Bovine herpes mammillitis in three dairy cows
A case report

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Introduction
Skin pathologies of the teat and udder are rare but a difficult to diagnose challenge for large animal practitioners. Due to their localisation, the milkability can be compromised partly or completely so that the economic value of the animals is seriously at risk. Skin pathologies of the udder can be of infectious or non-infectious nature. Most prevalent non-infectious skin lesions are primarily caused by trauma, especially with big or very low hanging udders, or can be caused by a generalised disease like Dermatitis solaris due to a cholestase (5). Infectious reasons can be of viral, bacterial or parasitological nature (5, 17).

Aim of this case study is to present the diagnosis, therapy and the course of a herpes mammillitis infection.

Case report
Patients and history
In September 2005, three Swiss Braunvieh cows that stood close to each other in the stall were presented with abnormalities of the udder and teat skin. The cows, two were 7 years old and one 5 years, originated from a herd of 17 milk cows, were kept in tie stalls with pasturing and had an average milk yield of 8000 kg per year. The most recent purchase of cattle had been in 2001. The cows were fed with grass and maize silage and pastured in summer.

Four months before presentation cow No. 1 had calved for the third time without any complications. After parturition she showed a severe mammary oedema. The owner treated the udder with an udder gel in order to reduce the oedema. Following this treatment the oedema decreased, but the owner noticed some alteration of the teat and udder skin, described as an allergic reaction or an irritation. After discontinuing the gel application, there was no improvement. Subsequently the two cows nearest to cow No. 1 that were in their 5th and 6th lactation, respectively developed skin lesions on udder and teats. The owner first noted skin irritations, which were red, circular and deep at the base of teats in the cow that stood on the right side of cow No. 1. The lesions spread from the teat to the udder. A few intact vesicles were observed.

Clinical examination and findings
The most severe lesions were seen in cow No. 1. The clinical examination revealed normal general behaviour and condition. A severe oedematous swelling of the udder was present. Skin lesions were visible on the skin of all four teats and the udder and extended caudally towards the perineal region. Pruritus or signs of systemic illness were not evident. The lesions were highly variable in nature. There were several intact vesicles, as well as ruptured vesicles and crusted areas. Additionally, blue, dark and circumscribed discolorations in the skin of the perineum and dark demarcated plaques consisting of necrotic skin and encrusted ulcers were found (Fig. 1). Sharply demarcated often circular, singular or coalescing, erythematous ulcerations with extensive sloughing of the epithelium with partial ablations of the udder skin could be observed at the teat and udder ground. Cows No. 2 and 3 showed

Fig. 1 Udder and teat of a cow with severe BHV-2 infection. Sharply demarcated, coalescing dermal lesions consisting of necrotic, locally sloughed epithelium, 14 days after appearance of the first dermal lesions.

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similar skin alterations at the teats and udder, but those were not so widely spread.

Cow No. 1 showed defensive reactions when milking was attempted manually, but not during milking by milking machine. Therefore she and the other two affected cows were milked by machine during the time of her illness without medical immobilisation. The milk from all four quarters was macroscopically normal and the California Mastitis Test gave a negative result. In all three animals the milk yield was slightly decreased during this period.

**Histological and electron microscopic analysis**

The clinical examination could not reveal the cause of the alteration of the udder skin. Consequently, skin biopsies were collected 10 days after the appearance of the first dermal lesions and were fixed in 4% buffered formaldehyde. After embedding in paraffin, 4 μm sections were stained with haematoxylin and eosin (HE) for histopathological examination. Large areas of sharply demarcated necrotic epithelium infiltrated by neutrophilic granulocytes and interspersed with numerous syncytial cells could be observed histologically (Fig. 2). These cells contained intranuclear eosinophilic inclusions filling the entire nucleus. Hair follicle infundibula were often involved, showing ballooning degeneration and necrosis, rarely extending to sebaceous glands, with associated purulent inflammation. No syncytial cells were visible in hair follicle infundibula. A moderate to severe, perivascular and diffuse inflammatory infiltration consisting mainly of neutrophilic granulocytes was present in the superficial and deep dermis.

Paraffin-embedded material was processed for electron microscopy, which revealed intranuclear particles with an average diameter of 90–100 nm and the typical morphology of herpes virus (Fig. 3). No serological examination was done.

**Diagnosis, treatment, and outcome**

Based on the anamnesis, the clinical signs and confirmed by the electron microscopic analysis of viral morphology, the diagnosis was bovine ulcerative mammillitis caused by herpes virus type 2. The affected animals were symptomatically treated with a disinfecting ointment (Polyvinylpyrrolidioniod, Betadine® Lösung standardisiert, Mundipharma, Basel) and always milked last. After milking, the teats were dipped in jodophor solution (Lorosol® GL 0.75%, Novartis, Basel).

None of the affected animals developed a secondary mastitis. Dermal lesions healed within 4 weeks in two of the affected animals. In the most severely affected cow No. 1 healing required 5 months and left depigmented focal scars. Within the following 12 months no other animal in that herd developed mammillitis. The source of the infection remained unknown, as no animal had been introduced into the herd during the previous 4 years and no other diseased herd could be found in the neighbourhood.
Discussion

The clinical course and the histological lesions were typical of bovine herpes mammillitis and the definitive diagnosis could be confirmed by electron microscopy. Bovine Herpes virus type 2 (BHV-2), an alpha-herpes virus, is the causative agent. BHV-2 is excreted from skin lesions and mucosa. Affected animals show only low antibody titers, which can be detected one week after infection. However, after the first infection the animals are immune to re-infection for approximately one year. Viraemia does not occur; the infection emanates by local spreading through the lymphatic system.

BHV-2 infection results either in a localized infection of the teat and udder, termed bovine ulcerative mammillitis, or a generalized skin disease termed pseudo-lumpy-skin disease or a stomatitis in calves (13). Bovine herpes mammillitis occurs sporadically worldwide (14), mostly in temperate regions during the late summer and autumn. Within 6–15 weeks after infection a high seroprevalence can be observed in a herd. The virus was first isolated in Africa (1), where various wild ruminants have antibody titers to the virus (12). However, they do not develop clinical signs but most likely they serve as the main reservoir (7). In Great Britain and North America about 20% of cattle are infected (2, 14). In Switzerland a seroprevalence of 7% was reported (3).

Herpes mammillitis is primarily a disease in lactating dairy cows. Heifers and beef cows as well as calves suckling from diseased cows are rarely affected. In the majority of cases, the origin of the infection remains unknown. Latent infections that are reactivated by stress are regarded as the most likely source for the spread of the infection within a herd. Latency is characteristic for herpes viral diseases and reactivation of experimental BHV-2 infection after application of corticosteroids was demonstrated. However, the site of latency remains unknown (10). Calving could represent such a reactivating stress factor and this might explain why cows, which have recently calved, are often severely affected by this disease.

Transmission from one cow to another can take place by direct or indirect contact, mostly through the milking machine. Insects have been assumed as vectors and might be important in warm climates (11). Intact skin is refractory to infection but BHV-2 may enter through small skin lesions. The optimal temperature for BHV-2 replication is lower than the normal body temperature. This might explain why the skin lesions are restricted to the teat and udder and the seasonality of the disease as well (8). The number of clinically affected animals during an outbreak is highly variable and depends on the animals’ immune status.

Swelling of the teats and the udder with formation of vesicles follows an incubation period of about 3–7 days. Several weeks or longer post partum infected cows may show characteristic skin lesions mainly in the teat area. However, immediately post partum the alterations in the udder and teat skin are more severe and directly proportional to the grade of mammary oedema (13). Mastitis with degeneration of udder tissue can be the result of these lesions due to secondary bacterial infections. Morbidity rate is 18–96% at the beginning of disease (13, 16). Hereafter necrotic, irregularly shaped plaques covered by scabs, mostly localized on the teat, can appear. In severe cases the plaques coalesce and spread to the udder. In some BHV-2 infected animals, ischemic necrosis of the teat base might develop (15). Uncomplicated lesions may heal within 3–4 weeks and depigmented scars may be left (3, 4, 18). Histological lesions are characterized by epidermal necrosis and formation of syncytial cells. They contain numerous intranuclear inclusion bodies that are present until the fifth day after macroscopic lesions appear (14), which disappear afterwards and allow a provisional etiologic diagnosis which can be confirmed by electron microscopy or virus isolation.

Usually, there is no mortality, but economic loss may be significant due to the decreased milk production of the affected animals and the development of secondary bacterial mastitis, which may lead to culling of the affected animal.

In the case presented, 3 of 17 animals showed clinical signs of herpes mammillitis. The source of infection could not be determined. Most likely a latent herpes virus infection was reactivated by an undetermined event. There is no specific treatment for the disease; strict hygiene must be observed and symptoms may be relieved. Disinfection to prevent the spread of the disease is advisable, especially during milking. A supportive treatment is furthermore indicated with disinfecting and nurturing solutions or ointments, in order to avoid a secondary bacterial infection. Mastitis is a common complication, being a consequence of the disturbed milkability due to the teat lesions. It is of paramount importance that a milking sequence is established and upheld together with a corresponding high level of milking hygiene. The healing process takes 10 days to 12 weeks and depends upon the degree and the condition of the lesions; the uncomplicated disease heals within 4 weeks.

Practical guidelines in clinical cases

Cows with teat and udder lesions are presented to the veterinarian when teat skin lesions disturb milking. A biopsy or scab sample taken from the lesions may be helpful to get a definite diagnosis because most differential diagnoses are difficult to exclude by clinical examination. Viral material remains present in the lesion for about 10 days. Typical changes like syncytial cells with intranuclear, eosinophilic inclusions may be found by histological examination, indicating that a virus is the cause of these changes. Primarily, an electron microscopical investigation can confirm a definite diagnosis. If the alterations are not complicated by secondary bacterial infection of the skin or by mastitis, complete healing can be achieved. Depending on the seroprevalence in the herd and the immunity of animals, a spreading of the infection can take place. In order to prevent this, affected animals should be milked at the end and afterwards the milking equipment should be cleaned with a disinfectant effective against the herpes virus. If involved udder quarters are still milkable, a local therapy would be sufficient to avoid a secondary bacterial infection. In case several teats are not milkable due to considerable skin alteration or pain, it is reasonable to temporarily dry off the cow using antibiotics.
Bovine ulcerative mammillitis seems to be a rare disease in Switzerland as it has only been reported twice (6, 11) and, to the authors’ knowledge, it has not yet been described in Germany. The main reasons for this may be difficulties in confirming the diagnosis and the probably widespread immunity within the cow population causing mild or even subclinical infections.

Primary differential diagnoses include other virus induced ulcerative dermatitis of the teat and/or udder, namely pseudocowpox (parapoxvirus) and cowpox (orthopoxvirus) (17). In contrast to bovine herpes mammillitis, no marked seasonal fluctuation in the incidence of pseudocowpox or cowpox infections exists. Furthermore the lesions are primarily proliferative whereas they are ulcerative in herpes mammillitis. In humans pseudocowpox and cowpox can cause localized skin lesions, whereas BHV-2 has no zoonotic potential. But even though these three diseases differ in some aspects of the clinical presentation (4), isolating the causative agent is required for diagnosis. Bacteria, namely Staphylococci, *Fusobacterium necrophorum* and *Borrelia burgdorferi* (9), and parasitic infections, such as Stephanofilaria, can cause similar lesions. Non-infectious diseases, such as photosensitivity reactions, allergy, chemical irritation and trauma should also be considered. The differential diagnosis should also include bluetongue because similar alterations, such as hyperemia, erosions and crusting at the teat are possible (16).

Conflict of interest
The authors confirm that they do not have any conflict of interest.

References