Efficacy of a pectin-lecithin complex for treatment and prevention of gastric ulcers in horses

M. G. Sanz, A. Viljoen, M. N. Saulez, S. Olorunju, F. M. Andrews

The objective of this study was to evaluate the effect of a commercial feed supplement containing pectin-lecithin on squamous mucosa ulceration in horses exposed to an experimental ulceration model. Five mares were treated while five mares were controls for this crossover, blinded study. The mares were fed concentrates and hay and were stable with a two-hour turn out per day for a period of four weeks. The pectin-lecithin complex was fed for the duration of the study on the treated group. At the end of a four-week period, all mares underwent a seven-day alternating feed deprivation (week 5). The study was repeated again after a four-week washout period. Gastroscopy was performed on days 1, 28 and 35 of the study and was digitally recorded. Independent evaluation of the recordings and scoring of the lesions using the Equine Gastric Ulcer Syndrome (EGUS), severity and number scores were performed by three experienced gastroscopists. The prevalence and severity of squamous ulcers significantly increased after intermittent feed deprivation (P<0.001). No significant effect of the treatment was observed (P=0.05). In this study, the addition of a commercially available pectin-lecithin complex to the feed of horses for five weeks did not prevent or minimise the risk for gastric ulceration of the squamous mucosa.

Ulceration of the squamous (non-glandular) mucosa of the stomach is common and a major health concern in horses. The prevalence of gastric ulceration using gastroscopy in adult horses is greater than 80 per cent in thoroughbred racehorses (Murray and others 1996, Vatistas and others 1999), ranges between 52 and 87 per cent in standardbred racehorses (Rabuffo and others 2002, Cave and others 2012), between 57 and 95 percent in endurance horses (Nieto and others 2004, Tamzali and others 2011) and affects 58 per cent of show standardbred racehorses (Rabuffo and others 2002, Cate and others 2012). Treatment with pharmaceutical agents is expensive, and must be administered once or multiple times daily for an extended time (Andrews and others 1999b, Endo and others 2012). Treatment with pharmaceutical products that possess anti-ulcerogenic properties are highly desirable to prevent squamous mucosa ulceration in horses that are at risk (Cargile and others 2004, Frank and others 2005, Huff and others 2012). Multiple feed supplements are currently available to horse owners; however, few have been scientifically evaluated (Cargile and others 2004, Frank and others 2005, Huff and others 2012, Stowers and others 2013). A commercial product containing a pectin-lecithin complex (Pronutrin, Boehringer Ingelheim, Ingelheim, Germany) is available in South Africa and is widely used for treatment of gastric ulcers in horses. Reports using this product are conflicting (Venner and others 1999, Murray and Grady 2002, Ferrucci and others 2003). Lecithin is a phospholipid that reduces surface tension at the air-water interface (Hills 1982, Kidd 2002). Natural phospholipids are often used as feed additives and have a role in gastric mucosal defence against the damaging effects of luminal acid in dogs (Swarm and others 1987). Exogenous phospholipids such as lecithin may be clinically useful in prevention of equine gastric ulcers (Ethell and others 2000). Pectins are found in numerous fruits, tubers and stem plants and are rendered into a gel when exposed to an acidic environment (Kidd 2002). Pectins may bind to bile acids of the gastroduodenal juice and prevent them from having deleterious effects on gastric mucosa (Venner and others 1999).

The purpose of this study was to evaluate whether a commercially available feed supplement containing a pectin-lecithin complex (Pronutrin) would prevent squamous mucosa ulceration in horses exposed to a model known to induce ulceration of that specific portion of the gastric mucosa. We hypothesised that addition of the feed supplement to the diet as instructed by the product’s label would prevent or significantly decrease the number and severity of squamous mucosal ulceration.

Materials and methods

Ten healthy mares were selected for the study. The mares were determined to be healthy based on physical examination, complete blood
cell count and fibrinogen concentration. Each mare was individually kept in a 3x3 m stall for 48 hours prior to and during the treatment periods and was allowed access to a dirt pen for two hours of exercise daily. During the washout period, mares were maintained in a pasture.

The 10 mares were randomly allocated to two groups. A crossover design was used with five-week treatment periods separated by a four-week washout period (14 weeks total). The mares were fed ad libitum teff hay and 1 per cent of their bodyweight of a commercially available concentrate (Epol, Division of Rainbow Farms, Johannesburg, South Africa) (week 1–4). The concentrates were incrementally introduced to the diet by 25 per cent every 48 hours as it was previously described (Frank and others 2005). The hay and concentrates were fed twice a day (morning and afternoon). In addition, the treatment group was fed the pectin-lecithin complex (Pronutrin) in the morning as indicated on the product’s label (30 g/100 kg of bodyweight once a day).

During week 5, the mares in both groups were deprived of feed for 24 hours (to a total of 96 cumulative hours) and fed as normal on alternative days (intermittent feed deprivation period) according to a previous model (Murray 1994, Murray and Eichorn 1996, Frank and others 2005). Feed deprivation was achieved by completely removing all source of food from the stable. During the feed deprivation period, the treatment group received the pectin-lecithin supplement (Pronutrin) once a day in the morning. A similar volume of concentrates (50 g/100 kg of bodyweight) was fed at the same time to the control mares. For the second phase of the study, after the four-week washout period, mares that received the treatment in the first period of the study served as control group and vice versa (crossover design). Mares were observed daily for any signs of colic.

Gastroscopy was performed under sedation (Romifidine (Sedivet, Boehringer Ingelheim, Ingelheim, Germany), 0.04 mg/kg, intravenously) using a 3 m endoscope (Olympus Medical System Corporation, Tokyo, Japan) at the start of the study (day 1), after four weeks of treatment (day 28) and at the end of the intermittent feed deprivation period (day 35). Feed was withheld for 16–18 hours and water for three to four hours prior to gastroscopy. All gastroscopies were performed in the morning by a single evaluator (M.S.) and bodyweight was recorded. The non-glandular mucosa (funda ventriculi), the glandular mucosa (corpus ventriculi) and the pylorus were evaluated after air insufflation of the stomach. All video gastroscopies were recorded (HDRW 720 DVD recorder, Koninklijke Philips Electronics N.V.). The recordings were independently evaluated in a mixed, randomised order at the end of the project separately by three experienced gastroscopists (M.N.S., F.M.A., A.V.) masked to the treatment given. Ulcers present in the squamous mucosa were scored by number (scale 0–4), severity (scale 0–5) and overall appearance (scale 0–4) using two previously described scoring systems (MacAllister and others 1997, Andrews and others 1999a) (Tables 1–3).

The protocol was approved by the University of Pretoria Animal Use and Care Committee (Protocol number V019-09).

### Statistical analysis

t Test was used to compare bodyweight results (kg). Pairwise comparison (treatment v non-treatment) of lesion scores on days 1 and 28 were assessed for differences between groups using the Wilcoxon signed rank test. Mann-Whitney U test was used to compare lesions scores.

### Results

The median age of the mares was four years (range three to six years). The mean±(sd) bodyweight before entering the study was 529 kg (±16.4 kg) and no differences were observed between groups (P=0.05). Bodyweight did not change during the study and no significant effect of treatment was observed (P=0.986). Only one horse had a small, single ulcer (lesion number, severity and EGUS scores ≤2) in the glandular mucosa. As a result, only lesions observed in the squamous mucosa were included in the analysis.

Mild ulceration of the squamous mucosa (lesion number, severity and EGUS scores ≤2) was observed in all the mares on day 1 of each study period (Tables 4 and 5). However, before inclusion in the study, all the mares had equal ulcer scores (P=0.05). There was no significant effect of treatment on number (P=0.266), severity (P=0.171) or EGUS (P=0.878) scores on day 28 of the study (Tables 4 and 5). Significantly higher number, severity and EGUS (P=0.0005) scores were recorded on day 35 (Tables 4 and 5). There was no significant effect of treatment on number (P=0.946), severity (P=0.547) or EGUS (P=0.341) scores on day 35 (Tables 4 and 5).

### Discussion

The results of this study support those of Murray and others (2002). Our study was of similar design; however, the treatment period used here followed that recommended by the manufacturer (28 days) instead of the seven-day period previously used (Murray and Grady 2002). A beneficial effect of the same product on gastric ulceration has been previously reported in clinical cases (Venner and others 1999, Ferrucci and others 2003). While a similar number of horses were included in those studies, lack of randomisation during treatment allocation and blindness of the evaluators to the treatment given may account for some of the disparities observed. In addition, because such studies were done under clinical circumstances, changes in management may have had an impact in the outcome. Both authors concluded that a longer treatment period might be more beneficial as complete resolution of the ulcers was not observed in either study (Venner and others 1999, Ferrucci and others 2003). Similar to that reported by others (Murray 1994, Murray and Grady 2002, Frank and others 2005), only ulceration of the squamous mucosa was artificially induced by intermittent feed deprivation. Even though this is an artificial way to induce gastric ulceration, it provides

### Table 1: Description of the Lesion Number Score system used to score gastric ulceration

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No lesion</td>
</tr>
<tr>
<td>1</td>
<td>1-2 localised lesions</td>
</tr>
<tr>
<td>2</td>
<td>3-5 localised lesions</td>
</tr>
<tr>
<td>3</td>
<td>6-10 localised lesions</td>
</tr>
<tr>
<td>4</td>
<td>&gt;10 lesions or diffuse (or very large) lesions</td>
</tr>
</tbody>
</table>

Source: MacAllister and others (1997)

### Table 2: Description of the Lesion Severity Score system used to score gastric ulceration

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No lesion</td>
</tr>
<tr>
<td>1</td>
<td>Appears superficial (only mucosa missing)</td>
</tr>
<tr>
<td>2</td>
<td>Deeper structures involved (&gt;depth than 1)</td>
</tr>
<tr>
<td>3</td>
<td>Multiple lesions and variable severity (1, 2 and/or 4)</td>
</tr>
<tr>
<td>4</td>
<td>Deeper structures involved (&gt;depth than 1) 0 and active (hyperaemic and/or darkened lesion crater)</td>
</tr>
<tr>
<td>5</td>
<td>Same as 4 plus haemorrhage or adherent blood clot</td>
</tr>
</tbody>
</table>

Source: MacAllister and others (1997)

### Table 3: Description of the EGUS score system used to score gastric ulceration

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>The epithelium is intact, and there is no appearance of hyperaemia or hyperkeratosis</td>
</tr>
<tr>
<td>1</td>
<td>The mucosa is intact, but there are areas of reddening or hyperkeratosis</td>
</tr>
<tr>
<td>2</td>
<td>Small, single or multifocal lesions</td>
</tr>
<tr>
<td>3</td>
<td>Large, single or multifocal lesions or extensive superficial lesions</td>
</tr>
<tr>
<td>4</td>
<td>Extensive lesions with areas of apparent deep ulceration</td>
</tr>
</tbody>
</table>

Source: Andrews and others (1999a)
an experimental standardized model without the variations that may occur when using clinical cases.

One of the limitations of this study was the presence of mild ulceration (scores <1.2 using all three scoring systems) of the squamous mucosa on the mares at the beginning of each study period (day 1). This finding was not unexpected as high incidence of squamous mucosal ulceration has been reported in broodmares out in pasture (Jeune and others 2009). In addition, the mares used in this study were young which may have predisposed them to ulceration (Peretich and others 2001, Murray and Grady 2002); however, complete resolution of these as mild by all the evaluators. Supplementation with the pectin-lecithin complex may have been more beneficial if administered at midnight as gastric pH has been shown to decrease from 01:00 to 09:00 (Husted and others 2006, 2007); however, such practice does not reflect routine horse management. Further studies are required to assess whether the pectin-lecithin complex (Pronutrin) has anti-ulcerogenic properties if it is administered at a higher volume or frequency.

A four-week washout period was selected to avoid potential carryover effects and to allow healing of the gastric ulcers (Murray and others 2001, Murray and Grady 2002); however, complete resolution of the squamous ulceration was not achieved. It is important to note that there were no differences between the scores assigned to each group on each different period, and hence a carryover effect can be ruled out. Ideally, omeprazole (GastroGard, Merial, Duluth, Georgia, USA) should have been given before the study and during the washout period to minimize presence of squamous ulceration at the beginning of each period (Sykes and others 2013). Unfortunately, at the time of the study, no formulations of omeprazole were available for the use in horses in the country. The use of H1 blockers was evaluated; however, efficacy of H1 blockers to induce complete healing of ulceration has been demonstrated in broodmares out in pasture (Jeune and others 2009). This is not measured in this study; there is a possibility that the diet did not could have influenced their bodyweight. In addition, the feed deprivation effects and to allow healing of the gastric ulcers (Murray and Eichorn 1996, Holland and others 1997, Orsini and others 2003).

A four-week washout period was selected to avoid potential carryover effects and to allow healing of the gastric ulcers (Murray and others 2001, Murray and Grady 2002); however, complete resolution of the squamous ulceration was not achieved. It is important to note that there were no differences between the scores assigned to each group on each different period, and hence a carryover effect can be ruled out. Ideally, omeprazole (GastroGard, Merial, Duluth, Georgia, USA) should have been given before the study and during the washout period to minimize presence of squamous ulceration at the beginning of each period (Sykes and others 2013). Unfortunately, at the time of the study, no formulations of omeprazole were available for the use in horses in the country. The use of H1 blockers was evaluated; however, efficacy of H1 blockers to induce complete healing of ulceration has been shown to be variable (Murray and Eichorn 1996, Holland and others 1997, Orsini and others 2003).

Table 4 Lesion number, severity and EGUS scores observed on the squamous mucosa on days 1, 28 and 35 of the study. The values represent the mean scores of the three observers for the two study periods.

<table>
<thead>
<tr>
<th>Day</th>
<th>Lesion number score</th>
<th>Lesion severity score</th>
<th>EGUS score</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Treatment</td>
<td>Control</td>
<td>Treatment</td>
</tr>
<tr>
<td>Day 1</td>
<td>0.93†</td>
<td>1.20†</td>
<td>0.80†</td>
</tr>
<tr>
<td>Day 28</td>
<td>0.70†</td>
<td>0.93†</td>
<td>0.70†</td>
</tr>
<tr>
<td>Day 35</td>
<td>2.63†</td>
<td>2.70†</td>
<td>2.50†</td>
</tr>
</tbody>
</table>

Table 5 Frequency of lesion number, severity and EGUS scores observed on the squamous mucosa on days 1, 28 and 35 of the study. The values are expressed in percentage.

<table>
<thead>
<tr>
<th>Day</th>
<th>LNS</th>
<th>Treatment</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≤2</td>
<td>&gt;2</td>
<td>≤2</td>
</tr>
<tr>
<td>Day 1</td>
<td>80</td>
<td>20</td>
<td>90</td>
</tr>
<tr>
<td>Day 28</td>
<td>94</td>
<td>6</td>
<td>100</td>
</tr>
<tr>
<td>Day 35</td>
<td>36</td>
<td>64</td>
<td>43</td>
</tr>
</tbody>
</table>

References


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