Case Report

The use of computed tomography to diagnose bilateral forelimb tendon pathology in a horse with unilateral lameness

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Summary

A horse with unilateral forefoot lameness had bilateral deep digital flexor tendon (DDFT) lesions on computed tomography (CT). Venous contrast enhanced CT revealed distal sesamoidean impar desmets in the lame forelimb. Computed tomography is useful for diagnosis of soft tissue lesions within the hoof capsule and contrast enhancement improves lesion conspicuity.

Introduction

Forelimb lameness referable to the distal limb is common in horses (Stashak 2002); however, definitive diagnosis can be challenging. Appropriate medical imaging is vital for accurate diagnosis. Radiographs can identify many osseous abnormalities but interpretation of findings in equine feet varies between evaluators (Grath et al. 2009). Soft tissues of the foot can be assessed with ultrasound but limited imaging windows are available and there is a high propensity for artefacts (Dyson et al. 2003). Advanced imaging is invaluable in diagnosing causes of foot lameness (Dyson et al. 2005). While magnetic resonance imaging (MRI) has excellent sensitivity and specificity for detecting soft tissue lesions in the foot (Dyson et al. 2005), computed tomography (CT) has recently proved to be a useful imaging modality for detecting soft tissue and osseous lesions of the foot (Vallance et al. 2012a,b). Use of contrast enhanced computed tomography improves the sensitivity of this modality for detecting selected lesions and allows assessment of angiogenesis within injured soft tissues (Puchalski et al. 2009; Vallance et al. 2012a,b).

Deep digital flexor tendonitis is common in equine foot lameness (Dyson et al. 2005), but advanced imaging and histopathology studies on horses with foot lameness have shown that multiple concurrent abnormalities are often present (Dyson et al. 2005; Blunden et al. 2006a; Dyson et al. 2010; Gutierrez-Nibeyro et al. 2010). With all imaging modalities, interpreting findings within the context of the clinical assessment is important. The presence and severity of lesions detected with imaging is subject to interpretation and may not correlate with the presence of lameness (Rouhoniemi and Tervahartiala 1999; Grath et al. 2009). Current treatment options for tendon injuries in the horse can be expensive and response to therapy variable (Kersh et al. 2006; Gutierrez-Nibeyro et al. 2010; Waguespack and Hanson 2011). Favourable response to therapy is more likely to occur when treatment is based on accurate diagnosis of the clinically active lesion.

Case details

History

A 7-year-old Quarter Horse gelding used for ranch work presented to a referral hospital for evaluation of chronic forelimb lameness. Onset of lameness had been sudden and severe in the left forelimb 7 months prior. Perineural blocks of the distal left forelimb by the referring veterinarian failed to localise lameness. The horse was treated with phenylbutazone and 6 weeks small paddock rest but despite treatment the owner reported persistence of a gait abnormality.

Clinical findings and diagnostics

On presentation, physical examination revealed bilateral forelimb heel contracture and mild effusion in the right front distal interphalangeal joint. The horse was shod with standard steel shoes. The hoof-pastern angle on both forelimbs was appropriate and the toes were rolled. Response to hoof testing was negative. When trotted on firm ground, the horse was grade 3/5 lame (AAEP grading scale) on the right front with lameness most obvious when circled to the right. Perineural anaesthesia of the right front palmar digital nerves removed all right front lameness and following this block the horse appeared sound. A diagnosis of unilateral right palmar foot pain was made. Given the propensity for palmar foot pain to be bilateral and with the history of left forelimb lameness a few months prior, radiographs of both forefeet were recommended. Projections included bilateral dorsopalmar, lateromedial and dorsoproximal palmarodistal oblique views of the distal phalanx, as well as dorsoproximal palmarodistal and palmaroproximal palmarodistal oblique views of the navicular bone. Radiographs revealed small osteophytes of the proximal interphalangeal joint bilaterally consistent with mild osteoarthritis. On the right front, a small enthesophyte was present on the proximal aspect of the navicular bone. Radiographic findings were considered insufficient to explain the degree of lameness demonstrated by the horse. Bilateral CT of the distal forelimbs with contrast enhancement of the right forelimb, low field or high field MRI were recommended. The client opted to pursue contrast enhanced CT as it was the most economic option and available at the present facility while MRI would have required travelling to a distant facility.

Three weeks following initial evaluation and radiographic assessment, the horse was placed under general anaesthesia and CT of both distal forelimbs performed with a helical CT scanner ([Toshiba Aquilion 64]© 2014 EVJ Ltd

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frontal planes with a slice thickness of 2 mm. Venous contrast enhanced computed tomography (CECT) images were obtained of the distal right forelimb with the same imaging parameters. A rubber tourniquet was placed on the proximal aspect of the metacarpus. An 18 gauge 1.88 inch Vialon catheter (BD Insyte-W)\(^2\) was placed in the medial palmar digital vein and 20 ml iodinated contrast medium (Iopamidol 370 mg I/ml, 25 ml) power injected over 10 s. Images were acquired at 60 s post contrast injection.

Evaluation of the precontrast images revealed bilateral DDFT lesions. On the precontrast images of the left front DDFT, there was a focal, well defined mildly hypoattenuating region of the medial lobe of the DDFT proximal to the navicular bone interpreted as a DDFT core lesion (Fig 1). The lesion extended dorsally to contact the navicular bursa and palmar to the collateral sesamoidean ligament. This lesion was present in multiple images and imaging planes and measured 16 mm in longitudinal length.

On precontrast images of the right front DDFT, there were focal, well defined mildly hypoattenuating regions on the dorsal aspect of both lobes of the DDFT located proximal to the navicular bone interpreted as a DDFT core lesions (Fig 2). Following contrast medium injection, the right front DDFT lesions were contrast enhancing and measured 8 mm in longitudinal length. In addition, a peripherally contrast enhancing, centrally hypoattenuating lesion was apparent in the distal sesamoidean impar ligament (DSIL) near its insertion on P3 (Fig 3). This finding was compatible with desmitis of the DSIL; an abnormality not evident on the precontrast images of the right front.

A small enthesophyte was present on the proximal aspect of the right front navicular bone and was associated with the collateral sesamoidean ligament. The collateral sesamoidean ligament was mildly enlarged but no contrast enhancing lesions were seen. No other abnormalities were present on the left or right front navicular bones.

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Fig 1: a) Mid-sagittal plane image, with a white line indicating the level of the transverse image in (b). b) Transverse image of the LF showing the focal, well defined mildly hypoattenuating core lesion of the medial lobe of the DDFT (medial is to the right). The arrow marks contact of the DDFT lesion with the navicular bursa at the level of the collateral sesamoidean ligament. Note the irregularity of the DDFT dorsal border and asymmetry of DDFT lobes with medial lobe being greater in size. Noncontrast image displayed in a soft tissue Window/Level (W320/L30).

Fig 2: a) Mid-sagittal plane image, with a white line indicating the level of the transverse images in (b) and (c). b) Precontrast transverse image of the RF showing the focal, well defined mildly hypoattenuating lesions of both lobes of the DDFT. c) Post contrast transverse image of the RF at the same level as (b). The arrows mark the contrast enhancement of the lesions depicted in (b). Images (a) and (b) are displayed in a soft tissue Window/Level (W320/L30). Image (c) is displayed in a bone Window/Level (W2100/L30).
Treatment

The horse was treated with 3 cycles of extra-corporeal shockwave therapy (ESWT) at 4 week intervals and confined to a small paddock. A protocol of 1000 pulses through the heel bulbs of each front foot at energy level 4 with a 20 mm trode and 700 pulses through the frog of the right front at energy level 4 using a 35 mm trode was followed. The horse improved following each ESWT treatment and was sound when trotting in a straight line on hard ground at the time of his final treatment. Grade 1/5 lameness was present on the right front when trotted in a circle to the right on hard ground. Switching from a standard shoe to a shoe with more heel support was recommended at the time of diagnosis. This change was implemented just prior to the third ESWT treatment when the horse presented in a straight bar shoe. Thirteen months following final treatment, the owner reported that the horse was still mildly lame on his right front and had been retired to pasture.

Discussion

Palmar foot pain in the horse can result from soft tissue injuries, bony abnormalities or a combination of both. Deep digital flexor tendonitis, alone or in combination with other injuries, has been reported to be the most common cause of foot lameness in horses undergoing MRI evaluation for foot pain (Dyson et al. 2005). Several causes of foot pain associated with a normal radiographic examination have been reported including navicular bursitis, desmills of the collateral ligaments of the distal interphalangeal joint and desmills of the DSIL (Dyson et al. 2005; Gutierrez-Nibeyro et al. 2010). Ultrasonography of these structures is unrewarding in many cases, necessitating advanced imaging in order to make a diagnosis.

High-field MRI is commonly recognised as the best modality for evaluation of soft tissue lesions within the equine foot; however, it is not universally available. Recently, the utility of CT in assessing diseases of the equine foot has been demonstrated (Whilton et al. 1998; Rouhaniemi and Tervahartiala 1999; Vallance et al. 2012a,b). A reliable technique for intra-arterial contrast enhancement of CT images has been developed in order to augment the utility of CT (Puchalski et al. 2007). Since that time, CT in combination with contrast enhanced CT (CECT) has been demonstrated to be a valuable modality in the diagnosis of lameness localised to the equine distal limb (Anderson and Nelson 2011; Vallance et al. 2012b). The combination has also been reported to be comparable to low field standing MRI in the value of the diagnostic information yielded (Vallance et al. 2012b). Although intra-arterial contrast enhancement is currently used as the technique of choice for the production of CECT images, catheterisation of the palmar medial artery is technically more challenging than the palmar digital vein. In some patients these authors have been unable to catheterise the palmar medial artery and have infused the palmar digital vein in an attempt to achieve contrast enhanced images. Our infusion rate is considerably faster and the volume infused lower than that reported for regional limb perfusion with antibiotics via the palmar digital vein (Rubio-Martinez et al. 2012), but our technique has produced diagnostic images. Given our rapid rate of infusion, complications such as haematoma formation or thrombophlebitis may occur using this technique. Although we have not experienced complications, we have done relatively few cases using this technique and complications with antibiotic perfusions are reportedly low at a 12% incidence of thrombophlebitis (Rubio-Martinez et al. 2012). In this report, CECT was essential to diagnose the lesion in the right front DSIL. Although studies comparing CT images of the distal limb following contrast injection via the palmar digital vein or the medial palmar artery are not available in the horse, the palmar digital veins have been used successfully for radiographic venograms in the past (Rucker 2010).

The relative importance of the DSIL lesion in comparison to the more obvious DDFT lesions is difficult to interpret in the right front. Given the close proximity of the DDFT to DSIL at the attachment of these structures to the third phalanx, adhesion formation between the 2 is possible. As adhesions may predispose to chronic lameness that is poorly responsive to treatment, high field MRI may have been useful in delineating whether adhesions were present in this case (Holowinski et al. 2012).

![Fig 3: a) Mid-sagittal plane image, with a white line indicating the level of the transverse images in (b), (c) and (d). b) Precontrast transverse image of the RF. c and d) Post contrast transverse images of the RF at the same level as (b). The arrow in (c) and circle in (d) mark the peripherally contrast enhancing lesion of the right distal sesamoidean impar ligament, which is not seen on the precontrast image (b). Images (a), (b) and (c) are displayed in a soft tissue Window/Level (W320/L30). Image (d) is displayed in a bone Window/Level (W2100/L30).](image-url)
Lesions of the DDFT are a well recognised cause of foot lameness in the horse, with the area just proximal to the navicular bone being most commonly affected region (Dyson et al. 2003). Histopathology of this area has shown that there are frequently moderate to severe structural differences of the dorsal 20–30% of the DDFT in comparison to more palmar sections in lame horses when compared to age matched sound horses (Blunden et al. 2006b). This same study, however, showed that the dorsal area of the DDFT showed moderate abnormalities in a small number of horses that had no history of lameness. Because histopathology in both lame and sound horses lacked evidence of inflammation, authors postulated that the DDFT changes were degenerative. Tendonitis of the DDFT in the distal limb is associated with a poor prognosis for return to athletic function with 53–78% of horses showing persistent lameness despite treatment (Dyson et al. 2005; Gutierrez-Nibeyro et al. 2010). Concurrent lesions of the navicular bone or navicular bursa further decreases prognosis. Computed tomography of the left front foot in this horse showed a large lesion of the DDFT with a suspected adhesion of the DDFT to the navicular bursa that did not result in a clinical lameness. Although the left front foot was treated with ESWT therapy, the CT lesion was considered an incidental finding because of the lack of clinical signs. Extracorporeal shockwave therapy was initiated to treat the right forelimb lesions and treatment of the left front foot was included as a precautionary measure.

The use of shockwave for treatment of tendonitis and desmitis in equine practice has yielded variable results. Extracorporeal shockwave therapy has been recommended as an adjunct therapy for navicular syndrome (Wagquespack and Hanson 2011). When used as a primary therapy for palmar heel pain, it has been shown to improve lameness in 56% of horses when horses were assessed by blinded evaluators (McClure et al. 2004). In this case, right front digital flexor tenoscopy, intralesional injection with platelet rich plasma or stem cells and ESWT were offered as treatment alternatives. The client opted for ESWT due to its noninvasive nature.

The absence of left front lameness in this horse is difficult to explain. Historically, a lameness was present on that limb, but the original lameness was not localised with perineural anaesthesia. Seven months ensued between detection of the original lameness and assessment at the referral hospital. Potentially, the left DDFT lesion was more chronic than its right front counterpart and adhesion to the navicular bursa had stabilised the lesion in a nonpainful position. As a means of assessing chronically, contrast enhancement of the left forelimb would have been useful to compare the degree of vascularisation to that seen in the right front DDFT lesions. It is also possible that at the time of referral assessment, the left forelimb had lameness below the level of clinical detection. Use of a body-mounted inertial sensor based lameness locator system may have been beneficial in detecting a subtle lameness not visible to the naked eye (Keegan et al. 2013).

This report highlights the usefulness of CT and CECT in diagnosing soft tissue lesions in the equine distal limb. In particular, DDFT lesions proximal to the navicular bone are easily recognised and venous contrast enhancement can be useful in determining the degree of vascularisation present. This report also proves that notable soft tissue abnormalities on CT may not be correlated with lameness. The appearance of DDFT lesions on CT not correlated with active lameness have not been previously reported to the knowledge of these authors. The findings in this case study emphasise the importance of interpreting medical imaging findings within the context of clinical findings.

Authors’ declaration of interests
No conflicts of interest have been declared.

Manufacturers’ addresses
1. Toshiba America Medical Systems, Irvine, CA, USA.
2. BD Becton Dickinson, Franklin Lakes, NJ, USA.

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