How Useful Is Nuclear Scintigraphy in the Diagnosis and Management of Proximal Suspensory Desmitis in the Horse?

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In many horses with proximal suspensory desmitis, radiopharmaceutical uptake (RU) in the proximal aspect of the third metacarpal (metatarsal) bone is normal. Increased RU reflects an enthesopathy, which may influence both treatment and prognosis. Authors’ address: Centre for Equine Studies, Animal Health Trust, Lanwades Park, Kentford, Newmarket, Suffolk CB8 7UU, UK; e-mail: sue.dyson@aht.org.uk (Dyson). © 2006 AAEP.

1. Introduction

Proximal suspensory desmitis (PSD) is a well-recognized cause of both forelimb and hindlimb lameness.\(^1\) The definitive diagnosis is dependent on localization of the pain causing lameness to the proximal palmar metacarpal (plantar metatarsal) region using local analgesia and ultrasonographic identification of structural abnormalities of the ligament. Radiography is useful to exclude other causes of pain in this region, such as an avulsion fracture at the origin of the ligament on the third metacarpal (metatarsal) bone\(^6\) or a palmar cortical fatigue fracture.\(^1,9\) In some horses, the degree of ultrasonographic abnormality of the proximal aspect of the suspensory ligament is not consistent with the degree of lameness. The contribution of entheseseous pain or osseous pain is difficult to determine radiographically or ultrasonographically. Nuclear scintigraphy and magnetic resonance imaging (MRI) have the potential to yield additional information; however, to date, there has been no description of radiopharmaceutical uptake (RU) in the proximal metacarpal and metatarsal regions of clinically normal horses in full work. Additionally, there have been no comprehensive descriptions of scintigraphic abnormalities that might be seen in horses with clinical and ultrasonographic evidence of PSD.

The aims of the current study were (1) to describe RU in the proximal metacarpal and metatarsal regions of clinically sound horses in full work, (2) to describe RU in a group of horses with proximal suspensory desmitis, and (3) to discuss the use of radiography, scintigraphy, and MRI in management decisions concerning PSD. It was hypothesized that there would be a standard pattern of RU across the proximal metacarpal and metatarsal regions in normal horses and that there would be a variation of this pattern with age. It was also hypothesized that there would be left/right symmetry in both forelimbs and hindlimbs but differences between the forelimb and hindlimb RU patterns.
It was hypothesized that RU in the proximal palmar (plantar) aspect of the third metacarpal (metatarsal) bone would be greater in lame limbs of horses with proximal suspensory desmitis than in sound limbs of lame horses and that limbs with more severe ultrasonographic abnormalities would have increased RU.

2. Materials and Methods

Inclusion Criteria
Retrospective analysis of the scintigraphic images of 64 clinically normal horses in full work at the time of examination was performed. The scintigraphic images of 126 horses examined between January 1996 and September 2003 with either forelimb or hindlimb PSD were retrospectively analyzed. Horses were included in the PSD group if lameness was abolished by perineural analgesia of the palmar metacarpal (plantar metatarsal) nerves, radiographic examination had been performed, and there was ultrasonographic evidence of PSD. Radiographic examination of the proximal metacarpal or metatarsal regions was performed using at least dorsopalmar (dorso-plantar) and lateromedial projections. Horses with an avulsion fracture of the third metacarpal (metatarsal) bone at the origin of the suspensory ligament were excluded.

In each study, scintigraphic images were excluded if the total counts acquired were <150,000, if there was movement blur, radioactive contamination, or increased RU associated with a clinically apparent exostosis (even if asymptomatic), or if limb obliquity was present. All scintigraphic analysis was performed by one experienced assessor (J. Weekes).

Image Analysis
Scintigraphic images were assessed subjectively and objectively using horizontal profile analysis and predefined regions of interest (ROIs) (Fig. 1). The ratio between RU in each ROI and the reference bone was calculated (RU ratio). One clinician (S. Dyson), blinded to the identity of the horse and the lame limb(s), graded the ultrasonographic images retrospectively and assigned each a grade of 0–3 (0 = no abnormality; 1 = mild: subtle focal changes in echogenicity; 2 = moderate: enlargement of the suspensory ligament and moderate alteration in echogenicity; 3 = severe: marked enlargement of the suspensory ligament and major disruption of its architecture). One clinician (S. Dyson), blinded to the identity of the horse and the lame limb(s), also graded the radiographic images retrospectively. The presence of increased opacity in the third metacarpal (metatarsal) bone in the dorsopalmar (dorso-plantar) view or endosteal new bone dorsal to the palmar (plantar) cortex in the lateromedial view was recorded.

Data Analysis
Data distribution was assessed using a Shapiro-Wilk analysis. Comparisons between limbs and regions of interest within each horse were performed using a paired Student’s t-test for normally distributed data and using a Wilcoxon signed-rank test for
non-normally distributed data. For the normal horses, left/right and forelimb/hindlimb comparisons were performed, and data for the ROIs was compared. For lame horses, a Mann-Whitney U-test was used to compare lame with sound limbs overall and to include data from horses with unilateral and bilateral lameness. A Kruskal-Wallis analysis of variance (ANOVA) was used to test for a difference in RU between ultrasonographic grades of the suspensory ligament. Multiple comparisons of the means were applied when the Kruskal-Wallis statistic was significant. All statistical analysis was performed using a statistical software package, and statistical significance was set at $p < 0.05$.

3. Results

Sample Population

The 64 normal horses ranged in age from 2 to 16 yr (median age = 8.1 yr) and were used for a variety of disciplines (showjumping = 25, eventing = 3, dressage = 18, racing = 3, general purpose [including unaffiliated competition] = 15). There were 126 lame horses: 40 had forelimb lameness, 82 had hindlimb lameness, and 2 had forelimb and hindlimb lameness. Their ages range from 2 to 18 yr (median age = 8.2 yr) and were used for a variety of disciplines (showjumping = 27, eventing = 21, dressage = 42, racing = 13, general purpose = 23).

Normal Horses

In 78% of forelimbs, the peak of radiopharmaceutical activity was at the dorsal aspect of the proximal metacarpal region; 75% of the dorsal plane profiles of activity were symmetrical with the highest peak over the medial to central portion of the proximal metacarpal region (Fig. 2). In 80% of hindlimb lateral images, the peak radiopharmaceutical activity was at the central to plantar aspect of the proximal metatarsal region (Fig. 3). All plantar image profiles of activity were symmetrical with the highest peak being over the lateral portion of the proximal metatarsal region (Fig. 4).

There was no significant left and right variation between sites for mean RU ratios on the lateral and dorsal images of the proximal metacarpal region. But, using lateral images, the mean RU ratios from all regions of the right proximal metatarsal region were greater than the left proximal metatarsal (dorsal, $p = 0.003$; plantar, $p < 0.0001$; whole proximal metatarsal region, $p = 0.0006$). There was no significant variation in mean RU ratios between left and right on plantar images; however, the mean RU ratio for the lateral proximal metatarsal region was significantly greater than for the medial proximal metatarsal region ($p < 0.0001$). Age had no significant effect.

Left/right symmetry of RU was present in the proximal metacarpal region; however, there was a significant difference between left and right proximal metatarsal regions. There was higher RU in the right proximal metatarsal region than the left.

There were differences in the pattern of RU between the forelimbs and hindlimbs. In the forelimbs, maximum RU was located at the dorsal aspect.
aspect of the proximal metacarpal region in the lateral image with peak activity over the medial to central portion of the proximal metacarpal region on dorsal images. In the hindlimbs, the maximum RU was at the central to plantar aspect of the proximal metatarsal region in the lateral images with peak activity over the lateral portion of the proximal metatarsal region on plantar images. There was no correlation between age and RU in either forelimbs or hindlimbs.

Lame Horses

Subjective Appearance and Profile Analysis
In the majority of limbs, there was a normal pattern of RU (Fig. 2). In 4 of 84 lateral forelimb images (5%), there was focal moderate increased RU in the proximopalmar aspect of the third metacarpal bone. In dorsal forelimb images, 11 limbs had mild to moderate increased RU in the third metacarpal bone centrally (6 of 78 or 8%) or medially (5 of 78 or 6%). In 15 of 168 lateral hindlimb images, there was focal moderate to intense (linear or triangular-shaped) increased RU in the proximoplantar aspect of the third metatarsal bone (Fig. 5). In plantar hindlimb images, there was increased RU in the central proximal aspect of the third metatarsal bone in 19 of 156 (12%) limbs. Profile analysis yielded little additional information.

Proximal Metacarpal Region
No significant difference in RU ratios between the sound and lame limbs was detected at any location in either the lateral or dorsal forelimb images. Comparison of relative uptake between the lame and sound limbs on dorsal images revealed a significant difference with greater RU in the medial (p = 0.0013), lateral (p = 0.0022), and proximal (p = 0.0004) metacarpal regions in the lame limbs.

Proximal Metatarsal Region
No significant difference in RU ratios between the sound and lame limbs was detected at any location in the lateral hindlimb images. In the plantar images, there was a greater RU ratio in the medial metatarsal region of the lame limbs compared with the sound limbs (p = 0.0397). Comparison of relative uptake between the lame and sound limbs revealed a significant difference with greater RU in the medial (p < 0.0001), lateral (p < 0.0001), and proximal (p < 0.0001) metatarsal regions in the lame limbs.

Comparison of RU With Radiographic Grading
There was a low prevalence of radiological abnormalities in both forelimbs (3%) and hindlimbs (15%), and there was no association between the presence of radiological abnormality and RU.

Comparison of RU With Ultrasonographic Grading
In both forelimbs (59.5%) and hindlimbs (61.1%), grade 2 ultrasonographic abnormalities were most prevalent followed by grade 3 lesions (forelimbs = 29.7%, hindlimbs = 25.7%) and grade 1 lesions (forelimbs = 10.8%, hindlimbs = 13.3%). In the fore-
limbs, there was no difference in RU ratio between the limbs with different ultrasonographic grades; however, in the hindlimbs, there was a significant difference in the RU ratio between limbs with different ultrasonographic grades in both plantar ($p = 0.016$) and lateral ($p = 0.048$) images and specifically at a plantar location ($p = 0.008$). Limbs with grade 3 ultrasonographic abnormalities had significantly greater RU ratios than limbs with lower grades ($p < 0.03$).

4. Discussion

The results of this study support the hypothesis that there would be a standard pattern of RU in the proximal metacarpal and metatarsal regions, but it revealed no variation of this pattern with age. In the majority of horses there was a standard pattern of RU for both forelimbs and hindlimbs. The lack of correlation between age and any of the parameters tested is probably caused by the small sample size of different ages. Most horses included in the study were 8–10 yr (median age = 8.1 yr), which is similar to the mean age of our normal hospital population (7.8 yr). Horses at 7 yr of age have reached skeletal maturity; thus, it is not surprising that there were no differences in the RU. Unlike human beings, who tend to become more sedentary with increasing age, horses continue to exercise throughout life, and decreased stimulation of bone modeling is less likely to occur.

Contrary to our hypothesis, there was no significant association between proximal suspensory desmitis and increased RU in the proximopalmar aspect of the third metacarpal bone. Nonetheless, there was a small number of horses with forelimb lameness with mild to moderate focal increased RU in the proximopalmar aspect of the third metacarpal bone of the lame limb. These horses had an acute onset and a moderate to severe lameness that was more persistent than most horses with forelimb PSD. In hindlimbs, there was both significant increased RU in the third metatarsal bone in lame limbs compared with sound limbs and positive association between ultrasonographic lesion grade and RU. In a high proportion of horses with proximal suspensory desmitis, gross evaluation of the images or the use of profile analysis failed to reveal any abnormality, and differences were only detected using ROI analysis. These results are consistent with previous and current clinical observations in our hospital population. A negative scintigraphic result does not preclude the presence of PSD.

A smaller group of horses with forelimb proximal suspensory desmitis compared with a group of horses with hindlimb proximal suspensory desmitis was examined using nuclear scintigraphy at the Animal Health Trust. This is because horses with hindlimb lameness are often referred for scintigraphic examination first, and then other diagnostic investigations are performed. The horses with hindlimb lameness often have a less well-defined duration of lameness; some present because of insidious onset of poor performance, whereas others have acute onset lameness.

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Fig. 4. Plantar scintigraphic image of the hocks of a normal horse. Three horizontal line profiles have been placed at pre-defined anatomical sites. The RU pattern is normal. Note the relatively greater RU proximolaterally in the metatarsal region (red profile).
In three horses with bilateral hindlimb lameness, ultrasonographic abnormalities were only identified in the lame limb. No horses with unilateral lameness had ultrasonographic abnormalities identified in the non-lame limb. Although there was a positive correlation between ultrasonographic lesion grade in hindlimbs, there were two horses with intense increased RU with grade 1 ultrasonographic lesions. It is presumed that this relates to a primary enthesopathy at the origin of the suspensory ligament, which has subsequently been documented using magnetic resonance imaging (MRI) in a small number of horses. Recognition of these different patterns of ultrasonographic grading and degree of increased RU is considered important, because it may influence management and prognosis.

Ultrasonographic grading did not take into account the presence of entheseous new bone on the palmar (plantar) aspect of the third metacarpal (metatarsal) bone. In our experience, ultrasonographic evaluation is potentially more sensitive than radiography for detection of such bone, but its presence is better determined during live imaging than from static, previously captured ultrasonographic images.

There was no relationship between the presence of radiographic abnormalities and RU. Moreover, in hindlimbs, the general site of increased RU, immediately distal to the tarsometatarsal joint, was often proximal to the site of endosteal new bone. Increased opacity of the proximal aspect of the third metatarsal bone, or less commonly, the third metacarpal bone, seen in dorsoplantar (dorsopalmar) radiographic views can be an incidental finding unassociated with lameness; however, it may reflect previous stress at the suspensory ligament’s origin.

The presence of increased RU in the proximal aspect of the third metacarpal bone is usually confined to horses with acute onset of moderate to severe lameness that persists for longer than horses with normal RU. It is presumed that bone modeling at the suspensory ligament’s origin and associated pain contribute to the lameness. In our experience, a longer period of rest is generally required for long-term resolution of lameness compared with horses with normal RU. In hindlimbs, treatment of PSD by neurectomy of the deep branch of the lateral plantar nerve and plantar fasciotomy may resolve lameness in horses with lesions confined to the suspensory ligament, but concurrent bony pathology, characterized by moderate to intense increased RU, may result in lameness that takes longer to resolve. This is important prognostic information. Horses with focal intense increased RU in the proximal plantar aspect of the third metatarsal bone with grade 1 ultrasonographic lesions have responded poorly to shock-wave treatment and have required many months for lameness to resolve. Ultimately, these horses returned to full athletic function.

In many horses with PSD in either forelimbs or hindlimbs, gross analysis of scintigraphic images reveals no abnormality, but ROI analysis reveals significantly increased RU in lame hindlimbs compared with sound hindlimbs. Generally, there is a positive correlation between ultrasonographic lesions severity and the degree of increased RU; however, intense RU is occasionally seen in association with mild suspensory ligament pathology. This does not adequately explain the degree of lameness, which may reflect principally entheseous injury and primary bone pain.
References and Footnotes


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