Footpad horn hypertrophy and vertical fissure accompanied by white line disease 2 in case of concurrent deep digital sepsis in a culling cow

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Abstract:

A 5.2 year-old Holstein cow was presented with lameness and abnormal weight bearing in a slaughterhouse. Widening of the periople and swelling of the heel area in the lateral claw was more permanent than the medial claw. Vertical fissure (VF) involving the coronary band to the middle of the dorsal wall of the medial hind claw was observed. It was also extended to the bearing surface in the inner surface of the claw wall. White line disease 2 (WLD2) was seen in the length of VF on the bearing surface. The horn of the bulb apex of the lateral hind claw was hypertrophic. There was a groove in the footpad between the apex and base of the bulb too. Grosspathologically, the digital bones showed a wide range of bone changes such as new bone formation, pedal osteolysis and bony ankylosis. The hind leg was amputated at the tarsus immediately after slaughter. The lower limbs of lame cows were examined and the type and distribution of digital lesions were tabulated. An x-ray machine was used in this study to take radiographic images. The radiographic images taken from the involved digits of the affected case depicted a quite wide range of radiographic signs. After the first review of the X-ray film, samples were selected for further procedures through putrefaction. Laminitis may have affected this case at some previous time. Routine trimming seems to have prevented the premature culling in the cows with claw lesion.

Case History

Economically, lameness is considered to be a major cause of premature culling in dairy cows (Esslmont and Kossaibati, 1997; Booth et al., 2004; Nouri et al., 2008, 2010). Deep sepsis of digital bones is a common feature in culling lame cows (Nouri et al., 2007, 2008). Vertical fissure (VF) is a claw lesion that may extend across the coronary band and continue distally to the solar surface of the dorsal wall of the claw (Greenough, 1997; Greenough, 2007; Nouri and Ashrafi, 2012). The cause of VFs has not been determined yet. This is a common claw lesion in beef cattle in western Canada, where the incidence of VFs in beef cattle on average is 37.2%, with an individual herd variation of 20.5% to 64.3% (Hand et al., 1992; Goonewardene and Hand, 1995; Greenough, 1997, 2001). Although the incidence of this condition is high in the mature Canadian beef cows, the prevalence of lameness in affected cattle is approximately as low as 0.5% (Greenough, 2007). In Iran, a study of 400 cows in NazarAbad demonstrated a 3.2% overall prevalence of VFs (Nouri and Ashrafi, 2012).

White line disease (WLD) is a commonly observed lesion and has frequently been reported as a major cause of the lameness, particularly where cattle

are housed and fed concentrates. Several reports refer to the conditions as being responsible for 12-39% of the lameness (Choquetta-Levy et al., 1985; Tranter and Morris, 1991; Collick, 1997; Kujala et al., 2010). The lateral claw of the hind foot (often both) is usually involved and the animal may stand with the medial claw bearing weight (Greenough, 2007).

Footpad horn hypertrophy in the inner surface of the claw is a rare condition and there is no report describing the presence of horn hypertrophy in cows. This paper also describes the clinical, radiologic, and gross pathologic presentation of vertical fissure accompanied by white line disease 2 in the case of the concurrent deep digital sepsis in a culling lame cow.

Clinical Presentation

A 5.2 year old Holstein cow was presented with signs of severe lameness in the winter of the year 2006 at an abattoir in the vicinity of Tehran (Meysam Slaughterhouse). Examination of the foot revealed a firm inflammatory swelling of the foot associated with VF (Figure 1A) and WLD2. Widening of the periople and swelling of the heel area in the lateral claw was more permanent than the medial claw. The opening of the claws was asymmetric too. The affected claws were more boxy than the normal ones and the abaxial wall was convex in all directions. A bark-like substance also occurred on the wall. Furthermore, the locomotion scoring assessment (1-5) of the case showed score 5.

The radiographic images taken from the involved digits of the affected case depicted a quite wide range of radiographic signs such as soft tissue swelling, new bone formation and pedal osteolysis (Figure 1B).

In the medial hind claw, VF involved the coronary band to the middle of the dorsal wall of the claw and in the inner surface extended to the bearing surface (21×8 mm) (Figure 1C).

WLD2 was seen in the length of VF on the bearing surface as well (5 mm). Both of the lesions showed marginal prominence on the inner surface of the claw. Widening of the axial and abaxial laminar zone was observed, too. Also, pedal osteolysis was found on the abaxial wall of the medial P3 bone (Figure 2A).

As shown in (Figure 2B), in the inner surface of the lateral hind claw, the horn of the footpad (the apex of the bulb) was hypertrophic. There was a groove in the footpad between the apex and the base of the bulb, too. There was a dent on the outer surface in the heel region. Bony ankylosis was seen between the P3 and the distal sesamoid bone (Figure 2A). Marked periosteal new bone formation was seen on the lateral and medial aspect of P1, P2 and P3 of the both digits and extended over the lateral and caudal surfaces of metatarsus.

Diagnostic Testing

This case was observed while standing and walking (on a concrete surface whenever possible), and using a scoring system presented by Sprecher et al., (1997). The affected hind leg was amputated at the tarsus immediately after slaughter. The claws and interdigital space were cleaned thoroughly with water and a brush before examination. The lower limbs of the lame cow were examined, and the type and distribution of digital lesions as well as the VFs type were tabulated using a VF typing system presented by Greenough (2001).

An x-ray machine was used in this study (Toshiba, model DC-12M) to take radiographic images. Four radiographs of lateromedial or mediolateral and dorsopalmar/ dorsoplantar, dorsolateral- palmaro-medial/dorsolateral-plantaromedial and dorsomedial-palmarolateral / dorsomedial-plantarolateral oblique views were taken from the affected limb using exposure factors of 25 mA, 85-95 KV in 0.04 or 0.02 seconds. The radiographs were recorded by the mammography cassettes in sizes of 18×24 and 24×30. After the first review of the X-ray film, if any diagnostic lesion was seen in a radiograph, that sample would be selected for further procedures through putrefaction (bacterial maceration and bleaching) (Nouri et al., 2007).

Assessment

The VF lesions are most commonly seen in older (Goonewardene and Hand, 1995) and heavier (Goonewardene and Hand, 1995; Greenough, 2001) cattle. Except in the worst-affected herds, VFs are not seen in the claws of heifers during their first lactation (Greenough, 2001; Nouri, 2012). VFs are predominantly found on the lateral claw of the forelimbs as reported in several surveys (Hand et al., 1992;

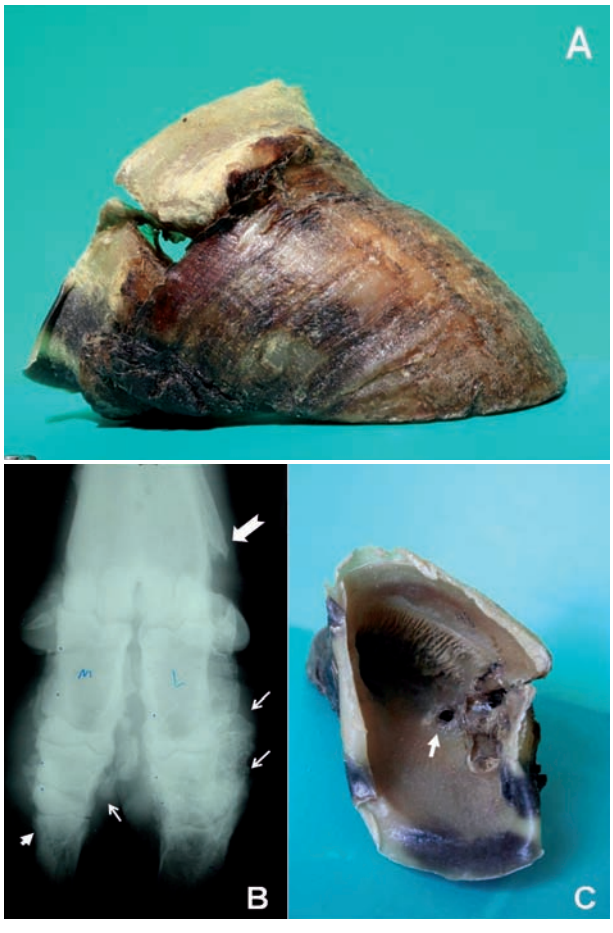

Figure 1. A. VF involved the coronary band to the middle of the dorsal wall of the medial hind claw. B: periosteal new bone formation is seen on all aspects of P1, P2 and P3 (thin arrows) and distal metacarpus (large arrow). There is a diffuse loss of bone density of the mid-portion of P3 of the medial digit (small arrow). C: the inner surface of the affected claw by WLD (white arrow) and VF that extended to the bearing surface.

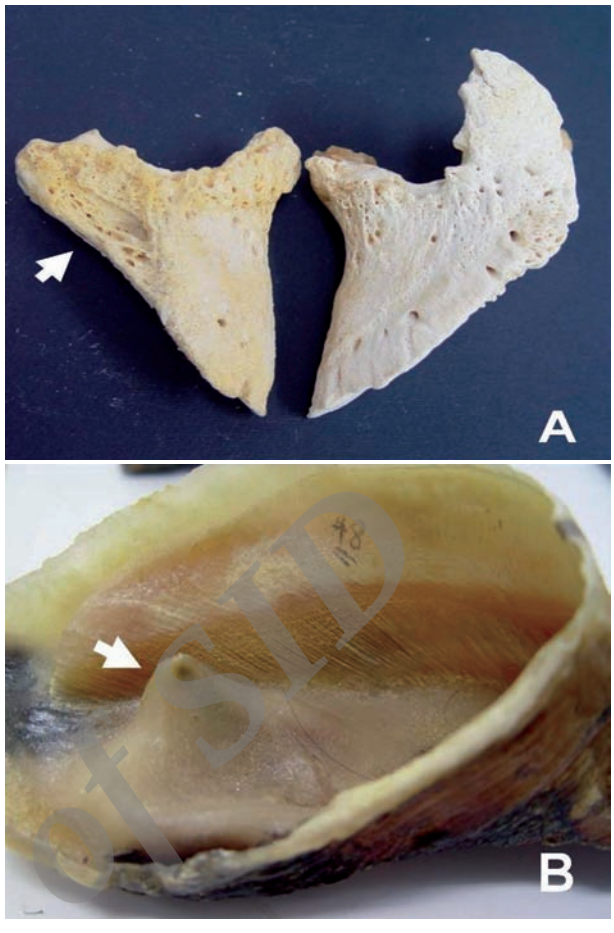

Figure 2. A. Pedal osteolysis is seen on the abaxial wall of the P3 bone of the medial digit (white arrow). In the lateral digit, bony ankylosis was seen between the P3 and distal sesamoid bone. B: The inner surface of the footpad horn in the heel region of the lateral hind claw is hypertrophic.

Goonewardene and Hand, 1995; Greenough, 1997, 2007; Clark et al., 2004). However, the finding of the current research is not in agreement with results of other researchers. This is probably due to the laceration of the claw wall that is caused by sharp materials in the farm. In another study undertaken in Iran, the highest prevalence of VFs was observed on the lateral hindclaw (69.2%) (Nouri and Ashrafi, 2012). In this case, VF involved the coronary band to the middle of the dorsal wall and in the inner surface extended to the bearing surface. Thus, the detection of the VFs type of using the Greenough VF typing system (2001) was not possible. The bending of the claw (concavity of the dorsal surface) (Greenough, 2001; Nouri and Ashrafi, 2012) and the slight angled solar surface (Nouri and Ashrafi, 2012) usually occur when VF is present. The bending of the claw may be associated with a fault (horizontal fissures) or may occur because the tensile strength of the claw has diminished (Greenough, 2001). This case would not show any sign of concavity of the dorsal surface or angling of the solar surface. Therefore, the cause of VF is not related to contributory factors such as laminitis or trace element deficiencies.

Widening of the periople (Nouri et al., 2007, 2008, 2010) and swelling of the heel area (Van Meter et al., 2005; Nouri et al., 2007, 2008, 2010) occur when a deep sepsis of digital bones is present. This case showed both of the signs.

In this case the bony ankylosis was also observed. Ankylosis is the abnormal immobility and consolidation of a joint due to disease, injury or surgical procedure (Bargai, 1989). Ankylosis can be acquired after degenerative joint disease (DJD), septic

arthritis, and several articular or periarticular trauma (Farrow, 1985; O'Brien and Biller, 1996; Nouri et al., 2007).

Also, it was observed that new bone formation extended to metatarsus. Periosteal response on P1 and P2 is typical for a chronic infectious process due to the soft tissue inflammation (Bargai, 1989). In the lateral digit with a marked periosteal response on P1 and P2, the outer surface of the claw did not show any sign of lesion. The footpad horn in the inner surface of the lateral claw was hypertrophic. The groove of the footpad is due to sinkage and new bone formation of the P3 in the chronic phase. The architecture of the hoof horn is determined by the surface formation of the underlying dermis (Mülling et al., 1999). The dermal layer of the skin and its ability to provide much needed nutrients along with hormonal exposure modulates and controls the cell differentiation in the epidermis, including keratin formation (Tomlinson et al., 2004). All distal layers of the epidermis are derived from these cells through a process of proliferation and differentiation (Tomlinson et al., 2004). Blowey (2011) suggested that, during weight bearing, these sharp protruding bone spicules will lead to further damage to the corium. This will be most pronounced in thinner cows where the solar fat pad thickness is reduced (Bicalho et al. 2009).

The pathogenesis of white line disease has never been demonstrated conclusively (Greenough, 2007). Breed, parity, housing type, some of management factors and claw deformities all have been associated with white line disease (Edwards, 1980; Green et al., 2002: Tomlinson et al., 2004; Greenough, 2007; Kujala et al., 2010). Trimming itself is a risk; at least if the trimmer takes away the supportive mechanism of the horn with a grinder or the sole becomes too thin during trimming (Kujala et al., 2010). This case showed the increase of the solar layer without any sign of trimming. Trimming therefore could not be responsible for WLD. WLD is related to laminitis and there are alterations in the horn production, weakening of the suspensory apparatus, a sunken pedal bone, and widening of WL (Kujala et al., 2010). Hemorrhage into the white line may reduce its quality and strength, thereby reducing its integrity (Collick, 1997).

Widening of the laminar zone may be caused by the accumulation of fluid, blood or cell debris and subsequent separation at the dermal-epidermal junction of the wall; or the separation of the same cell layers due to sinkage and hyperplasia of the laminae in the chronic phase (Ossent and Lischer, 1998). Once the involved regions in the wall have grown down to the weight bearing surface, they appear as a broadened white line (Ossent and Lischer, 1998).

The pedal osteolysis was also found on the abaxial wall of the P3 bone of the affected claw with WLD2. This sign is due to the persistence of the external lesion. Once the corium of WLD2 is exposed, infection penetrates in the white line and drives upwards causing septic laminitis, and eventually ending in the pedal osteolysis at the abaxial wall of the P3 bone (Edwards, 1980). The osteolysis and pedal osteitis in the region of the laminae at the dorsal edge of the P3 bone is considered as signs of laminitis (Bargai, 1989).

The results of the present study indicate that laminitis may have affected this case at some previous time. Also, routine trimming seems to prevent premature culling in cows with claw lesion.

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هیپرتروفی نسج شاخی پاشنه و شکاف عمودی سم همراه با بیماری خط سفید در یک رأس گاو شیری حذفی مبتلا به عفونت عمقی

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چکیده

یک گاو شیری هولشتاین ۵/۲ ساله با تظاهرات بالینی لنگش و وزن‌گیری غیر عادی در کشتارگاه مشاهده گردید. اتساع پریوپل و تورم ناحیه پاشنه در سم خارجی بیشتر از سم داخلی قابل توجه بود. در دیواره پشتی سم، یک ترک عمودی از ناحیه تاجی تا میانه سم داخلی اندام حرکتی خلفی را درگیر نموده و در سطح داخلی تا سطح وزن‌گیری شونده امتداد یافته بود. در کف سم، بیماری خط سفید در امتداد ترک عمودی مشاهده شد. نسج شاخی سطح داخلی سم در ناحیه پاشنه هیپرتروفیک بود. بین راس و قاعده پاشنه در سطح داخلی سم یک ناودانی شکل گرفته بود. استخوان‌های انگشت دامنه وسیعی از تغییرات استخوانی را مانند تزاید استخوانی جدید، استئولیز استخوان و انکیلوز استخوانی را نشان دادند. پس از کشتار، اندام حرکتی خلفی از مفصل ساق قطع شد. اندام حرکتی مورد معاینه قرار گرفت و تیپ و توزیع جراحات انگشت ثبت گردید. از یک دستگاه رادیوگرافی در این مطالعه استفاده شد. تصاویر رادیوگرافی دامنه وسیعی از نشانه‌های رادیوگرافی را نشان داد. سپس نمونه‌ها با استفاده از روش گندان مورد مطالعه پاتولوژی دقیقتر قرار گرفت. التهاب نسج مورق در گذشته بر این مورد اثر گذاشته است. به نظر می رسد اصلاح سم مدون از حذف زودرس گاوهای شیری به علت جراحت سم پیشگیری نماید.

واژه‌های کلیدی: لنگش، عفونت عمقی، شکاف عمودی سم، بیماری خط سفید، هیپرتروفی

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