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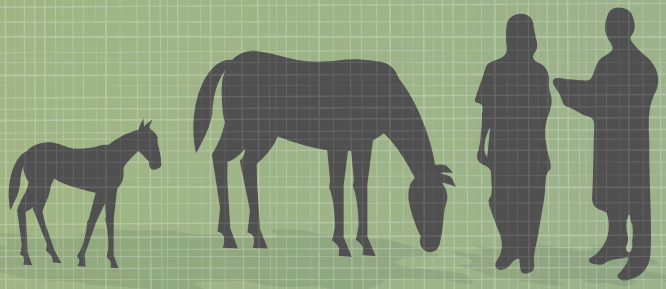

IMAGING

Chair: Safia Barakzai

16.00

Getting the best out of the ultrasound examination of the suspensory ligament

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Ultrasonography of the proximal suspensory ligament represents a challenge in equine musculoskeletal ultrasonography, both for technical reasons and for the peculiar anatomy of this anatomical structure making interpretation of the ultrasonographic images more difficult in comparison with other metacarpal/tarsal tendinous structures. However, ultrasonography remains the first-line modality to assess the suspensory apparatus in horses as ultrasound machines are affordable, easy to use in the field and their technical quality has greatly improved in recent years.

To overcome at least some of the difficulties, some practical and technical tips and tricks can be used. The width of the proximal portion of the suspensory ligament is larger than the flexor tendons in fore- and hindlimbs and its outer portions and margins can therefore be easily missed if the ultrasonographic examination is performed without adapting the technique. The use of the trapezoid mode of the linear probe or the use of a large curvilinear (convex) probe may help in assessing the entire width of the proximal suspensory ligament in transverse sections. In any case a combination of a palmaromedial and palmarolateral approach in the forelimb, the use of the plantaromedial approach in the hindlimb and the examination of the ligament on the flexed limb (both in the fore- and hindlimb) are essential for a complete evaluation.

The proximal suspensory ligament contains ligamentous fibres as well as adipose and muscle tissue in the normal horse, making its architecture and echogenicity less homogeneous in comparison with digital flexor tendons. The use of the so-called 'angle contrast ultrasound technique' has been proposed to facilitate the differentiation of regions of tendinous fibres from adipose tissue and muscle. This technique consists of imaging the anatomical structures using a nonperpendicular ultrasound beam in order to use the anisotropic properties of the tissues. Because anisotropic properties of tendon and ligament fibres differ from those of adipose tissue and muscle, muscle and adipose tissue will not appear to have the same echogenicity as tendon fibres. Tendon echogenicity is in fact angle dependent and tendon fibres will become hypoechoic when the ultrasound beam is not perpendicular to them. On the contrary, muscle and adipose tissue echogenicity are respectively less and not modified depending on the beam angle. The result will be the ability to differentiate the hypoechoic tendinous part of the proximal suspensory ligament from the echogenic muscular/adipose bundles when the structure is imaged using a nonperpendicular beam angle.

To use anisotropy to distinguish different type of tissues the examination of the proximal suspensory ligament is carried out on the flexed limb with a linear probe in transverse section. No stand-off is required as the relaxed flexed tendons allow a better contact of the entire probe surface. In the flexed nonweightbearing forelimb, the suspensory ligament can be approached slightly palmaromedially or palmarolaterally by displacing the flexor tendons with the probe on the opposite side. To compare right and left suspensory images it is important to use the same approach. On the flexed hindlimb, the approach of the proximal suspensory ligament requires a plantaromedial approach because of the different anatomy of the hindlimb, where the relative position of the flexor tendons differs from the forelimb and the superficial digital flexor tendon is located lateral to the lateral digital flexor tendon (the larger head of the deep digital flexor tendon running on the sustentaculum tali). Using the approach on the flexed limb the probe will be closer to the proximal suspensory ligament and the skin–probe contact will be on a larger surface. This will result in a better visualisation of the entire surface of the suspensory ligament on transverse sections.

Despite the use of the combination of standard and angle contrast ultrasound techniques, as well as imaging the flexed nonweightbearing limb, image interpretation remains challenging. The ultrasonographic changes that have to be looked for include thickening, changes in echogenicity and architecture, and alteration of the bone surface of the enthesis. For a better assessment, the contralateral limb should always be examined for comparison, although bilateral disease occurs frequently. Because of the deep location of the proximal suspensory ligament between the metatarsal bones dorsally and dorso-abaxially and carpal/tarsal check ligament and digital flexor tendons palmarly, particular attention should be paid to the collapse of the adjacent vascular structures to identify the thickened suspensory ligament. In the forelimb, when thickened, the proximal suspensory ligament will reduce or erase the hypoechoic vascular space that normally separates its dorsal profile from the hyperechoic metacarpal bone surface. In the hindlimbs, a severe increase in size of the suspensory ligament will displace and then collapse the medial plantar metatarsal vein.

Using the angle contrast ultrasound technique, changes in echogenicity and architecture in the proximal portion of the suspensory ligament may be better identified by assessing the relative position of the hypoechoic fibrous portion of the ligament and the echogenic musculo-adipose bundles on the flexed limb. In fact the increase in size of the affected fibrous area will produce a relative enlargement of the hypoechoic portion of the section surface and will induce compression and displacement of the adjacent echogenic bundle.

Finally, because of the difficulty of the ultrasonographic examination and the consequent potential for a high rate of false-negative and false-positive results, the cognitive approach, both during the technical obtention of images and during their interpretation, is crucial. In fact, the role of imaging in the diagnostic work-up is to confirm the pre-test odds more than giving a diagnosis and, even though this consideration should be borne in mind in any diagnostic imaging examination, it is even more important where difficulties and limitations arise. A critical cognitive approach, a continuous questioning during image acquisition and awareness of unavoidable cognitive biases will reduce the risk of giving an inappropriate role to the ultrasonographic examination in the clinical picture.

Further reading

Denoix, J.M. and Bertoni, L. (2015) The angle contrast ultrasound technique in the flexed limb improves assessment of proximal suspensory ligament injuries in the equine pelvic limb. *Equine Vet. Educ.* **27**, 209-217.

Denoix, J.-M., Coudry, V. and Jacquet, S. (2008) Ultrasonographic procedure for a complete examination of the proximal third interosseous muscle (proximal suspensory ligament) in the equine forelimbs. *Equine Vet. Educ.* **20**, 148-153.

Werpy, N.M., Denoix, J., McIlwraith, C. and Frisbie, D.D. (2013) Comparison between standard ultrasonography, angle contrast ultrasonography, and magnetic resonance imaging characteristics of the normal equine proximal suspensory ligament. *Vet. Radiol. Ultrasound.* **54**, 536-547.