Case Report

Suspensory Branch Desmitis in a Horse: Ultrasonography, Computed Tomography, Magnetic Resonance Imaging, and Gross Postmortem Findings

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ABSTRACT

Injury of suspensory ligament (SL) branch is a frequently diagnosed problem in horses of different ages and disciplines. This case report is for the first time the ultrasonography, computed tomography (CT), magnetic resonance imaging (MRI) findings in a 10-year-old draught horse with traumatic chronic SL branch desmitis of 8 months duration. The horse had a grade 3 of 5 left hindlimb lameness with a moderately hot, painful, and diffuse swelling from the tarsus till the hoof. Ultrasonography, both SL branches appeared as enlarged hyperechogenic structures with poor demarcation of their margins and massive periligamentous echogenic materials consistent with fibrosis. Computed tomography showed no osseous lesions but did show enlarged, hypodense, and heterogeneous SL branches with an evidence of periligamentar and peritendinous adhesions and air entrapment areas intermingled within fibrous adhesion. Magnetic resonance imaging revealed no abnormal signal intensity received from the proximal part of SL and its body. There were high and intermediate signal intensities received from inflammatory fluid and periligament fibrous adhesions, respectively, around SL branches. Both CT and MRI findings were confirmed by gross postmortem examination. In conclusion, CT and MRI are valuable tools for diagnosis of extensive adhesions associated with chronic SL branch desmitis.

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1. Introduction

Injury of suspensory ligament (SL) branch in forelimbs and hindlimbs is a relatively common disorder in horses of various ages and disciplines [1]. Although both branches may be affected, especially in hindlimbs, a single branch is usually affected in a single limb [1].

According to the affected area, injuries of SL are classified into proximal suspensory desmopathies (lesions restricted to the proximal one third), body lesions (lesions of the middle third, and sometimes extending into the proximal third) and branch lesion (lesions of the medial and/or lateral branches) [2].

Traditionally ultrasound (US) has been used for diagnosis of SL injury with several limitations. These limitations include; certain types of SL injuries cannot be diagnosed definitely using the standard US technique (SL desmitis associated with primary sepsis [1]), heterogeneous appearance because of fat and muscle forming the ligament and associated acoustic shadowing, the diagnostic value of US depends largely on the operator, it has low reproducibility, it remains limited to soft tissues and surface of the bone, and it is inconclusive to identify adhesions between SL and surrounding soft tissues and bone [3–5]. Ultrasound tissue characterization (UTC) is a useful imaging modality for tendons and ligaments that allows visualization and quantification of a threedimensional tendon matrix without the limitations of conventional US. Ultrasound tissue characterization is operator independent, highly reproducible, and is able to discriminate a variety of pathologic states. Compared with CT and MRI, it also has the advantage of portability, reduced expense, and no need for general...
Despite all this, however, UTC would be unlikely to have any additional ability over conventional US to delineate adhesions.

Computed tomography is a very useful tool for the evaluation of bones particularly in fractures of complicated anatomic regions such as the carpus or tarsus [7]. Lesions of the deep digital flexor tendon (DDFT) and collateral ligaments of the distal interphalangeal joint, navicular bursa, collateral sesamoidean ligaments, and distal sesamoidean impar ligament are imaged with a similar frequency as those identified using MRI [8,9]. On plain CT, tendon and ligament lesions appear enlarged, hypodense, and heterogeneous [10].

Magnetic resonance imaging is very useful in the area of multiple lesions within metatarsophalangeal region [11]. It was successfully applied for diagnosis of proximal suspensory desmitis, periligamentous thickening, presence or absence of osteoarthritis in the carpometacarpal and middle carpal joints, osseous contusion of the palmar cortex of McIII at the PSL origin, osseous proliferation at the insertion on McIII, endosteal/trabecular fluid, sclerosis, and resorption within McIII, and exostoses between McIII and McII/IV [12–16].

To our knowledge, there are no reports describing CT and MRI findings in SL branch (SLB) desmitis except one case of a small longitudinal tear in SL lateral branch [11]. Therefore, it is not clear if there are some advantages behind using CT and MRI in SLB lesion. This case report records—for the first time—CT and MRI findings of chronic SLB desmitis of traumatic origin in a 10-year-old horse.

2. Case Presentation

A 10-year-old draught stallion was admitted to Brooke Charity Hospital, Egypt, for investigation of moderate left hindlimb lameness of 8 months duration in addition to multiple chronic diffusely located tethering wounds. The horse was reported to suffer a traumatic “slipping” event while dragging a heavy weight on an upward asphalt road. Just after admission of the horse, the referring veterinarian carried out low and high planter perineural blocks with poor improvement. Therefore, he suggested chronic superficial and/or DDFT endenitis. He gave the horse two regimens of nonsteroidal anti-inflammatory drugs with no improvement. These regimens were phenylbutazone injection at a dose of 4.4 mg/kg given IV once daily for 7 days then reduced to 2.2 mg/kg once daily for 3 days. This regimen was repeated after 1 month with no improvement.

On examination, the horse had a grade 3/5 left hindlimb lameness at the trot on a smooth hard surface according to AAEP [17]. There was a moderately hot, painful, and diffuse slightly hard swelling from the tarsus distally to the hoof (Figs. 1A and 1B). Digital palpation of this swelling elicited mild pain. A painful response was elicited specifically over both SLBs. No perineural blocks were applied because of the presence of diffuse swelling of the limb, and they were carried out before by the referring veterinarian.

Lateromedial and dorsoplantar radiographic views of the affected limb show no osseous involvement in metatarsal bones or proximal sesamoid bones (PSB) and an increased radiopacity plantar to metatarsals, suggesting problems within the plantar soft tissues in the hind cannon region (Figs. 1C and 1D). These radiographic findings guided us to intensify the investigation on the soft tissue injuries.

Ultrasonography of the plantar aspect of hind cannon and phalangeal regions of both hindlimbs was performed by the third author (Toshiba just vision, SSA-320A, Japan, 7.5 MHz linear transducer). The limbs were clipped from above the tarsus till coronet for US examination. Ultrasound coupling gel was applied and then longitudinal and transverse scans of this area were taken. The ultrasonographic abnormalities included enlarged SLBs with hyperechogenic masses inside them, irregular contour of the

![Fig. 1.](A and B) Left hindlimb of a 10-year-old draught horse with chronic suspensory branch desmitis showing a diffuse swelling along the hind cannon and phalangeal region. Notice the increasingly upright pastern conformation and raised heels. (C and D) Lateromedial and dorsoplantar radiographic views of the affected limb showing no osseous involvement in metatarsal bones or proximal sesamoid bones and an increased radiopacity plantar to metatarsal bones.
ipsilateral PSB (Figs. 2A–C), echogenic material between the medial and lateral branches, abnormal increased amount of anechoic fluid within the DDFT sheath (DFTS; Fig. 2D), distention of metatarsophalangeal joint capsule, and subcutaneous echogenic lines and masses.

The owner refused further diagnostics or treatment options, and euthanasia of the horse was requested by him due to some personal circumstances.

After euthanasia, both hindlimbs were dissected directly post-mortem at the level of tibiotarsal joint and CT of the distal limbs was performed (TOSHIBA, Asteion 4, Japan) within 4 hours by the first and fourth authors with the following technical parameters: 120 kV (peak), 150 mAs, helical CT with an image field of view (FOV) of 110 mm diameter. RadiAnt Digital Imaging and Communications in Medicine (DICOM) Viewer (Version: 4.6.8.18460) was used to study the images after collection from picture archiving and communication system.

Computed tomography of the affected hindlimb revealed no reactions on osseous tissue of Mt II, III, and IV, suggesting that the problem progressed solely within the plantar soft tissues (superficial digital flexor tendon [SDFT], DDFT, and suspensory apparatus). On sagittal slices, there was a radiolucent air entrapment in multiple sequential slices (Fig. 3A). This air might be a part of the injury process. Proximally located cross-sectional slices demonstrated a normal proximal SL and a normal body. Streaks of fibrous tissue were imaged between the medial and lateral branches, in addition to between MtIII, the plantar flexor tendons, and the subcutaneous tissue indicative of the chronic nature of the injuries. Both medial and lateral branches of SL were found to be enlarged, hypodense, and heterogeneous. Strands of periligamentar and peritendenious tissue were seen between the principle tendons that appeared of normal shape, size, and hypodensity. The PSBs imaged within normal limits (Figs. 3B–D).

Magnetic resonance imaging of metatarsal and fetlock region of both limbs was performed. Images were obtained with a 0.3 T MRI system (Siemens AG 2009, Syngo MR A35, ID: 008). All images were obtained with a brain circular coil. Transverse (axial), sagittal, and dorsal T1-weighted, proton density (PD), T2-weighted (T2-WT), and fast low-angle shot sequence (FLASH) imaging sequences were performed. T1 image sequence was taken by repetition time (TR), 15.0 ms; echo time (TE), 17.0 ms. Proton density image sequence was taken by TR 3330.0 ms and TE 17.0 ms. T2-weighted image sequence was taken by TR 2000.0 ms, TE 100.0 ms, 150.0 cm FOV, 512 × 512 acquisition matrix with 3 mm slices and 0.5 mm interslice gaps in sagittal and dorsal slices and 5 mm slices, 2 mm interslice gaps in axial slices. Fast low-angle shot sequence was
taken by TR 36 ms in transverse slices and TR 18 ms in dorsal slices, TE 10 ms, 140 cm FOV, 256 × 256 acquisition matrix with 2 mm slices and 2 mm interslice gaps in sagittal and dorsal slices and 5 mm slices, 2 mm interslice gaps in axial slices. Magnetic resonance images were taken and interpreted by first and fourth authors. Both CT and MRI images of the affected limb were compared with those of the contralateral limb to determine abnormalities in size, shape, and fluid content.

Parasagittal PD and FLASH MRI of metatarsal region revealed high signal intensity received from inflammatory fluid around SLBs and intermediate periligamentar signal intensity around SLBs, suggesting fibrous adhesions (Figs. 4A and 4B). This adhesion was found connecting to Mt III enthesis from the dorsal aspect and also to the flexors tendons from the plantar aspect. Therefore, this adhesion was observed in the dorsal slices at the level of distal third of the SL and measured 4.86 × 10.04 cm (Figs. 4C and 4D). Superficial digital flexor tendon/deep digital flexor tendon and proximal SL were all within normal limits, and the pathology was identified from the SL body distally (Figs. 4A and 4B).

Parasagittal FLASH MRI of phalangeal region revealed continued adhesions (periligamentar tissue of intermediate and low signal intensities) between DDFT/DFTS and SSL (Fig. 5).

Both limbs were dissected, and the gross postmortem findings were recorded and photographed as shown in Fig. 6.

Supported by postmortem findings, the final diagnosis of the case was chronic suspensory branch desmitis associated with massive adhesions reaching distally to midpastern region.

3. Discussion

Suspensory ligament branch desmitis is a fairly common condition in horses [18]. Clinical examination and ultrasonography are usually used for diagnosis of SLB desmitis with many limitations. Therefore, this case report records, for the first time, CT and MRI findings of chronic SLB desmitis in a draught horse.

Suspensory ligament branch desmitis is usually resulted from repeated stretching of the ligament and hyperextension of the fetlock [19]. The presented horse was subjected to suspected trauma in the form of slipping while dragging a heavy weight. The slipping was corresponding to the injured hindlimb.

Clinically, lameness associated with suspensory branch desmitis is strongly proportional to the degree of damage [18]. In the presented horse, a moderate degree of lameness was reported because of severe damage of both SLBs. In addition, a diffuse swelling was recorded in the presented horse because of enlargement of the SLBs, periligamentous edema, and fibrosis. Similar findings were reported before [19]. Moreover, distention of metatarsophalangeal joint capsule was also recorded by US, which increased the swelling. This distention could be attributed to running of the axial distal third of ligament under the synovial capsule of the joint. In addition, a significant distention of the DFTS in the affected horse was seen by the various diagnostic modalities. Similarly, Minshall and Wright [19] recorded this finding in 18 horses with intra-articular insertion injuries of SLB diagnosed arthroscopically.

The horse was subjected to radiographic examination to exclude any osseous involvement. In this regard, Dyson et al. [16] recorded SL desmitis associated with MT II fracture.

Generally speaking, conventional US technique is traditionally used in the diagnosis of suspensory desmitis [20,21]; however, degenerative injury can occur in SL without any ultrasonographic finding [1]. Therefore, we did not depend on US alone in the diagnosis of the presented untreated horse. Additional diagnostic imaging modalities including CT and MRI were applied to reach a final diagnosis of the case.
The ultrasonographic examination of the case showed enlarged hyperechogenic SLBs, presumably, because of chronic inflammation, an irregular contour of the ipsilateral PSB because of adhesions, echogenic material between the medial and lateral branches, which extended to the subcutaneous tissue and represented the fibrous tissue, and abnormal amount of anechoic fluid within the DFTS because of tenovaginitis. Similar findings were recorded by Dyson [18].

Historically, adhesions between the SL and splint bone have been another challenge to identify completely [16]. In the present case, CT and MRI gave us the ability to obtain a three-dimensional reconstruction of the SL along with its associated bony attachments and track the extent and course of any adhesions. We could measure the length of adhesion dimensions (about 5 × 10 cm) from the beginning of fetlock joint and proximally. This may be useful during application of shockwave therapy sessions to improve its effect.

Lesions of the proximal aspect of SL, that were not identified on ultrasonography, have previously been imaged with MRI or CT [22,23]. In the presented case, MRI has also identified adhesions to the MtII, MtIV, endosteal, and entheseous reactions at the ligament’s branch. In this regard, Gonzalez et al. [11] found that MRI may be more sensitive in detecting tissue changes in the SLB than ultrasonography.

Computed tomography is capable of identifying pathologic bone change; however, CT provides limited soft tissue detail, even with contrast enhancement [5,24]. Despite this in the present case, CT gave us almost a complete tool to identify the lesion properly.

Parasagittal PD and FLASH MRI of metatarsal region revealed high signal intensity received from inflammatory fluid around SLBs and intermediate periligamentar signal intensity around SLB suggesting fibrous adhesions. These findings are more or less similar to those reported in an 11-year-old Arabian horse with a tear in the lateral branch of SL [11].

The complexity of the recorded chronic untreated case with more than one condition could be explained by involvement of adhesions to DFTS and SSL either primarily or as extension from the primary affected SLB.

Axial PD and FLASH MRI at the level of the proximal phalanx gave us a unique image of adhesions course and how they traveled aside and how was the associated fluid present between different structures till the subcutaneous tissues. In addition, it was noticed that FLASH sequence of MRI had superiority for tendon, ligament, and periligamentar tissue examination.

In our opinion, UTC may be sufficient in the acute and simple conditions of SLB desmitis. However, US, CT, and MRI are best used in a complementary fashion in chronic SLB desmitis concurrent with massive fibrosis and other associated affections such as intersesamoidean desmitis, oblique sesamoidean desmits, SDFTenditis, DDFTendinitis, degenerative conditions, and sesamoiditis. Ultrasound alone cannot be conclusive in the aforesaid mentioned conditions, and differentiation between primary and secondary lesions is difficult. Surely this will change the treatment maneuvers. Also, CT and MRI give a three-dimensional image of adhesions, its massiveness as well as its course (pathogenesis) and conclude the prognosis.

On the other hand, we also have to remind the readers of, not only, the unusual nature of this current case. This was a chronic traumatic origin SLB injury that was left untreated for an extended period of time but also of the cost of using CT/MRI and the need for general anesthesia and its risks (if not standing MRI/CT) in a clinical setting. The usefulness or need of these modalities for acute cases of
SLB desmitis was not assessed in this study and required further investigation.

The main limitation of this case report was the lack of confirmation of the source of lameness. Perineural analgesia was not performed because of the diffuse swelling of affected limb, and the referring veterinarian carried out these perineural blocks before.

In conclusion, CT and MRI may be valuable tools for diagnosis of extensive adhesions associated with chronic SLB desmitis in horses.

Fig. 5. (A) Parasagittal FLASH image obtained from 0.3 T MR system of phalangeal region in a 10-year-old horse. Dorsal is to the left. FLASH image showing strands of intermediate and low signal intensity adhesions between DDFT and straight sesamoidean ligament (SSL; arrows) reaching to subcutaneous tissue (s/c) area and s/c area shows high signal intensity due to presence of s/c edema. (B) Dorsal T2-weighted image of phalangeal region at the slice between DDFT, SSL, and part of manica flexoria of SDFT showing adhesions of intermediate signal intensity intermingled among these structures (circle). (C) Transverse (axial) FLASH MR image of the proximal aspect of the proximal phalanx, close to the origin of distal sesamoidean ligaments. Lateral is to the left of the image. This sequence showing image of adhesions (arrows) originated from SL branch above and continued distally to the level of pastern region. This is a negative image of the original one produced by RadiAnt DICOM Viewer (Version: 4.6.8.18460). (D) Transverse (axial) FLASH MR image of the distal aspect of proximal phalanx at the level of middle scutum. Lateral is to the left of this image. Similar lesions are present with deep digital flexor tenovaginitis that showing low signal intensity in the sheath consistent with strands of adhesion (arrows). P I, first phalanx; DDFT, deep digital flexor tendon; DS, Flexor Digital sheath; FLASH, fast low-angle shot sequence; MS, middle scutum.

Fig. 6. (A) Transverse anatomical section at the level of SL body showing no adhesions (arrows). (B) Transverse anatomical section of the distal third of metatarsus showing beginning of SL branch with massive adhesions between the SL branch, SL branch and Mt III, SL branch and DDFT and in s/c tissues around the limb (arrows). DDFT, deep digital flexor tendon; Mt III, third metatarsal bone; SL body, suspensory ligament body; SL branches, suspensory ligament branches.
References


