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Five- versus seven-day dosing intervals of extended-release injectable omeprazole in the treatment of equine squamous and glandular gastric disease

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Abstract

Background: An extended-release injectable omeprazole formulation (ERIO) has become a popular treatment for equine squamous gastric disease (ESGD) and equine glandular gastric disease (EGGD) where it is available; however, published data are limited and optimal treatment regimens have not been determined.

Objectives: To compare effects of treatment on ESGD and EGGD when an ERIO formulation is administered at either 5- or 7-day intervals.

Study design: Retrospective clinical study.

Methods: Case records and gastroscopy images of horses with ESGD or EGGD treated with ERIO were reviewed. Images were anonymised and graded by one researcher masked to treatment group. Treatment responses were compared between the two treatment schedules using univariable ordered logistic regression.

Results: Forty-three horses were treated with ERIO at 5-day intervals and 39 horses at 7-day intervals. Signalment and presenting signs did not differ between groups. The proportions of horses with EGGD healing (to grade 0 or 1) in association with ERIO used at 5-day intervals (93%) were higher than associated with treatment at 7-day intervals (69%; odds ratio [OR]: 2.41, 95% CI: 1.23–4.74, $p = 0.01$). For ESGD, there was no significant difference in the proportion of horses healing in association with treatment at 5-day intervals (97%) compared with 7-day intervals (82%; OR: 2.75, 95% CI: 0.91–8.31, $p = 0.07$). Four of 328 injections were associated with an injection-site reaction (1%).

Main limitations: Retrospective study design, lack of randomisation and limited case numbers.

Conclusions: The use of ERIO at 5-day intervals might be more appropriate than the 7-day interval that is used currently.

KEYWORDS
acid suppression, gastric ulcer, horse, proton pump inhibitor, therapeutics

1 | INTRODUCTION

Equine squamous gastric disease (ESGD) and equine glandular gastric disease (EGGD) are two distinct disease entities that have high prevalences across multiple breeds and equestrian disciplines and impact equine welfare and performance.[1–4] The aetiopathogenesis of ESGD has been well documented, with mucosal injury occurring as a result of acid injury to a tissue that has limited defence against a low pH environment.[1] In contrast, the aetiopathogenesis of EGGD is less well understood and is likely multifactorial.[2] Unlike ESGD, EGGD is believed to result from the breakdown of the normal defence mechanisms that protect the glandular mucosa.[2] While enhancing mucosal barrier function might facilitate healing of glandular mucosal lesions, acid-suppressive therapy currently remains the cornerstone of treatment.[5] Effective acid suppression is therefore central to the management of both ESGD and EGGD.[1,2]

In both human and veterinary medicine, proton-pump inhibitors are the most effective means of suppressing gastric acid production and increasing intragastric pH. Oral omeprazole is the only proton-pump inhibitor registered for the treatment of ESGD and its use is typically associated with healing of lesions in around 70%–77%,[3–6] of horses within 4–5 weeks. Initial work that was performed to register oral omeprazole only investigated effects on ESGD, and subsequent studies have shown that oral omeprazole is frequently ineffective for EGGD[2] with healing in less than 50% of cases being reported.[7–9] Unregistered treatments are used widely in the treatment of EGGD with medications aimed at promoting the barrier function of the glandular mucosa such as misoprostol[10,11] or sucralfate[12,13] often used alongside or as an alternative to proton pump inhibitors.[11–13]

An extended-release injectable omeprazole formulation (ERIO)[14,15] has become popular as an alternative to oral proton pump inhibitors. The use of ERIO was first reported in 2017 and the administration of two doses, 7 days apart was associated with healing in 100% and 75% of Thoroughbred racehorses with ESGD and EGGD, respectively.[15] The product has previously been termed 'long acting' but as it does not have inherent properties that extend its action but rather contains excipients that prolong the release of omeprazole to the circulation, the term 'extended-release' is more appropriate. Administration of ERIO resulted in consistent rises in intragastric pH at the mucosal surface.[15] Median intraday pH peaked 3 days after administration and then declined gradually to Day 7.[15] Between Days 4 and 7, acid suppression was suboptimal in some horses. Subsequent reports have detailed the effectiveness of an ERIO at 7-day intervals in the treatment of both ESGD and EGGD.[9,16,17] However, in all studies, a proportion of horses have failed to heal, particularly those that have EGGD. Treatment at 5-day intervals might be more effective than treatment at 7-day intervals as the drop in gastric pH that occurs between Days 4 and 7[15] would be avoided. Although there are no reports of treatment at 5-day intervals, some clinicians have adopted this regimen as they perceive that it is more effective. It is hypothesised that treatment with ERIO (the same formulation investigated by Sykes et al.[15]) at 5-day intervals will be associated with higher proportions of ESGD and EGGD healing than treatment at 7-day intervals.

2 | MATERIALS AND METHODS

2.1 | Horses

A convenience sample of case records and gastroscopy images of horses presenting to Avon Ridge Equine Practice for gastroscopy between July 2020 and November 2021 were reviewed to identify horses that had been treated with ERIO (BOVA Aus). Gastroscopy had been performed following sedation with 0.01 mg/kg detomidine hydrochloride (Dozadine, Virbac Pty Ltd) using a 3.3-m flexible gastroscope (Endo I, Steris). Gastroscopy had been repeated 5–7 days after the administration of the fourth dose of ERIO. Cases were excluded if clinical records or gastroscopy images before and after treatment were incomplete, if additional treatments were administered concurrent to ERIO or if owners had deviated from the standardised written set of dietary and management recommendations.

2.2 | Treatments

Treatments had been chosen by the attending veterinarian in consultation with the owner. At present, ERIO is not registered for use in horses or other species and is currently produced as an extemporaneous formulation in the UK and Australia in regulated premises in accordance with the principles of Good Manufacturing Practice. The product is supplied as a vial containing 20 mL omeprazole at 100 mg/mL and undergoes regular testing in accordance with European Medicines Agency (EMA) and International Council for Harmonisation of Technical Requirements for Registration of Pharmaceuticals for Human Use (ICH) guidelines. In short, (i) long-term stability study for 12 months at 25 ± 2°C and 60% ± 5% relative humidity, (ii) accelerated stability study for 6 months at 40 ± 2°C and 75% ± 5% relative humidity, (iii) high-performance liquid chromatography analytical testing up to 12 months from manufacture to assess degradation of the active ingredient and presence of impurities, (IV) sterility and bioburden assessment up to 12 months from manufacture. Vials are sold as single use and were used in this manner throughout the study. Recent work has indicated that the product remains stable and sterility is not compromised when multiple doses are drawn from the bottle over a 2-week period (manufacturer's unpublished data).

Informed client consent was obtained prior to commencing treatment. In the absence of a registered treatment for EGGD and in accordance with the local legal framework, ERIO had been used as a primary treatment for all horses presenting to the practice with EGGD or a combination of EGGD and ESGD. Horses received treatment at 5- or 7-day intervals based primarily on clinician preference but occasionally for logistical reasons if owners could not accommodate one or other regimen. All owners were provided with written guidelines to maximise turnout, minimise the frequency of exercise to 4 days per week, provide ad-libitum roughage, eliminate grain from the diet, minimise the number of riders and handlers, and to identify and reduce stressors for each individual horse.

Horses were injected four times with 2 g (20 mL) of a 100 mg/mL ERIO formulation (BOVA Aus) at 5- or 7-day intervals. Weight was estimated using a validated weigh tape (Virbac). Correct im injection technique and site selection (gluteals) were demonstrated by the treating veterinarian when administering the first dose. The injection site was cleaned with chlorhexidine scrub (Chlorhex-S, Jurox Animal Health) and isopropyl alcohol (PharmAust Manufacturing) prior to injection and the total dose was administered into a single injection site. Owners administered subsequent doses themselves and were advised to contact their veterinarian immediately if any adverse effects were observed. Some owners elected not to follow advice to inject into the gluteals and chose to inject into the neck.

2.3 | Grading

Gastroscopy images were anonymised and reviewed by one of the authors (D. R.) who was blinded to the treatment group and stage of treatment. Squamous lesions were graded using Equine Gastric Ulcer Council (EGUC) 0–4 scale[18] with healing defined as improvement to grade 0. The EGGD lesions were graded using both descriptive terminology and a modified EGUC scale (Table S1).[1] In the absence of complete healing, the stage of treatment was unblinded and pre- and post-treatment images for each horse were reviewed concurrently to assess whether there had been an improvement, a deterioration or no change in endoscopic appearance in response to treatment. Given the conjecture around what constitutes EGGD healing,[2] poor correlation between mucosal erythema and underlying pathology,[19] and the inconsistency between previous studies in defining 'healing', the analysis was performed using both grades 0 and 1 as benchmarks for 'healing' in order to facilitate comparison with previous and future studies. Information was obtained from the records on whether owners considered the initial clinical signs had resolved, improved, remained unchanged or worsened.

2.4 | Data analysis

Data were collated in Microsoft Excel and analysed in Stata/MP 15.1 (StataCorp). Baseline characteristics of horses were compared between the two groups using univariable logistic (sex and presence of erythematous, haemorrhagic and fibrinosuppurative lesions), linear (horse's age), ordinal (distribution of pylorus lesions at initial scope) and multinomial logistic (breed and primary reason for scope) regression. Gastroscopic appearance and clinical signs were compared between the two treatment schedules using univariable ordered logistic regression. The assumption of proportional odds was tested using a log-likelihood test of proportionality of odds. All ordered logistic regression models met the assumption of proportionality. Each EGGD case was also classified as responding (healed/improved) or not responding (unchanged/worsened) to treatment and compared between the two treatment schedules using univariable logistic regression. This was done to capture improvements in grade that did not lead to resolution, for example, a reduction from grades 4 to 2. Spearman rank-order correlation coefficient was used to examine the correlation between the owner's perceived change in clinical signs and the gastroscopic results.

3 | RESULTS

3.1 | Equine glandular gastric disease

One-hundred and two horses with EGGD out of a total of 247 horses with EGGD ± ESGD were treated with ERIO (Figure 1). Follow-up gastroscopy was performed in 79.6% and 81.1% of horses receiving ERIO at 7- and 5-day intervals, respectively, leaving 82 horses with EGGD; 43 horses treated at 5-day intervals and 39 treated at 7-day intervals. Treatment with a total body dose of 2 g of ERIO resulted in an estimated dose range of 3.2–4.6 mg/kg. Both groups were comprised of horses of a range of ages (2–32 years) and breeds (Table 1). There were no differences in signalment, presenting complaint, lesion type or lesion severity between the two groups, with the exception of more horses in the 5-day treatment group presenting with cutaneous sensitivity or girthiness than in the 7-day group (33% compared with 15%, $p = 0.04$). A change in behaviour was the most common reason for performing gastroscopy in both groups.

For EGGD, treatment at 5-day intervals was associated with better outcomes than 7-day intervals (63% compared with 39%), using either grade 0 as the definition of healing (odds ratio [OR]: 1.75, 95% CI: 1.14–2.70, $p = 0.01$) or considering horses with grades 0 and 1 lesions to be healed (OR: 2.41, 95% CI: 1.23–4.74, $p = 0.01$; Table 2). The 5-day schedule was associated with increased odds of EGGD improving with treatment (OR: 2.43, 95% CI: 1.24–4.80, $p = 0.01$) (compared with not improving). There was no difference in owner perceived success of treatment for clinical signs of EGGD between groups (OR: 1.30, 95% CI: 0.86–1.97, $p = 0.2$). There was a weak positive association between owner perception of clinical improvement and improved gastroscopic appearance of EGGD lesions, using healed as grade 0 (Spearman's rho: 0.345, $p = 0.002$), and healed as grade 0 or 1 (Spearman's rho: 0.313, $p = 0.004$).

3.2 | Equine squamous gastric disease

A subset of the 60 horses with EGGD were also diagnosed with ESGD; 33 horses treated at 5-day intervals and 27 treated at 7-day intervals. There was no difference between the two treatment groups in terms of sex, age, breed or presenting complaint (Table 3). Lesions in the greater curvature were however more severe in the 5-day treatment group compared with the 7-day treatment group prior to treatment ($p = 0.003$; Table S1).

Proportions of horses with ESGD healing were 97% and 82% in the 5- and 7-day groups, respectively; however, there was no difference between the two groups (OR: 2.75, 95% CI: 0.91–8.31, $p = 0.07$; Table 4). The proportions of horses improving were 100% and 89%, respectively. There was no difference in owner perceived

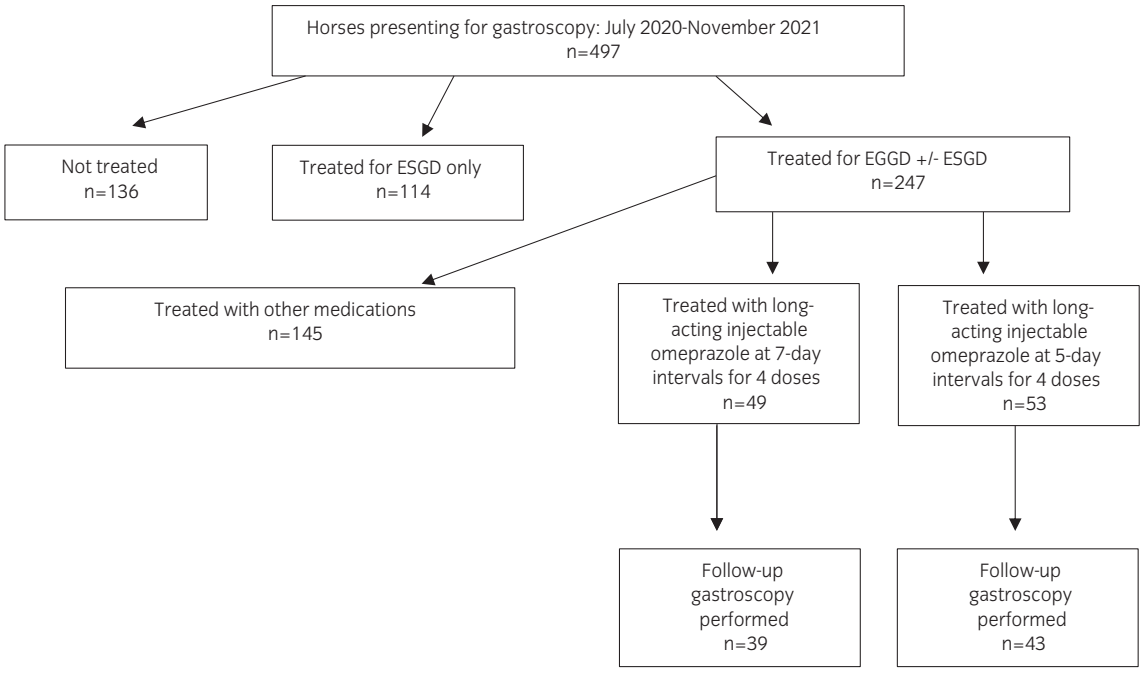

FIGURE 1 Flow chart showing the recruitment and treatment of horses with equine gastric disease. EGGD, equine glandular gastric disease; ESGD, equine squamous gastric disease.

TABLE 1 Signalment and presenting complaints for 82 horses with equine glandular gastric disease that were subsequently treated with extended-release injectable omeprazole at either 5- or 7-day intervals.

	Day 5 ($n = 43$)	Day 7 ($n = 39$)	*p* Value
Sex (gelding), *n* (%)	26 (60%)	24 (62%)	0.9
Age (years), mean ± SD	11.1 ± 5.7	12.1 ± 5.6	0.4
Breed, *n* (%)			
Thoroughbred	9 (21%)	9 (23%)	Ref
Pony	6 (14%)	10 (26%)	0.5
Warmblood	10 (23%)	5 (13%)	0.3
Western/working breed[a]	4 (9%)	9 (23%)	0.3
Standardbred	6 (14%)	2 (5%)	0.2
Other	8 (19%)	4 (10%)	0.4
Primary reason for scope, *n* (%)			
Behaviour change	14 (33%)	21 (54%)	Ref
Colic	5 (12%)	0 (0%)	>0.9
Crib biting	1 (2%)	0 (0%)	>0.9
Cutaneous sensitivity or girthiness	14 (33%)	6 (15%)	0.04
Poor appetite/weight loss/scouring	3 (7%)	7 (18%)	0.6
Poor performance	6 (14%)	5 (13%)	0.4
Distribution of pylorus lesions at initial scope, *n* (%)			
Focal	4 (9%)	10 (26%)	0.08
Multifocal	29 (67%)	20 (51%)	
Diffuse	10 (23%)	6 (15%)	
Presence of erythematous lesions, *n* (%)	31 (72%)	24 (62%)	0.3
Presence of haemorrhagic lesions (%)	26 (61%)	17 (44%)	0.1
Presence of fibrinosuppurative lesions, *n* (%)	18 (42%)	14 (36%)	0.6

[a]Paint, Quarter Horse, Appaloosa, stock horse, waler.

TABLE 2 The results of equine glandular gastric disease treatment in 82 horses that received extended-release injectable omeprazole at either 5- or 7-day intervals.

	Day 5 ($n = 43$)	Day 7 ($n = 39$)	OR (95% CI)	p Value[a]
Glandular disease (healed grade 0), *n* (%)				
Healed	27 (63%)	15 (39%)	1.75 (1.14–2.70)	0.01
Improved	14 (33%)	15 (39%)		
Unchanged	1 (2%)	7 (18%)		
Worsened	1 (2%)	2 (5%)		
Glandular disease (healed grade 0/1), *n* (%)				
Healed	40 (93%)	27 (69%)	2.41 (1.23–4.74)	0.01
Improved	1 (2%)	3 (8%)		
Unchanged	1 (2%)	7 (18%)		
Worsened	1 (2%)	2 (5%)		
Owner assessment of clinical signs, *n* (%)				
Resolved	12 (28%)	6 (15%)	1.30 (0.86–1.97)	0.2
Improved	20 (47%)	20 (51%)		
No change	11 (26%)	13 (33%)		
Worsened	0 (0%)	0 (0%)		

Abbreviations: *n*, number; OR, odds ratio.
[a]Comparisons between the Days 5 and 7 groups were made using univariable ordinal logistic regression, using Day 5 as the reference.

TABLE 3 Signalment and presenting complaints for 60 horses with equine squamous gastric disease (and concurrent equine glandular gastric disease) that were subsequently treated with extended-release injectable omeprazole at either 5- or 7-day intervals.

	Day 5 ($n = 33$)	Day 7 ($n = 27$)	p Value
Sex (gelding), *n* (%)	19 (58%)	16 (59%)	0.9
Age (years), mean ± SD	11.3 ± 6.1	12.0 ± 5.5	0.6
Breed, *n* (%)			
Thoroughbred	6 (18%)	6 (22%)	Ref
Pony	6 (18%)	7 (26%)	0.8
Warmblood	6 (18%)	5 (19%)	0.8
Western/working breed[a]	3 (9%)	6 (22%)	0.4
Standardbred	5 (15%)	1 (4%)	0.2
Other	7 (31%)	2 (7%)	0.2
Primary reason for scope, *n* (%)			
Behaviour change	10 (30%)	17 (63%)	Ref
Colic	5 (15%)	0 (0%)	>0.9
Crib biting	1 (3%)	0 (0%)	>0.9
Cutaneous sensitivity or girthiness	8 (24%)	3 (11%)	0.05
Poor appetite/weight loss/scouring	3 (9%)	3 (11%)	0.6
Poor performance	6 (18%)	4 (15%)	0.2

[a]Paint, Quarter Horse, Appaloosa, stock horse, waler.

success of treatment between groups (OR: 1.50, 95% CI: 0.92–2.45, $p = 0.01$) and no association between owner perception of improvement and improvements in gastroscopic appearance (Spearman's rho: 0.080, $p = 0.5$).

3.3 | Adverse reactions

Four owners reported that they did not follow veterinary advice and administered the subsequent three doses of ERIO on alternating sides of the neck rather than gluteals. Four horses developed localised swelling at a single injection site giving a 1.2% complication rate. Two site reactions occurred in the neck in horses that were treated at 7-day intervals on the fourth injection. Two site reactions developed in the gluteals (one in the 5-day group on the fourth injection and one in the 7-day group on the second injection). A total of 156 injections were administered in the 7-day group, giving a 1.9% risk of an adverse reaction. A total of 172 injections were administered in the 5-day group, giving a 0.6% risk of an adverse reaction. Three out of four site reactions did not require medical intervention. One horse (in the

	Day 5 ($n = 33$)	Day 7 ($n = 27$)	OR (95% CI)	p Value[a]
Squamous disease, *n* (%)				
Healed (grade 0)	32 (97%)	22 (82%)	2.75 (0.91–8.31)	0.07
Improved	1 (3%)	2 (7%)		
Unchanged	0 (0%)	1 (4%)		
Worsened	0 (0%)	2 (7%)		
Owner assessment of clinical signs, *n* (%)				
Resolved	11 (33%)	4 (15%)	1.50 (0.92–2.45)	0.1
Improved	15 (46%)	14 (52%)		
No change	7 (21%)	9 (33%)		
Worsened	0 (0%)	0 (0%)		

[a]Comparisons between the Days 5 and 7 groups were made using univariable ordinal logistic regression, using Day 5 as the reference group.

TABLE 4 The results of equine squamous gastric disease treatment in 60 horses that received extended-release injectable omeprazole at either 5- or 7-day intervals.

7-day group) developed an abscess in the neck that was lanced and subsequently healed without further complications.

4 | DISCUSSION

In this study, an ERIO formulation administered at 5-day intervals resulted in higher proportions of EGGD healing than treatment at 7-day intervals. No significant difference was identified in the proportions of ESGD healing between the two treatment regimens.

In human medicine, healing for peptic ulcer disease is directly proportional to the length of time the intragastric pH remains above 4 and similarities between peptic ulcer disease in people and EGGD in horses has been described.[1] In the treatment of peptic ulcer disease, there is a target for gastric pH to be maintained above 4 for at least 66% of each day[20] and this benchmark has also been applied in horses albeit without a sound evidence base.[15] Following administration of the same ERIO formulation as used in this study, the proportion of time that pH is >4 diminishes[14] and the results herein suggest that eliminating this period of suboptimal acid suppression might improve outcomes.

The proportions of both ESGD and EGGD healing in this study are comparable with previous reports in similar populations of horses in which the same ERIO formulation, administered at 7-day intervals, has been investigated.[14,16] The use of a different ERIO formulation has also been reported but was associated with much lower proportions of horses healing (35% for ESGD) and far more frequent complications (23% overall, with 48% site reactions at the fourth injection).[21] Differences in formulation and the extended-release vehicle likely account for the differences in outcome between the different formulations. These studies highlight the potential for differences in safety and efficacy profiles of unregistered formulations produced by different manufacturers and the need for safety and efficacy studies.

The results of this study compare favourably to the proportions of horses with EGGD reported to have healed with other therapeutic regimens. Reports of oral omeprazole and sucralfate in combination are limited to conference proceedings but indicate EGGD healing in 20%–71% horses.[11,13,22] However, this combination might present practical challenges regarding the administration of both medications at different times on an empty stomach as the absorption of oral omeprazole is affected by the acidic gastric environment and the presence of feed.[23,24] In addition to its superior effect on acid suppression,[15] the ERIO formulation also overcomes the varied compliance and bioavailability that is associated with daily administration of oral proton pump inhibitors.[2,24] Misoprostol is an alternative treatment for EGGD and has been reported to be associated with EGGD healing in 55%–72% of horses; however, one report also demonstrated that 42% of cases treated with misoprostol had development or worsening of ESGD lesions during treatment[10,11] supporting the notion that misoprostol is not a potent acid suppressor.

It has been suggested that EGGD lesions require a minimum of 28 days of treatment regardless of the medication administered.[1,2] The findings of this study indicate that EGGD healing might be achieved in as little as 21 days (i.e., after four doses at 5-day intervals) and suggests that it might not be the total duration of acid suppression but rather the consistency of acid suppression that influences healing. In the original study of this ERIO formulation, 75% of horses with EGGD healed after the administration of two doses 7 days apart.[14] These results suggest that the ERIO formulation used in the current study might have the potential to resolve EGGD lesions more rapidly than other treatments, a finding that has potentially positive implications for equine welfare.

The results of ESGD healing reported in both groups are comparable to previously published studies[15,16] and shortening the treatment interval had no significant impact on the proportion of horses with ESGD that healed. However, considering the results for EGGD healing observed in this study and previous work,[14] it would seem logical to treat horses with ESGD lesions at 5-day intervals. With greater case numbers, a significant difference in ESGD outcome for 5- and 7-day treatment regimens might be observed. Previous reports have demonstrated that results with 2 weeks of ERIO treatment for ESGD are similar to results for 4 weeks[15,16] and there are also oral omeprazole products that are registered for 14 days of treatment. Four weeks of treatment is probably excessive for ESGD and further investigation of two doses of ERIO at 5-day intervals is warranted.[12,17]

Inconsistency of reports on what constitutes EGGD healing[2] and the inevitable subjectivity in assessing EGGD lesions frustrates research in this area and complicates comparison between studies. Furthermore, there is poor correlation between mucosal erythema and underlying pathology[19] and the hierarchical scales that are used to facilitate statistical analysis may be misleading as EGGD is thought to represent a syndrome rather than a single disease with a continuum of severity.[5] In view of the inconsistency between previous studies in defining 'healing', the analysis was performed using both grades 0 and 1 as benchmarks for 'healing' in order to facilitate comparison with previous and future studies. The grade 0 benchmark that was used for EGGD in this study is the same as used in other recent studies of ERIO.[9,14] It is our opinion that with optimal acid suppression, the squamous mucosa should have a completely normal appearance with no evidence of hyperkeratosis. To facilitate direct comparisons with previous studies[15–17] investigating the use of ERIO in the treatment of ESGD, healing was classified as grade 0 in this study.

Regardless of the treatment interval, there was no association between owner perceived improvement in clinical signs and endoscopic healing for ESGD. These findings support those of previous reports[1,2,14] and might highlight the difficulty of assigning clinical significance to gastroscopic lesions. In this series, all of the horses with ESGD also had EGGD and it is therefore likely that the clinical response was influenced by the degree of EGGD healing. However, this is the second[11] study to report an association between endoscopic healing of EGGD lesions and owner reported improvement in clinical signs.

The retrospective convenience sample and lack of prospective, randomised allocation to treatment groups were weaknesses of the current study as is the absence of an accepted validated scale for grading EGGD. Cases were allocated according to clinician preference and following a discussion of what was practical for the owner and no differences were identified between the two groups in terms of breed, age or sex. Although the allocation decision was not based on clinical factors, the absence of randomisation is clearly a weakness of the study, which might have caused confounding. Additionally, the response to treatment may have differed by characteristics such as age, breed and sex. However, the study was not sufficiently powered to investigate such interactions.

During the study period, horses presenting to the practice received treatments other than ERIO and not all cases (irrespective of treatment) were available to re-examine (Figure 1) and there is therefore the potential for bias in the horses that were studied. Case numbers were relatively small, particularly for ESGD, which resulted in only univariable analysis being carried out. Although characteristics including age, sex and breed of the horses within each group were not significantly different, the inability to adjust covariates is a limitation. Further larger investigations are warranted to truly establish the safety and efficacy of different treatment regimens.

5 | CONCLUSIONS

The administration of ERIO at 5-day intervals resulted in more horses with EGGD healing compared with 7-day intervals without an apparent increase in the risk of complications. This treatment regimen might be more appropriate than the weekly dosing that is currently advocated, and the results of this study should inform future larger field trials that are performed into ERIO. Pending larger clinical field trials, the results herein provide guidance for clinicians on likely outcomes and complications when using ERIO.

AUTHOR CONTRIBUTIONS

This study was conceived by David Rendle and Tania Sundra. Data were collated by David Rendle and Tania Sundra and analysed by Erin Kelty. All authors contributed to the preparation and final approval of the manuscript.

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FUNDING INFORMATION

No funding was received for this research.

CONFLICT OF INTEREST STATEMENT

David Rendle provides consultancy services to BOVA UK and BOVA Aus, who produce the extended-release injectable omeprazole preparation that was investigated, and to other companies who produce products for the treatment of equine gastric disease. Tania Sundra has received travel and accommodation expenses for attendance at CPD events from BOVA Aus and payment for consultancy services provided to the manufacturers of other treatments for gastric disease. Erin Kelty has no conflicts to declare.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request: Open sharing exemption granted by editor for this descriptive retrospective case series.

ETHICAL ANIMAL RESEARCH

Research ethics committee oversight not required by this journal: retrospective study of clinical records.

INFORMED CONSENT

Written client consent was obtained for the administration of unregistered medications and use of clinical data in research.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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