Original Research

Chronic Collateral Sesamoidean Desmopathy in Draft Horses: Magnetic Resonance Imaging and Histopathological Findings

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ABSTRACT

Desmopathy of the collateral sesamoidean ligament (CSL) is an unusual disorder in draft horses. This study records the magnetic resonance imaging (MRI) features of chronic CSL desmopathy in eight draft horses and confirms these features by histopathology. The recorded chronic CSL desmopathy has usually affected the forelimbs (100%) and commonly bilateral (62.5%). All horses showed positive proximal digital nerve block, positive front digital flexion test, and negative interphalangeal extension test. Radiography revealed no osseous abnormalities in all feet. MRI features of chronic CSL desmopathy included thickening of the ligament with increased moderate intensity in fast low-angle shot, T1 turbo spin echo, and proton density images in the affected part of the ligament. Chronic CSL desmopathy was concomitant with deep digital flexor tendon injury and distal sesamoidean impar desmitis. In most chronic cases of CSL desmopathy, heterogeneous signal intensities were seen with multiple foci of low signal intensities interlaced with increased moderate signal intensities of thickened CSL. Histopathology confirmed the MRI findings and revealed separated bundles and fascicles by septa of less organized and loose connective tissues containing fibroblasts and loose collagen fibers. Multifocal islands of cartilaginous metaplasia, mineralized areas, and dystrophic calcification were observed in the injured ligament. In conclusion, chronic CSL desmopathy may progress to cartilaginous metaplasia and dystrophic calcification. MRI is a beneficial diagnostic and prognostic tool for chronic CSL desmopathy, and histopathology is a gold standard to document the MRI findings associated with CSL desmopathy in draft horses.

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1. Introduction

Collateral sesamoidean ligament (CSL) consists of a horizontal band located at the proximal border of navicular bone (NB) and two vertical bands on both sides of the second phalanx (P2), suspending the NB to the first phalanx (P1) [1]. Biomechanical studies concluded that the greatest forces are applied during the propulsion phase of the stride. Increased tension in the CSL usually occurs during the extension of the distal interphalangeal (DIP) joint that increases the pressure of deep digital flexor tendon (DDFT) on the NB [2–4].

Injuries of the CSL were rarely observed as a sole problem and are commonly conjugated with other lesions of podotrochlear apparatus (PTA) [5]. Collateral sesamoidean ligament injuries are commonly associated with chronic forelimb lameness, decreased caudal phase of the stride during tight circling on hard ground, and improved strides on straight line moving on soft ground. In addition, front digital flexion test and interphalangeal extension test have a great value in the diagnosis of CSL injuries [6].

Navicular syndrome is a common injury causing forelimb lameness in equine [7]. Absence of abnormal radiographic changes of NB does not conclude normal PTA, but tendon or ligament injuries should be suspected [4,6,8].

In equine practice, ultrasonography is the most available technique for diagnosis of both tendon and ligament lesions of the PTA with some limitations such as difficult examination of the DDFT through the distopalmar approach of the pastern in case of high heels and difficult examination of PTA by transcuneal approach.
because of hindrance of ultrasound waves through the dry and narrow frog [6,7].

Recently, magnetic resonance imaging (MRI) was used for accurate diagnosis of desmopathy in horses [9–15]. On MRI, a thickened ligament and increased signal intensity in all image sequences were frequently seen in acute injuries of CSL [16]. To the authors’ knowledge, little previous studies dealt with histologic abnormalities of CSL desmopathy are available in veterinary literature [17]. Most of these studies have been focused on the NB in horses with radiographic abnormalities consistent with navicular disease [2,17].

None of the previously published studies on CSL desmopathy confirmed the MRI features by histopathology. Therefore, this study describes the MRI and histopathological findings of chronic CSL desmopathy in eight draft horses.

2. Materials and Methods

2.1. Animals

The guidelines of the Animal Care and Use Committee at the Faculty of Veterinary Medicine, Cairo University, Egypt, were followed up. Moreover, all international measures for animal use and care were conducted during this study. The owner acceptance was essential before examination and euthanasia of the animals.

Eight horses with forelimbs lameness since 8–15 months were admitted to the surgery clinic at Brook Charity Hospital, Cairo, Egypt.

Case history, thorough clinical examination, proximal digital nerve block, front digital flexion test (the horse’s limb was held in a flexed position for 1–2 minutes), and interphalangeal extension test were carried out for each horse. Lameness grades were scaled from 0 to 5 according to the American Association of Equine Practitioners guidelines [18]. Radiographic examination of the foot was performed. Both lateromedial and cranio-caudal views were undertaken.

Horses were included in this study if they were referred for MRI of the foot after lameness examination that localized a component of the lameness to the foot, and the MRI indicated that CSL desmopathy was the most important finding.

The horses underwent euthanasia by I/V administration of an overdose of barbiturates because of various indications such as nontolerated temperament and deadly lameness. Just after euthanasia, both distal forelimbs were harvested from carpus level till the hoof and examined with MRI within 8 hours.

2.2. Magnetic Resonance Imaging

Both front feet were imaged by MR. Each foot was positioned in a 0.3 T magnet (Siemens AG 2009, Syngo MR A35). All images were obtained with a human brain circular coil wrapped around the center of the coronet.

Imaging was begun with routine protocol formed of proton density (PD) and T2 ( dual echo) turbo spin echo (TSE) sequences in sagittal and transverse planes with a slice thickness of 3 and 4 mm, respectively, with a sagittal or transverse short-TI inversion recovery sequence with slice thickness of 3 or 4 mm, respectively. A comprehensive MRI protocol was applied as shown in Table 1 for complete assessment of PTA. Images of both bones and soft tissues were collected from picture archiving and communication system, then evaluated using RadiAnt Digital Imaging and Communications in Medicine Viewer software (Version: 4.6.8.18460).

2.3. Histopathological Examination

All forefeet were dissected, and then specimens of CSL were collected for histopathological examination. The samples were fixed in 10% buffered formalin solution, processed as usual and stained by hematoxylin and eosin dye.

3. Results

Of eight animals, six light draft stallions and two mares had CSL desmopathy. Their age ranged between 7 and 16 years. Collateral sesamoidean ligament desmopathy was bilateral in five horses and unilateral in three horses. The affected horses had 3–4/5 forelimbs lameness and pain on coffin joint manipulation. All horses showed positive proximal digital nerve block, positive front digital flexion test, and negative interphalangeal extension test. Radiography revealed no osseous abnormalities in all forefeet, including the phalanges, proximal interphalangeal (PIP), and DIP joints.

3.1. MRI Findings

Magnetic resonance imaging of normal CSL showed normal low signal intensities of the ligaments with normal thickness compared with the common digital extensor tendon (CDET; Fig. 1A). Both lateral and medial branches of the CSL were affected in four horses, whereas the lateral branch was affected in three horses, and only the medial branch was affected in the remaining horse.

Magnetic resonance imaging features of CSL desmopathy included thickening of collateral sesamoidean ligament with increased moderate intensity in fast low-angle shot (FLASH), T1, TSE, and PD images in the affected part of the ligament (Fig. 1B). On T2-weighted images, chronic CSL desmopathy showed a thickened ligament with low signal intensity. In most affected horses, prominent thickening of subchondral bone with low signal intensity consistent with sclerosis was observed at the origin of ligament into PI. Collateral sesamoidean ligament desmopathy was concomitant with DDFT injury and distal sesamoidean impar desmitis in six horses. In most chronic cases of CSL desmopathy (n = 5), heterogeneous signal intensities were seen with multiple foci of low signal intensities interlaced with increased moderate signal intensities of the thickened CSL.

Table 1
Pulse sequences and their parameters taken during foot MRI in the examined horses.

<table>
<thead>
<tr>
<th>Sequence</th>
<th>TR (ms)</th>
<th>TE (ms)</th>
<th>FA</th>
<th>Matrix Size</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1 SE</td>
<td>429</td>
<td>11</td>
<td>80</td>
<td>250*300</td>
<td>3:42</td>
</tr>
<tr>
<td>FLASH 3D</td>
<td>50</td>
<td>17</td>
<td>15</td>
<td>222*222</td>
<td>6:20</td>
</tr>
<tr>
<td>T1 3D GE</td>
<td>50</td>
<td>43</td>
<td>40</td>
<td>187*230</td>
<td>4:02</td>
</tr>
<tr>
<td>T2 3D GE</td>
<td>80</td>
<td>43</td>
<td>8</td>
<td>256*177</td>
<td>4:14</td>
</tr>
<tr>
<td>Dixon</td>
<td>1,280</td>
<td>34</td>
<td>90</td>
<td>300*300</td>
<td>3:15</td>
</tr>
<tr>
<td>T2 TSE</td>
<td>4,650</td>
<td>106</td>
<td>180</td>
<td>250*250</td>
<td>5:23</td>
</tr>
<tr>
<td>PD</td>
<td>3,330</td>
<td>17</td>
<td>180</td>
<td>244*244</td>
<td>5:39</td>
</tr>
</tbody>
</table>

Abbreviations: FA, flip angle; FLASH, fast low-angle shot; GE, gradient echo; PD, proton density; SE, spin echo; TE, time of echo; TR, time of repetition; TSE, turbo spin echo.
3.2. Postmortem Findings

Postmortem examination of normal CSLs showed normal thickness of CSLs compared with CDET (Fig. 1C), whereas CSL desmopathy showed severe thickening of either one or both CSLs (Fig. 1D) compared with the CDET. In five long-standing cases with a 12–15 months history of lameness, the cross-section of CSLs showed severe thickening of the ligament with central areas of hard tissues (Fig. 2).

3.3. Histopathological Findings

The CSL desmopathy showed bundles and fascicles separated by septa of less organized and somewhat loose connective tissue.
containing fibroblasts and loose collagen fibers (Fig. 3A). Adipose tissue and perivascular edema were seen (Fig. 3B). Some affected ligament showed severe disorganization and fragmentation of the connective tissue with increased cellularity (Fig. 3C and D). Moreover, severe destruction in connective tissue fibers was noticed with some areas of multifocal islands of cartilaginous metaplasia (Fig. 4A). Focal and extensive mineralized areas were seen and had abundant, finely granular and extracellular deposits within the ligament fibers because of dystrophic calcification in the affected ligament (Fig. 4B).

4. Discussion

The CSL desmopathy is an uncommon disease in horses. This study records the MRI features of chronic CSL desmopathy in eight draft horses and confirms these features through postmortem findings and histopathology. In the present study, CSL desmopathy was commonly bilateral (62.5%) and usually affected the forelimbs (100%). Moreover, CSL desmopathy was seen in conjunction with other injuries of the PTA in six horses. Similar findings were reported by earlier workers [4]. This may be because of the inclusion of NB, DDFT, and CSL during the DIP extension in the propulsive phase of the stride [2,3,19]. Differently, CSL desmopathy as a sole injury was recorded in two horses. Similar sole CSL desmopathy was reported before [20]. This could attribute to direct trauma or further biomechanical causes that require future investigation. In the present study, both branches of the CSL were more injured than lateral branch or medial branch. In contrast to our findings, previous studies showed high incidence of lateral branch injuries [4,20].

Comparing to CDET, MRI of normal CSL showed similar low signal intensity and thickness. Increased moderate signal intensity and thickness of CSL in FLASH, T1 TSE, and PD images indicate...
chronic CSL desmopathy. On T2 sequence, chronic CSL desmopathy showed thickened ligament with undifferentiated low signal intensity similar to that of normal ligament. In this regard, even acute injuries are characterized by thickening of the ligament and increased signal intensity in all image sequences [4]. Dyson and Murray also reported increased moderate signal intensities in degenerative, chronic, or disruption of the collagen structure of the ligament in T1-weighted images [4].

In the present study, the most chronic cases of CSL desmopathy (n = 5) showed heterogeneous signal intensities because of the presence of multiple foci of low signal intensities interlaced with increased moderate signal intensities of the thickened CSL. Histologically, these foci represent old fibrocartilaginous metaplasia with dystrophic calcification. On MRI, both calcified foci and healthy parts of the injured ligament appeared as low signal intensities because of scarce water content, resulting in confusion. Therefore, histopathology was essential to differentiate between the calcified foci and normal parts of the injured ligament.

According to the results reported here, MRI can play an important role in the diagnosis and prognosis of chronic CSL desmopathy in horses. Similar roles of MRI were applied in the important role in the diagnosis and prognosis of chronic CSL foci and normal parts of the injured ligament.

Blunden et al [16] mentioned that transitional change in the form of smooth transitional fibrocartilaginous metaplasia. Moreover, degenerative changes were seen in the form of focal and irregular fibrocartilaginous metaplasia, replacing an area of ligament fascicles [16]. Blunden et al [16] mentioned that transitional fibrocartilaginous metaplasia of CSL has no pathologic significance because they found it in normal ligament as a local adaptation to normal activity. They added that there was a localized fibrocartilaginous metaplasia with tissue degeneration of unknown clinical significance. We suggest that false ringbone around PIP joint (PIJ) may be a sequel to dystrophic calcification recorded in the present study. Therefore, further studies are recommended to document the role of chronic CSL desmopathy in development of false ring bone around the PIJ in horses.

5. Conclusion

Chronic CSL desmopathy may progress to cartilaginous metaplasia and dystrophic calcification. Magnetic resonance imaging is a diagnostic and imaging tool for chronic CSL desmopathy, and histopathology is a gold standard technique to document the MRI findings associated with CSL dysmopathy in draft horses.

Acknowledgments

None.

Financial disclosure

This work did not receive any specific grant from funding agencies from any sector.

References

[10] Elemmawy YM, Abu-Seida AM, Senna NA, Yousef AF. MRI Features of fetlock and pastern regions in 30 chronically, untreated lame draft horses [16]. In addition, treating DIP joint collateral ligament desmopathy using MRI-guided ligament injection was successfully conducted [21].

Previous histopathological study on CSL desmopathy revealed an adaptive change in the form of smooth transitional fibrocartilaginous metaplasia. Moreover, degenerative changes were seen in the form of focal and irregular fibrocartilaginous metaplasia, replacing an area of ligament fascicles [16]. Blunden et al [16] mentioned that transitional fibrocartilaginous metaplasia of CSL has no pathologic significance because they found it in normal ligament as a local adaptation to normal activity. They added that there was a localized fibrocartilaginous metaplasia with tissue degeneration of unknown clinical significance. We suggest that false ringbone around PIP joint (PIJ) may be a sequel to dystrophic calcification recorded in the present study. Therefore, further studies are recommended to document the role of chronic CSL desmopathy in development of false ring bone around the PIJ in horses.

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