Gastric ulcer syndrome is common in horses used for many competitive activities, including racing,1-4 dressage and show jumping,5,6 endurance events,7 and western performance.8 Exercise and training are proven risk factors for EGUS,3,9,10 and as the intensity of training increases, the prevalence and severity of gastric ulcers increase.3 It has generally been believed that EGUS is primarily a disorder of horses in intensive training, usually at a professional level. However, it was reported that 37% of horses used for light activities had mild gastric lesions,1 and a recent report 11 demonstrated that conditions simulating a recreational 3-day show and training activity, including transport to and from the show grounds, stall confinement in unfamiliar surroundings, and light exercise, were associated with an increased incidence of gastric ulcers in horses.

In most studies in which endoscopic examination was used to determine the prevalence of EGUS, ulcers were identified in the gastric squamous mucosa. Gastric squamous ulceration has been found to develop rapidly in research models used to experimentally induce EGUS, such as feed deprivation (ie, withholding feed for 48 hours),12,13 simulated race training (7 days),9 and simulated recreational show and training (5 days).11

Previous studies14,15 have shown that omeprazole prevents development and recurrence of gastric ulcers when administered at a dosage of 1 mg/kg (0.45 mg/lb), PO, once daily as a paste formulation. In those studies, horses in race training were evaluated, and gastroscopic examinations were performed in control and treated horses before and after 28 days of treatment. To our knowledge, however, efficacy following a shorter duration of administration in a controlled study has not been reported.

The purposes of the study reported here were to determine the effects of 8 days of light to heavy exercise on gastric ulcer development in horses and determine the efficacy of omeprazole in preventing development of gastric ulcers when administered in a paste formulation at a dosage of 1 mg of omeprazole/kg, PO, once daily, for 8 days.

Materials and Methods

Horses—The study was designed as a multicenter study and was performed at private training facilities.
in Iowa, Oklahoma, and Texas. A total of 102 horses were included in the study. All horses were privately owned, under the guidance of a licensed trainer, and subject to routine training activities of the facility. Horses were all housed in the same types of individual stalls and in proximity to other horses in the same replicate throughout the study period. Rations were typical for horses in their respective disciplines. To be included in the study, horses had to be free from gastric ulcers and in a training regimen. Horses included in the study had not received medications for treatment of gastric ulcers during the 2 weeks prior to the start of the study (day 0). In all horses, a physical examination was performed and body weight was measured 1 (day −1) to 2 (day −2) days prior to the start of the study and again on day 7 of the study. Horses were observed at least once daily, and any clinical signs of illness were recorded. All observers were unaware of treatment group allocation.

Allocation and treatment—Replicates of 2 horses were formed at each site on the basis of similarity of breed, weight, sex, and age. The training regimen was the same for all horses within a replicate. Within replicates, 1 horse was randomly allocated to the control group and the other was randomly allocated to the treatment group by use of a randomization schedule. Horses allocated to the control group were sham dosed with an empty syringe once daily on day 0 through day 7. Horses allocated to the treatment group received omeprazole paste orally at a minimum dosage of 1 mg of omeprazole/kg, once daily, on day 0 through day 7.

Endoscopic examination—Gastroscopy was performed according to a previously described protocol on day −2 or −1 and day 7 of the study. For all horses, feed was withheld prior to endoscopy. Horses were restrained in stocks and sedated with xylazine hydrochloride and detomidine hydrochloride or with xylazine hydrochloride and butorphanol. The entire squamous portion of the mucosa and most of the glandular portion of the stomach were viewed in all horses. The endoscopist was unaware of treatment group allocation. Gastric lesion severity was scored as previously described, in brief, a score of 0 corresponded to no erosions or ulcers, and scores of 1, 2, and 3 corresponded to the presence of erosions and ulcers of increasing size and apparent depth.

Training—Of the 102 horses in the study, 40 were Quarter Horses at 2 training centers that were in race training. Of these, 14 were females, 8 were males, and 18 were geldings; all were 2 to 3 years of age and weighed between 350 and 500 kg (775 and 1,105 lb). The 2-year-old horses were commencing race training, and the 3-year-old horses were racehorses that had been rested for the winter and were reentering training. Thirty of the horses in the study were Thoroughbreds that were being exercised by use of a mechanical exerciser. This group included 14 females and 16 geldings, 2 to 10 years of age and weighing between 443 and 563 kg (974 and 1,239 lb). Horses were placed in a 72-foot-diameter exercise wheel that turned, inducing them to trot and jog. Horses were exercised daily until signs of fatigue were apparent. Duration and speed were determined by the condition of each horse.

The remaining 32 horses in the study were Quarter Horses used for western performance activities. This group included 12 females, 6 males, and 14 geldings, 1 to 9 years of age and weighing between 308 and 342 kg (678 and 1,192 lb). All horses in replicates 1 through 7 in this group received daily moderate exercise, and all horses in replicates 8 through 16 received daily halter training and light exercise, which did not begin until after the first treatment.

Statistical analysis—Gastric lesion score data from all study sites were combined for analysis. The primary efficacy variable was the binomial proportion of successes at day 7, where success was defined as a gastric lesion score of 0 on day 7 and failure was defined as a gastric lesion score ≥1 on day 7. χ² Tests were performed on the primary efficacy variable for the combined data.

Results

Forty-five of 51 omeprazole-treated horses (88%) were free from ulcers on day 7, whereas 14 of 51 sham-dosed horses (27%) were free from ulcers on day 7. The proportion of omeprazole-treated horses that was free from ulcers was significantly (P < 0.001) greater than the proportion of sham-dosed horses that was free from ulcers on day 7. Results for each training discipline were summarized (Table 1).

Of the 37 sham-dosed horses with ulcers, 21 had grade 1 ulceration, 8 had grade 2 ulceration, and 8 had grade 3 ulceration. Of the 6 omeprazole-treated horses with ulcers, 5 had grade 1 ulceration and 1 had grade 2 ulceration.

One sham-treated horse had reduced feed intake on 2 occasions and had grade 1 ulceration at the end of the study. One horse had signs of mild colic during the study period and was treated with 2 doses of flunixin meglumine (500 mg, PO) and 1 dose of mineral oil by nasogastric tube. This horse was in the omeprazole treatment group and had no ulcers at the end of the study. No other abnormal findings were detected in the study horses. Three horses (1 sham-treated horse with grade 1 ulceration on day 7 and 2 omeprazole-treated horses with grade 0 gastric scores on day 7) each received a single dose of flunixin meglumine (500 mg, PO) after a training session on day 2.

Table 1—Summary of results of gastroscopic examination following 8 days of light to heavy exercise in 102 horses that were treated with omeprazole paste orally or sham dosed.

<table>
<thead>
<tr>
<th>Exercise regimen</th>
<th>Sham-treated horses</th>
<th>Omeprazole-treated horses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ulcers</td>
<td>No ulcers</td>
</tr>
<tr>
<td>Race training</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Mechanical exerciser</td>
<td>11</td>
<td>4</td>
</tr>
<tr>
<td>Western performance</td>
<td>16</td>
<td>0</td>
</tr>
<tr>
<td>Overall</td>
<td>37</td>
<td>14</td>
</tr>
</tbody>
</table>

Data represent number of horses.
Discussion

Results of the present study indicated that gastric ulcers can develop within 8 days in a high percentage of horses engaged in various exercise regimens typically used for training. These data yield further evidence of how readily gastric ulcers can develop in horses and suggest that the intensive training regimens typically used with racehorses are not required for ulcers to develop in horses. It is noteworthy that in several of the sham-treated horses, ulceration was judged to be moderate or severe (grades 2 and 3).

In previous studies,10,14,15 omeprazole paste prevented ulcers in approximately 80% of horses in race training. In those studies, the duration of treatment was 28 days and efficacy was not assessed prior to treatment day 28. In the study reported here, the efficacy of treatment with omeprazole paste in preventing ulcers after 8 days of treatment was comparable to results seen in these previous studies. The omeprazole paste formulation was identical to that evaluated in previous studies,14,15 but the syringe container used in the present study had different plunger rod markings, consistent with use as an ulcer prevention product.

Several risk factors for EGUS have been identified and include exercise, stall confinement, transportation, and feeding regimens. Ulcers in the gastric squamous mucosa result from contact of the mucosa with hydrochloric acid,12 with possible contribution from short-chain fatty acids produced in the gastric lumen.16 The gastric squamous mucosa in horses is highly sensitive to hydrochloric acid. In studies involving in vitro models, mucosal injury has been induced within 30 minutes of exposure to solutions acidified with hydrochloric acid. Thus, the presence of this acid-sensitive mucosa in the stomach may be considered an inherent risk factor.

Risk factors for EGUS presumably contribute to an increased duration of contact of the gastric mucosa with acidic gastric contents, but mechanisms by which this occurs have not been thoroughly determined. Risk factors, acting singly or interacting, contribute to the ulcerogenic pressure in a given horse, and expression of the ulcerogenic pressure as a gastric ulcer depends on individual characteristics of the animal as well as the risk factors themselves. It is the expression of ulcerogenic pressures that is assessed in endoscopic examinations, and on the basis of results in the study reported here and previous reports, it is apparent that horses engaged in a variety of activities that are used across many disciplines are at risk of developing gastric ulcers.

References