Proceedings of the 13th International Symposium and 5th Conference on Lameness in Ruminants

11th - 15th February 2004, Maribor, Slovenija

Session 11 - Miscellaneous

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Introduction

The carpus in cattle is frequently affected by a number of different diseases. Although studies of various regions of interest as well as pathological cases have been published (Kofler 1995, 2000), a complete ultrasonographic survey of the carpal region in cattle is lacking. The aim of this study was therefore to create a standardised ultrasonographic examination procedure of the carpal region based on the anatomical structures.

Material and Methods

All examinations were carried out with a real-time ultrasound unit Sonoline Prima (Siemens), equipped with a 5/7.5-MHz multi-frequency linear transducer. For a better imaging of surface-near structures, Aquaflex®-Gel-Pads (Parker Laboratories, Inc., NJ) were used.

Initially, 8 isolated cadaver specimens were prepared to show the topographic anatomy, and directly scanned to recognize the typical ultrasonographic appearance. Later in 13 cadaver limbs, frozen sections of the carpus were made, prepared and photographed.

Plane 1: At the level of the distal physis of the radius.
Plane 2: At the level of the palpable joint space of the antebrachiocarpal joint.
Plane 3: At the level of the palpable intercarpal joint space, distal to the Os carpi accessorium.
Plane 4: At the level of the palpable carpometacarpal joint space, proximal to the Os metacarpale quintum.

Results

A concise picture of each of the 32 carpal planes could be produced using this examination procedure. The topography of each ultrasonographic picture could be explained in detail by means of illustrations and by comparing it to the corresponding frozen anatomical section (Fig. 2). By doing so, a good comparison of the structures in the ultrasonographic images and the anatomical parts could be made.

The carpal flexor and extensor tendons, partially their tendon sheaths, the medial and lateral collateral ligament, the ligamentum accessorimetacarpum and the surfaces of the carpal bones could be imaged without major problems. The only exception was the musculus abductor pollicis longus. This muscle had to be examined in an oblique direction. With this ultrasound system, it was not always possible to distinguish it clearly from the surrounding tissue.
Fig. 2: Example images of one examination plane: Plane 3 - mediopalmar - horizontal.
Upper left: transducer position. Upper right: ultrasound image. Lower left and right: anatomical section and drawn illustration of the same region as in the ultrasound image.
R = radius; Ci = Os carpi intermedium; Ca = Os carpi accessorium; Flexdigsup = Musculus flexor digitorum superficialis (o: surface near, t: deep part); Flexdigpro = Musculus flexor digitorum profundus; Flexcarprod = Musculus flexor carpi radialis; Flexcarpuln = Musculus flexor carpi ulnaris; MSB = medial collateral ligament; Haut = skin;

Ultrasonographic imaging of the larger vessels and the median nerve, running over the palmar and medial aspects of the carpus, required some practice and was not possible in every case. The antebrachiocarpal joint space and the intercarpal and carpometacarpal joint spaces could be clearly defined as interruptions of the echo-genic bone surfaces, whereas the joint pouches could only be detected around the dorsal and the lateral aspects. The joint capsules could not be identified. In young animals the cartilaginous growth plates of the distal physes of radius and ulna could be seen as anechogenic zones interrupting the hyperechogenic bone surface.
The experimental filling of the joints showed that the joint pouches of the carpus could be illustrated most easily close to the puncture sites of joints described in the literature. This worked out best when holding the transducer vertically.

Discussion
For a reliable ultrasound examination, a thorough knowledge of anatomy is prerequisite (Kofler 2000). To get accurate information out of every region of interest, however, typical images of each single plane together with the corresponding anatomical sections and drawn illustrations are very helpful. Based on these reference images, an ultrasonographic examination of both healthy and diseased carpal joints can be performed easier.

References
1) Corrosive effects of concrete on buffalo hooves
A request from the attending Veterinarian to travel 400 kilometres to examine a very lame, valuable buffalo bull was fulfilled. A number of buffalo from a disease breeding facility had been purchased a few weeks previously. The animals had been placed under roof in concrete pens similar to the previous lodgings. The new facilities were over 1 year old.

On arrival, the buffalo bull was crawling around on his elbows and knees. Due to his aggressive behaviour it was decided to bleed and examine hooves of some of his herd mates. It was very noticeable that the hooves of the darted buffalo were freshly and severely worn. The bull was heavily sedated and examined. All 8 claws had been worn down to the sensitive lamina with a few areas covered by a paper thin sole that was readily and simply peeled away. Prognosis was ZERO and the owner was advised to euthanasia on welfare grounds. Due to the value and extreme reluctance of the owner, and against veterinary advice, it was decided to try and treated subsequently the less severely claws on all 4 feet were blocked. The blocks were attached solely to the hoof walls with cotton wool padding between the exposed sensitive lamina and the blocks. Painkillers and antibiotics were administrated systemically and the bull was placed in a rapidly erected outside camp with relatively soft soil. A better history revealed that due to the bull’s aggressive nature he had, with the previous owners, been kept in an adjoining camp (without concrete flooring) that was wet and damp in certain areas. Consequently, his hooves were softer than the other buffalo and were not adapted to concrete. The new facilities, although over 1 year old, had never been used nor hosed down and were well protected from the elements. The concrete was therefore relatively fresh and very abrasive and together with the aggressiveness of the buffalo bull with the continual pacing and mock charging and his relatively soft, non-adapted hooves, disaster was eminent. The case is well illustrated.

2) Progressive complications of the claws of a Holstein Bull
Occasionally requests to attend complicated hoof problems of valuable bulls at a large semen producing concern arise. A 6-year-old Holstein bull with a very disjointed history was one such request. The initial complaint was of a severe all round lameness and that the claws seemed to be peeling away from the coronets. The first visit revealed a lame bull with severe chronic interdigital dermatitis but as the resident veterinarian was unavailable it was not certain if this was the correct animal. Curative trimming was attempted and along with the severity of the lesions and since the bull was unproven as regards semen quality and genetics the prognosis was guarded. Two weeks later, a second visit to the same bull was met with a significant deterioration with a severe weight bearing lameness, especially of the front feet. All 8 claws showed severe, deep, black “V”, eroded ridges typical of interdigital dermatitis but with “golf-ball” like swellings in zone 6, axial to the ridges, involving the heels. These swellings were hard and painful on palpation. Curative trimming with reducing ridge wall and cap of the “golf-ball” swellings was attempted plus the right fore lateral claw was blocked to try and ease the extremely painful medial claw. Daily phenylbutazone per os was recommended. It was then discovered that the bull had been placed in a formalin footbath daily for over 3 weeks. A third visit, 2 weeks later, found the bull much improved with an increased appetite and more ambulatory but with pronounced the left hind leg lameness. Both hind feet exhibited lesions as described previously but also with large necrotic scabs between the claws and just above the bulb region. Removal of the sensitive scabs left raw, well-circumscribed lesions that possibly could be confused with digital dermatitis but probably were the aftermath of excessive formalin exposure. Both block feet produced very large tylomas in addition to the already existing typical tylomas which were extremely painful and had to be removed surgically. Topical oxytetracycline and a tight bandage were applied with good results. The later tylomas were possible due to severe irritation from the corrosive effect of the formalin and complicated by secondary infection from the interdigital dermatitis. The case is still pending and is well illustrated.

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**Summary**

This paper presents ten cases of true neoplasms located on bovine extremities. Neoplasms are rarely diagnosed in cattle. Clinical presentation, ultrasonographic findings, the results of the necropsies and pathohistological findings are presented. The diagnoses were a synovial sarcoma, a chondrosarcoma originating at the cartilage of the right scapula, metastases of an adenocarcinoma of unknown primary, a fibrosarcoma, two...
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fibromas as well as a fibropapillomas, two squamous cell carcinomas of the distal phalanx and a carcinoma of the convoluted glands.

Introduction

Contrary to humans with the highest frequency of neoplasms followed by dogs, horses and cats, tumours are less common in cattle and have not been well documented in literature. There exist only a few reports about neoplasms originating from the extremities of cattle (Alton and Kofler, 1998). Neoplasms of the cartilage are extremely rare in cattle (Richardson and Acland, 1982). Several studies on neoplasms showed an incidence of chondrosarcoma on bovine species of less than 0.1% of all tumours recorded (Anderson et al., 1969; Shorridge and Cordes, 1971). Benign neoplasms on the limbs can also disturb normal movement mechanically and thus cause lameness. Malignant neoplasms destroy the surrounding tissues by infiltrating growth. Benign limbneoplasms can also disturb normal movement mechanically and thus cause lameness. Cartilaginous neoplasms, whether malignant or benign, are relatively rare in all domestic species. Chondrosarcoma is more common than its benign counterpart. Only a few cases of bovine chondrosarcomas have been described in detail, all of which being recorded as originating in the sternum and the ribs.

Material and Methods

The case records comprising clinical, radiographic and ultrasonographic findings as well as the results of necropsies and pathohistological findings from 10 cattle, ranging from 6 months to 8 years old, with various neoplasms originating on the limbs are presented. All patients underwent routine clinical examination. Blood samples were taken during hospitalisation. Depending on the size and the localisation of the tumour, ultrasonographic and radiographic examination was done. Ultrasonography was carried out with the Sonoline Sienna (Siemens) unit, equipped with a 7.5 MHz linear and a 3.5 MHz convex transducer. Radiography was performed with the Super 100 CD (Philips). Digital radiographic examination was done with the Fuji FCR AC - 3 unit (Fuji). Biopsies and/or fine-needle aspiration cytology were performed in some cases. Tissue samples obtained either by biopsy or during necropsy were fixed in 7 per cent neutral buffered formalin and sections were stained with haematoxylin and eosin (HE).

Results

A 6-months-old male calf had a congenital synovial sarcoma. After the first operation done by the referring veterinarian the tumour had immediately recurred. The calf presented with a partly crude, partly soft-to-elastic tumour double the size of a human fist midway between the right hock and stifle joints on the dorsolateral aspect of the tibia, the surface being ulcerated and partly necrotic. On pathohistological examination a malignant synovial sarcoma was diagnosed.

An 8-year-old Simmental cow presented with anorexia and a firm, painful swelling of the right shoulder region. Weight loss and respiratory distress had occurred within the last weeks. Clinical examination revealed a poor body condition. The normal bone structure of the right shoulder was totally destroyed, ultrasonography showed many irregularly shaped, hyperechoic small reflexes. A chondrosarcoma, which had already spread to the lungs, was diagnosed.

An 8-year-old Simmental cow was referred a subcutaneous phlegmon involving a melon-sized, crude tumour on the caudolateral aspect of the right hind limb. The pathohistological examination revealed metastases of an adenocarcinoma of unknown primary. These were found in the muscles of the right hind limb, the lung and the pleura.

A 3.5-year-old Simmental cow had been referred with the history of a slowly growing neoplasm of two years duration. On the lateral aspect of the elbow a tumour nearly spheroid, possibly having its origin in the skin, was diagnosed. Pathohistological examination was consistent with the suspected diagnosis of a fibropapilloma. The cow was discharged two weeks after surgical treatment.

A 1.5-year-old Simmental heifer presented with a tumour of the claws of the right hind limb. After the first operation done by the referring veterinarian the tumour had immediately recurred. After pathohistological examination a diagnosis of fibrosarcoma was made.

Two cows in this study were diagnosed with a fibroma after pathohistological examination of the tissue samples. A 6-year-old Brown Swiss cow presented with a painless growth double the size of a human fist localised on the left tuber coxae. In the case of a 6-year-old Simmental cow the melon-sized tumour was situated on the left calcaneal region.

A 3-year-old Simmental showed a severe lameness of the right frontlimb. Radiography revealed extensive osteolysis of the medial distal phalanx. The first clinical diagnosis of an apical pedal bone necrosis was followed by amputation and pathological examination of the claw. Macroscopically, the horn capsule showed no lesions. The pathoanatomical examination of the sagittally transected claw revealed a soft consistency of the pedal bone and a yellowish crumbling material, had replaced most of the pedal bone. Histologically a poorly keratinized squamous cell carcinoma was identified. The cow was discharged five weeks after surgery.

A similar tumour was found in a four years old Simmental cow. This cow presented a moderate lameness of the right front limb caused by white line disease and necrosis of the pedal bone.

A six year -old Simmental cow presented a severe lameness of the right hindlimb and a severe swelling of the coronary region. The diagnosis of a purulent necrotising arthritis of the distal interphalangeal joint was followed by amputation. On pathohistology a carcinoma of the convoluted glands was diagnosed. Four weeks after surgery the cow was discharged from the clinic.

5 cattle showing tumours on the claws, the elbow and cal-
caneal region were surgically treated with good success: digital amputation allowed removal all the affected tissues in this area and the fibropapilloma of the elbow region and the fibroma of the calcaneal region were well demarcated from the underlying tissues.

Discussion

According to relevant literature, tumours are less common in cattle than in other species. In the authors opinion this might be due to the fact that most cattle are slaughtered before reaching a higher age, which is probably a predisposition for the development of neoplasms. Neoplasms of the extremities present with a slowly developing growth. In some cases, lameness is not caused by pain or destruction of the joint itself or adjoining structures, but by mechanical obstruction alone. Infiltration of surrounding tissues, metastases in regional lymph nodes or other organs as well as anorexia, loss of milk yield, emaciation and perhaps fever are signs of malignancy. Benign tumours, on the other hand, are characterised by solitary appearance, slow growth, good demarcation from the surroundings, absence of metastases, good general condition and appetite.

Diagnoses were made after clinical, radiographic and ultrasonographic and most importantly the patho-historical examinations of tissue samples fixed in 7 per cent neutral buffered formalin. It is most important to take the samples from various parts of the suspected neoplasm in the zone between sound and diseased tissue. Surgical excision of neoplastic bone and cortical or osteochondral allograft is used in small animals and humans (Brown and Cruess, 1982; Hanson and Markel, 1992) but is not practicable in cattle and horses. In these species weight bearing on the affected limb after extensive resection of neoplastic bone can lead to instability and pathological fractures. Although reconstruction and use of prosthesis after surgery of malignant bone tumours is performed in humans (Wada et al., 1999) this technique is not feasible in large animals. Chemotherapy should be only performed in pets and not in production animals. Surgical intervention is of limited use in malign neoplasms, because the animals will not be referred until the disease has already spread to vital organs. In benign cases, the outcome of the operation depends on the size and site of the tumour and the treatment costs.

References


Introduction

Ruminants kept in a zoological garden under conditions simulating the wild are difficult orthopaedic patients. Examination and treatment is only possible under general anaesthesia and the necessary changes of bandages until the wound is healed poses a problem. Repeated general anaesthesia carries a high risk in ruminants, quite apart from the costs. In many cases it is not even possible to separate the patients from the herd during convalescence. Even if it seems possible to shut the patient in a stable, the wild animal may suddenly go beserk, breaking its neck in the attempt to break free.

Material and Methods

A 2-year-old Pére David hind of the wild park Gänserndorf presented with a severe lameness of the right front limb. Not being domesticated, it had to be narcotised using a blow pipe (Immobilon®). The clinical examination including x-rays were performed under general anaesthesia. The operation was performed after the application of a tourniquet under additional regional intravenous anaesthesia using 10 ml of procaine-hydrochloride (Minocain® 2%, Atarost, Germany). A tourniquet of rubber tubing was applied directly to the middle of the metacarpus.
Results

The right lateral claw showed a hole at the tip of the toe. The claw itself was partly exungulated. There was no swelling of the soft tissues proximal to the coronary band. The loose parts of the claw horn were removed. The corium was necrotic with a superimposed infection. The distal third of the pedal bone showed a possible pathological fracture with bone necrosis, yellow to greenish in colour. The x-ray findings were consistent with a diagnosis of pathological fracture showing marked osteolysis of the bone structure. The diseased bone was removed using a hammer and mallet. The resulting wound cavity was lavaged with isotonic saline solution with diluted 0.1% polyvidon-iodine-solution. Ampivet® (100 mg/ml Ampicillin-trihydrat) was used as a local antibiotic treatment. This was supplemented with a long acting penicillin given intramuscularly (Duplocillin®, Mycoform, Netherlands). A protective wound bandage up to the middle of the metacarpus was applied. The bandage was changed three times having stayed in place for a week. At no time did the wound show any signs of infection and healed very fast. Four weeks after the operation the hind was successfully reintegrated in the herd.

Follow-Up

Three months later a slight lameness recurred. The hind was in heat at that time and therefore pestered by the male deer. An orthopaedic control examination of the claw showed normal findings. After a separation for three days, she was reintegrated into the herd showing no signs of a lameness. The hind is still alive and well.

Discussion

Reports on the orthopaedic treatment of wild ruminants are rarely found in the relevant literature with a preponderance of case-reports (Butt et al., 2001; Cruz et al., 1999; Kaneps, 1996; Toews et al., 1998). Treatment and surgery was performed as described in cattle (Kofler, 1999). The long-term prognosis depends not so much on the medical problem itself as on the post-operative management. As soon as lameness persists, the hind instinctively tries to rid itself of the animal in question because of a possible liability in a conflict with a predator. The lame deer is attacked by the males of the herd and are not strong enough to fight for their share of the feed leading to death by starvation. If the deer can be separated, one has to take care that it is returned as quickly as possible to its natural habitat. In our case, the wound healed quickly enough for the animal to be turned out in time to get the winter coat. Another problem with residual lameness is the public opinion of the visitors. With the best intentions, visitors might report the zoo to the authorities leading to expensive law suits.

References


TREATMENT OF INFECTED WOUNDS AND ABSCESSES IN BOVINE LIMBS WITH LIGASANO®-POLYURETHANE-SOFT FOAM DRESSING MATERIAL

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Introduction

Reports on the treatment of wounds in bovine patients and wound healing abnormalities in bovines are rare compared with the corresponding literature in horses. The treatment of traumatic injuries with subsequent infection of the digital flexor tendon sheath and the therapy of traumatic exungulation and bone sequestration in limbs was described in cattle by some researches (1, 3, 5, 7, 10). Other authors reported on the surgical therapy of infected abdominal incisions after abdomapexy, cesarean section and colic surgery in cattle (3, 6, 9).

In cattle, regarding the treatment of wounds beside the surgical techniques and the possibilities that are available, it is necessary to incorporate also economic aspects for the prognosis. So, if there are dressing materials available that are not expensive and have been proven in human medicine, they should be applied also for wound therapy in cattle (11-12).

Polyurethane-soft foam dressing material is frequently used in human patients since many years for treatment of infected wounds, as postoperative wound dressing material, for the prophylaxis of decubital ulcers and for mechanical wound debridement (11, 12).
polyurethane-soft foam dressing material has been used also with good results for therapy of various large sized wounds in equine and bovine patients since about 5 years at our clinic. The objective of this report is present this special polyurethane-soft foam dressing material for the treatment of wounds in bovine limbs, to show its most important indications and to illustrate the healing progress and the outcome of selected clinical cases which were treated with Ligasano® polyurethane-soft foam dressing material.

Material and Methods

For this study 23 bovine patients were selected which were treated between 2001-2003 at the clinic for infected cuts and laceration wounds (n=14) on the limbs with involvement of digital joints, for large abscesses in the tarsal and thigh region (n=7), intertrigo on the distomedial crural region (n=1) and for deep puncture wounds leading to purulent tenosynovitis of the digital flexor tendon sheath (n=4) by carrying out a total resection of both digital flexor tendons, and open surgical wound management. After routine wound cleaning, wound debridement or surgical intervention with subsequent wound lavage, Ligasano®-polyurethane-soft foam dressing material (Ligamed medical products, Cadolzburg-Wachendorf, Germany) was applied as a direct wound dressing instead of conventional cotton gauze swabs, or as drainage material in all cases. Ligasano® is available sheets 59 x 49 x 1 cm, and can be cut to size and shape for any wound, and can also be sterilised.

Results

Depending on the wound depth Ligasano® can be applied as a sheet onto the wound, or as a roll pushed into the wound, to cover both the surface and margin, so that they are in full contact with this material under moderate pressure. Its porous and alveolar surface structure causes mechanical wound cleaning and a mechanical stimulation of the wound surface resulting in an increased exudate and decreased fibrous adhesions and adhesions of bacteria. The large suction effect of this bulky porous wound dressing material ensured good drainage of exudate, avoiding the accumulation of exudate and resultant maceration of the surface. Ligasano® stimulated the formation of healthy granulation tissue over a level wound surface. In all cases of digital joint and purulent digital flexor tendon sheath infections, starting with surgical treatment, no purulent exudate was observed during the postoperative healing period. Also when this material was used for drainage of large abscesses incised on the lateral aspect of the tarsus, distal crural and caudal thigh region, only a slightly purulent exudate was noted and rapid secondary closure by granulation tissue could be seen. The adhesion of this material to the wound surface, even when mainkained in place for several days was not as great as with gauze. The detachment of a gauze dressing usually caused extensive bleeding. In contrast the Ligasano® dressing could always be easily detached from the wound when soaked with saline solution.

Discussion

In contrast to many other wound dressings Ligasano® can be cut in one piece from sheets 59 x 49 x 1 cm appropriate to the particular the wound. In all the above mentioned indications for Ligasano® treatment either no or a slight purulent exudate was observed. Especially in treatment of purulent tenosynovitis with complete resection of the superficial and deep digital flexor tendons of one digit the healing period was much shorter (about 14 days) then reported previously (5, 8).

The therapeutic success with Ligasano® was so convincing in these cattle, that currently this material is used more or less exclusively as primary dressing material in bovine orthopaedic patients in our clinic and conventional cotton gauze swabs (1, 2, 8) have been discarded.

References

Introduction

Actinobacillosis is a well-recognised condition in ruminants (Swarbrick, 1967) caused by infection with the Gram-negative bacterium Actinobacillus lignieresii. Classically, the best known conditions of actinobacillosis in cows are “wooden tongue” and local infections of the pharyngeal region in cattle (Gillespie and Timoney, 1981). Other forms of actinobacillosis in cattle are described in different publications. In this poster, a presentation of Actinobacillus lignieresii infection is described on the hind legs, which gave problems in two 1-2 years old animals. Although this form of actinobacillosis has been described earlier e.g. by Weaver and others, it has never been reported before in the Netherlands.

History

Two Holstein-Friesian yearlings (18 and 20 months old) were presented to the local practitioner with “potato sized” nodules on one hind leg, which started to bleed when touched. The farmer had moved from another dairy farm to this location last winter, where cows had never before been kept. The housing of the milking cows was new build cubicles, while the young stock were housed in a reconstructed existing building. The lesions were first noticed in spring and had increased during the last 2 months.

Clinical inspection and pathology

Clinical inspection, revealed that the two yearlings were in good condition, but smaller than animals of the same age in the group. None of the other animals showed lesions. Nodules were present on the right hind legs of both animals and located on the dorsal and lateral surfaces of the tarsus, metatarsus, ferlock and on phalanx I (see Pictures). The round-shaped nodules had a maximum diameter of 12cm, and had a broad contact place with the skin. The nodules were firm and painful, and bled easily. It seemed that the nodules were located on skin or subcutis without contact with bone. The regional lymph nodes were not considered enlarged.

One non-pregnant animal was slaughtered and the affected hind leg presented to the pathologist for further investigation. Macroscopica examination revealed three well defined, protruding round processes in the skin with a firm wall and a fibrous aspect on cross-section. The subcutis surrounding these masses was oedematosus. At histological examination the diagnosis of actinobacillosis was made, based on the characteristics of the macroscopical and histological aspects of the process. The specific microscopic features included: micro-abscesses with granules, consisting of colonies of bacteria with a circle of surrounding eosinophilic-like bodies. It was not possible to isolate the bacterium. This rarely happens and could have its origin in the fact that the process is often presented to the pathologist in a very late phase, and/or the animals have been treated with antibiotics.

The other yearling was treated with streptomycin (25 mg/kg b/w.) for twelve days, following post-mortal diagnosis. The leg lesions resolved satisfactorily.

Conclusion

The diagnosis usually can be made based on clinical and post-mortem examination. Frequently, it is not possible to isolate the bacterium.

THE ISOLATED HAEMOPERFUSED COW LIMB AS A MODEL FOR STUDYING THE PATHOGENESIS OF BOVINE LAMINITIS

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Introduction

According to many authors, laminitis is regarded as the most important predisposing factor for the development of lameness (GREENOUGH, 1985; BOOSMANN, 1991; LISCHER, 1994; COLLICK, 1997). Nevertheless, the pathomechanisms of laminitis in cattle are still poorly understood. Many theories, whose experimental proof are still pending, exist. The knowledge on the pathophysiology of equine laminitis derives extensively from animal experiments. Animal experiments, however, are problematic under ethical and economical considerations.
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Isolated limb perfusion models represent a potential alternative for animal experiments. A number of different isolated organ models, including an isolated porcine limb model already exist. These models are used by the pharmaceutical industry for development and testing of drugs. Examples are the isolated perfused pig heart (LUEGER et al, 2002) and the isolated perfused bovine udder (KIETZ-MANN et al, 1993). The aim of our work was to develop and characterise an isolated haemoperfused cow limb model, based on a pre-existing porcine limb model (WAGNER et al, 2003). This work is part of the fundamental research work done under the Lamecow project. The first developmental phase will be followed by an experimental phase, i.e. a series of studies on the effects of bioactive molecules on the claw tissue.

Material and Methods

The perfusion apparatus and regularisation mechanism were taken from the porcine limb model. All parameters were under similar physiological conditions, only perfusion flow and pressure had to be calculated based on values given in literature for equine and porcine limbs, since there are no cattle specific values published. ROBINSON recorded in 1974 measurements of equine limbs. He found pressure values of 93-154 mmHg and flow values of 24-116 ml/min. SCOTT et al recorded in 1978 pressure values of 78-130 mmHg and flow values of 25.5-80 ml/min in equine limbs. For the pig comparable values were published (flow values of 100-250 ml/min and a pressure value of 100 mmHg) (NOGUEIRA et al, 1999; WAGNER et al, 2003).

Isolated limbs and blood were obtained from routinely slaughtered healthy cows older than 24 months from local abattoirs. Immediately after slaughter the arteria metacarpa dorsalis III and arteria digitalis palmaris communis III were cannulated and injected with an oxygenated electrolyte solution supplemented with glucose, heparin and insulin until the outflow solution was clear. Then the limb was transported to the laboratory at 4°C, where it was connected to the perfusion apparatus. The perfusion apparatus developed by Vitrotec Entwicklungs GmbH, Berlin, Germany, comprised two circuits, a perfusate and a dialysate circuit. They are connected through a capillary dialyzer (Hemoflow F7 low flux, Fresenius) for oxygenation and exchange of metabolites.

First perfusions were conducted with a pressure of 100 mmHg and a resulting flow of 230-250 ml/min over a total time of 4 hours. The light microscopic analysis did not show cell degeneration, but vascular dilations and interstitial oedema were located in all regions of the claw. The following limbs were perfused with a lower and constant flow of 150-200 ml/min. The resulting pressure varied from 30 to 117 mmHg. The light microscopic analysis indicated only few thromboses in a couple of smaller vessels. There was no indication of cell and/or tissue damage. When the 4 hour perfusions provided satisfactory results, the perfusion period was extended to 5 hours. The light microscopic analysis showed pressure-related damage limited to the wall region, where we found vascular dilations and cellular necrosis in the apical third of the dermal lamellae. In all other regions of these claws however, there was no histological indication of cell damage. The potassium content in no perfusion exceeded 5 mmol/l.

Discussion

For perfusion of the isolated pig limb it was an acceptable method to adjust the pressure to 100 mmHg. The resulting flow amounted generally to 230-250 ml/min. After the first perfusion it seems, that these parameters could be transferred. However the light microscopic analysis indicated vascular dilations and oedema showing that the exposure to the vessels was too intensive. The limbs evinced a sizable variance in the vascular diameters, so that in some limbs a pressure of 100 mmHg effected a very pathological flow (> 400 ml/min). To achieve reproducible results in spite of the different vascular diameters, a constant flow interval had to be defined and the resulting pressure recorded (unless > 150 mmHg). With very large vessels the flow interval contained pressures of 30-50 mmHg. But these low pressures, according to current knowledge, were not physiological and microscopic analysis also suggested that the perfusion is not adequate. Therefore it is recommended one should eliminate these limbs in the slaughterhouse.
already.
The degenerative alterations in perfusions 9 and 10 suggest an outflow disturbance. During a perfusion there is the possibility of vascular obliteration initiated by thrombosis. If a bigger vessel is occluded, the pressure will increase. Occlusion of a small vessel remain undetected until light microscopic analysis. Morphological evaluation of tissue integrity turned out to provide the most valuable information whereas the pyruvate/lactate ratio was less valuable. In all perfusions the light microscopic analysis supplied the most authentic information about the tissue vitality and integrity in the perfused claws. During 8 to 10 further perfusions the developmental phase will be finished. Subsequently, the model will be used to study the effects of reduced flow rates and reduced oxygen levels on the tissue.

This work was funded by the EU Lamecow project OLRT-2001-00969.

Figure 1: Isolated limb and technical equipment during perfusion

Figure 2: Micrograph from the wall region of a perfused limb showing intact dermal and epidermal laminae. H&E stain, x 125. Insert: Physiological cell morphology in the strata basale and spinosum. X 250.

Figure 3: Time course of blood pressure, perfusion flow and organ resistance during a limb perfusion

References

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Introduction

General: The causes of claw diseases can be attributed to various factors, however, most frequently they are associated with housing systems, nutrition, genetic factors, breeding influences and physiological state. Increasingly intensified milk production in the last three decades has led to an exaggerated rise in the occurrence of non-infectious claw diseases. Relatively little is known about the cellular and molecular processes behind these disorders. To date few investigations have dealt with the complex interactions of proteins and other signal-producing molecules with cellular structures. On the contrary extensive studies have been done with human skin in this field. A number of them involve GJIC (Gap Junctional Intercellular Communication), may to play a crucial role in maintaining tissue homeostasis including differentiation and stratification processes.

GJ and connexins (figure 1): In almost all tissues the transmission of information between cells takes place via gap junctions. These channels directly connect the cytoplasm of neighbouring cells. They are formed through concentrations of certain proteins, so-called connexins. The connexins belong to a multigene family composed of at least 20 members in humans. Based on similarities in sequences they were divided into 2 groups: and connexins. The current nomenclature refers to the molecular weight of the protein. Six connexins together build up so-called hemichannels, or connexons, which are then integrated into the gap junctional plaques of the cell membranes. Because most of the cells express more than one connexon type, there are homomeric (consisting of a single connexin type) and heteromeric connexons (consisting of various connexins). In order to build a functional channel, it is necessary that the extracellular domains of connexons from neighbouring cells interact with each other. Depending on the combination of homomeric or heteromeric connexons, homotypical, heterotypical or heteromeric gap junctional channels can be formed, which allow the passage of low weight molecular substances (1 kDa) such as ions, metabolites and second messengers. In human skin 10 different transcripts for connexins (Cx26, Cx30, Cx30.3, Cx31, Cx31.1, Cx32, Cx37, Cx40, Cx43 and Cx45) have been discovered so far. Seven of them (Cx26, Cx30, Cx31, Cx32, Cx40, Cx43 and Cx45) have been approved on the protein level by immunohistochemical methods (Di et al, 2001). Best studied in human skin are Cx26 and Cx43. Gap junctions of human keratinocytes mainly consist of Cx43 (Guo et al, 1992) which can be found in all living epidermal layers in both interfollicular epidermis and epidermal appendices. Cx26 is mostly found in the appendices where it is co-localised with Cx43 (Salomon et al, 1994), rare in interfollicular epidermis but conspicuously expressed in the skin of palms and soles (Salomon et al, 1994, Lucke et al, 1999). Cx31 and 37 occur in human skin suprabasal in spiny cell and granular cell layers (Richard, 2000).

Materials and Methods

Tissue: Tissue samples were obtained from 5 regions of bovine hooves of slaughtered dairy cows provided by local abattoirs. Claws were sectioned on a band saw and samples were cut out. Subsequently tissue samples were either fixed in neutral buffered formaldehyde for 24 hours or embedded in Tissue-Tek® fresh snap frozen in liquid nitrogen and stored at -80°C. Dehydration for wax embedding was done in a Histokinet (Shandon) and the tissue was embedded in paraflin wax. 4-5 μm sections (cryosections 8 μm) were deposited on Capillary Gap Microscope Slides 155 μm (ChemMate®, DakoCytomation, Hamburg). Cryosections were fixed in ice cold acetone for 8 min. before immunostaining.

Immunohistochemistry: All reagents were from the ChemMate series (DakoCytomation, Hamburg). Slides with sections were washed with Buffer 1 and positioned into a immunostainer (TechMate -Horizon, DakoCytomation, Hamburg). The automatically run staining protocol included the following steps: rinsing with buffer, incubation with the primary antibodies (Rabbit anti-Mouse Cx26, Rabbit anti-Mouse Cx31, Rabbit anti-Mouse Cx37, ADI, USA; Mouse anti-Mouse Cx43, Chemicon, USA) for 35 min, rinsing with buffer, peroxidase block, incubation with the secondary antibody Goat anti-Rabbit and Mouse coupled with peroxidase labelled dextran (ChemMate EnVision /HRP, Rabbit/Mouse, Dakocytomation, Hamburg), rinsing with buffer, incubation with the chromogen diaminobenzidine, washing and counterstaining with haematoxylin. Cover slides were mounted with Canadabalm. Specimens were examined with a Olympus BX51 light microscope equipped with a Colour view® digital camera (SIS).

Electron microscopy Samples were fixed in Karnovsky’s solution, rinsed with Cacodylatbuffer, postfixed with osmic acid solution (OsO4, 1%), dehydrated and embedded in epoxy-resin. Semithin sections were prepared and stained with Toluidine blue. Ultrathin sections of selected areas were stained with uranyl acetate and lead citrate. Samples were examined with a Zeiss EM 10 transmission electron microscope.
Cx26, 31, 37 and 43 in bovine hoof tissue immunohistochemistry in bovine keratinocytes. We were not able to detect unequivocal levels of Cx26, Cx31 and Cx37 by immunohistochemically detectable levels of Cx43. The staining pattern described above was present in epidermal tissue from all the five regions of the bovine claw (Coronary, Wall, Sole and Bulbar region). We were not able to detect unequivocal levels of Cx26, Cx31 and Cx37 by immunohistochemistry in bovine keratinocytes.

**Results**

Connexin 43 expression in bovine claw epidermis (figures 3 and 4) To assess whether keratinocytes from bovine claw epidermis express connexin proteins we performed immunohistochemical analysis using four commercially available anti connexin antibodies (Cx26, Cx31, Cx37 and Cx43). We found a punctuate staining pattern for Cx43 at the plasma membrane from keratinocytes implying that the protein occurred at gap junctional plaques between adjacent cells. In the same position gap junction formation was confirmed by electron microscopy (figure 2). Basal cells expressed high levels of Cx43 protein. In suprabasal layers (stratum spinosum) Cx43 expression declined to a weak staining in the stratum granulosum and in terminal differentiating cells. The stratum corneum from bovine claw epidermis did not contain immunohistochemically detectable levels of Cx43. The staining pattern described above was present in epidermal tissue from all the five regions of the bovine claw (Coronary, Wall, Sole and Bulbar region). We were not able to detect unequivocal levels of Cx26, Cx31 and Cx37 by immunohistochemistry in bovine keratinocytes.

**Discussion**

As part of investigations of cellular biological causes for lameness in dairy cattle, we examined the expression of Cx26, 31, 37 and 43 in bovine hoof tissue immunohisto-chemically and showed that Cx43 was expressed strongly in the stratum basale of the claw epidermis. Cells of the stratum spinosum have been found to express lower levels and terminal differentiating cells showed only weak expression of Cx43. Cx26, 31 and 37 could not be detected.

Because antibodies against bovine connexin proteins are not yet available, we used a mouse anti-mouse Cx43. A synthetic peptide corresponding to position 252-270 of the mouse Cx43 represents the immunogen and its sequence is identical in bovine. Cx 26, 31 and 37 antibodies were anti-mouse from rabbit and actual antibody crossreactivity with these connexins from other species was not known. Therefore further investigations are required to verify our findings and to examine these connexins by other immunological methods, PCR and in situ hybridisation techniques, but it is likely that connexins exist in bovine epidermis in a distribution similar to human epidermis (resp. epidermal appendices). Tissues will show specific patterns of connexin expression depending on their state of differentiation and function. There is evidence for changing patterns of connexin expression during human fetal skin development (Arita et al, 2002). Intercellular communication was shown to be intimately involved in regulating epidermal wound repair (Goliger and Paul, 1995) and changes in normal expression of connexins are associated with changes in the proliferation and differentiation program which keratinocytes undergo in psoriasis (Labarthe et al, 1998). To date a number of connexin gene mutations have been described to cause several epidermal dysfunctions (Richard, 2000), which supports the importance of gap junctions in epidermal differentiation. Therefore connexins in bovine claw epidermis are supposed to play a similar role in maintaining tissue homeostasis, controlling growth and development and consequently they must be involved in physiological and pathological processes of claw horn formation.

This work was founded by the EU Lamecow project OLRT-2001-00969

**References**


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**Figure 1**: Schematic drawing of a gap junctional plaque and the arrangement of connexin proteins. Illustration modified according to Richard 2000.

**Figure 2**: Electron micrograph of a gap junction (GJ) and a desmosome (D) between 2 neighbouring cells in the stratum spinosum (sole). Cell membranes have converged to 1 nanometer (arrowhead). Desmosomal adhesion disk (HP), keratin filaments (KF); Figure according to Muelling 1993

**Figure 3**: Connexin 43 protein in bovine claw epidermis, expression pattern in the distal bulbar region; Stratum basale (Sb), Stratum spinosum (Ssp), Terminal differentiating cells (Tdc)

**Figure 4**: Connexin 43 protein in the epidermis of the wall region of the claw. Dermis (D), Dermal lamella from the Wall region (DLW), Stratum corneum (Sc)
Introduction

Horn production and the maintenance of functionally important structures are continual processes in bovine claw tissue. These are dependent on the proliferation and differentiation of horn-producing cells of the epidermis and the synthesis and breakdown of structural macromolecules and adhesion molecules in the basement membrane and dermis. A range of chemical messengers have been identified in integumental tissues such as skin and hair follicle (e.g. Stenn et al, 2001) but their presence and role in the bovine claw are poorly understood. The aim of the present study was to investigate the expression and localisation of two signalling molecules, basic fibroblast growth factor (bFGF) and transforming growth factor-β (TGF-β) in bovine claw epidermis and dermis. These growth factors have been shown to influence proliferation and morphogenesis in a range of tissues of the integument.

Materials and Methods

Hind right lateral claws were obtained immediately after slaughter from crossbred female beef cattle. The claws were transported to the laboratory on ice. Tissue blocks containing a small amount of horn and soft tissue epidermis and dermis were prepared, frozen in liquid nitrogen and then stored at -80 °C. These were then sectioned by cryostat at a thickness of 10 μm and then mounted onto Vectabond (Vector Laboratories) coated glass slides. The sections were subjected to immunohistochemical examination using primary antibody systems as follows: rabbit anti-bovine bFGF (Sigma, cat no. F3393) at a dilution of 1:1500 and mouse anti-human TGF-β (Serotec, cat no. MCA 797) at a dilution of 1:3000. Detection was achieved using the second antibody Vectastain Universal Elite ABC kit (Vector Laboratories) with appropriate anti-mouse and anti-rabbit negative controls. Sections were treated as appropriate with supplied blocking serum and 3 % hydrogen peroxide in methanol to deplete endogenous peroxidase activity. Sections were counterstained with hematoxylin.

Results

Examination of the immunostained histological sections established the location of bFGF consistently along the dermal-epidermal border and predominantly in the basal and suprabasal epidermal cells in the solear sections tested. Typical examples (highlighted by arrows) of vertical (Figure 2) and horizontal (Figure 3) sections show clear signals, which may be compared with the absence of stain in the IgG control (Figure 1). In contrast, the signals for TGF-β were localised in papillary dermis in representative solear (Figure 4), coronary (Figure 5) and laminar region (Figures 6, 7) sections.
11. Miscellaneous

Discussion

It is concluded that the claw tissues studied express the growth factors in locations typical of those in other integumental tissues. For example, bFGF expression has been previously described in keratinocytes in skin, in which mitogenic, angiogenic and morphogenic effects have been recognised (Arbiser et al, 2000). Similarly, members of the TGF-β superfamily have been identified as components of the extracellular matrix produced by dermal fibroblasts. These signalling molecules produce downstream effects on synthesis of collagens and other proteins in extracellular matrix and act as inhibitors of keratinocyte proliferation (Yamasaki et al, 2003). The properties of extracellular matrix in dermal tissue, the proliferation of keratinocytes and interactions between the two are important in the function of claw tissue. Results from the present study can be used to assist investigation into mechanisms of regulation of these processes that are essential to maintain good health in the bovine claw.

References


Acknowledgements

This work was funded by BBSRC and the Scottish Executive Environment and Rural Affairs Department. The technical assistance of Mr J Struthers and Mr M Birnie is gratefully acknowledged.

VALIDATION OF LAME LIMB IDENTIFICATION THROUGH THERMAL IMAGING

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Abstract

The limb temperature of 50 dairy cows was recorded through using a thermal camera. The locomotion of each cow was then observed and scored. Of the 25 cows found to have detectable hind limb lameness a significantly higher temperature was found on surface of the limb in which lameness was detected. This increased temperature found on the lame limb was detected not only in the region of the horn capsule but also further up the limb on the metatarsus and at the tarsal joint.

Introduction

Thermography records the surface temperature of an object and is used in many industrial situations. It also has the potential to be used as a non-invasive assessment tool to detect areas of heat and swelling expressed on the skin of animals. As the collecting of images can be carried out remotely from the animal requiring little or no restraint the technique avoids temperature artefacts associated with capture and restraint.

Deterioration in the locomotion of dairy cattle was found to be among the most important determinants of cattle welfare in a survey of cattle welfare experts (Whay et al. 2003). However, in both a research and a commercial context reliable lameness detection remains a challenge. The sensitivity of locomotion scoring and lameness detection is difficult to validate other than through assessment of repeatability of trained observers. In addition it is known that in comparison with an observer trained in lameness detection UK dairy farmers only perceive about a quarter of lameness cases within their herds (Whay et al. 2002). The pathological changes in the claws of cattle showing
signs of lameness may be detectable through thermographic imaging. A pilot study was carried out to investigate whether such changes in the surface temperature of the limbs of lame cows were detectable using thermal imaging.

**Methods**

Thermal images and surface skin temperature recordings were taken from 50 lactating dairy cows during May 2003 following Spring turnout on two farms in the South West of England. The measurements were made using a thermal imaging camera (ThermaCAM® E2, FLIR Systems). Temperature recordings were taken of the lateral aspects of both hind-limbs at the metatarsal joint, mid metatarsus and the abaxial aspect of the lateral claw horn capsule. The lowest, average and maximum surface temperatures were recorded from each region. The cows were then walked on a flat concrete surface and their locomotion scored on a scale of 0 - 3 (0 - sound, 3 - severe lameness) and where detectable the lame limb was identified.

The thermography data recorded from the limbs of the dairy cows was corrected against the average temperature of the udder on the same side. This allowed a correction for variations in skin temperature due to changes in ambient temperature. A general Linear Model was then used to examine the relationship between the points on each limb where temperature was recorded and between the limb which was identified as being lame through locomotion scoring.

**Results**

Of the fifty animals observed 36 animals were scored as having some abnormality of locomotion of which 25 had clear hind-limb lameness where one limb could be identified as causing the limp. Analysis of the results found that at all three points measured on the limb the average and maximum temperature was significantly higher on the side of the lame limb than the sound limb (P<0.01) whereas measurement of minimum temperature was found to be a less consistent measure (Table 1). At the level of the hocks and the metatarsus the temperature on the lame limb was elevated by an average of 0.8°C while at the claw the temperature was raised by between 1 and 2°C. Fewer significant associations were found between lameness and the minimum temperature recorded at each region of the limb.

**Table 1.** The effect of lameness on the limb temperature recorded at the tarsal joint, metatarsus and claw horn capsule

<table>
<thead>
<tr>
<th>Region of limb where surface temperature was recorded</th>
<th>Minimum temperature</th>
<th>Maximum temperature</th>
<th>Average temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lateral aspect of tarsal joint</td>
<td>n /s</td>
<td>n /s (0.051)</td>
<td>*</td>
</tr>
<tr>
<td>Lateral aspect of metatarsus</td>
<td>*</td>
<td>*</td>
<td>* *</td>
</tr>
<tr>
<td>Lateral claw horn capsule</td>
<td>n /s</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

**Discussion**

The results demonstrated that an increase in temperature of the lame limb was detectable. Also that this temperature difference between the lame and sound limb extends further up the limb than may have been expected. A strong correlation between prevalent of lame cows and hock lesions (hair loss, swelling and ulceration) at the herd level have been reported by Whay et al. (2003). Findings supported by Klaas et al. (2003) who speculated that lame cows lie down more frequently than healthy cows and have difficulties in rising or changing position, so are more likely to develop pressure lesions. A combination of lameness causing lesions and increased lying time possibly associated with lesions on the hocks (lateral aspect of tarsal joint) may account for the widespread increase in limb temperature although this has not been confirmed.

The result showed an increased surface temperature on the lame limb of the cow this offers validation of identification of the lame limb using visual locomotion scoring. Work in the future will include characterising these changes in temperature in more detail and examining their association with specific lesion types.

**References**


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Introduction

Interdigital phlegmon is perhaps the disease with the most synonyms: infectious pododermatitis, interdigital necrobacillosis, foot rot, foul in the foot, foot abscess, panaritium are often mentioned. Traumatic lesions of the interdigital skin, caused by rough floor, uneven ground, stones, straw or pieces of wood are the most common causes. Maceration of the skin by wet weather conditions, faeces and urine may predispose the claw to injuries (1-12). Pain, leading to mild or severe lameness and moderate to severe swelling of the interdigital space are major signs of the disease. Interdigital phlegmon has a worldwide occurrence with massive economical losses in milk and meat production. Fusobacterium necrophorum and Bacteroides melaninogenicus are mostly isolated from this infection. Clark et al. (1986) were able to reproduce foot rot by experimental cultures of F. necrophorum alone, as they injected the agent through the skin into the dermis. Interdigital phlegmon is usually sporadic, but may be endemic in high intensity beef or dairy cattle production units (1, 3, 8, 10).

Material and Methods

In this retrospective study clinical and radiographic findings, treatment and outcome of 43 cases (1998-2003) with interdigital phlegmon are presented. All these patients had been referred by the local veterinarians to the clinic, with an advanced stage of an interdigital infection. Clinical signs included moderate or severe lameness with marked swelling of the coronary region and the soft tissues of the interdigital space. In cases of advanced infection a characteristic fetid smell caused by the interdigital necrotizing lesions was noted.

Radiographic examination was performed in cases of severe lameness and obvious circular swelling over the whole coronet from dorsal to abaxial to rule out infection of the distal or/and proximal interphalangeal joint or involvement of the remaining claw.

The patients were prepared for surgical resection of the infected and necrotic tissues and/or digital amputation with an intravenous regional anaesthesia using 20 ml of procaine-hydrochloride (Minocain 2%, Atarost, Germany). A tourniquet of rubber tubing was applied directly in the middle of the metatarsus or metacarpus.

Results

Twenty-two cows showed a severe lameness (grade 3 and 4 out of 4), thirteen cows presented a moderate lameness (grade 2 of 4) and in 8 cases only a slight lameness (grade 1 of 4) was noted. In 19 cows the left hindlimb was affected, in 20 cases interdigital phlegmon was located at the right hindlimb. Two cows had infections of both hindlimbs. The right frontlimb was affected in 2 cows. Radiography was performed in 15 cattle with a severe lameness. Radiographic signs of bone and/or joint infection were widening of the joint space, loss of joint and bone architecture as well as reactive periostal new bone formation.

Surgical resection of the affected soft tissues of the interdigital space was performed in 19 out of 43 cattle. Starting from the causative penetrating wound the infected and necrotic soft tissue structures of the interdigital space were resected completely. In one case the infected and necrotic tissue reached the axial capsule of the distal interphalangeal joint showing a serous, slightly turbid effusion: in this case the distal interphalangeal joint was opened from this track and was lavaged with 2000 ml isotoncit saline solution with diluted 0.1% polysidion-iodine-solution.

Although surgery and parenteral antibiotics was done infection spread to the distal interphalangeal joint in one case and led to amputation of the affected claw.

In 23 cows (out of 43) a purulent arthritis of the distal interphalangeal joint and in 1 cow a purulent-necrotising arthritis of the proximal interphalangeal joint had developed from the interdigital phlegmon. 12 of the 24 cows were euthanized or slaughtered due to the bad condition, the poor prognosis or economic reasons.

Amputation of the infected claw was performed in 11 cases, another one was treated by resection of the distal interphalangeal joint. In addition, infections of the digital flexor tendon sheaths occurred in five cases (out of 24). Three of them were euthanized after diagnosis: one cow had already developed an infection of the fetlock joint, another one showed a severe swelling of the remaining hind claw because of a deep sole ulcer. In one case amputation was refused by the owner. In 2 cows the deep and superficial flexor tendons and the infected flexor tendon sheaths were resected.

One out of these 24 cases showed a severe interdigital phlegmon with a purulent arthritis of the distal interphalangeal joint, multiple abscesses on the lateral digit and distal limb and a purulent endocarditis and was euthanized.

Systemic and local antibiotics was used for 3-5 days. For systemic antibioticus the cattle were treated with 1 mg cepfiafur (Excenel, Pharmacia & Upjohn) per kg body weight or 10 mg oxytetracycline (Engemycin10%, Intervet,
Vienna) per kg body weight. When amputation of the claw was performed 20,000 IU benzyl-penicillin and 20 mg streptomycin per kg body weight (Peni-strepto, Virbac Laboratoires) were given for 5 days. Depending on the surgical technique clinic hospitalisation ranged from 2-28 days (mean 10.4).

Discussion

The first observed signs of foot rot are varying degrees of lameness, from barely noticeable to an extensive condition in which cows get more or less recumbent (1, 12). Symptoms like widening of the interdigital space due to a reddening of the skin and the coronary band, heels and necrotic and demarcated interdigital tissue could be detected in all cases. If the foot rot condition is severe and is not treated in the early stages, complications may result such as septic arthritis of the distal or/proximal interphalangeal joint, septic inflammation of the digital flexor tendon sheath, other deep infections of the foot as local abscesses and haematogenous spread of infectious material with subsequent purulent endocarditis, abscesses in the lung, liver or kidneys (1, 12). In this study 24 cows showed a purulent arthritis of the distal and proximal interphalangeal joint, in 5 cases an inflammation of the flexor tendon sheaths and in one case a septic endocarditis.

References


Abstract

In a digit of dairy cattle obtained from a slaughterhouse, three horizontal grooves were observed on the wall. In the vertical section of the sole, two horizontal thin layers were seen, which had yellowish color. The first horizontal groove formed nearest under the digital band was connected to the first horizontal thin layer in the sole. From this observation, the growth of the sole could be estimated. The surface of the heel horn was detached at the groove on the heel bulb. The relationship between horizontal grooves and the sole changes will be discussed.