Journal of Equine Veterinary Science 47 (2016) 9–15

Contents lists available at ScienceDirect

Journal of Equine Veterinary Science

journal homepage: www.j-evs.com

Original Research

Enthesophytosis and Impingement of the Dorsal Spinous Processes in the Equine Thoracolumbar Spine

Hilary M. Clayton [a,b,*], Narelle C. Stubbs [a,c]

[a] Department of Large Animal Clinical Sciences, Mary Anne McPhail Equine Performance Center, Michigan State University, East Lansing, MI
[b] Sport Horse Science, LLC, Mason, MI
[c] Department of Equine Sports Medicine, Veterinary Clinic of the Hippo Arena Samorin, Napoli Slovak Equestrian Club, Šamorin-Ćilistov, Slovak

ARTICLE INFO

Article history:
Received 28 May 2016
Received in revised form 20 July 2016
Accepted 20 July 2016
Available online 30 July 2016

Keywords:
Horse
Back pain
Spinal osseous pathology

ABSTRACT

Impingement of the dorsal spinous processes (DSPs) is a common cause of pain and poor performance in sport horses, but there is limited information regarding regional differences in the prevalence and severity of DSP osseous lesions in the equine thoracolumbar spine. It was hypothesized that lesion severity would increase with horse age and height, and that severe lesions would be more prevalent in the mid-caudal thoracic region. The thoracolumbar spines of 33 horses were removed postmortem, disarticulated, and boiled out. The thoracic and lumbar DSPs were examined for the presence of proliferative or lytic osseous lesions of the DSPs. Age and height of the horses were recorded, and severity of pathologic changes at each vertebral level was scored using an ordinal grading system (grades 0–3) and a continuous visual analog scale (VAS). Osseous lesions of the DSPs were present at every vertebral level from C7–T1 to L6–S1, and 70% of horses had at least one lesion of severity grade 2 or higher. Grade 3 lesions were found in the cranial thoracic (T2–T4), mid-thoracic to cranial lumbar (T11–L1) and mid-lumbar (L4–L5) segments. Analysis of VAS data using analysis of variance indicated that increasing age and height were associated with more severe osseous lesions ($P < .001$). DSP osseous lesions occur frequently in horses with more severe lesions in the cranial thoracic, mid to caudal thoracic, and mid-lumbar regions. Lesions in the cranial thoracic and lumbar regions present a challenge for diagnostic imaging and may be underdiagnosed clinically.

1. Introduction

Pathologic changes in the vertebrae and associated soft tissues are recognized as causes of back pain and poor performance in athletic horses [1–3]. Osseous lesions that have been associated with equine back pain include vertebral body spondylosis, impingement or overriding of the dorsal spinous processes (DSPs), and osteoarthritis of the synovial intervertebral articulations (SIAs) [1–10]. Impingement of the DSPs has been reported to be the most common osseous pathology of the equine thoracolumbar vertebrae [1,5,11,12]. However, osseous pathology of the DSPs may be present without signs of back pain [11,13,14].

The size, shape, and orientation of the DSPs show regional differences along the length of the thoracolumbar spine [15]. A rudimentary DSP appears on the last cervical (C7) vertebra with the succeeding thoracic vertebrae having progressively longer DSPs to the level of T4 or T5 beyond which they become shorter to the level of T12 [15]. The T12 DSP marks the transition between the narrower processes that form the withers and the wider processes of the more caudal vertebrae [16]. The DSP on T16 is vertically oriented and indicates the juncture between the caudally

* Corresponding author at: Hilary M. Clayton, 3145 Sandhill Rd, Mason, MI 48854.
E-mail address: claytonh@cvm.msu.edu (H.M. Clayton).

0737-0806/$ – see front matter © 2016 Elsevier Inc. All rights reserved.
http://dx.doi.org/10.1016/j.jevs.2016.07.015

sloping DSPs of the more cranial vertebrae and the cranially sloping DSPs of the more caudal vertebrae; for this reason, T16 is called the anticlinal vertebra. Attachment sites of the supraspinous and interspinous ligaments, which limit distraction of the DSPs, m. multifidi, which move and stabilize the intervertebral joints, and the thoracolumbar fascia are potential sites for the development of enthesophytes. It has been suggested that adjacent DSPs should be separated by a distance of at least 4 mm [6,17] and, if there is insufficient separation of adjacent spines, impingement or overriding of the DSPs with bone-on-bone contact may occur, leading to proliferative or lytic osseous lesions.

Mechanical loading of the spine due to ground reaction forces transmitted through the limb girdles, gravitational and inertial effects of the horse's visceral mass, and the rider's weight are likely to affect the regional susceptibility to impingement of the DSPs. The thoracolumbar spine as a whole is supported peripherally by the limbs, but the midthoracic region has relatively poor mechanical support and becomes lordotic during locomotion [18], which approximates the DSPs in this area. Therefore, it is not surprising that most clinically significant lesions of the DSPs have been reported to involve the region from T13 to T18 [3,9,13].

Necropsy studies are useful to characterize details of the type and severity of DSP osseous lesions that may not be apparent radiographically or ultrasonographically. Previous necropsy studies of the equine DSPs have focused on the caudal thoracic and lumbar regions of Thoroughbred racehorses [2,5,19,20]. Prevalence of osseous lesions at different spinal levels has been correlated with thoracolumbar biomechanics to better understand the regional distribution of lesions [8]. The present study expands knowledge by evaluating osseous lesions of the DSPs along the entire length of the thoracolumbar spine in horses of various ages and sizes. It was hypothesized that lesion severity would increase with age and height of the horse and that severe lesions would be more prevalent in the mid to caudal thoracic region, which undergoes a relatively large range of motion in extension as a consequence of having poor mechanical support.

2. Materials and Methods

2.1. Specimens

The spines were from 33 horses euthanized for reasons other than primary back pain. Twelve breeds were represented: Thoroughbred (9), Quarter Horse (6), Pony (5), Warmblood (3), Arabian (2), Appaloosa (2), Missouri Fox Trotter (1), Percheron (1), Belgian (1), Morgan (1), Morgan cross (1), and Palomino (1). Ages ranged from 2 to 29 years, and individuals were categorized as young (17 horses aged $<$15 years) or old (16 horses $\geq$15 years). Horses were also classified by height at the withers as small (13 horses $<$152 cm) or large (20 horses $\geq$152 cm).

2.2. Preparation of Specimens

The entire thoracolumbar spine from C7 to the sacrum was removed intact. After dissecting away the soft tissues, the vertebrae were disarticulated, boiled in water, soap, and bleach for 15 hours to remove any remaining soft tissue, and then soaked in a solution of 34.5% isopropyl alcohol (99%), 1.7% hydrogen peroxide (30%), 0.6% ammonium hydroxide, and 63.2% water for at least 2 days to remove residual soft tissues from the bone. The vertebrae were air-dried before being evaluated.

The location, size, and shape of DSP lytic and proliferative osseous lesions were recorded. Because impingement involves contact between the articular processes of adjacent vertebrae, a vertebral level was defined as the caudal surface of one DSP and the cranial surface of the next, more caudal, DSP. Twenty-four vertebral levels were examined from C7–T1 to L6–S1 for osseous lesions indicative of impingement or the presence of enthesophytosis. The lesions were graded both on an ordinal scale and on a continuous visual analog scale (VAS).

2.3. Grade Assignment

A noncumulative grading system as described by Stubbs et al [20] and based on methods used previously [3,5,8] was used. For each spinal level, the caudal surface of one DSP and the cranial surface of the adjacent, more caudal DSP were graded separately for severity of osseous lesions on a scale from 0 to 3 according to the following criteria: Grade 0: no lesions, smooth periosteum with no evidence of direct contact between successive DSPs; Grade 1: mild osseous lesion $<$2 mm in length, which might include some impingement of DSPs, mild periosteal proliferation, and mild eburnation but no lysis; Grade 2: moderate osseous degenerative changes 2 to 4 mm in length that might include moderate impingement of, or interference with, the adjacent DSP, moderate to large active periosteal proliferation and/or lysis, moderate eburnation and moderate active remodeling; and Grade 3: severe osseous degenerative changes with bony proliferation $>$4 mm long and that might show evidence of severe impingement of adjacent DSPs, extensive periosteal proliferation and/or lysis, marked eburnation, marked active bone remodeling, and ankylosis. Examples of lesions within each grade are shown in Fig. 1. After grading the lesions on the adjacent caudal and cranial aspects of adjacent DSPs, the higher of the assigned grades was used to represent that level in the statistical analysis.

2.4. Visual Analog Scale

The lesions between each pair of adjacent DSPs were also scored using a VAS. The VAS scores were assigned by the same evaluator as the ordinal grades but on a different occasion and with the evaluator blinded to the previously assigned grades. Continuous numerical data were obtained using a 20-cm line, the left edge of which represented no lesion, and the right edge represented an extremely severe lesion. A mark was made along the line to represent the overall severity of the DSP osseous lesions at that spinal level. The distance from the left side of the line to the mark was measured in centimeters to obtain the VAS score for DSP osseous pathology at each spinal level. The VAS scores have the advantage of allowing a larger range of pathologic changes to be incorporated into the score.