

Diagnostic Ultrasound Examination in Bovine Lameness

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Introduction

Sonography has received only little attention for diagnosis of bovine limb disorders,^{1,2,3} although this imaging diagnostic method has long been applied in cattle for diagnosis of pregnancy, abdominal and thoracic diseases (liver, kidney, heart) and teat disorders. Until recently the classical examination of orthopaedic bovine diseases was based primarily on clinical examination, on exploring lesions with a probe, and on centesis of diseased synovial cavities followed by macroscopic, microscopic and bacteriological examination of aspirated synovial fluid samples.⁴ In many cases these methods enable us to reach a diagnosis, but in cases with disorders of soft tissue or disorders of proximal limb structures, sonography can be applied as a helpful tool in the differential diagnostic evaluation. The obvious advantages of sonography as compared with radiography in the examination of soft tissue disorders of the bovine locomotory system are revealed in this study.

Materials and Methods

Besides the classical orthopedic examination, ultrasonography has been applied for the last 3 years for the investigation of bovine limb disorders. With the aid of 52 videotape documented sonograms of orthopedic diseases in cattle, 10 representative cases were selected: 8 cows/heifers and 2 bulls aged 6 months to 9 years showed various grades of lameness and various swellings of the limbs. After clinical and radiographic (lateromedial and dorso-palmar/plantar radiographs) examination, an ultrasonic investigation of the swelling using a real-time ultrasonic unit (Sonoscope 3®, Kranzbuhler, Germany) with a linear- (7.5 MHz) and/or a sectorscanner (5 MHz) was performed. The hair in the region of interest must be shaven and the skin cleaned and a high viscosity coupling gel applied to the skin surface. After an ultrasonic orientation (location of bone surfaces, tendons, joint-gaps and vessels) the region of interest (synovial cavities, adjoining soft tissues, muscles) was examined in transverse and sagittal planes

systemically.

The echogenicity, echopattern, size and border conformation of swollen soft tissue structure, the presence or even absence of shadows, the dorsal enhancement and the flow-phenomena were assessed. In this report the clinical, radiological and centesis findings were compared with sonographic ones.

Results

Clinical, radiographic, sonographic findings, centesis and diagnosis

The lameness grading system at our clinic is assessed in 4 grades, where grade 4 indicates the most severe lameness. By means of radiography, 5 out of 8 cattle showed a soft tissue swelling only and no other findings. Radiographs in 2 out of 8 cattle revealed distinct widening of the joint space of the antebrachio-carpal joint and in another a 6 x 2.5 x 2 cm sized, oval shaped translucent lesion with a sclerotic margin with distinct bony proliferation on the distal ulna.

The sonographic examination in all cases enabled an accurate anatomical localization of the clinically assessed soft tissue swelling and helped to clarify differential diagnostic doubts. After the ultrasonic examination, centesis of the diseased structures of all 10 cattle using 1.8 x 50 mm needles was performed. In cases 1, 2 and 4 the ultrasonic findings also drew attention to clinically unsuspecting structures, which consequently were punctured. In this way fluid-filled areas of each swelling could be localized and a more accurate centesis was enabled. By means of centesis in 9 out of 10 cases, a sample could be aspirated; in one case the centesis achieved a negative result. This case report was also backed by the surgical or postmortem (slaughtering) findings.

Case 1

Simmental bull, 2 years old, showing a grade 2 lameness of the left hindlimb with a diffuse swelling of the fetlock region, the lateral flexor tendon sheath and a puncture wound proximal of the lateral accessory digit.

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Radiology: soft tissue swelling; *Sonography*: normal digital flexor tendon sheath, distinct extension of the plantar fetlock recess filled with anechoic, partly hypoechoic content without enhancement and flow-phenomena. *Centesis*: negative. *Diagnosis*: septic fibrinous arthritis of the fetlock joint. *Therapy*: removing of clothed fibrin masses by arthrotomy, joint lavage, antibiotics.

Case 2

Brown Swiss heifer, 1 year old, showing a grade 2 lameness of the right hindlimb and painful swelling of the total digital region. *Radiology*: soft tissue swelling. *Sonography*: distinct extension of the outer proximal compartments of both digital flexor tendon sheaths filled with anechoic content and evident flow-phenomena. *Centesis* of lateral tendon sheath: dark-yellow, turbid synovial fluid without coagulation, Medical tendon sheath: dark-yellow, highly viscous fluid with flocculent fibrinous debris. *Diagnosis*: fibrinous tenosynovitis of the medial digital flexor tendon sheath, serous tenosynovitis of the lateral one. *Therapy*: surgical opening of the medial tendon sheath, removal of clothed fibrin masses, lavage, antibiotics. Lateral tendon sheath: through and through-lavage.

Case 3

Holstein-Friesian cow, 6 years old, showing a grade 4 lameness of the right forelimb and a painful swelling of the carpus with evident fluctuation at the proximal joint. *Radiology*: soft tissue swelling and widening of the antebrachio-carpal joint space. *Sonography*: predominant anechoic filling with only a few echoic reflections of the recess of all 3 carpal joints and evident flow-phenomena. *Centesis* of the antebrachio-carpal-joint: 20 ml dark-yellow, turbid sample with fibrino-flocculent and purulent debris. *Diagnosis*: fibrino-purulent carpalitis. *Slaughtering*: coagulated fibrinous masses and pus in all joints.

Case 4

Simmental bull calf, 6 months old, with a grade 4 lameness of the left forelimb and a painful swelling of the carpus, especially the dorsal aspect. *Radiology*: soft tissue swelling and widening of the antebrachio-carpal joint space. *Sonography*: distinct extended bursa filled with hypoechoic content and evident communication with dorsal recess of the antebrachio- and mediocarpal-joint. Dorsal and palmar recess filled with hypoechoic content, modest evident flow-phenomena. *Centesis* of bursa: yellow, turbid and highly viscous (purulent) sample with fibrino-flocculent debris. *Diagnosis*: purulent bursitis praecarpalis and fibrino-purulent carpalitis of all 3 joints. *Slaughtering*: fibrinous masses and pus in the bursa and in the joints.

Case 5

Brown-Swiss cow, 3 year old, showing a solid, non-painful swelling on the dorsal aspect of the carpus and the distal antebrachium with little fluctuation without lameness. *Radiology*: soft tissue swelling; *Sonography*: well demarcated anechoic and hypoechoic structure with irregular echopattern (bursa). Distinct extension of the extensor carpi radialis tendon sheath with anechoic content and partly echoic adhesions on the tendon and tendon sheath with evident flow-phenomena. *Centesis* of the bursa: reddish, aqueous sample; of the tendon sheath: yellow, little turbid and aqueous synovia. *Diagnosis*: chronic bursitis praecarpalis and chronic aseptic tenosynovitis of the extensor carpi radialis tendon sheath. Conservative treatment.

Case 6

Holstein-Friesian cow, 3 years old, showing a grade 2 lameness of the left forelimb and a semisolid, painful swelling of the lateral aspect of the distal antebrachium with little fluctuation. *Radiology*: soft tissue swelling and a 6 x 2.5 x 2 cm sized translucent lesion in the distal ulna with marked bony proliferations. *Sonography*: well demarcated area located between the subcutis and bone surface with irregular patterned hypoechoic structure and evident flow-phenomena; the adjoining bone surface gave irregular and rough reflections. *Centesis*: yellow, highly viscous purulent exudation. *Diagnosis*: Osteomyelitis of the distal ulna and subcutaneous abscess. Slaughter.

Case 7

Simmental cow, 3 years old, showing a grade 2 lameness of the left hindlimb and a melon-sized soft and slightly painful swelling in the pelvic region caudal of the left tuber coxae with fluctuation. *Radiography*: not performed. *Sonography*: on the dorsal aspect of this swelling a horizontal reflection-strip (= bacterial gas) in the subcutaneous area was found: in a more distal position a 6.5 x 3 cm sized anechoic area indistinctly demarcated from surrounding muscle with only few hypoechoic reflections and a centrally situated damaged muscle structure was evaluated. *Centesis*: gas and a yellow-brownish purulent exudation. *Diagnosis*: intramuscular abscess of the gluteobiceps muscle. *Therapy*: after surgical opening 1 liter of pus and also muscle debris flowed out.

Case 8

Holstein-Friesian cow, 9 years old, showing a grade 1 lameness of the right hindlimb with a headsized, soft and scarcely painful swelling with evident fluctuation on the right Tuber ischiadicum. *Radiography*: soft tissue swelling. *Sonography*: well demarcated area with predominant anechoic structure and hypoechoic, partly

echoic centrally situated echos and evident flow-phenomena. *Centesis*: 1 liter of a brown-reddish, aqueous fluid. *Diagnosis*: hematoma. Conservative treatment.

Case 9

Simmental cow, 3 years old, showing a grade 1 lameness of the left hindlimb with a small melonsized, semisolid swelling on the dorsal aspect of the stifle, movable over the stifle joint without evident fluctuation. *Radiology*: not performed. *Sonography*: well demarcated, on the marginal areas predominant hyperechoic, partly echoic structure with a central 7.5 x 5 cm sized anechoic zone with internal echos and evident flow-phenomena. *Centesis*: brown-reddish, aqueous bloodlike fluid. *Diagnosis*: hematoma in advanced organization. Conservative treatment.

Case 10

Simmental cow, 3 years old, showing a grade 2 lameness of the left hindlimb. On the lateral aspect of both calcaneal tubera 2 cm sized skin-lesion with a painful swelling was evident. By pressure of the right swelling a creamy pus flowed out. *Radiology*: soft tissue swelling. *Sonography* of the left side: well demarcated, predominantly anechoic area was revealed beneath the achilles tendon. Right side: on the lateral aspect of the achilles tendon and subcutaneously a well demarcated, longish and anechoic structure was found; evident flow-phenomena on both ones. *Centesis* of left swelling: yellow creamy purulent exudation. *Diagnosis*: purulent subtendinous calcaneal bursitis on the left and purulent subcutaneous calcaneal bursitis on the right side. *Therapy*: surgical opening, lavage and drainage.

Discussion and Conclusions

According to my study, disorders of the above mentioned structures in cattle can be proposed as indications for ultrasonic application: digital flexor tendon sheath, digital joints^{1,2,3} carpal-, tarsal-, stifle- and pelvic region. Further indications are suspected hematomas, abscesses and muscle lesions.

Sonography is the preferred imaging method used when only soft tissue and joint-recesses are affected, radiographic findings in these cases reveal often only swollen soft tissue and enables no soft tissue differentiation.^{5,6} This fact was confirmed by this study: ultrasonic examination produced accurate findings in 5 cattle which revealed only soft tissue swelling with means of radiography (cattle 3, 6, 8, 9, 10).

By sonographic imaging of the distended joints could be depicted the enlarged recesses, filled with anechoic or hypoechoic content. In considering the typical sonomorphology and the absence of any inflammatory signs, the diagnosis of hematoma in cattle

6 and 7 was determined rapidly by sonography.^{7,8} Sonographically examined muscle lesions produce obviously more information than radiography.⁹

After an ultrasonic orientation in the region of interest by looking for familiar anatomical structures such as bone surface, tendons, joint space and vessels,¹⁰ sonography allows an exact anatomical localization of the soft tissue swelling and provides accurate preoperative details about the extent and character of fluid accumulations and soft tissue swellings (liquid, highly viscous, solid). By application of pressure using the scanner, flow-phenomena could be demonstrated in the region of interest, which indicates the presence of liquid content.¹¹ In many bovine limb disorders, the inflammatory products have become thick and have lost their liquid character because flocculent fibrin, coagulated fibrinous masses, highly viscous purulent exudation and necrotic tissue debris are produced,³ so that centesis often reveals negative samples. In such situations the evidence of flow-phenomena or solid masses can be proven by sonography.^{8,11,12}

Depending on the actual inflammatory products, an increased degree of filling is represented by an anechoic, hypoechoic or more echoic and well demarcated area with evidence of flow-phenomena, when there is a liquid content 1, 2, 3, 5, 6. A variable ultrasound-beam enhancement resulting from minimal attenuation of the sound beam of the far side of fluid filled areas can be observed.^{11,12} When there is no liquid present (inevident flow-phenomena) the assessed content consists of clotted fibrin masses with no or little echogenicity, clotted fibrin masses in organization with a weak or stronger echo, respectively highly viscous purulent exudation with no evident fluctuation.^{3,6} No far enhancement is seen on such semisolid or solid structures.

The observed advantages of sonography in contrast with radiography in diagnosing bovine soft tissue disorders should be used to a greater extent because of its diagnostic strength and easy use.

Summary

Besides the classical orthopedic examination, radiography and centesis of diseased synovial or other cavities, the obvious advantages of sonography in the diagnosis of soft tissue disorders were used in 10 clinical cases to improve the diagnosis of orthopedic diseases in cattle. These cattle showed various swellings of the carpus, antebrachium, tarsus, stifle, digital and pelvic region and arthritis, tenosynovitis, bursitis, abscesses and hematomas were observed. The clinical and radiographic findings as well as the results of centesis were compared with the sonographic ones. For the ultrasonic examination of bovine limbs, a 7.5 MHz linear-scan or

a 5 MHz sector-scan were used. The examination technique and the most significant criteria for ultrasonic diagnostic are described. The ultrasonic findings have produced more information than the radiographic ones when only soft tissues and joint-recesses are affected. As a complimentary tool to the classical examination of locomotory system disorders in cattle, sonography provides accurate preoperative details of the extent and character of fluid accumulations and soft tissue swellings (edema, hemorrhage, synovial fluid, purulent exudation, coagulated fibrin masses); it helps to differentiate rapidly and on a noninvasive basis between affected structures and any subtle defects in neighboring tissues, it enables a more accurate centesis of evident fluid filled areas of synovial cavities or other swellings and reveals much more information than often insufficiently depicted by radiographs.

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Abstract

Some risk factors associated with clinical lameness in dairy herds in Minnesota and Wisconsin

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An observational study of the relationships between clinical lameness and herd-level risk factors was made in 18 dairy herds in Minnesota and Wisconsin. Lameness in the lactating cows was assessed by two observers during herd visits made in the summer of 1989 and the spring of 1990, using a uniform scoring system. A questionnaire was used to obtain information about the general management, routine hoof care, nutrition,

housing and flooring on the farms. Factors associated with the prevalence of clinical lameness in the summer included stall moisture, the size of the exercise area for the lactating cows and the amounts of dry concentrates and fresh forages fed to them. Factors associated with clinical lameness in the spring included the use of parlour milking facilities and the frequency with which the rations for the lactating cows were balanced.