see https://www.aphis.usda.gov/aphis/ourfocus/animalhealth/nvap/NVAP-Reference-Guide/Appendix/APHIS-VS-District-Offices for state-specific contact information).

Diagnosing dermatological conditions in small ruminants can be challenging. Sheep and goat pox may manifest clinical signs similar to other dermatologic conditions in small ruminants that are widespread and not considered foreign animal diseases in the United States. Effectively differentiating conditions with dermatologic lesions requires a thorough examination of the affected animal/s and potentially a herd/flock investigation to determine whether SGP is a viable differential diagnosis.

Acute SGP causes nonspecific clinical signs of systemic illness that may include fever, anorexia, and depression.6 Superficial lymphadenopathy/lymphadenitis has also been described.1,5 Conjunctivitis and rhinitis can occur. Mildly affected animals may not show clinical signs beyond these nonspecific findings, but dermatologic lesions including papules, nodules, pustules, and rarely vesicles usually follow (Figure 1).5,6 Pustules may
Figure 1—A—Early macules of capripox infection on the skin of an experimentally infected sheep. (Courtesy of National Veterinary Services Laboratories.) B–F—Capripox infection in sheep. (Courtesy of USDA, Plum Island Animal Disease Center.) G—Capripox infection in a goat (Courtesy of Margaret Thompson, DVM.)
become umbilicated with a central depression and later form scabs and crusts. Areas of nonhaired or nonwooled skin and the mucous membranes are often the regions in which SGP lesions may be most apparent. Anatomic regions affected by SGP include lips, nares, muzzle, eyelids, pinnae, axillae, perineum including the vulva and under the tail, udder, teats, scrotum, and prepuce. In goats, the lesions may be most prominent on the lips, periocular region, scrotum, udder, or medial hindlimbs. Generalized skin lesions are common in SGP and particularly in sheep but can be more difficult to identify without a complete hands-on examination, especially in heavily wooled/haired animals. Small ruminants with severe cases may develop plaques and ulcers in the oral mucosa, esophagus, and trachea. Lesions in the gastrointestinal tract may lead to diarrhea. Pregnant animals may abort, and viral interstitial pneumonia is also possible. Secondary bacterial infections, including pneumonia and mastitis, can complicate the primary *Capripoxvirus* lesions.

Transmission of sheep and goat pox occurs via direct contact or indirectly through aerosolization, environmental contamination, or insect vectors. Only small ruminants (sheep and goats) are susceptible to SGP; cattle and wild ruminants have not been shown to be clinically affected in cases of natural disease. Similarly, SGP is not known to be zoonotic. Animals that are young, stressed, or have a comorbidity are considered more susceptible to developing clinical SGP but all age groups may be affected. Endemic areas may experience up to 75% to 100% morbidity and 10% to 85% mortality. Imported breeds from nonendemic areas are reported to have a mortality of up to 100%. In susceptible animals, particularly the young, the mortality rate may also approach 100%. Generally, goats are less severely affected. Secondary bacterial infections, including *Dermatophilus congolensis*, may complicate orf lesions.

A presumptive diagnosis of SGP can be made based on clinical signs and should be confirmed with laboratory testing. Labtopraphic diagnostics for SGP include ELISA, agar gel immunodiffusion, PCR, electron microscopy, virus isolation, indirect fluorescent antibody, and serum neutralization testing. Sheep pox and goat pox are foreign animal diseases in the United States/worldwide. The virus persists in the environment in infected tissue for months to years. Lesions on the neck and chest may also be affected. Clinical disease is relatively common in the United States/worldwide. A manifestation of contagious ecthyma, characterized by severe, persistent, generalized lesions that fail to regress, is sometimes referred to as malignant contagious ecthyma and has been infrequently reported in young Boers and Boer crosses (Figure 2). The esophagus and forestomachs can also be affected. Lesions on the neck and chest have also been reported. Secondary bacterial infections, including *Dermatophilus congolensis*, may complicate orf lesions.

**Etiology:** Viruses, Poxvirus family, genus, and species *Parapoxvirus ovis*. **Clinical signs:** Papules, vesicles, pustules (initial stages often missed) that become either umbilicated with a central depression, thickly crusted, or large and papillomatous lesions. The lesions may be painful and cause kids/lambs to refuse to nurse or become lame, and dams with affected teats may refuse to allow young to nurse. A manifestation of contagious ecthyma, characterized by severe, persistent, generalized lesions that fail to regress, is sometimes referred to as malignant contagious ecthyma and has been infrequently reported in young Boers and Boer crosses (Figure 2). The esophagus and forestomachs can also be affected. Lesions on the neck and chest have also been reported. Secondary bacterial infections, including *Dermatophilus congolensis*, may complicate orf lesions.

**Epidemiology:** Transmission: The virus is found in the lesions and can be spread via direct contact or fomites. The virus persists in the environment in infected tissue for months to years. Hosts: Sheep, goats, camels, and wild ruminants may also be affected. Animals less than 1 year of age are most often clinically affected. Diagnosis: Diagnosis is usually made based on history and clinical signs, but in unusual cases, a definitive diagnosis can be made with electron microscopy, PCR, or immunohistochemistry. Treatment: Supportive care, particularly in neonates unwilling to nurse, pain control, and treatment of secondary infections may be necessary, but most mild lesions resolve without treatment. Prognosis: While contagious ecthyma is highly contagious with up to 100% morbidity in kids/lambs, mortality in age-matched groups is usually low, approximately 1% up to 20%. Prognosis for return to function with generalized disease (malignant orf) is poor without extensive supportive care, as the severity of progressive lesions often necessitates humane euthanasia. Reportable? No. Zoonotic? Yes.

**Ulcerative Dermatosis (Lip and Leg Ulcers, Ovine Venereal Disease)**

**Etiology:** *Parapoxvirus* similar to contagious ecthyma. Content experts have expressed concern that this could be a multifactorial condition or a condition that has not been fully elucidated.
Figure 2—A—Sheep with orf lesions. (Courtesy of Stephanie Steele, DVM, Muleshoe Animal Clinic.) B—Goat with periocular orf lesions. (Courtesy of Rachel E. Oman, DVM, MS, DACVIM.) C—Boer-breed goat with orf lesions. (Courtesy of Emily J. Reppert, DVM, MS, DACVIM, Kansas State University.) D—Boer-breed goat with malignant orf lesions. (Courtesy of Rachel E. Oman, DVM, MS, DACVIM.)
Clinical signs: Sheep: Pustules that become necrotic and progress into circular granulating ulcers on the lips, legs, feet, and genitalia. Lesions occur between the lip and nostril but not usually on mucous membranes. More severe lesions of the legs may result in lameness. Clinically apparent disease is relatively rare.

Affected anatomic locations: Lips, legs, feet, and genitalia.

Epidemiology: Transmission: Direct contact and probably indirect contact may result in the disease spreading. The disease is reported to be more prevalent in the western United States.

Hosts: Sheep, but not goats, are susceptible to disease with older animals more susceptible than younger.

Diagnosis: Laboratory testing with dermatohistopathology, viral antigen detection, or virus isolation.

Treatment: Treatment is aimed at supportive care including pain medication as needed and control of any secondary bacterial infections.

Prognosis: Morbidity can range from 20% to 80% (higher in venereal form) with low mortality.

Reportable? No.

Zoonotic? No.

Bluetongue

Etiology: Virus, family Reoviridae, genus Orbivirus, 27 serotypes worldwide.

Clinical signs: Sheep: Susceptibility varies by breed with European fine-wool breeds more commonly and severely affected. Newly introduced/naïve may also be more severely affected than animals from endemic regions; however, it is important to consider that certain strains of bluetongue virus (BTV; serotypes 2, 10, 11, 13, and 17) are considered endemic throughout much of North America. Clinical signs vary from subclinical to rapidly fatal. Pyrexia, lameness, or stiffness/reluctance to move may be the first signs noted. Lips, muzzle, coronets, feet, and genitalia may become hyperemic and/or ulcerated (Figure 3). Generalized vasculitis, pulmonary edema, and edema of the face and ears may also occur and result in drooping of the ears. The tongue may become cyanotic (“bluetongue”), but this clinical sign is often not present. Abortions and birth defects may occur in some pregnant animals. Clinical disease is sporadic and seasonally influenced by the presence of insect vectors (see transmission below).

Goats and cattle: Most infections are clinically inapparent although clinical signs similar to those seen in sheep are possible. In the author’s experience (SMD), more common clinical signs in goats, when affected, may include fever with lameness, stiffness, unwillingness to walk, and signs consistent with laminitis and coronitis.

Alpacas: Disease in alpacas has been reported to cause dyspnea, progressive weakness, and death with no oral lesions noted. Anatomic regions affected: The oral cavity, head, face, digits, lungs, skeletal muscle, and cardiac muscle may all be affected and generalized vasculitis can also occur.

Epidemiology: Vector-borne transmission via midges from the genus Culicoides is primarily responsible for the spread of bluetongue. In North America, seasonal transmission is most likely in late summer and early fall. Ecological factors can impact vectors.

Hosts: Many ruminant species have been demonstrated to become infected with BTV, although the disease is not necessarily a common occurrence. Cattle and goats generally remain subclinical for infection, and cattle are considered to be a potential reservoir host for BTV. South American camelids are susceptible to severe bluetongue disease, as well as many wildlife species, including bighorn sheep, white-tailed deer, and pronghorn in North America. BTV infection may result in acute death in white-tailed

Figure 3—A—Lesions in a sheep with bluetongue virus infection. (Courtesy of Emily J. Reppert, DVM, MS, DACVIM, Kansas State University.) B—Lesions in a sheep with bluetongue virus infection. (Courtesy of Emily J. Reppert, DVM, MS, DACVIM, Kansas State University.) C—Bluetongue virus infection in a sheep, with swollen face, and drooping ears due to edema. (Courtesy of Christie E. Mayo, DVM, PhD.)
deer and pronghorn. Worldwide, studies have indicated that most large herbivores are susceptible to infection with BTV; dromedaries, water buffalo, bison, kudu, elk, antelope, and others all have demonstrated seropositivity to BTV. Dogs and wild carnivores also are occasionally infected with BTV, either through the consumption of infected meat or vaccine contamination with improperly inactivated fetal bovine serum. The role that these species play in BTV’s epidemiology remains poorly understood.17,20,21

**Diagnosis:** Laboratory testing via complement ELISA, quantitative pan or serotype-specific PCR, or virus isolation.18

**Treatment:** Treatment is aimed at providing supportive care18 such as cautious fluid therapy, nutritional support for anorexic animals, antibiotics when indicated for secondary infections such as pneumonia, anti-inflammatory medication, and pain control.13 Prevention primarily includes preventing exposure to vectors, and vaccination, although vaccine availability is variable depending on region and serotype.

**Prognosis:** Morbidity and mortality rates vary markedly depending on an infected animal’s species and breed, as well as its immune status, the viral strain, and various environmental factors. Clinical sequelae in sheep are most significant and may result in up to 100% morbidity and 30% to 70% mortality.17

**Reportable?** Yes.

**Zoonotic?** No.

### Dermatophilosis (Rain Scald, Lumpy Wool)

**Etiology:** *Dermatophilus congolensis*, Gram-positive, nonacid-fast, aerobic actinomycete bacteria.22

**Clinical signs:** Clinical signs associated with dermatophilosis are common and may include matted wool/fiber/hair in thick crusts (“paintbrush lesions,” Figure 4).6

![Figure 4](image)

---

[Figure 4](#) —A—Goat with dorsal dermatophilosis. (Courtesy of Melanie Boileau, DVM, MS, DACVIM, Oklahoma State University.)

B—“Paintbrush” lesion from a goat with dorsal dermatophilosis. (Courtesy of Melanie Boileau, DVM, MS, DACVIM, Oklahoma State University.)

C—Goat with dermatophilosis of the lower limb. (Courtesy of Rachel E. Oman, DVM, MS, DACVIM.)
papules and pustules that become exudative, or raised lesions that resemble warts. Erosions and ulcerative lesions may be associated with crusting lesions.

Anatomic regions affected: While lesions may occur anywhere on the body and generalized disease has been reported to occur, the dorsum, Figure 4 and distal limbs (including coronet), especially in sheep although this manifestation is less common in the United States,13 are most commonly affected. Lesions may also be present on the face including the tips of ears in young goats,11 muzzle, pinnae, tail, udder, and scrotum.

Epidemiology: Transmission: Disease transmission occurs via direct contact, environmental contamination and fomites such as contaminated shearing and grooming equipment, and mechanical vectors including biting insects. Carrier animal(s), wet conditions, and skin abrasions are all necessary for clinical disease to manifest.10,22

Hosts: Many species worldwide, including horses, cattle, sheep, and goats may be affected and may serve as carrier animals, although the primary reservoir is likely to be subclinical, chronically infected animals. Clinical disease tends to be most common in juvenile, immunosuppressed, or debilitated animals.16

Diagnosis: Diagnosis can be made by Gram staining a direct impression smear from under 1 of the crusts. Microscopy of the stained slide will reveal Gram-positive cocci in 2 to 8 parallel rows or “railroad tracks.” Other laboratory diagnostics include aerobic culture of crusts/skin biopsies and dermatohistopathology.6

Treatment: Parenteral antimicrobial therapy with procaine penicillin G or long-acting oxytetracycline in conjunction with moving the animal to a dry environment along with topical treatments/washes to remove crusts have been recommended.22

Prognosis: Good with appropriate treatment and management strategies.

Reportable? No.

Zoonotic? Yes.

Clinical findings associated with SGP infection that can help differentiate it from the above diseases are described (Table 1). It is important to note that SGP often results in systemic clinical signs that precede or accompany skin lesions. Contagious ecthyma does not usually cause systemic signs of illness in adult small ruminants, except in cases of malignant orf9 or in cases where secondary bacterial infection is significant, such as toxic mastitis associated with teat lesions. Typical cases of orf involve proliferative and “scabby” lesions10 primarily affecting the mucocutaneous junctions on the face and oral cavity and occasionally the digits and teats/udder as well. Additionally, orf usually causes clinical disease in young animals. Bluetongue in sheep often causes systemic disease (pyrexia, regional/generalized vasculitis) in conjunction with oral ulceration. However, additional dermatologic signs are limited to crusting of the mouth, nose, and eyes during the recovery stages.10 Ulcerative dermatosis causes circular ulcers on the lips, legs, and genitalia of sheep only. The ulcerative lesions look different than the raised type of lesions that affect multiple anatomic locations noted in SGP.

Other diseases such as vesicular stomatitis and foot and mouth disease can also cause oral erosions and ulcerations in sheep and goats. However, these diseases also cause severe clinical signs in other species, in particular horses and cattle, respectively, whereas SGP only affects small ruminants. Small ruminants are rarely clinically affected by vesicular stomatitis. Foot and mouth disease infection of sheep can cause pyrexia, lameness, and anorexia followed by vesicles and ulcerations of the oral cavity, feet, and teats/udder.6 Goats however are usually subclinically affected by foot and mouth disease.13

In summary, livestock veterinarians and small ruminant producers in the United States should be aware of the clinical signs of SGP and be vigilant for unusual presentations in sheep and goats that include dermatologic lesions with systemic signs of disease and high morbidity and/or mortality across age groups. A concerted effort between veterinarians and producers to increase awareness of foreign animal diseases in livestock is necessary to help prevent the introduction and spread of these devastating diseases within our borders.

### Table 1—Comparison of selected dermatologic conditions in small ruminants with special focus on clinical signs.

<table>
<thead>
<tr>
<th>Disease</th>
<th>Agent</th>
<th>Clinical signs</th>
<th>Proliferative lesions in muzzle region</th>
<th>Crusting (ears/eyes)</th>
<th>Conjunctivitis</th>
<th>Muzzle/ear edema</th>
<th>Fever</th>
<th>Lymph adenopathy</th>
<th>Lame</th>
<th>Pneumonia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sheep and goat pox</td>
<td>Capripoxivirus, O, C</td>
<td></td>
<td>+/− Oral lesions can also be ulcerative</td>
<td>+</td>
<td>+</td>
<td>+ (Acute stages)</td>
<td>+/−</td>
<td>−</td>
<td>+/−</td>
<td>+/−</td>
</tr>
<tr>
<td>Contagious ecthyma/orf</td>
<td>Parapoxivirus, O &gt; O</td>
<td></td>
<td>+/− May also be on teats</td>
<td>+/− (Rare)</td>
<td>−</td>
<td>+/−</td>
<td>−</td>
<td>−</td>
<td>+/−</td>
<td>−</td>
</tr>
<tr>
<td>Ulcerative dermatosis</td>
<td>Parapoxivirus, O only</td>
<td></td>
<td>− Ulcerative lesions but not on oral mucosa</td>
<td>−</td>
<td>−</td>
<td>−</td>
<td>−/−</td>
<td>−</td>
<td>−/−</td>
<td>+/−</td>
</tr>
<tr>
<td>Bluetongue</td>
<td>Orbivirus, O &gt;&gt;&gt; C (rare)</td>
<td></td>
<td>− Ulcerative lesions</td>
<td>+/−</td>
<td>+</td>
<td>+/−</td>
<td>−</td>
<td>−</td>
<td>−/−</td>
<td>−</td>
</tr>
<tr>
<td>Dermatophilosis, rain rot/scald</td>
<td>Dermatophilus congolensis, C, O</td>
<td></td>
<td>+/−</td>
<td>+/−</td>
<td>−</td>
<td>−/−</td>
<td>−</td>
<td>−</td>
<td>−/−</td>
<td>−</td>
</tr>
</tbody>
</table>

C = Caprine. O = Ovine.
The muzzle region includes lips, gums, nares, and muzzle. It should be noted that both contagious ecthyma and dermatophilosis have zoonotic potential.
Acknowledgments

The authors declare that there were no conflicts of interest or external funding in the preparation of this manuscript.

References