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Barrel racing is a timed event during which a rider attempts to guide his or her horse in a cloverleaf pattern around 3 barrels (typically 55-gallon steel drums). The distance covered varies with size of the arena in which the competition is held, but the distance from the starting line to the first barrel is generally 14 to 18 m, the distance from the first to the second barrel is generally 21 to 27 m, and the distance from the second to the third barrel is generally 27 to 32 m. The fastest time to complete the pattern varies with arena size, but a good run for a large arena is 15 to 16 seconds.

Barrel racing is currently one of the highest-paying equine sports, with the result that it has become popular throughout the United States. Horses often start competing at 5 years of age and may continue to compete until 18 to 20 years of age. The sport is considered by many to be one of the most demanding Western performance events that a horse can be asked to perform. Not surprisingly, therefore, barrel-racing horses, like other Western performance horses, are frequently examined by equine practitioners because of lameness or decreased performance. It seems likely, however, that these horses will not have the same type of injuries encountered by flat-racing or steeplechase horses. Unlike flat-racing and steeplechase horses, barrel-racing horses do not run at top speed over long distances when competing. Thus, injuries generally associated with speed and fatigue, such as superficial digital flexor tendonitis and metacarpophalangeal and carpal bone chip fractures, would be expected to be less common in barrel-racing horses.

There are few published reports that relate particular horse activities with specific lameness problems. Those that have been published involve horses used for English performance events and Standardbreds or Thoroughbreds used for racing. To our knowledge, the only report describing the frequency of musculoskeletal injuries causing lameness in horses used for Western performance events is a recent study describing the incidence of musculoskeletal injuries in horses used for team roping. Anecdotal descriptions of lameness problems in Western performance horses have been published; however, such data are scant and based on veterinarians’ clinical experiences and impressions and do not reflect data that have been systematically collected and analyzed.

The purpose of the study reported here, therefore, was to identify the types of musculoskeletal problems associated with lameness or poor performance in barrel-racing horses. We hypothesized that the specific limbs affected and the musculoskeletal injuries sustained would differ from those reported for horses performing other English and Western performance activities.

Criteria for Selection of Cases

Medical records of all horses used for barrel racing that were examined at the Texas A&M University Veterinary Teaching Hospital between January 1, 2000, and December 31, 2003, because of lameness or poor performance were reviewed. Only records of horses used solely for barrel racing were included in the study.

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**Procedures**

Data obtained from medical records of horses enrolled in the study included date of admission; signalment; duration of clinical signs; body weight; owner complaint; type of horseshoe worn; history of recent performance changes; previous medical treatments; physical examination findings, including hoof conformation, hoof-tester examination findings, presence of joint effusion, lameness examination findings, limbs affected, and response to flexion tests; diagnostic tests used to establish a diagnosis (eg, diagnostic anesthesia, radiology, ultrasonography, and nuclear scintigraphy); final diagnosis; and treatment recommended. A diagnosis of foot pain was made if a source of pain was localized, on the basis of results of diagnostic testing, to the caudal aspect of the foot by 1 of 2 attending veterinarians (RMD, GKC). In these horses, the source of pain was commonly suspected to be localized to the navicular region; however, the precise structure in the foot causing pain was not determined in all horses. This group of horses was differentiated from horses with identifiable sources of pain involving the foot, such as horses with a bruised foot, white line disease, or an abscess. Horses with suspensory ligament desmitis included horses with lesions of the suspensory ligament body or its branches.

**Statistical analysis**—Data were compiled with standard software, and prevalences of specific musculoskeletal injuries were tabulated. Descriptive statistics were calculated for each of the variables. The Wilcoxon rank sum test and the χ² test were used to determine whether there were associations between owner complaint (lame vs poor performance) and independent continuous variables (eg, age and weight). For all analyses, a value of P ≤ 0.05 was considered significant.

**Results**

**Signalment**—One hundred eighteen horses met the criteria for inclusion in the study. Of these, 110 (93%) were Quarter Horses and 8 (7%) were Appendix horses (Quarter Horse–Thoroughbred cross). Median age was 9 years (range, 3 to 19 years), and median body weight was 509 kg (1,120 lb; range, 409 to 611 kg [900 to 1,340 lb]). Eighty-six (73%) horses were geldings, and 32 (27%) were female.

**History**—Median duration of lameness or poor performance prior to examination at the Veterinary Teaching Hospital was 4 weeks (range, < 1 week to 52 weeks). Seventy-two (61%) horses were examined because of an owner complaint of lameness, and 46 (39%) were examined because of an owner complaint of a decrease or other change in performance. Thirty-five of the 46 (76%) horses examined because of poor performance were < 10 years old, which was not significantly (P = 0.170) different from the proportion of horses examined because of lameness that were < 10 years old (40/72 [55%]). Ten (8%) of the horses were referred to the Veterinary Teaching Hospital by veterinarians in the area; 108 (92%) were examined on a primary care basis.

The most common performance change reported by owners was that the horse would refuse or fail to turn correctly around the first barrel (19/46 [41%]), followed by a recent decrease in the horse's speed (14/46 [30%]). Other performance changes were that the horse would make a wide turn around the second or third barrel (4/46 [9%]), the horse would not enter the arena (3/46 [7%]), the horse would not turn to the left (3/46 [7%]), the horse ran with its tail in the air (3/46 [7%]), and the horse would not take its correct lead (1/46 [2%]).

Forty-four of the 118 (37%) horses had received medical treatment prior to examination at the Veterinary Teaching Hospital. Medical treatments included oral administration of nonsteroidal anti-inflammatory drugs (44/118 [37%]), intra-articular administration of various medications (36/118 [30%]), IM administration of polysulfated glycosaminoglycans (34/118 [29%]), oral administration of a supplement (32/118 [27%]), and IV administration of sodium hyaluronate (30/118 [25%]). However, information on dose and frequency of administration was not recorded in the medical records.

**Physical examination findings**—Type of horseshoe worn on the front feet was recorded for 97 horses. The horseshoe most commonly worn on the front feet was a steel rim shoe (39/97 [40%]), followed by a flat steel keg shoe (26/97 [27%]), wedged heel shoe (11/97 [11%]), rockered-toe shoe (7/97 [7%]), eggbar shoe (4/97 [4%]), and half-round shoe (3/97 [3%]). Seven (7%) horses reportedly did not wear shoes on the front feet.

Information on hoof conformation was recorded for 32 horses. Twenty-five of the 32 (78%) reportedly had mismatched front feet (ie, variation in hoof size or heel angle), 3 (9%) had contracted heels, 2 (6%) had underrun heels, and 2 (6%) had a pigeon-toed conformation.

Information regarding other musculoskeletal findings was available for 93 horses. Abnormalities that were recorded included metacarpophalangeal joint effusion (27/93 [29%]), digital flexor tendon sheath effusion (21/93 [23%]), exostoses on the medial aspect of the distal tarsal joints (14/93 [15%]), carpal joint effusion (5/93 [5%]), and medial femorotibial joint effusion (5/93 [5%]). Five (5%) horses reportedly did not have any musculoskeletal abnormalities, and 11 (12%) had signs of pain in response to palpation of the lumbar muscles.

Information regarding results of hoof-tester examination was available for 79 horses. In 23 of the 79 (29%), results of hoof-tester examination were negative. Forty (51%) horses had signs of pain in response to hoof-tester pressure over the central aspect of the frog, 10 (13%) had signs of pain in response to pressure over the toe region, 3 (4%) had signs of pain in response to pressure over 1 or both heels, and 3 (4%) had signs of pain in response to pressure anywhere over the sole of the foot.

**Lameness examination findings**—The right forelimb was affected in 57 of the 118 (48%) horses, the left forelimb was affected in 51 (43%), the left hind limb was affected in 31 (26%), and the right hind limb was affected in 25 (21%). In 31 (26%) horses, both forelimbs were affected, and in 6 (3%), both hind limbs were affected.
were affected. Eight (7%) horses had 1 forelimb and 1 hind limb affected, 6 horses (5%) had 3 limbs affected, and 4 (3%) horses had all 4 limbs affected.

Results of limb flexion tests were recorded for 111 horses. Fifty of the 111 (45%) horses had an increase in severity of lameness after flexion of the lower portion of 1 or both forelimbs, and 43 (39%) had an increase in severity of lameness after flexion of the upper portion of 1 or both hind limbs. Eighteen (16%) horses had no change in lameness after flexion tests on either forelimbs or hind limbs.

Median severity of lameness, graded on a scale from 0 to 5 according to American Association of Equine Practitioner guidelines, was 1 (range, 0 to 4).

Diagnostic testing—Diagnostic anesthesia (peripheral nerve or intra-articular anesthesia) was performed in 93 of the 118 (79%) horses in an attempt to localize the cause of lameness. Radiography was performed in 97 (82%) horses, and ultrasonography was performed in 27 (23%). Three (3%) horses underwent nuclear scintigraphy.

Final diagnosis—The most common diagnosis was foot pain only (39/118 [33%]), followed by osteoarthritis of the distal tarsal joints (17/118 [14%]), desmitis of the suspensory ligament (15/118 [13%]), foot pain in combination with osteoarthritis of the distal tarsal joints (11/118 [9%]), bruised feet (10/118 [8.5%]), and osteoarthritis of the medial femorotibial joint (6/118 [5%]; Table 1). There was no significant association between final diagnosis and age (P = 0.450) or body weight (P = 0.890) of the horse.

A diagnosis of foot pain was made in 33 of the 40 (83%) horses with signs of pain in response to hoof tester pressure over the central aspect of the frog and in 17 of the 25 horses with mismatched front feet.

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>No. of horses (%)</th>
<th>Affected limb (No. of horses)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foot pain</td>
<td>39 (33)</td>
<td>Forelimb (39)</td>
</tr>
<tr>
<td>OA distal tarsal joint</td>
<td>17 (14)</td>
<td>Forelimb (17)</td>
</tr>
<tr>
<td>Suspensory ligament injury</td>
<td>15 (13)</td>
<td>Hind limb (9), forelimb (6)</td>
</tr>
<tr>
<td>Forelimb and OA distal tarsal joint</td>
<td>11 (9)</td>
<td>Forelimb and hind limb (11)</td>
</tr>
<tr>
<td>Bruised feet</td>
<td>10 (8.5)</td>
<td>Forelimb (9), hind limb (2)</td>
</tr>
<tr>
<td>OA medial femorotibial joint</td>
<td>6 (5)</td>
<td>Hind limb (6)</td>
</tr>
<tr>
<td>OA carpal joint</td>
<td>3 (2.5)</td>
<td>Forelimb (3)</td>
</tr>
<tr>
<td>OA MCP or MTP joint</td>
<td>3 (2.5)</td>
<td>Forelimb (2), hind limb (1)</td>
</tr>
<tr>
<td>Deep digital flexor tendinitis</td>
<td>2 (1.7)</td>
<td>Forelimb (2)</td>
</tr>
<tr>
<td>Fractured tarsal coxae</td>
<td>2 (1.7)</td>
<td>HInd limb (2)</td>
</tr>
<tr>
<td>Desmitis of accessory ligament of deep digital flexor muscle</td>
<td>2 (1.7)</td>
<td>Forelimb (2)</td>
</tr>
<tr>
<td>Foot pain and suspensory ligament desmits</td>
<td>2 (1.7)</td>
<td>Forelimb and hind limb (2)</td>
</tr>
<tr>
<td>Foot pain and OA medial femorotibial joint</td>
<td>2 (1.7)</td>
<td>Forelimb and hind limb (2)</td>
</tr>
<tr>
<td>Back pain</td>
<td>2 (1.7)</td>
<td>NA</td>
</tr>
<tr>
<td>Sole abscess</td>
<td>1 (0.8)</td>
<td>Hind limb (1)</td>
</tr>
<tr>
<td>White line disease</td>
<td>1 (0.8)</td>
<td>Forelimb (1)</td>
</tr>
</tbody>
</table>

OA = Osteoarthritis. MCP = Metacarpophalangeal joint. MTP = Metatarsophalangeal joint. NA = Not applicable.

Discussion

Results of the present study suggest that in horses used for barrel racing that are examined because of lameness or poor performance, the forelimbs are more likely to be affected than the hind limbs, with foot pain and osteoarthritis of the distal tarsal joints being the most common underlying abnormalities. Whereas musculoskeletal injuries associated with speed and fatigue are common in flat-racing and steeplechase horses, results of the present study suggest that such injuries are not common in barrel-racing horses.

Almost all horses in the present study were Quarter Horses (93%), and most were Geldings (73%). Median age was 9 years, which is similar to that reported for horses used for team roping (11 years) and for English performance events (eg, jumping). Given their ages, it is not surprising that wear-and-tear-type injuries such as osteoarthritis and tendon and ligament strains are common in these types of performance horses, regardless of their specific activity.

The percentage of horses examined in the present study because of an owner complaint of a change or decrease in performance (40%), rather than an owner complaint of lameness, was higher than the percentage reported in a previous study of horses used for team roping (25%). Most barrel racers train their own horses and are, in general, very aware of their horses’ abilities in any arena of any given size or at any particular competition level. In contrast, most team ropers buy horses that were trained or ridden by someone else. Because barrel racers train their own horses, they may be able to detect subtle changes in performance of their horses. Alternatively, performance changes may be more obvious in barrel-racing horses because these horses run the identical cloverleaf pattern during every competition and their times are generally quite consistent for a given arena size. Team-roping horses make several runs during each competition. Conditions for team roping are variable, and the time for any particular run is dependent on factors other than the horse’s performance, such as the speed and quality of the steers being roped and the ropers’ performance.
The most common performance change reported by owners of horses in the present study was that the horse would refuse or fail to turn correctly around the first barrel, and the most commonly affected limb was the right forelimb. Most barrel racers begin the cloverleaf pattern by going to the right barrel first,\textsuperscript{1,9} so that after a short run at full speed, the horse must slow down sufficiently to make a 360° turn in a clockwise direction around the first barrel. It is possible, as suggested by other veterinarians who work on barrel-racing horses,\textsuperscript{9} that horses are refusing to turn sharply around the first barrel because they have a subtle right forelimb lameness and are trying to avoid a painful stimulus. The second most common performance change reported by owners of horses included in the present study was a recent decrease in the horse's speed, which also could relate to subtle musculoskeletal problems causing the horse to run more slowly.

It is possible that a body system other than the musculoskeletal system could have been responsible for poor performance in some horses in the present study. For instance, exercise-induced epistaxis and poor dentition have been described as contributing to poor performance in barrel-racing horses.\textsuperscript{1,2} Therefore, a complete physical examination is recommended for all horses examined because of a performance change.

It was not surprising to us that most barrel-racing horses examined because of poor performance in the present study were < 10 years old. One would expect younger horses to be more immature and to have more behavioral problems than older, more experienced horses. Our findings confirm suggestions made by other veterinarians working on barrel-racing horses.\textsuperscript{9}

About a third of the horses examined in the present study had received medical treatment prior to being examined at the Veterinary Teaching Hospital. Frequencies of nonsteroidal anti-inflammatory drug and intra-articular treatments were similar to those reported for team-roping horses,\textsuperscript{1} but frequencies of polysulfated glycosaminoglycan, sodium hyaluronate, and oral supplement treatment were higher in barrel-racing horses (25% to 29%) than in team-roping horses (5%). The reason for this is unknown, but it may be related to the higher value usually placed on barrel-racing horses.\textsuperscript{9}

In the present study, the forelimbs were affected more often than the hind limbs. This differs from findings in a previous report,\textsuperscript{1} which suggested that barrel-racing horses more often have hind limb injuries, but is consistent with findings of a report\textsuperscript{1} describing injuries sustained by horses used for barrel racing. Both of these previous reports were based on clinical impressions of veterinarians in private veterinary practice who commonly treated horses used for barrel racing. It is possible that these clinical impressions were subjective or unwittingly biased and not as accurate as the systematically collected data used in the present study. Alternatively, the types of musculoskeletal injuries seen in barrel-racing horses examined at the Texas A&M University Veterinary Teaching Hospital may differ from those seen in horses examined in general equine practices. Other factors, such as environment, ground surface, and fitness of the horse, could also account for these differences. We speculate that the first barrel is the hardest barrel to turn because the horse is running at full speed when it reaches the barrel and must slow down quickly to make the 360° turn. Because most horses go to the right-hand barrel first, we suspect that the inside right forelimb may be under great strain during this first turn. In contrast, when the horse approaches the second and third barrels, which require left-hand turns if the horse took the right-hand barrel first, the horse’s speed is slower, so that the left forelimb may be under less strain. Balancing this is the fact that most horses make 2 left-hand turns and 1 right-hand turn, which may explain why there was no significant difference in prevalences of right versus left forelimb lameness. Future studies are needed to determine how specific limb involvement is related to racing activity in barrel-racing horses.

In most horses in the present study, diagnostic anesthesia was used to help determine the site of the lesion causing lameness or poor performance. We used the term foot pain to describe pain localized to the caudal third of the foot by means of diagnostic anesthesia, radiography, ultrasonography, and scintigraphy. We chose to classify such lesions as foot pain because the specific structure injured within the foot was not always determined.
Horses with foot pain are commonly assumed to have a lesion of the navicular area. However, there are numerous structures in the foot, including the navicular bone, its surrounding ligamentous attachments, the laminae, the navicular bursa, the joint capsule of the distal interphalangeal joint, and the distal aspect of the deep digital flexor tendon, that could be the source of pain in these horses. Horses having an identifiable foot problem such as a bruise or sole abscess were not included in this group of horses with foot pain.

Foot pain involving the forelimbs was the most common problem in horses in the present study, followed by osteoarthritis of the distal tarsal joints and desmities of the suspensory ligament. In a previous report,12 distal tarsal joint osteoarthritis and hind limb suspensory ligament desmities were described as the most common injuries sustained by horses used for barrel-racing. Another report13 described right forelimb suspensory ligament desmities as the most common injury in horses used for barrel racing and suggested that horses used for barrel racing have a higher incidence of shoulder injuries than do horses used for other activities. The top of the barrel is the height of the horse’s shoulder when the horse turns around it, and if the horse gets too close and knocks the barrel over, the barrel will hit the horse in the shoulder region. However, none of the horses in the present study were found to have a shoulder injury. Again, the differences could be related to the subjective nature of previous reports or could reflect differences between horses examined at a referral hospital versus those seen in a general equine practice.

Most horses (86%) in the present study received treatment at the Veterinary Teaching Hospital, with the most common treatments being administration of phenylbutazone (88%) and intra-articular administration of various medications (69%). The distal interphalangeal joint (42%) was the most commonly treated, followed by the distal tarsal joints (24%). These findings were not surprising because those areas were most often identified as the cause of lameness. Similar treatment has been described for horses used for team roping.7 Systemic administration of chondroprotective agents was recommended for 27 (23%) barrel-racing horses in this study, which was higher than the percentage of team-roping horses for which such treatment was recommended (3%).7 Because injuries in horses used for barrel racing were similar to those seen in team-roping horses, we speculate that the higher value of barrel-racing horses, compared with most team-roping horses, resulted in this discrepancy. A professional-level barrel-racing horse is often valued at $60,000 to $80,000, whereas a professional-level team-roping horse is typically valued at $20,000 to $25,000.12,17

An important limitation of the present study was that only horses examined at a teaching hospital because of lameness or poor performance were included. Although most of these horses (92%) were examined on a primary care basis, musculoskeletal injuries seen in barrel-racing horses examined at this referral hospital may differ from those seen in horses examined in general equine practices. Also, data collected retrospectively may not be as reliable as data collected prospectively; however, we do not believe that there was substantial bias in historical and physical examination data. The lameness service at the Texas A&M University Veterinary Teaching Hospital, where all horses in this study were evaluated, is comprised of 2 veterinary clinicians (RMD, GKC) and a single veterinary technician (SN), which should ensure some consistency in recording history and physical examination findings. The goal of the present study was to obtain descriptive information for a specific group of performance horses. Future studies are needed to determine risk factors for these specific musculoskeletal injuries in barrel-racing horses so that they can be eliminated or decreased.

References