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Original Research

Assessment of Gastric Ulceration and Gastrin Response in Horses with History of Crib-Biting

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ABSTRACT

It was hypothesized that horses exhibiting crib-biting (CB) have a greater degree of gastric mucosal damage and higher serum gastrin response to concentrate feeding than non-crib-biting (NCB) horses. Eighteen mature horses, 9 CB and 9 NCB, were used to determine prevalence and severity of gastric mucosal damage and effect of concentrate feeding on circulating gastrin. Horses were maintained on pasture with free access to hay and fed a pelleted concentrate diet twice daily. Number of crib-bites and duration of cribbing bouts were recorded in a 24-hour period. Endoscopic examinations (EE) of the squamous mucosa were performed and gastric fluid sampled after 24 to 28 hour feed removal. Following EE, horses were returned to pasture for 72 hours. Blood was collected following 12-hour feed removal (0 minutes), and at 60 and 120 minutes after consuming 1 kg of concentrate. Mean number of crib bites in 24 hours was 1,558 ± 303 with CB peaking prior to and during the afternoon feeding (3:30 PM, $P < .05$). There were no differences in the number or severity of ulcers, prevalence of hyperkeratosis, or baseline gastric pH between CB and NCB. Serum gastrin concentration at 60 and 120 minutes was greater ($P < .05$) and tended to be greater ($P < .06$), respectively, in CB than in NCB horses following feeding of concentrate. Crib-biting behavior in horses maintained on pasture was not associated with gastric mucosal damage; however, consumption of concentrate feed resulted in greater serum gastrin concentration in CB horses.

1. Introduction

Crib-biting (CB) is an oral stereotypic behavior unique to horses. It is characterized as a repetitive behavioral sequence in which the horse anchors its incisor teeth on a fixed object (e.g., building structures), pulls backward, contracts the neck muscles, and draws air into the cranial esophagus emitting an audible grunt [1,2]. The prevalence of CB in horses in the United States is approximately 4.4% [3], with similar prevalence rates reported in other countries [4]. CB is recognized as a welfare and management concern. For instance, the behavior has been reported to be associated with epiploic foramen colic [5] and temporomandibular osteoarthropathy [6] and has been suggested as a coping mechanism to alleviate stress [7,8]. CB may also limit the horse's acceptance into boarding facilities.

In mature horses, CB has been associated with lower basal and post-feeding gastric pH [9], and long-term treatment with antacids reduces the frequency of CB [10]. However, the underlying cause of lower gastric pH in CB

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horses has not been determined. Moeller et al [11] reported that salivation is stimulated with CB, supporting the earlier suggestion [12] that horses may perform CB to reduce gastric acidity through the production of alkaline saliva.

Gastric acidity with mucosal damage has been demonstrated in horses [13,14]. Gastric acid secretion is stimulated by gastrin, a peptide hormone secreted by G cells located in the glandular portion of the stomach in response to gastric distension, dietary protein, and increased luminal pH [15]. Gastrin concentration in horses increases following feeding [16,17,18], with greater and more prolonged gastrin secretion occurring in response to pelleted and sweet feed diets than roughage [19]. Concentrate feeding is also associated with an increased risk of CB behavior [20,21], with increase in CB frequency observed in periods following concentrate feeding [22,23].

In mature horses, gastric ulcers occur primarily in the squamous mucosa adjacent to the margo plicatus [24] and the area bordering the margo plicatus is frequently exposed to high acidity [14]. Damage to the gastric mucosa has been associated with bruxism and behavioral signs of colic [25]. However, an association between gastric ulceration and CB in mature horses has never been reported.

The aim of this study was to investigate the relationship between CB and the integrity and function of the gastric mucosa in mature horses. We hypothesized that horses exhibiting CB have a higher degree of gastric mucosal damage and higher serum gastrin response to concentrate feeding than non-crib-biting (NCB) horses. The specific objectives were first to determine the prevalence and severity of gastric mucosal damage and second to measure serum gastrin concentration response to concentrate feeding.

2. Materials and Methods

2.1. Animals and Diet

Eighteen mature horses, 9 with history of CB and 9 NCB, were used. Horses were housed at the Auburn University Horse Unit in Auburn, Alabama. CB and NCB horses were matched as closely as possible based on sex, age, and breed. All horses were maintained on Coastal Bermudagrass (*Cynodon dactylon*) pasture with free access to Bermudagrass hay (8% crude protein (CP), as-fed). Twice daily (7:30 AM and 3:30 PM), horses received 2 kg of a 10% CP, 9% crude fiber commercial pelleted diet (Nutrena Life Design Compete, Minneapolis, MN). All experimental procedures were carried out with Auburn University Institutional Animal Care and Use Committee approval (PRN 2007-1289).

2.2. Behavioral Observations

On day 0 of the study, CB horses were observed on pasture during a 24-hour period for frequency of crib-bites and duration of cribbing bouts. A CB station was constructed in the pasture approximately 10 m away and readily visible from the observation area located just outside of and adjacent to the pasture. The cribbing station was constructed of pine boards, each measuring approximately 5 × 15 cm and 4.9 m in length. The boards were attached at each end to 15-cm-diameter wooden posts at a height of approximately 1.1 m. Electric fencing was placed at the top of the pasture fence to prevent performance of cribbing on locations other than the cribbing station or the metal round-bale hay feeder. The metal hay feeder in the pasture was approximately 20 m away from the observation area. CB horses were regularly housed outdoors in this pasture and were therefore well acclimated to this location. A crib bite was defined as the placement of the horses' incisors on a surface with an attempt to pull backward. A crib bout began with the first crib bite after some other activity and ended when the horse stopped cribbing and began a new activity. The NCB horses did not exhibit CB during the study.

2.3. Endoscopic Examination, Blood Collection, and Gastric pH Measurement

Forty-eight hours after behavioral observations, horses were led in from the pasture and placed in box stalls. Feed was withheld and water removed 24 to 28 hours and 12 hours, respectively, prior to endoscopy. Horses were transported in stock trailers to the Auburn University College of Veterinary Medicine, located directly across the road from the Auburn University Horse Unit. Blood samples were collected between 8:15 and 11:45 AM for a complete blood count and blood gas profile prior to endoscopic examination. Horses were divided into two groups ($n = 9$ in each group) for endoscopic examination. Endoscopic examinations were performed between 8:30 AM and 12:00 PM over a 2-day period, with 5 CB and 4 NCB horses examined on day 1 and 4 CB and 5 NCB horses examined on day 2. The order in which CB and NCB horses underwent endoscopy was randomized on both days. Horses were sedated via IV administration of butorphanol (0.02 mg/kg) and detomidine (0.01 mg/kg) and confined in treatment stocks. A nose twitch was applied for further restraint. A nasogastric tube was passed through the nasal passages into the esophagus, and a 3-m video endoscope (model EV-40-45-LP5-30; Fujinon, Wayne, NJ) was inserted through the lumen of the nasogastric tube into the esophagus and into the stomach. Insufflation with room air was used to facilitate visualization of the gastric mucosa. Video records (approximately 10-minute clips) of the squamous mucosa of the saccus caecus, nonglandular fundus, and area along the margo plicatus were obtained for ulcer scoring.

During the examination, 10 to 20 ml of gastric fluid was aspirated from the glandular fundus region of the stomach through the channel of the endoscope using a 60-ml syringe. One sample per horse was transferred to a specimen cup for determination of pH using a digital pH meter (Omega PHH-26; Omega Engineering, Inc., Stamford, CT). Immediately following endoscopy, each horse was returned to an outpatient stall until all horses had been examined. Horses were returned to their home pasture 1 to 3 hours after endoscopy. No adverse effects as a result of the procedure were observed.

2.4. Ulcer Scoring

Video records from each horse were viewed by two observers (experienced veterinarians) blinded to the horses' behavioral classification. Condition of the gastric mucosa was assessed using an accepted gastric ulcer scoring system [26]. This system assigns both a lesion