Applied Animal Behaviour Science 142 (2012) 160–167

Contents lists available at SciVerse ScienceDirect

Applied Animal Behaviour Science

journal homepage: www.elsevier.com/locate/applanim

Behaviour and stress responses in horses with gastric ulceration

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ARTICLE INFO

Article history:
Accepted 3 October 2012
Available online 31 October 2012

Keywords:
Behaviour
Equine Gastric Ulcer Syndrome (EGUS)
Faecal cortisol metabolites (FCM)
Gastric ulceration
Horse
Stress

ABSTRACT

Only little is known about behaviour and stress responses in horses with gastric ulceration, despite the high prevalence of this condition. Our objectives in the present study was to (i) describe the severity of gastric ulceration in horses, housed under relatively standardised conditions, and (ii) to investigate whether horses with severe glandular gastric ulceration have increased baseline and response concentration of stress hormones and behave differently than control horses. We investigated stomachs of 96 horses at one stud, and compared an ulcer group ($n = 30$; with severe lesions in the glandular mucosa) to paired controls ($n = 30$; free from gastric ulcers). Baseline and response concentrations of faecal cortisol metabolites (FCM), heart rate and behaviour were measured in a novel object test (NOT, Day 1) and behaviour during postponed feeding (PF, Day 2). Glandular lesions occurred in 55.2% and non-glandular lesions in 40.6% of the horses. The amount of starch in the feed ($P = 0.006$) and paternal stallion ($P = 0.031$) influenced ulceration in the non-glandular region only; it should be noted that our study does not allow for separating hereditary from environmental influences, as offspring may be e.g. trained differently dependent on breeding line. Ulcer horses pawed more ($P < 0.001$) and ate quicker ($P = 0.050$) during PF. Although displayed by ulcers horses only during PF, we failed to demonstrate a significant association between glandular gastric ulceration and crib-biting/weaving; the total number of horses with these types of abnormal behaviour was low ($n = 5$). Behaviour and heart rate did not differ between groups in the NOT. Baseline concentration of FCM was similar ($P = 0.79$), however, ulcer horses responded stronger to novelty than controls (26% higher FCM; $P = 0.018$). We conclude that the prevalence of gastric ulcers was high, and our results suggest different factors affecting ulceration in the glandular versus the non-glandular region of the horse stomach. Obvious external signs (e.g. poor body condition) identifying ulcer horses were absent. Horses with severe glandular ulcers had a higher stress hormone response to novelty, thus they were more stress sensitive. Consequently, management evoking stress in horses should be reduced to dampen the development of glandular ulceration, or to protect horses with this condition.

1. Introduction

Gastric ulceration is frequently observed in horses in hard training – 86% of 345 not randomly selected racehorses (with performance problems in Begg and O'Sullivan, 2003), 93% of 30 high-level endurance horses during the competition season, reduced to 48% outside this season

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http://dx.doi.org/10.1016/j.applanim.2012.10.002

(Tamzali et al., 2011) – and in horses used for leisure riding (53% of 201 horses in Luthersson et al., 2009a).

Gastric ulceration occurs in both the non-glandular squamous and the glandular portion of the equine stomach, with squamous ulcers most frequently reported, but also the most studied (Bell et al., 2007a) and more easily accessed during gastroscopic examination (Murray et al., 2001). Intensity and duration of training/competition activity increases the occurrence of gastric ulceration in the squamous mucosa, presumably following increased exposure of this less protected part to acidic gastric contents during exercise (Tamzali et al., 2011). In the glandular part of the stomach a protective mucous-bicarbonate layer reduces the risk of acid injury (Bell et al., 2007a). Yet 33% of examined horses may have gastric lesions here (Tamzali et al., 2011). In classical experiments with laboratory rodents, glandular gastric ulceration has been related to stress (Selye, 1936; Weiss, 1968; Sapolsky, 2005). Similarly in horses, stress-induced release of endogenous cortisol has been proposed to increase the risk of developing gastric ulceration; e.g. by reducing the regenerating capacity of the glandular mucosa leading to less resistance towards ulceration (Andrews et al., 2005), of which the horse may be particularly prone due to a constant secretion of gastric acid according to their natural foraging behaviour with continuous grazing. *Helicobacter* spp. has not been found associated with stomach lesions in horses (Husted et al., 2010).

In the present study, we describe gastric ulceration in 96 sport horses kept under relatively similar conditions, at one commercial stud. Whereas a few studies have focussed on risk factors and the pathogenesis of equine gastric ulceration (e.g. Andrews et al., 2005; Bell et al., 2007b; Nadeau and Andrews, 2009; Luthersson et al., 2009b), the consequences for the horse are less well studied. It is unknown whether severely affected horses are in a state of stress or respond differently to acute stressors, which is of importance for both horse performance and welfare. We aimed to investigate whether horses with severe glandular gastric ulceration have higher baseline concentrations of stress hormones, and react differently (1) in a novel object test, and (2) during postponed feeding. During tests, we additionally studied whether eating behaviour and the occurrence of abnormal behaviour – such as crib-biting previously linked to ulceration in young horses (Nicol et al., 2002) – differ between adult horses with and without severe glandular gastric ulcers.

2. Materials and methods

2.1. Animals

We used Danish warmblood horses at one stud ($n = 98$; 17 mares, 33 geldings, 48 stallions), aged between 3 and 19 years, bred for competition in dressage or jumping, and housed individually in boxes (ca. 3 m × 3 m) on straw bedding. Data collected for each horse were: age, gender, paternity, body weight, body condition (according to scale in Henneke et al., 1983), stable within stud (1–5), training status (defined as 'in training', if exercised by humans for at least 5 h weekly), type/number of daily meals, and the amount of starch per meal. The health was evaluated by two veterinarians prior to the endoscopic examination; no individuals were excluded due to signs of illness.

Table 1
Experimental groups of control ($n = 30$) and ulcer ($n = 30$) horses. Medians with 25%; 75% quartiles, and means with SE.

Item	Control horses	Ulcer horses
[a]Glandular ulcer score, median	1 [1; 1]	3 [3; 3]
Range	0–1	3–4
[a]Nonglandular ulcer score, median	1 [1; 1]	1 [1; 2]
Range	0–1	0–3
Age (years)	7 (0.7)	7 (0.4)
Gender (mare, gelding, stallion)	M:6, G:8, S:16	M:5, G:13, S:12
Body weight (kg)	530 (7.9)	532 (8.9)
Body condition score (median)	5 [4; 5]	5 [5; 5]
Proportion of horses in training (%)	67	77
Starch feed per meal (g/kg BW)	1.1 (0.06)	1.1 (0.09)
[b]Hay served per day (kg)	4.2 (0.83)	4.2 (0.86)

[a] Using the EGUS scoring system described in Andrews et al. (1999).
[b] Excluding two horses per group with ad libitum access.

The horses were examined using a flexible video endoscope of 300 cm according to the method described in (Luthersson et al., 2009a), including fastening for 16 h, deprived of water for 5 h and sedated with detomidine (10–15 μg/kg BW i.v., Domosedan vet, Orion Corporation, Espoo, Finland) prior to the endoscopic examination. Gastric ulceration was scored for (1) the oesophagal nonglandular squamous mucosa and (2) the glandular mucosa of the stomach, simultaneously by two veterinarians, followed by an agreement on the final scores for the horse. The lesion grading system for Equine Gastric Ulcer Syndrome (EGUS) recommended by the Equine Gastric Ulcer Council was used (Andrews et al., 1999), with EGUS score 0 representing a healthy mucosa and score 4 for extensive and deep lesions. Two horses could not be assessed satisfactorily due to feed residuals in the stomach.

The experiment comply with the 'Principles of animal care', publication no. 86-23, revised 1985 of the National Institute of Health, and with current Danish laws. Informed owner consent was given. The owner, trainers and stable managers were blind regarding the ulceration scores, until after the experimental period; then veterinary advice regarding treatment was provided.

2.2. Experimental procedure

We selected horses to two groups: an ulcer group ($n = 30$) with lesions in the gastric glandular mucosa, EGUS scores 3–4, and a control group with intact mucosa (EGUS scores 0–1) (Table 1). EGUS grade 1 and below represents an intact mucosa, thus these horses have no ulceration present, but may have signs of reddening or hyperkeratosis (Nadeau and Andrews, 2009). Thirty pairs were made by pairing similar (regarding age, gender, body weight, paternity) horses. Each pair (one ulcer and one control horse) were tested on the same test days between 1 and 2.5 weeks