Ankylosis of the Digit Bones in Six Culling Lame Cows

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Abstract

Objective- To review the six cases for determination the radiological, pathological and clinical features of bony ankylosis of the interphalangeal joint.

Design- Cross-sectional and Observational study

Animal- Six Culling Lame Dairy Cows

Procedures- Forty one culled lame cows of 1135 culled cows having digit disorders which were randomly selected for clinical and radiographic and pathological purpose. A among 41 culled lame cows; six cases were affected by bony ankylosis. After recording information for each cow, diseased digit was amputated and carried to the Veterinary Teaching Hospital, Radiology Department for more detailed radiographical as well as pathological studies.

Results- In 6 (14.6%) cases of the culled lame cows, the signs of ankylosis and injuries in their sole surface at zone 2, 4, 5 and 6 were prevailed. All of the ankylosed cases were involved in the lateral claw of the hindlimbs. Pathological findings recorded from 6 cases had some similarities to the solar surface had no natural wearing and showed an increase in thickness of the keratinized tissues. Widening of the periople and swelling of the heel area in the involved digit were the permanent features of the culled lame cows. Morphopathologic finding recorded from 6 cases strongly illustrated bony ankylosis between (P1+ P2 bone, P3+ distal sesamoid bone, P2+ P3 bone+ distal sesamoid bone, P2+ distal sesamoid bone) was observed. Radiographic images taken from the involved digits of the 6 culled lame cows depicted a quite wide range of radiographic signs such as soft tissue swelling, new bone formation and gas density.

Conclusion and Clinical Relevance- Radiological and morphopathological pattern of boney structures in bony ankylosis indicates that noninfectious factors like subluxation of the joint besides ascending infection under hoof surface can stimulate bridge-like periosteal proliferation in the periarticular surface, and they eventually result in ankylosis such as subluxation of the joint between P2 and P3 bones. However, ankylosis of the coffin joint is a factor that causes subluxation in the pastern joint.

Key words: Ankylosis, Culling, Digit, Dairy Cow, Lameness

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Introduction

Lameness in dairy cattle is a major cause of financial loss and inconvenience to dairy farmers and of pain and discomfort to cows. Next to mastitis and reproductive failure, lameness is an important cause of involuntary culling in dairy herds. Lameness decreases milk yield and fertility and increases the risk of culling. Therefore, the ultimate cost of lameness is substantially greater than treatment costs alone. Effect of lameness on culling is not clear-cut, because several authors have reported little or no increase in culling due to lameness. The majority (88-92%) of bovine lameness involves the structures of the digit, if not treated promptly, can progress to create infection of bone, synovial structures, tendons and ligaments of the digit. These deeper structures may also become infected from solar puncture wounds, lacerations, avulsion injuries of the hoof and proximal progression of subsolar abscesses. Ankylosis is abnormal immobility and consolidation of a joint due to disease, injury. Ankylosis may be caused by destruction of the membranes that line the joint or by faulty bone structure. It is most often a result of chronic arthritis, in which the affected joint tends to assume the least painful position and may become more or less permanently fixed in it. Ankylosis can be acquired after degenerative joint disease, septic arthritis, and several articular or periarticular trauma. The present study deals with culling lame cows due to ankylosis of the interphalangeal joints.

Materials and Methods

This cross-sectional and descriptive study was carried out in the winter of the year 2006 at an abattoir in the vicinity of Tehran (Meysam Slaughterhouse). According to the data gathered in that place, an average of 35 cows was culled everyday among which around 2 cases were lame. Forty one cases of culled lame cows having digit disorders which were randomly selected for clinical, radiographical, and morphopathological study. The claws and interdigital space cleaned thoroughly with water and a brush before radiography to be able to exactly diagnose the kind of injury in the radiographic projections. In each case, records of the injuries and their geographical distribution were conducted on solar surface of the involved digit through a model presented by established zones of sole protocol. A Toshiba X-ray machine (model DC-12M) was used in this study. Four radiographs were taken from each digit, in lateral-medial or medial-lateral, dorsopalmar/dorsoplantar, dorsolateral-palmaromedial / dorsolateral-plantaromedial and dorsomedial-palmarolateral / dorsomedial-plantaromedial. Radiographs were recorded by the mammography cassettes in sizes of 18×24 and 24×30, and the required exposure factors of 85-95 KV, 25 mA in 0/04-0/02 seconds. After the first review of X-ray film, if any diagnostic lesion was seen in a radiograph, the sample was selected for further procedures and the record of qualitative findings. New bone formation, osteolysis, soft tissue swelling, and gas density were 4 indices considered for assessing the severity of the disease. For availability and study of the probable changes in soft tissues, the skin of digit was dissected in each sample by a scalpel. The bones were taken away from the joints by the scalpel in order to be naked. Through the method of putrefaction (bacterial maceration and bleaching), the bones were put in a special dish (a plastic cover). In this regard, some plastic dishes with sufficient water were used and placed near the heater. The bones were in the water for at least 72 hours, and this action repeated again after changing the old water. Thus, all the soft tissues were taken away from the bones. All the samples were disinfected by diluted disinfectant (30 minutes), and the existing tiny tendons and ligaments beside the new bones were taken away slowly and delicately by the scalpel.
Then, the bones became dried in free air and prepared for the pathological study. Finally, the findings were discussed descriptively.

Results

Locomotion scoring assessment of 41 culled lame cows showed a range from score 4 (19%) to 5 (81%). In 30 (71.9%) cases of the culled lame cows, injuries in solar surface were determined. Problems with weight bearing and arching of the backbone (Fig. 1) were considered as a significant clinical feature, in evaluation of locomotion scoring. In 6 (14.6%) cases of the culled lame cows, the signs of ankylosis and injuries in their sole surface at zone 2, 4, 5 and 6 were prevailed. In one case, there was an injury in the interdigital space. All of the ankylosed cases were involved in the lateral claw of the hindlimbs.

Pathological findings recorded from 6 cases had some similarities to the solar surface had no natural wearing and showed an increase in thickness of the keratinized tissues. Moreover, in all cases, the quality of the keratinized tissues changed and they became soft powdery horn. Widening of the periople and swelling of the heel area in the involved digit were the permanent features of the culled lame cows. The axial wall was deviated into medial surface and showed some waving pressed strips. Furthermore, the abaxial wall had deviation into medial surface and uneven horizontal horn ridges in its surface. Some cases had special pathologic and radiographic signs comparing to other cases, because there was subluxation in radiographic image but this sign resulted in bony ankylosis in pathological finding. Morphopathologic finding recorded from 6 cases strongly illustrated bony ankylosis, in a way that one case of joint remodeling with arthrodesis between P1 and P2 bone (Fig. 2), two cases of joint remodeling with arthrodesis between P3 and distal sesamoid bone (Fig. 3), two cases of joint remodeling with arthrodesis between P2, P3 bone and distal sesamoid bone (Fig. 4), one case of remodeling with arthrodesis between P2 and distal sesamoid bone was observed (Fig. 5). Radiographic images taken from the involved digits of the 6 culled lame cows depicted new bone formation around joint surface with increased bone density. Radiographic images taken from the involved digits of the 6 culled lame cows depicted a quite wide range of radiographic signs such as soft tissue swelling, new bone formation and gas density. These signs, especially in the sole ulcer, were distributed in different sizes, and contrary to other regions, they were more significant considering the increased infection and the involvement of other neighboring structures, such as coffin’s joint, distal sesamoid bone and other digit. Increased bone density showed reactive new bone response was bridging the destroyed joint in the radiographs (Fig. 2). Reactive new bone that is chronic in duration is distinctly marginated and relatively homogeneous in opacity; however, it can be quite irregular or rough in surface contour. Ankylosis was manifested as painful, immobile articulation, conformational abnormalities,
lameness and local fibrotic or enlarged periarticular structures. In cases of bony ankylosis between P1 and P2 bone, the swelling has appeared locally in coronary band of the involving digit. While in cases of bony ankylosis between P2 and P3 bone and or between P2 and distal sesamoid bone on the hind limb were swollen from the coronary band to the proximal portion of the metatarsus. All the cases showed signs of disability in weight bearing, but three cases were more inclined to have weight bearing on their pastern region (Fig. 1). This feature was more prominent in cases which P2 and P3 bone were involved.

Discussion

Ankylosis is the abnormal immobility and consolidation of a joint due to disease, injury or surgical procedure. Ankylosis can be acquired after degenerative joint disease, septic arthritis, and several articular or periarticular trauma. Various degrees of bone remodeling take place in the phalanges of the cow during the healing of the infectious process in the joint. These appear as extensive deposits of new bony tissue and proliferative periostitis. A part of this response may be due to an effort to strengthen otherwise weakened bone or it may be an effort to create a bony wall to contain the infectious process. Moreover, the factors which are not infectious, like subluxation can be the reason of this happening. Subluxation may produce ankylosis because of direct truma at the interphalangeal joint and in other word ankylosis may produce from dynamic compression related to abruptly abnormal motion. In the radiographic images, deviation in the digit is observed to axial line having

Fig. 2: Reactive new bone is seen surrounding P1 and P2 and distal sesamoid bone and its Dorsoplantor radiograph.

Fig. 3: Remodeling with arthrodesis between P3 and distal sesamoid bone and its Oblique radiograph.

Fig. 4: Remodeling with arthrodesis between P2 and P3 and distal sesamoid bone and its Dorsoplantor radiograph.

Fig. 5: Remodeling with arthrodesis between P2 and distal sesamoid bone and its Dorsoplantor radiograph.
periostal proliferation without any signs of demolition, scratch or reduction of density (Fig. 2). Failure to penetrate the bones of the digit in radiographic image makes it more difficult to evaluate the status of the joints and thus determine the etiology or status of the reparative process, but no sign of demolition and scratch of joint surface are seen while the bones suffering from ankylosis is cutting, and only periostal proliferation around joint. Architecture of bones in the digits is changed markedly following subluxation (Fig. 2). In morphopathologic studies of bony ankylosis between P1 and P2, there were no signs of pedal osteitis and bone proliferation caused by sole ulcer and white line disease in typical sites of the P3 bone. This pattern showed that there were not injuries on the hoof surface. However, in dorsal flexure of the P3 bone, some thin pedal osteitis was observed which indicated oversensitivity of the small vessels radiating from the terminal arch in such regions when subluxation of the pastern joint occurs, or when abnormal weight bearing during abnormal motion culminates in such an event. Moreover, some signs of regular and non-spongy new bone formation in the extensor tuberosity with a tension origin were observed resulting from abnormal weight bearing. On the other hand the ascending infection under hoof wall has caused ankylosis of the two joints as well as marked bony thickening by reactive periosteal new bone. Creation of injury on the solar surface and traumatized characteristics in these cases result to deep sepsis. In morphopathologic bony ankylosis between P3 bone and distal sesamoid bone, medial claw infection extended through the lateral claw, and the exudative discharges could not come out of the hoof, thus stimulation of bone proliferation and ankylosis between P3 and distal sesamoid bones occurred. morphopathologic findings of the foot revealed slight sclerosis of coffin joint surfaces of P2 and P3 bone, so that it was indicative of the fact that after infection of the cortex of P2 and P3 bones, the joint surface was infected, too. Furthermore, traumatized characteristics in these cases increased potentially culminated in penetration of infectious agents from the skin surface into the deep tissues of the digit which stimulated the accelerated new bone formation.

Sometimes, ankylosis in the coffin joint is a factor that causes subluxation in the pastern joint (Fig. 4). Its reason was the reduction in flexibility of joints surfaces during walking, digits could not balance their pressure on the digital joint surfaces; thus, during walking or sliding, the digits had more pressure on the fetlock joint surface leading to its subluxation.

Clinical findings related to the rate of chronic heel swelling and the apparent condition of the claw capsule can be proper factors for the prognosis of the P3 changes. In our experience, all culled lame cattle with swollen feet had deep sepsis of the digit. Deep sepsis of a digit usually results in asymmetrical swelling of the foot, with the majority of swelling located on the side of the affected digit, 12 and also Deep sepsis of a digit is characterized by appreciable widening of the periople on the affected side, the axial wall was deviated into medial surface and showed some waving pressed strips. Furthermore, the abaxial wall had deviation into medial surface and uneven horizontal horn ridges in its surface and increase in thickness of the keratinized tissues in the involved digit were the permanent features of the culled lame cows (Nouri M., Nowrouzian I., unpublished observation). In cases of deep sepsis of the digit, antimicrobial therapy alone does not usually elicit a cure. It is possible that necrosis 18, 19 or anatomical changes of infected or non-infected tissue and the resultant loss of blood supply prevent effective concentrations of antimicrobials from reaching all areas of bacterial colonization.

In conclusion, according to this research, studying and comparing the radiological and morphopathological cases under study play a significant role in clarifying the pathogenesis and predicting lameness treatment or culling the dairy cows suffering from chronic and recurrent lameness, because the treatment failure is the result of misdiagnosis or correct
diagnosis with therapeutic failure. Occasionally, some events in the body bring complications leading to culling of the animal. Subluxation can be one of the factors that eventually results in bony ankylosis with noninfectious source. However, ankylosis of the coffin joint is a factor that causes subluxation in the pastern joint. On the other hand, the ascending infection under hoof wall has caused ankylosis of the joints.

References

چکیده

انکیولوز استخوان‌های انگشت در شش گاو شیری حذفی مبتلا به لنگش

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هدف: ارزیابی موارد حذفی گاوان شیری مبتلا به انکیولوز استخوان‌های انگشت از ابعاد بالینی، رادیولوژی و مورفوباتولوژی.

طرح: مطالعه حاضر در طول زمستان سال 1384 بر روی شش گاو مورد از 41 مورد دام حذفی مبتلا لنگش صورت گرفته و این جمعیت مبتلا به لنگش از میان 115 راس گاو شیری حذفی به شکل تصادفی انتخاب و مورد مطالعه بالینی (وقتار، درجه لنگش، رادیولوژی (شرايط لازم برای تصویربرداری از چهار ناحیه مبتلا به ضخامت لنگش و توده و نوع حالت گمار در 95 کیلو ولت یا 35 میلی امپر در 0/3، تئودر ریتس و مورفوباتولوژی (به منظور بر اساس استخوانان روز گندانن باکتریایی و سفید کردن به کمک آب زاول رقیق شده استفاده شد) قرار گرفتند.

نتایج: درصد موارد (از میان 41 مورد گاو شیری حذفی مبتلا به لنگش) مبتلا به انکیولوز استخوانی در نواحی انگشتی بودند و درجه لنگش 4 و 5 را نشان می‌دادند. در همه این موارد انگشت حاسی مبتلا بود. سطح کف آثاری از رشته‌ای از بتن و پلاستیک کسول شاخی ممکن با تغییر در به دلیل تغییرات پایه‌ای و توده‌ای توده‌های به همین مبتلا به لنگش خود انکیولوز استخوانی در نواحی مختلف استخوان‌های انگشت (بین استخوانان اول و دوم دوم، بین استخوانان پنجم و ششم، انجام کننده با ویژگی‌های دارای دو دم و استخوان کننده انجام پایینی) بود. این استخوانا در دوم و پنجم، استخوان اول و دوم استخوان کننده انجام پایینی، رخ داده بود.

نتیجه گیری: نتایج این مطالعه نشان داد که رویدادهای غیب عفونت (درکنتن مفصل) و عفونت (عفونت های بالاروده) می‌تواند منجر به بروز چنین بیماری‌ها در شهروندان ف رسیده و مسبب حذف دام‌ها باشد. از سویی نیز جدول انکیولوز در مفصل می‌تواند این بیماری به پایین‌ترین بین بند انگشتی می‌تواند عاملی یافته در بروز درکنتن مفصل بالایی بین بند انگشتی نقش داشته باشد.

کلید واژ‌های کلیدی: انکیولوز، حذف، گاو شیری، لنگش، انگشت

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