

Polyarthrititis caused by *Erysipelothrix rhusiopathiae* in three Austrian sheep flocks- diagnosis, treatment and management measures

J. Schoiswohl¹, J. Spergser², J. Kofler¹

¹University Clinic for Ruminants, Department for Farm Animals and Veterinary Public Health, University of Veterinary Medicine Vienna, Austria; ²Institute of Microbiology, Department of Pathobiology, University of Veterinary Medicine Vienna, Austria

Zusammenfassung

Polyarthrititis verursacht durch *Erysipelothrix rhusiopathiae* ist eine bekannte Erkrankung bei Schweinen, bei Schafen erkranken am häufigsten zwei bis sechs Monate alte Lämmer.

Dieser Beitrag beschreibt drei Fälle, bei denen Lämmer geschwollene Gelenke und Lahmheit zeigten. Besonderes Augenmerk wurde im Fallbericht einerseits auf die Ergebnisse der klinischen Untersuchung und der bildgebenden Diagnostik gelegt, andererseits auch auf die bakteriologische Untersuchung der gewonnenen Synovia sowie auf die Darstellung des Therapieregimes. Lämmer mit geringgradiger Lahmheit, seröser Arthritis und ohne Knochenveränderungen (Ultraschall- und röntgenologische Untersuchung) wurden mit systemischer Antibiose (nach durchgeführtem Antibiotogramm) und NSAIDs therapiert. Lämmer, die eine hochgradige Lahmheit und hochgradig geschwollene Gelenke aufwiesen, wurden euthanasiert und pathologisch untersucht, besonderes Augenmerk wurde dabei auf die Gelenkveränderungen gelegt. Im Anschluss wurde eine stallspezifische Vaccine von einem Speziallabor hergestellt.

Zusammenfassend soll die Botschaft vermittelt werden, dass beim Auftreten von Lahmheit und geschwollenen Gelenken bei Lämmern im Alter von zwei bis zu 17 Monaten an eine *Erysipelothrix rhusiopathiae* Infektion als Differentialdiagnose gedacht werden sollte.

Schlüsselwörter: Arthritis, Rotlauf, Lämmer, geschwollene Gelenke, Lahmheit, Röntgen, Ultraschall, Vaccine

Abstract

Polyarthrititis caused by *Erysipelothrix rhusiopathiae* is a well-known disease in pigs, and ovine erysipelas infection also commonly affects two-to-six month-old lambs. This report describes case histories of three sheep flocks where lambs exhibited swollen joints and lameness. Special emphasis was given to clinical and diagnostic imaging findings, synovia sampling and the treatment regime. Lambs with only mild lameness, liquid serofibrinous joint effusion and lambs showing no bone involvement, as revealed by ultrasonography or radiography, were treated with systemically administered antibiotics selected from results of antimicrobial susceptibility testing of *E. rhusiopathiae* isolated from synovial samples, and non-steroidal anti-inflammatory drugs. Lambs with severe lameness and severely swollen joints were euthanized, and routine necropsy was undertaken with a focus on the joints. Further, a herd-specific autogenous vaccine was produced by a specialized laboratory. In conclusion, *E. rhusiopathiae* infection should be considered as a differential diagnosis in herds associated with lameness and polyarthrititis in lambs aged between two up to 17 months.

Key words: Arthritis, ovine erysipelas, lameness, swollen joints, ultrasound, x-ray, vaccine

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Introduction

Erysipelothrix rhusiopathiae, an ubiquitous gram-positive bacterium, is as well commensal as pathogen in a wide range of vertebrates, including humans and birds.^{18, 23} This bacterium can survive for at least up to five weeks in the environment, and pigs are the most important reservoir of infection.^{11, 23} The disease caused by these bacteria, erysipelas, has an economic importance, especially in swine, but also in domestic poultry, and cattle and sheep may also be involved.^{1, 7, 14, 19, 23} There are also reports of natural infections in horses, dogs, ducks, mice, and wildlife species.^{4, 23} *Erysipelothrix rhusiopathiae* infections in swine, called swine erysipelas, are very common and can be controlled by vaccination.²³

Polyarthritis caused by *E. rhusiopathiae* in sheep, in particular in two to six month old lambs, is a relatively common infection being characterized by high morbidity (7–28%) and low mortality (1,7%), and chronic manifestation lead to severe changes in affected joints.¹⁰ Ersdal et al.⁶ described acute and chronic *E. rhusiopathiae* infections in lambs during an outbreak in a Norwegian sheep flock. 20% of lambs developed clinical signs in the acute phase and 1,7% died. At necropsy *E. rhusiopathiae* was cultured from samples taken from organs and from carpal and tarsal joints,⁶ the latter showing a fibrinous arthritis. 33% of diseased lambs developed a chronic polyarthritis. At necropsy, all animals showed

lesions of the articular cartilage in mayor limb joints, and *E. rhusiopathiae* could be cultured.⁶ By pulsed-field gel electrophoresis typing isolates indicated that acute and chronic disease was caused by the same strain. In addition, all chronically diseased lambs had a glomerulonephritis.⁶ Sodoma et al.¹⁹ reported that all strains of *E. rhusiopathiae* detected in swine, lambs and turkeys were sensible for penicillin. In contrast to swine in many countries there is no vaccine registered for sheep. Pfister et al.¹⁴ described a herd problem of lameness and polyarthritis caused by *E. rhusiopathiae* affecting approximately 20% of young lambs in a sheep flock in Switzerland, housed together with fattening pigs in one farm. When such an anamnestic information is given that sheep and pigs are kept together in a farm where lambs develop lameness and polyarthritis, an infection with *E. rhusiopathiae* must always be considered.

The aim of this case report is to describe the diagnostic work-up procedure in cases of polyarthritis in lambs caused by *E. rhusiopathiae* in sheep-flocks and the applied treatment and management measures.

Case histories and results

Between December 2017 and December 2018 eight lambs (male and female, with an age between one and



Figure 1a, 1b: Lateral view of the severely distended dorsal and plantarolateral tarsocrural joint pouches (a), and the severely distended carpal joint pouches (b) of one of the lambs of farm 2.

17 months) from three different farms were referred to the University Clinic for Ruminants due to lameness and swollen joints. The lambs originated from farms with approximately 100 to 150 sheep, and the flocks were recognized as free of CAE and Maedi-Visna. By anamnestic case history interview the farmers reported that all animals suffering from lameness were lambs of twin or multiple births. Beside of these referred animals, 18 other lambs at these farms showed signs of lameness and two had been already euthanized due to swollen joints, recumbency and poor condition. The affected lambs were lame, showed a stiff gait and swollen joints, however no signs of pneumonia or lameness were reported in adult sheep. Before this outbreak of polyarthritis in these three flocks, never any lameness was observed in lambs and adult sheep. Furthermore, it was revealed that in farm 1 and 2 sheep and pigs were kept together, and in farm 3 poultry was kept on the same farm.

Clinical findings

Clinical and orthopedic examination revealed that the lambs showed cachexia (Body condition score (BCS) 1 and 2) and the lung auscultation showed bilaterally slightly harsh lung sounds in one of the female lambs. All lambs showed a moderate lameness on the fore- and the hind limbs, moderately to severely swollen carpal, tarsal and stifle joints, and obvious moderate flexion of the affected carpal joints (Fig. 1a, b; Tab. 1). All other clinical parameters including body temperature (38,5–39,5 °C) based on full clinical examination were normal.

Diagnostic imaging findings

Ultrasonographic examination of the swollen joints using a 7,5 MHz linear probe (Mindray DP-30Vet, Mindray Bio-Medical Electronics Co. Ltd, Shenzhen, China) revealed a mild to moderate anechoic to hypoechoic effusion with and without flow-phenomena, the latter indicating a fibrinous effusion. In addition, in four lambs the articular surfaces of carpal, tarsal and stifle joints showed raw contours with loss of the articular cartilage (Fig. 2a,b; Tab. 2). Radiological examination on un-sedated living animals using latero-medial and cranio-caudal projections confirmed the diagnosis of polyarthritis, in cases of chronic joint infection in four lambs the contours of the articular bones (Fig. 3a–d) showed irregular and bone-dense osteophytes (Tab. 2).

Sampling of synovial fluid, laboratory and necropsy findings

Blood analysis revealed that the blood count was inconspicuous and calcium, phosphorus, magnesium, iron and selenium were within physiological ranges (calcium 2,20–3,00 mmol/L; phosphorus 1,30–2,20 mmol/L; magnesium 0,78–1,07 mmol/L; iron 73–179 µg/dl; selenium 21–123 µg/L).

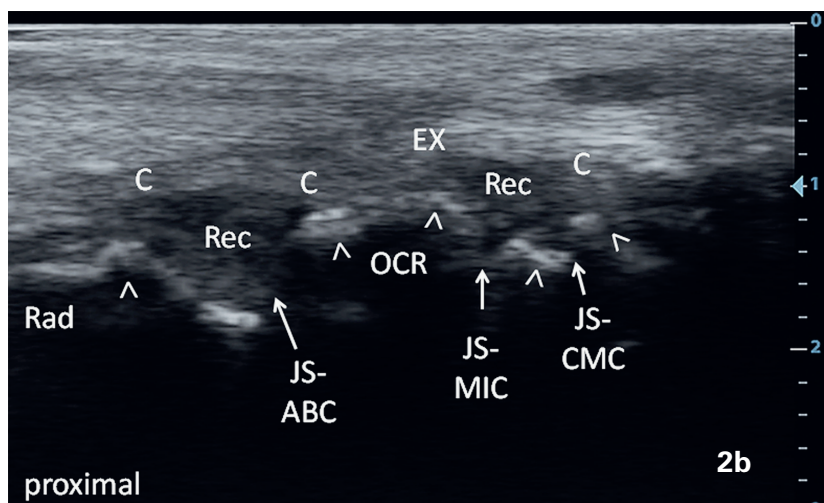
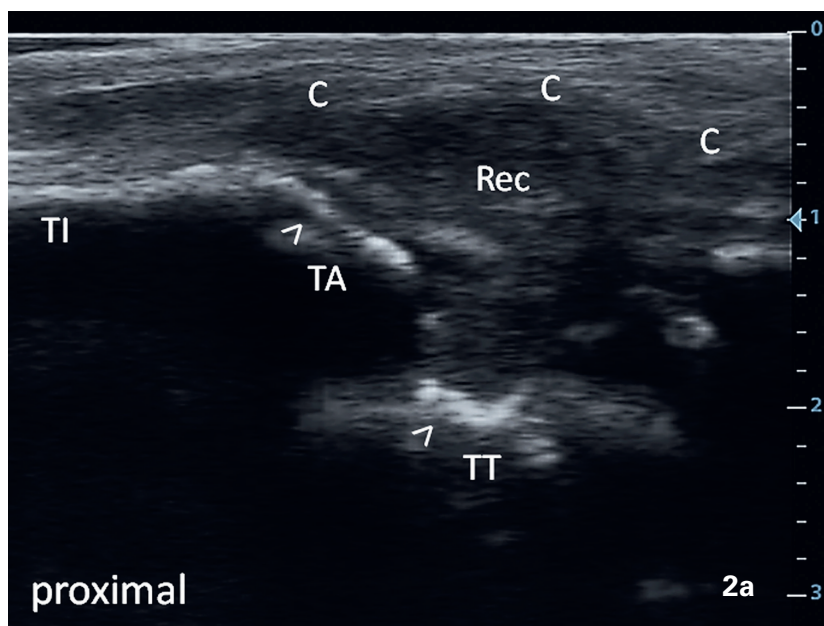


Figure 2a, 2b: Longitudinal sonograms (7,5 MHz linear) of the dorsal tarsocrural joint pouch (a) and of the dorsal carpal joint region (b) of the lamb from Fig. 1a, 1b showing the hypoechoic effusion in the joint pouches (Rec) surrounded by the elevated joint capsule (C); flow-phenomena could not be elicited; the bone surfaces of talus (TA) and talar trochlea (TT) appear slightly irregular (white arrows), the same could be imaged at the dorsal bone surfaces of the carpal bones (white arrows) indicating bone infection. Smooth hyperechoic bone surface of the distal tibia (TI), distal radius (Rad); radial carpal bone (OCR); radial carpal extensor tendon (EX), joint spaces (JS) of the antebrachioacarpal (ABC), middle carpal (MIC) and carpometacarpal (CMC) joints.

Synovial samples were taken aseptically by arthrocentesis using hypodermic 1,6 mm wide needles from joints showing the clinically and ultrasonographically most evident effusion (Tab. 1). Synovial samples were transferred into sterile tubes and submitted to the diagnostic laboratory for microbiological examination. Due to unfavourable prognosis two lambs were euthanized after the diagnostic procedure. Standard necropsies were undertaken with special emphasis on the joints and samples were collected aseptically for microbiological

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testing. In addition, an antimicrobial susceptibility testing from synovial samples was carried out (Tab. 3). At necropsy, in the carpal, tarsal, stifle and coxofemoral joints of these two lambs an increased amount of flocculent synovial fluid and/or fibrin clots was assessed, the joint capsule was thickened, and the synovial membrane showed villous proliferations. The right tarsal joint (lamb 1) showed significant erosions/ulcerations in the articular cartilage with the focus at the lateral part of the talar trochlea, parts of damaged cartilage were superseded by loose connective tissue. In the carpal joints extensive erosions/ulcerations of the articular cartilage were assessed at the articular surface of the distal radius. Lamb 2 also showed severe erosions/ulcerations of the articular cartilage at the lateral part of the talar trochlea and similar severe cartilage lesions in both stifle joints (Fig. 4a,b). Less pronounced cartilage lesions were observed in the carpal and the metatarsophalangeal joints.

Microbiological examination

Samples were inoculated onto Columbia agar with 5% sheep blood (BBL™, BD Diagnostics, Austria) incubated at 37°C under microaerobic conditions (5% CO₂ atmos-

phere) and daily checked for growth. Samples were additionally examined for mycoplasmas using a protocol described elsewhere.²⁰ Moderate to abundant growth of *E. rhusiopathiae* identified by matrix-assisted laser desorption ionization – time of flight mass spectrometry (MALDI-TOF MS) (Bruker Daltonik, Bremen, Germany) was observed in all samples after two days of incubation. Susceptibility testing and test interpretation was performed according to the Clinical and Laboratory Standards Institute using the agar disk diffusion method in the same manner as for streptococci employing blood-supplemented Mueller-Hinton agar (BBL™, BD Diagnostics, Schwechat, Austria) as well as broth microdilution susceptibility testing³. Mycoplasmas were not detected in any samples examined.

Treatment regime

Lambs that showed only a mild lameness, a liquid sero-fibrinous joint effusion and lambs showing no bone involvement (assessed by ultrasonography or by radiography) were treated for five days with Ampicillin (10 mg Ampicillin/kg BW IM., Ampicillin «Vana» 200 mg/ml – Injektionssuspension für Tiere®, Vana GmbH,

Table 1: Summarized clinical findings of the orthopedic examination of the affected lambs, and findings of the macroscopic evaluation of the synovial samples yielded by arthrocentesis of the joints showing the most severe effusion;

Farm	Animal number	Involved joints	Degree of swelling	Conformation of involved joints	Palpatory findings on affected joints	Punctured joints	Macroscopic appearance of synovial sample
1	1	left & right carpal	moderate	slight to moderate flexion	not painful		
	2	left & right carpal	moderate	slight to moderate flexion	not painful		
	3	left & right carpal	moderate		not painful		
		left & right stifle	moderate		painful	left stifle	severely cloudy, yellow & liquid (serofibrinous)
	4	left & right coxofemoral	not palpable		painful		
		left & right carpal	severe		not painful	left carpal	
		left & right tarsocrural	moderate		painful	right tarsocrural	
2	5	left & right carpal	severe		not painful	left carpal	
		right tarsocrural	slight		not painful	right tarsocrural	severely cloudy, yellow and liquid (serofibrinous)
	8*	right tarsocrural	severe		painful	right tarsocrural	severely cloudy, yellow & liquid (serofibrinous)
		right tarsocrural	severe		painful	right tarsocrural	
3	6	left & right carpal	slight		not painful	right carpal	fibrinous
		left & right tarsocrural	moderate		painful	left tarsocrural	fibrinous
	7	left & right carpal	slight		not painful	left carpal	fibrinous
		left & right tarsocrural	moderate		painful	right tarsocrural	fibrinous

*Lamb 8 was presented at the clinic 12 month later.

Vienna, Austria) and for 3 days with non-steroidal anti-inflammatory drugs (3 mg Ketoprofen/kg BW IM.; Rifen®, Richter Pharma AG, Wels, Austria). The farmers and local vets were advised to treat animals with mild lameness and mild joint effusion with the same regime, and to euthanize lambs with severe lameness and severely swollen joints, and furthermore to vaccinate all sheep twice (at the beginning of the program and six month later) against *E. rhusiopathiae* with a herd-specific autogenous vaccine which was produced by a specialized laboratory (BS Immun GmbH, Vienna, Austria) from isolated *E. rhusiopathiae*. In addition, farmers were advised to remove pigs (farm 1 and farm 2) and poultry (farm 3) from the farm due to risk of infection, because pigs and poultry were not tested.

Two year outcome

As suggested, in farm 1 pigs were removed from the farm, and all mild infected animals were treated with

the mentioned medication, and severely infected animals were euthanized. Furthermore, the local veterinarian on farm 1 started the same vaccination program after the definite diagnosis was taken by bacteriological culture. Since this time farm 1 had no problems with lameness again. In farm 2, the recommendations being the same as given for farm 1 were not implemented at all, and approximately 20 other lambs developed polyarthritis during the subsequent months. These lambs were treated by the local veterinarian repeatedly over several months with different antibiotics (i. a. Marbofloxacin, Tetracycline) but development of new infections could not be stopped. Approximately 12 months after the first referral, another one-month-old male Laune lamb (Tab. 2 and 3; lamb 8) was presented at the Clinic for Ruminants showing lameness and swollen joints. Blood analysis revealed that the blood count was inconspicuous, and calcium, phosphorus, iron and magnesium were within the physiological range. Samples

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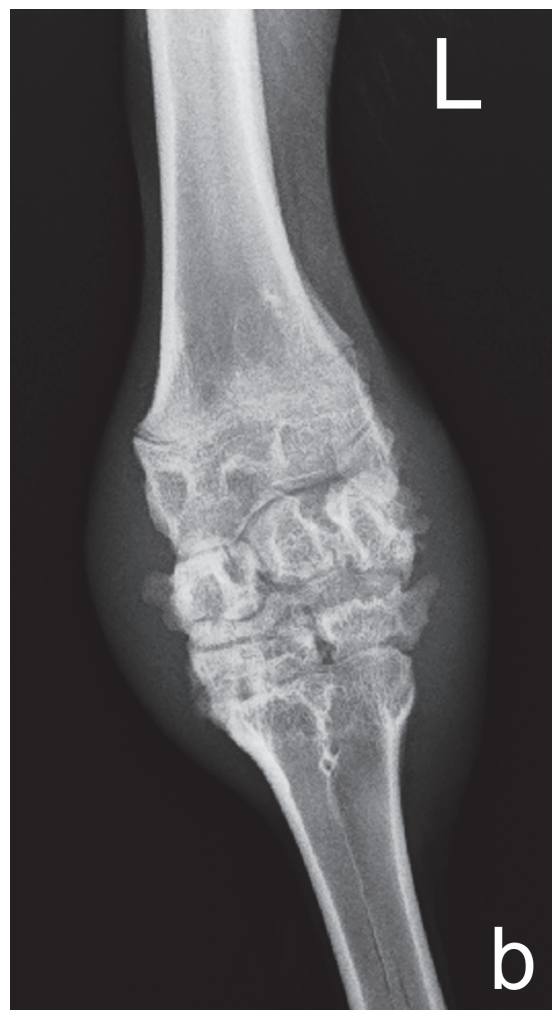
Table 2: Overview of radiographic and ultrasonographic findings in diseased lambs; ABC=antebrachio-carpal, MIC=middle carpal, CMC=carpometacarpal;

Farm	Animal number	Investigated joints	Radiographic findings	Ultrasonographic findings
1	1	left & right carpal	–	mild anechoic effusion with flow-phenomena, fibrin mass in MIC-joint and raw bone contours at the dorsal carpus
	2	left & right carpal	Moderately distended joint spaces in all three carpal joints, irregular formation osteophyte formation at the articular bone contours	mild anechoic effusion with flow-phenomena, fibrin mass in MIC-joint and raw bone contours at the dorsal carpus
	3	left carpal	Severely distended joint spaces of the ABC and MIC joints, irregular formation of osteophyte formation at the articular bone contours	mild anechoic content in carpal joint left, hypoechoic effusion (fibrin) in joint capsule (MIC), raw articular surfaces in carpus
		right stifle	–	mild anechoic effusion in the right lateral and medial femorotibial joint with hypoechoic fibrin masses adhering the in joint capsule
2	4	left & right carpal	–	mild anechoic effusion without flow-phenomena in the ABC- and MIC-joint, articular surfaces normal
		right tarsocrural	–	severe and mainly hypoechoic effusion with flow phenomena, articular surfaces normal
	5	left & right carpal	–	moderate to severe anechoic to hypoechoic effusion of the precarpal bursa (precarpal hygroma), and moderate and anechoic effusion in the ABC and MIC joints, articular surfaces normal
		right tarsocrural	–	moderate anechoic to hypoechoic effusion without flow-phenomena, raw articular contours dorsally
	8*	left & right carpal	–	mild anechoic to hypoechoic effusion with flow-phenomena, and articular surfaces normal
		right tarsocrural	–	moderate mainly hypoechoic effusion with adhering fibrin masses at the capsule in the dorsal pouch, hypoechoic effusion without flow phenomena (fibrin masses) in the latero-plantar pouch, articular surfaces normal
3	6	left carpal	–	mild anechoic effusion in the ABC joint), articular surfaces normal
		left & right tarsocrural	–	moderate hypoechoic effusion without flow-phenomena, articular surfaces normal
	7	left & right carpal	–	mild anechoic effusion in ABC, MIC and CMC joint without flow-phenomena, articular surfaces normal

*Lamb 8 was presented at the clinic 12 month later.

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were aseptically collected from affected joints by arthrocentesis using a 1,6 mm puncture needle and submitted for microbiological examination, again resulting in the detection of *E. rhusiopathiae*. The lambs were euthanized due to poor general condition and afterwards the owner decided to start a vaccination program. Since starting the vaccination program approximately two months after diagnosis, no new cases of lameness were assessed and the herd infection could be resolved in farm 2. In farm 3 all mild infected animals were treated using the above mentioned medication (Ampicillin (10 mg Ampicillin/kg BW IM., Ampicillin «Vana» 200 mg/ml – Injektionssuspension für Tiere®, Vana GmbH, Vienna, Austria) and with non-steroidal anti-inflammatory drugs (3 mg Ketoprofen/kg BW IM.; Rifen®, Richter Pharma AG, Wels, Austria), and severely infected animals having a poor prognosis were euthanized. The farmer did not vaccinate the animals, but he removed poultry from the farm and since this time no problems with lameness were encountered anymore on farm 3.

Discussion

This report describes the occurrence of polyarthritis in lambs from three Austrian sheep flocks caused by an *E. rhusiopathiae* infection, in particular their clinical,

diagnostic imaging and laboratory work-up and their treatment regime. Polyarthritis caused by *E. rhusiopathiae* infection is a well-known disease in pigs.⁶ Ovine erysipelas infection most commonly affects two to six months-old lambs,^{1, 6, 10, 14} which was in agreement with our findings, however even sheep until an age of 17 months were involved. Polyarthritis in lambs is mainly caused by pathogens which reach joints by bacteraemia. From a differential point of view in such cases of polyarthritis the infection with ubiquitous pyogenic organisms such as *Streptococcus dysgalactiae*, *Staphylococcus aureus* and *Trueperella pyogenes* may enter into the bloodstream via the umbilicus or wounds,^{8, 15} and can be caused by *Mycoplasma* spp. and/or *Chlamydia* spp.^{14, 19} However, also older sheep can be infected by *E. rhusiopathiae* showing pathologies of other organs without involvement of joints.^{2, 6, 23} The acute disease is described as having a morbidity ranging from 7% to 28% and low mortality (1,7%), and more than one third of infected lambs develop chronic stages of joint infection associated commonly with poor body condition,^{6, 10, 14} which could be observed even in the

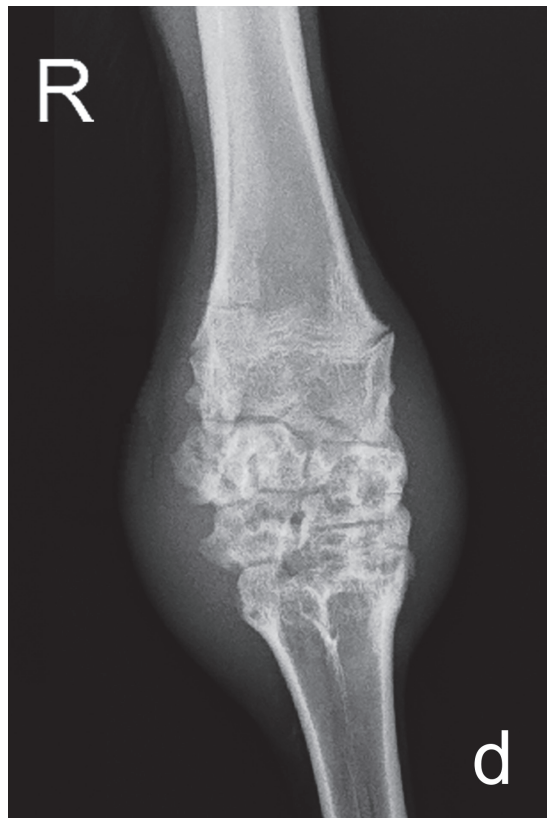


Figure 3a–d: Lateromedial (a, c) and dorsopalmar radiographic views (b, d) of the left (a, b) and the right carpal regions (c, d) of the lamb from Fig.1b showing the evident soft tissue swelling caused by the severe joint effusion. Furthermore, the joint spaces appear narrowed, in particular in the dorsopalmar views, caused by joint cartilage degradation, and the outer contours of the carpal bones show irregular and bone-dense osteophytes, in particular in the dorsopalmar views. The latter radiographic findings are signs of a progressive, chronic joint infection with *E. rhusiopathiae* (Figs. 3a–d: Courtesy of Clinical Unit of Diagnostic Imaging, Vet-meduni Vienna, Austria).

three presented sheep flocks. In the described cases lambs from twin birth and multiple births were affected. It cannot be assumed with certainty, but there is a high confidence that inadequate colostrum supply was responsible for the clinical manifestation of infection due to insufficient immune responses. Antibodies to *E. rhusiopathiae* are excreted per colostrum intake. For optimal protection, a newborn lamb should have a colostrum intake for the first time within the first two to four hours of life and have consumed 15–20% of its body weight of colostrum by 24 hours after birth. An IgG concentration of 15–40 g/L in the serum is optimal (24 hours after parturition).⁹ In all 3 flocks, lambs from twin birth and multiple births were effected and therefore they may had a worse colostrum supply and so these lambs were more susceptible to infection. In lambs raised for meat production, management procedures such as shearing increase the risk for joint infection.¹³ In addition to bacterial infections mineral deficiency could lead to lameness, but in all three flocks minerals were within the physiological range (calcium 2,20–3,00 mmol/L; phosphorus 1,30–2,20 mmol/L; magnesium 0,78–1,07 mmol/L; iron 73–179 µg/dl; selenium 21–123 µg/L).

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Table 3: Results of antimicrobial susceptibility testing of *E. rhusiopathiae* isolated from synovial samples

Farm	Antimicrobial susceptibility testing results	
	susceptible to	resistant to
1	Penicillin, Ampicillin, Amoxicillin-Clavulanic acid, Ceftiofur, Cefovecin, Cefquinome, Enrofloxacin, Marbofloxacin, Florfenicol	Doxycycline, Tetracycline, Erythromycin, Clindamycin, Sulfamethoxazole-Trimethoprim
2	Penicillin, Ampicillin, Amoxicillin-Clavulanic acid, Ceftiofur, Cefovecin, Cefquinome, Enrofloxacin, Marbofloxacin,	–
	Doxycycline, Tetracycline, Erythromycin, Clindamycin, Sulfonamid/Trimetoprim Florfenicol	
3	Penicillin, Ampicillin, Amoxicillin-Clavulanic acid, Ceftiofur, Cefovecin, Cefquinome, Enrofloxacin, Marbofloxacin, Florfenicol	Doxycycline, Tetracycline, Erythromycin, Clindamycin, Sulfamethoxazole-Trimethoprim

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Infected lambs should be treated as early as possible. Penicillin (30000 IU/kg BW SID) is recommended as therapy for at least five days additionally a non-steroidal anti-inflammatory drug (Flunixin, Ketoprofen) should be administered for three days. However, recurrence is not uncommon. Chronically infected lambs should be euthanized. Metaphylactic treatment with penicillin after birth is unsatisfactory and rarely prevents polyarthritis.¹⁴ *Erysipelothrix rhusiopathiae* is generally considered resistant to sulfonamides, while susceptibility is variable to streptomycin and tetracyclines,^{12, 19} which is consistent with

our findings from the sensitivity tests. The antimicrobial drug of choice for treatment of *Erysipelothrix* infections is penicillin^{6, 23} or ampicillin,¹⁴ the latter was administered in the described cases. Chronic ovine erysipelas has been described as a disease that is restricted to joints with subchondral bone involvement.^{6, 23}

By anamnestic case history interview the farmer from flock 1 reported that the problems started when there were introduced two pigs for the own use into the farm. There had been no problems with lameness before. So in this case *E. rhusiopathiae* could be probably introduced by the pigs since these pigs were not vaccinated against *E. rhusiopathiae*. Vaccination against *E. rhusiopathiae* in pigs is one of the oldest vaccinations. In countries with large sheep farms, sheep are also successfully vaccinated against *E. rhusiopathiae*.²³ The first immunization of adult sheep and rams takes place every three to six weeks. Revaccinations are necessary every six months, and it is recommended that ewes should be vaccinated four weeks before birth, lambs can be vaccinated first time with the age of eight weeks.¹⁶ Swiss vaccines against *E. rhusiopathiae* are only approved for use in pigs and contain inactivated Serovar 2 and formed antibodies show a cross-reaction against Serovar 1,¹⁷ Antibodies against *E. rhusiopathiae* are excreted via the colostrum. The duration of immunity of *E. rhusiopathiae* vaccines varies between six and 12 months. The efficacy is variable and depends on the type of strains used and use of the appropriate vaccine in different species of animals.^{18, 21} In Australia, between 1995 and 1998,³⁴ swine herds experienced vaccine failure.⁵ The farmer of flock 1 started vaccination of sheep and since this time he had no problems with lameness anymore. There is no corresponding vaccine registered for sheep in Austria and so a herd-specific autogenous vaccine was produced from isolated *E. rhusiopathiae* by a specialized laboratory. In flock 2 there were also pigs at the same farm. Pigs and sheep were kept in the same stable, just separated in two different compartments. In this case *E. rhusiopathiae* could also be introduced by pigs. Flock 3 was the neighbour of farm two. There were no pigs at this farm, however poultry and so *E. rhusiopathiae* could be introduced probably by poultry. Farm 3 did not practice a vaccination program. In this farm all affected lambs were treated with antibiotics systemically, severely affected lambs were euthanized and poultry was eliminated from the farm, after the diagnosis of *E. rhusiopathiae*-associated polyarthritis had been made.

In conclusion, even associated with a low occurrence in Middle European countries,^{14, 19} an *E. rhusiopathiae* infection should be considered as a differential diagnosis in cases of herd problems associated with lameness and polyarthritis in lambs aged between two to 17 months. In lambs with chronic infection, a thickened joint cap-



Figure 4a, 4b: View of the femoral condyles of the femorotibial joint (a) and the corresponding articular surface of the tibia (b) with the menisci at necropsy showing multiple severe full-thickness cartilage lesions on both condyles and on the tibial articular surface characteristic for chronic joint infection with *E. rhusiopathiae*.

sule, a mainly fibrinous joint effusion, and extended erosions/ulcerations of the articular cartilage are characteristic ultrasonographic and/or necropsy findings. However, for stating a definite diagnosis of ovine erysipelas infection sterile sampling of synovial effusion or synovial membrane and a bacteriological culture are crucial. It must be remembered that *E. rhusiopathiae* infection is a zoonosis²² which for veterinarians and farmers is occupationally related, mainly occurring as a result of contact with infected animals, their products or wastes, or contaminated soil.²³ The use of gloves and single-use overall during examination of animals suggestive with an erysipelas infection is highly recommended.

Declaration of Competing Interest

The authors declare that they have no competing interests.

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Polyarthrite causée par *Erysipelothrix rhusiopathiae* dans trois troupeaux de moutons autrichiens – diagnostic, traitement et mesures de gestion

La polyarthrite causée par *Erysipelothrix rhusiopathiae* est une maladie bien connue chez le porc. Chez les ovins, l'infection touche le plus souvent les agneaux âgés de deux à six mois. Ce rapport de cas décrit trois troupeaux de moutons où des agneaux présentaient des articulations enflées et une boiterie. Un accent particulier a été mis sur la clinique, les résultats de l'imagerie diagnostique, les prélèvements de synovie et le mode de traitement. Les agneaux présentant uniquement une légère boiterie, des épanchements articulaires séro-fibrineux et ceux ne présentant pas d'atteinte osseuse, révélée par échographie ou radiographie, ont été traités avec des antibiotiques administrés par voie systémique, sélectionnés à partir des résultats de la sensibilité d'*E. rhusiopathiae* isolé sur les échantillons synoviaux, ainsi qu'avec des anti-inflammatoires non stéroïdiens. Les agneaux présentant une boiterie sévère et des articulations gravement enflées ont été euthanasiés et une autopsie de routine a été réalisée avec un accent particulier mis sur les articulations. De plus, un vaccin autogène spécifique au troupeau a été produit par un laboratoire.

En conclusion, l'infection à *E. rhusiopathiae* doit être considérée comme un diagnostic différentiel dans les troupeaux où l'on constate des boiteries et des polyarthrites chez les agneaux âgés de 2 à 17 mois.

Mots clés: Arthrite, érysipèle ovine, boiterie, gonflement des articulations, échographie, vaccin, radiographie

La poliartrite causata da *Erysipelothrix rhusiopathiae* in tre greggi di pecore austriache – diagnosi, trattamento e misure per la gestione

La poliartrite causata da *Erysipelothrix rhusiopathiae* è una malattia ben nota nei suini, ma l'infezione da erisipela ovina colpisce comunemente anche gli agnelli da due-sei mesi. Questo studio descrive le casistiche in tre greggi di pecore in cui gli agnelli hanno manifestato gonfiore delle articolazioni e zoppia. Un particolare rilievo è stato portato ai risultati clinici e diagnostici di imaging, al campionamento del liquido sinoviale e al trattamento. Gli agnelli che presentavano solo una lieve zoppia, un'effusione liquida delle articolazioni sierofibrine e gli agnelli che non mostravano alcun coinvolgimento osseo, come risultato dall'ecografia o dalla radiografia, sono stati trattati con antibiotici selezionati dai risultati di test di suscettibilità antimicrobica di *E. rhusiopathiae* isolati da campioni sinoviali, e con farmaci antinfiammatori non steroidei. Gli agnelli con grave zoppia e articolazioni gravemente gonfie sono stati eutanasiati e l'autopsia di routine è stata effettuata portando particolare attenzione alle articolazioni. Un vaccino autogeno specifico per l'allevamento è stato in seguito prodotto da un laboratorio specializzato. In conclusione, l'infezione da *E. rhusiopathiae* dovrebbe essere considerata come una diagnosi differenziale nelle greggi associate a zoppia e poliartrite negli agnelli di età compresa tra i due e i 17 mesi.

Parole chiave: artrite, erisipela ovina, zoppia, rigonfiamento delle articolazioni, ecografia, vaccino, raggi

Polyarthritis caused by *Erysipelothrix rhusiopathiae* in three Austrian sheep flocks- diagnosis, treatment and management measures

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References

- 1 Brooke CJ, Riley TV. *Erysipelothrix rhusiopathiae*: bacteriology, epidemiology and clinical manifestations of an occupational pathogen. J. Med. Microbiol. 1999; 48, 789–799
- 2 Capucchio MT, Lanteri G, Marino F, Biasibetti E, Reale S, Guarda F, Macri B. Myocardial infarctions due to *Erysipelothrix rhusiopathiae* infection in an adult sheep. Schweiz Arch Tierheilk 2016; 158 (11), 765–767.
- 3 Clinical and Laboratory Standards Institute (CLSI) Methods for antimicrobial susceptibility testing of infrequently isolated or fastidious bacteria isolated from animals. 1st ed. CLSI Supplement VET06. 2017: CLSI, Wayne PA.
- 4 Cross GM, Eamens GJ. *Erysipelothrix rhusiopathiae* infection. Clinical and gross pathology and bacteriology. In: Australian Standard Diagnostic Techniques for Animal Diseases, Australian Bureau of Animal Health 1987: 1–6.
- 5 Eamens GJ, Forbes WA, Djordjevic SP. Characterisation of *Erysipelothrix rhusiopathiae* isolates from pigs associated with vaccine breakdowns. Vet Microbiol 115, 2006: 329–338.
- 6 Ersdal C, Jørgensen HJ, Lie KI. Acute and chronic *Erysipelothrix rhusiopathiae* infection in lambs. Vet Pathol 52 (4), 2015: 635–43.
- 7 Fthenakis GC, Christoulopoulos G, Leontides L, Tzora A. Abortion in ewes associated with *Erysipelothrix rhusiopathiae*. Small Rum Res 63, 2006: 183–188.
- 8 Griffiths IB, Done SH, Readman S. *Erysipelothrix pneumonia* in sheep. Vet Rec 128, 1991: 382–383.
- 9 Klobasa F, Herbort B, Kallweil E. Erforderliche Versorgung neugeborener Lämmer mit Schafskolostralmilch. 1. Mitteilung: Verabreichungsintervall, 2. Mitteilung: Verabreichungsdauer. Tierärztl Prax 20 (G), 1992: 249–253.
- 10 Lamont MH. *Erysipelothrix rhusiopathiae*: epidemiology and infection in sheep. Vet Bull 49, 1979: 479–495.
- 11 Opriessnig T, Wood RL. Erysipelas. In: Zimmermann JJ, Karriker LA, Ramirez, A. Diseases of Swine. 10th ed. Ames, IA: John Wiley, 2012: 750–759.
- 12 Ozawa M, Yamamoto K, Kojima A, Takagi M, Takahashi T. Etiological and biological characteristics of *Erysipelothrix rhusiopathiae* isolated between 1994 and 2001 from pigs with swine erysipelas in Japan. J Vet Med Sci 71, 2009: 697–702.
- 13 Paton MW, Rose IR, Sunderman FM, Holm Martin M. Effect of mulesing and shearing on the prevalence of *Erysipelothrix rhusiopathiae* arthritis in lambs. Australian Vet J. 81, 694–697, 2003
- 14 Pfister P, Wollschläger N, Kirchhofer M. *Erysipelothrix rhusiopathiae* polyarthritis as a herd problem on a milk-producing sheep farm. Tierärztl Prax 35 (G), 2007: 203–209.
- 15 Pierson RE. Polyarthritis in Colorado feedlot lambs. J Am Vet Med Assoc 50, 1967: 1487–1492.
- 16 Scott PR. Infectious polyarthritis. In: Sheep Medicine. London: Manson Publishing. 2007: 212–218.
- 17 Selbitz HJ. Schutzimpfung bei Schaf und Ziege. In: Tierärztliche Impfpraxis. Stuttgart: Enke, 2003: 89.
- 18 Shimoji Y. Pathogenicity of *Erysipelothrix rhusiopathiae*: virulence factors and protective immunity. Microbes Infect 2 (8), 2000: 965–972.
- 19 Sodoma E, Krassnig G, Dünser M. Rotlaufkrankungen beim Schaf. Klauentierpraxis 26, 2018: 111–113.
- 20 Spengler J, Loncaric I, Tichy A, Fritz J, Scope A. The culturable autochthonous microbiota of the critically endangered Northern bald ibis (*Geronticus eremita*). PLoS One 13(4). 2008:e0195255.
- 21 Swan RA, Lindsey MJ. Treatment and control by vaccination of erysipelas in farmed emus (*Dromaius novohollandiae*). Australian Vet J 76, 1998: 325–327.
- 22 Tan EM, Marcelin JR, Adeel N, Lewis RJ, Enzler MJ, Tosh PK. *Erysipelothrix rhusiopathiae* bloodstream infection – a 22-year experience at Mayo Clinic, Minnesota. Zoonoses Public Health 64, 2017: DOI: 10.1111/zph.12348.
- 23 Wang Q, Chang BJ, Riley TV. *Erysipelothrix rhusiopathiae*. Vet Microbiol 140, 2010: 405–417.

Corresponding author

J. Schoiswohl
University Clinic for Ruminants,
Department for Farm Animals and Veterinary Public Health,
University of Veterinary Medicine Vienna
Veterinärplatz 1
1210 Vienna, Austria
Telefon: +43 125 077 52 03
E-Mail: julia.schoiswohl@vetmeduni.ac.at