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Equine gastric ulcerative syndrome in Antioquia (Colombia): Frequency and risk factors¤

Síndrome ulcerativo gástrico equino en Antioquia (Colombia): Frecuencia y factores de riesgo

Síndrome da úlcera gástrica equina em Antioquia (Colombia): Frequência e fatores de risco

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Abstract

Background: Equine gastric ulcer syndrome (EGUS) has been associated with duration of confinement, grain supplementation, exercise, stress, use of non-steroidal anti-inflammatory drugs, and the gastric microbiome. On the other hand, limited information is available on the risk factors for EGUS in Colombia. **Objective:** To determine the frequency and risk factors for the presentation of EGUS in several municipalities of Antioquia. **Methods:** A total of 103 male and female horses were evaluated. Endoscopic samples from different portions of the stomach were taken and subjected to histopathological analysis. Information on management conditions for each animal was also obtained. Descriptive statistics, association analysis and logistic regression were performed. **Results:** A 69% of the animals presented at least one gastric lesion: 22.3% lesions in the squamous mucosa, 39.2% in the *Margo plicatus* (MP) and 48.9% in the glandular region. Diet was associated with the presentation of ulcers in the squamous mucosa (p = 0.003). MP ulceration was associated with concentrate feed consumption (p = 0.032). **Conclusion:** The EGUS frequency is 69%. Consumption of concentrate feed by horses in Antioquia is a critical factor for the development of ulcers in the stomach squamous and glandular regions.

Keywords: *EGUS, endoscopy, equine, ulcer.*

Resumen

Antecedentes: El síndrome ulcerativo gástrico equino (SUGE) se ha asociado a factores como estabulación, consumo de concentrado, ejercicio, estrés, uso de AINEs y microbiota del estómago. Por otro lado, la información sobre los factores de riesgo para EGUS en Colombia es limitada. **Objetivo:** Determinar la frecuencia y factores de riesgo para la presentación de SUGE en caballos de Medellín y municipios cercanos. **Métodos:** Fueron evaluados 103 equinos de ambos sexos. Se realizó análisis histopatológico a muestras tomadas por endoscopia en diferentes porciones del estómago. Adicionalmente, se obtuvo información sobre las condiciones de manejo de cada animal. Se realizó estadística descriptiva, análisis de asociación y regresión logística. **Resultados:** El 69% de los animales presentaron al menos una lesión gástrica, 22,3% lesiones en la mucosa escamosa, 39,2% en el *Margo plicatus* (MP) y 48,9% en la región glandular. La dieta estuvo asociada a la presentación de úlceras en la mucosa escamosa (p = 0,003). La ulceración en MP estuvo asociada al consumo de alimento concentrado (p = 0,032). **Conclusión:** La frecuencia de SUGE es del 69%. El consumo de alimento concentrado por equinos en Antioquia es un factor crítico para el desarrollo de úlceras en las regiones escamosa y glandular del estómago.

Palabras clave: *endoscopia, equine, SUGE, úlcera.*

Resumo

Antecedentes: A síndrome da úlcera gástrica equina (SUGE) tem sido associada a fatores como estabulação, subministro de ração, exercício, estrese, uso de AINE e microbiota do estômago. Por outro lado, a informação sobre os fatores de risco para o EGUS na Colômbia é limitada. **Objetivo:** Determinar a frequência e fatores de risco para a apresentação da SUGE em uma população de cavalos de Medellín e cidades próximas. **Métodos:** Foram estudados 103 equinos de ambos sexos. Amostras das diferentes porções do estômago tomadas pela endoscopia foram submetidas a análises histopatológico. Igualmente, dados das condições de manejo de cada animal foram obtidos. Se realizou estatística descritiva, análises de associação e regressão logística. **Resultados:** O 69% dos animais estudados apresentarão pelo menos uma lesão gástrica, 22,3% lesões na mucosa escamosa, 39,2% no *Margo plicatus* (MP) e 48,9% na região glandular. Se determinou que a dieta é um fator associado à apresentação de úlceras na mucosa escamosa (p = 0,003). A ulceração em MP foi associada ao subministro de ração (p = 0,032). **Conclusão:** A frequência da SUGE foi do 69%; a presença de ração na dieta é um fator crítico para o desenvolvimento de úlceras nas regiões escamosa e glandular.

Palavras-chave: *endoscopia, equine, SUGE, úlcera*

Introduction

Equine gastric ulceration syndrome (EGUS) is a multicausal entity characterized by lesions in the gastric mucosa, which involve loss of continuity of the gastric epithelium and, consequently, organ dysfunction. Gastric disease can be associated with recurrent colic, weight loss, stereotypies, and diarrhea. This syndrome can lead to economic losses and reduced performance in horses. Theories about EGUS etiology include chemical erosion by hydrochloric acid, reduced gastric mucosal blood flow, and microbial interactions that affect maintenance of intragastric pH. Some researchers claim that squamous and glandular gastric ulceration are different entities because lesion pathophysiology differ and should be addressed independently (Sykes *et al.*, 2015; Mónki *et al.*, 2016).

Although EGUS has been reported worldwide, it does not have a homogenous characterization in terms of distribution and risk factors, since they differ according to geographic location, subspecies, feeding conditions and management of the populations. Studies on this pathology have been conducted in donkeys (Al-Mokaddem *et al.*, 2015; Cardona *et al.*, 2015b), horses for teaching sports (Chameroy *et al.*, 2006), horses at slaughter (De Souza *et al.*, 2014), military patrol horses (Aranzales *et al.*, 2012); Brazilian equestrian horses (Martinez *et al.*, 2014), Thoroughbred horses (Le Jeune *et al.*, 2009; Orsini *et al.*, 2009), stabled horses (Luthersson and Nielsen, 2009), endurance horses (Tamzali *et al.*, 2011; Nieto *et al.*, 2004), and westerny, jumping, and dressage horses (Hartmann and Frankeny, 2003; Tamzali *et al.*, 2011).

Factors associated with EGUS have not yet been studied in Colombia, nor is its epidemiological behavior known. Some researchers have reported specific cases of gastrointestinal lesions secondary to nonsteroidal anti-inflammatory drugs (NSAIDs) use (Cruz and Montoya, 2011), but the dynamics of the appearance of gastric lesions in Colombian horses is not known. However, non-randomized studies have been undertaken to investigate this syndrome in Colombia (Cardona *et al.*, 2015).

The objective of this study was to characterize EGUS presentation in several municipalities of Antioquia and to identify risk factors associated with this syndrome.

Materials and methods

Ethical considerations

The study was approved by the Ethics Committee on Animal Experimentation of Universidad de Antioquia (Act No. 3082013).

Location

Animals from Medellin and other municipalities of Antioquia (Envigado, Copacabana, Barbosa, San Pedro de los Milagros, Titiribí, and Salgar) were used. The cases were divided into clusters and an each horse was identified with a number.

Animals

The sample was selected by convenience. A total of 103 horses of different breeds were evaluated: Colombian Creole, Appaloosa, Quarter horse, Argentinian saddle horse, and Arabian horse. The average body weight was 347.7 ± 61.8 Kg, aged 9 ± 4.9 years, of both sexes, in grazing (45 animals) and stabled (58 animals) systems. Body condition score (BCS) of the animals was assessed with the method described by Henecke *et al.* (1983), as follows: Nine animals had low BCS, 90 animals had an ideal BCS, and seven animals showed high BCS,

Stabled horses were housed in individual stalls with wood shavings bedding and individual drinking trough. Their diet consisted of green forage and commercial concentrate feed (2 Kg/d/animal), or green forage, concentrate feed, and hay. The grazing animals were fed grass and were not supplemented with concentrate feed in any of the cases.

Esophagus-gastro-duodenoscopy

Endoscopy of the anterior digestive tract was performed after a fast of 12 and 4 hours for solid and liquid foods, respectively. Sedation was performed with 10% xylazine (Anased®, Lloyd Laboratories, Iowa, USA; 0.5mg/Kg/IV). Subsequently, the endoscopy was performed using a 300 cm long and 12 mm external diameter video endoscope (PortaScope®, 1800PVS, Bradenton, FL, USA). Macroscopic findings were recorded by number and severity of lesions according to MacAllister *et al.* (1997).

The endoscopic procedure began with the examination of the pharynx, followed by the esophagus. Air and water insufflation was used to allow examination of the oesophageal and gastric mucosae. The entire stomach was examined as previously described (Murray and Grodinsky, 1989; Murray, 2002; Aranzales *et al.*, 2012; Martinez *et al.,* 2015). In some cases, it was possible to enter the first portion of the duodenum (73% approximately).

Biopsies of the gastric mucosa were taken through the insertion of a flexible clamp. Biopsies of approximately 3×3 mm were obtained using gastroscopy biopsy forceps (PortaScope®, 1800PVS, Bradenton, FL, USA) from the gastric squamous mucosa (blind sac), *margo plicatus* (MP; major curvature), glandular mucosa (fundus), and pyloric antrum for histopathological analysis.

Histopathology

Samples were fixed with 10% formalin buffer solution, processed according to conventional paraffin inclusion techniques, and cut to 5 µm. Samples were stained with hematoxylin and eosin (H & E) and Wright-Giemsa special staining. The lesions were categorized according to Martineau *et al.* (2009).

Surveys

Anamnesis and management information of each animal was obtained through surveys, in forms previously elaborated using Microsoft Access® 2013 software. The variables included in the study, obtained through the survey and endoscopic evaluation, are presented in Table 1.

Table 1. Study variables and categories.

1. Individual description

a. Age (years)

b. Breed

c. Sex

d. Calculated body weight (Kg)

e. Physiological condition

Non-pregnant mare

Pregnant mare

Stallion

Gelding

f. Body condition score (Hennecke *et al.,* 1983)

g. Clinical exam findings

2. Medical record

a. Last colic developed

Pharmacologically solved

Recidivant

Surgically solved

b. Use of NSAIDs

c. Last NSAIDs treatment (duration)

3. Training (physical activity)

a. Training frequency (times per day)

b. Training frequency (times per week)

c. Horse use

Riding

Education

Reproduction

Police patrol

Resting

d. Training frequency (hours per training)

e. Duration of stabling

4. Feeding

a. Diet

Green forage

Green forage + concentrated feed

Green forage + concentrated feed + hay

b. Portion per day

c. Supplement supply

d. Water disposition (*Ad libitum*/by portion)

e. Water supply mechanism

f. Concentrated feed supply (Kg/d)

5. Gastric lesions categorization

a. Squamous mucosa

b. Glandular mucosa

c. *Margo plicatus*

d. Pyloric antrum

e. Macroscopic findings

6. Histopathology

a. By Martineau *et al.* (2009)

Statistical analysis

Descriptive statistics were performed for age, breed, sex, type of physical activity, histopathology, and categorization of stomach ulcerative lesions using Microsoft Excel® 2013.

Variables were re-categorized and subsequently subjected to association analysis to determine the factors associated with presentation of disease grade ≥ 2 (regarding severity) in each stomach portion, according to the category adopted. This analysis was performed with STATA 12® software. For the construction of the cross tables it was taken into account that when all expected values were greater than five observations, a Chi-square test was performed. In contrast, if at least one of the boxes had five or less expected values, Fisher's exact test was performed. The variables for characterization, physical activity, and feeding groups were analyzed by logistic regression analysis, considering as a response variable the presence of ulcerative lesions grade ≥ 2 (regarding severity) in each stomach portion. Animals were divided into clusters to determine risk within groups of individuals from the same geographical

location. The STATA 12® software was used to perform this analysis.

Results

Esophagus-gastro-duodenoscopy

The frequency of EGUS in the population was 69%. In the stabled animals, a wide variety of lesions were found at endoscopy, with gastritis being the most frequent finding (36%), followed by hyperkeratosis of the MP (25%), and hyperemia of this same region (17%). Other lesions found in other gastric regions are described in Table 2, some of which corresponded to superficial lesions of the pyloric antrum (Figure 1) or severe ulceration in the MP (Figure 2). For grazing animals, 49% of observations were absent. Within the lesions found in this group of animals, MP hyperkeratosis was the most common (38%; Table 2). During endoscopy, no lesions affecting the esophagus were observed.

Table 2. Frequency of ulcerative lesions, according to gastric portion and setting.

	Gastric portion	N	Affected horses	%	LD
General	At least one gastric portion involved	103	71	69	-
Gastric portion (studied population)	Sq. mucosa				
	MP	103	23	22.3	-
	Gland. mucosa	102	40	39.2	1
	PA	103	19	18.6	-
		76	23	30.3	27
Grazing animals	Sq. mucosa	45	4	8	-
	MP	45	22	48.8	-
	Gland. mucosa	45	7	15.5	-
	PA	31	11	35.5	14
Stabled animals	Sq. mucosa	58	19	32.7	-
	MP	57	18	31.6	1
	Gland. mucosa	58	12	21	-
	PA	45	12	37.5	13

Sq. mucosa: Squamous mucosa; MP: *Margo plicatus*; Gland. Mucosa: Glandular mucosa; PA: Pyloric antrum; LD: Lost data.
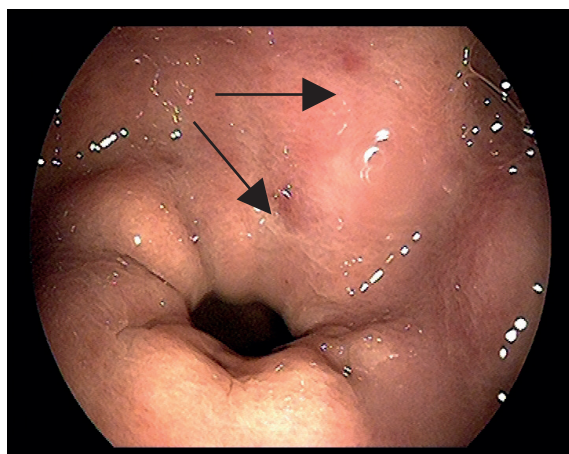

Figure 1. Endoscopic image of an equine pylorus evaluated in the study. Evidence of localized hyperemic lesions (arrows). Category 1/5 (regarding severity) according to MacAllister *et al.* (1997).

Figure 2. Endoscopic image of MP (minor curvature) of a studied equine. Evidence of localized ulcerative lesions. Category 5/5 (regarding severity) according to MacAllister *et al.* (1997).

Histopathology

The severity of microscopically evident lesions did not strictly reflect macroscopic findings (gastroscopy). A similar result was found when comparing the histopathological diagnosis, the presence of leukocyte infiltrate, and the macroscopic evaluation of each horse and gastric portion.

When histopathological diagnoses were compared with gastroscopy findings, stomachs categorized with lesions ≥ 2 (regarding severity) did not show histological lesions in most cases; in contrast to stomachs whose macroscopic category did not exceed grade 1, for which the number of abnormal histopathological findings was notorious.

Association analysis and logistic regression

In the univariate analysis, the "concentrate feed supply" variable was associated with presentation of ulcerative lesions of ≥ 2 (regarding severity) in the MP (p = 0.032). In the correlation analysis, variables "sex" and "physiological condition" behaved in a similar way (r = 0.95). Therefore, "physiological condition" was chosen to conduct the logistic regression analysis.

When the variables of interest and their effect on EGUS appearance in the glandular mucosa were evaluated, horse use and BCS were candidates to become associated factors (when p-value were <0.25). In the multivariate analysis for EGUS in glandular mucosa and these two significant variables, BCS continued to be significant (horse use OR = 2.35, p = 0.085, CI(OR) = 0.888-6.233; BCS OR = 30, p = 0.025, CI(OR) = 1.525-590.44).

Diet was associated with presentation of ulcerative lesions grade ≥ 2 (regarding severity) in the squamous mucosa. When the risk of developing EGUS in squamous mucosa according to type of diet was evaluated in detail, green forage and concentrate feed consumption were significantly associated with diets that only included forage or added hay (OR = 29.3; p = 0.003; CI(OR) = 3.14-274.2).

Regarding ulcerative lesions of clinical importance located in the MP, BCS and diet were associated factors. Diet influenced the appearance of ulcerative lesions in the MP. Compared to only-green forage consumption, those containing concentrate feed promoted the appearance of ulcerative lesions grade ≥ 2 (regarding severity) in the MP, with a higher risk of developing in animals that were not fed hay or only-green forage. No relationship was found between the variables described and the appearance of ulcers grade ≥ 2 (regarding severity) in the pyloric antrum.

Discussion

This study illustrates EGUS frequency in the horse population of Medellín and near municipalities. Information about the syndrome is scarce for this region, so these results can be useful for the clinical routine of veterinary doctors in the area.

Several variables were not used in the statistical analysis because of lack of information from the animal caregivers. They included "medication and medical history", "frequency of physical activity", "duration of physical activity", and "supply of supplements". In addition, "number of rations per day" was the same (three rations) for all stabled animals. "Clinical examination findings" and "weight" were used to establish the feasibility of sedation and subsequent gastroscopic evaluation.

The 10% xylazine sedation protocol was effective in all gastroscopic studies, once it allowed the animals to stay in quadruple-station, without adverse effects before, during or after the test. This shows that xylazine -which is easier to get in Colombia- can replace detomidine -a sedative used in similar studies (Zuluaga, 2016).

The fasting period coincided with the literature (Murray, 2002). However, some animals required more time and even gastric lavage prior to gastroscopy. This situation could interfere with the evaluation of the gastric surface, leading to loss of important information for the statistical analysis. In addition, it implies not conducting gastroscopy in patients for which it could be medically relevant.

The most severe ulcers were found adjacent to the MP, as reported in the literature (Murray and Eichorn, 1996; MacAllister *et al.,* 1997; Camacho

and Andrews, 2015). Ulcerative lesions of the squamous mucosa were also common. Although EGUS frequency in the MP was higher for grazing animals, it should be noted that it did not exceed grade 2 (regarding severity), while some of the MP lesions in stabled animals were categorized as grade 4 (regarding severity).

Gastric ulcers grade 2 or greater (regarding severity) involved loss of mucosal layer of the stomach. This led to muscle tissue exposure, which does not endure the chemical irritation caused by gastric juice and duodenal reflux, leading to potential loss of muscle tissue and predisposing the stomach to gastric rupture. For these reasons, gastric lesions graded ≥ 2 were considered of clinical relevance.

Gastric lesion frequency differed from similar studies. This could be explained by the occasional difficulty to evaluate the most caudal portion of the stomach (glandular mucosa and pyloric antrum), generating incomplete evaluations, thus underestimating the frequency. Luthersson *et al.* (2011) found that 54.6% gastric ulcers were grade ≥ 2 in the glandular mucosa. In contrast, the present study found that 48.9% of gastric lesions were located in the glandular mucosa and pyloric antrum, regardless of the severity. Although both frequencies do not correspond to the same degree of damage according to their severity, this finding accounts for a remarkable involvement of EGUS in these portions of the stomach, differing from literature reports.

Comparison of frequencies among studies is difficult since categorization systems differ. A detailed system was used in the present study; therefore, the information became dense for the statistical analysis. This system can be useful for research studies, but complex for routine clinical evaluations. Simpler systems for determining the extent, intensity, and characteristics of ulcerative lesions are preferred in clinical cases.

A study on horses destined to teaching university sports found 11% frequency of ulcerative lesions on squamous mucosa and found that age and sex are significantly associated factors (Chameroy *et al.,* 2006). In contrast, the present study found 22.3% lesions on squamous mucosa and 39.2% on MP, with

no association between sex and squamous mucosa lesions (p = 0.522, according to Fisher's test) or MP (p = 0.157, according to Chi-square test).

Similar to this work, a Danish study applied a linear logistic regression model to explore the factors that could explain EGUS occurrence in a group of non-active athletic horses. In agreement with the present work, they found that diet was the most notable factor for EGUS presentation in the squamous mucosa (Luthersson *et al.,* 2009b; Luthersson and Nielsen, 2009). It should be noted that both studies used the same case criterion and the same rating scale for gastric lesions, making this finding comparable.

Consumption of concentrate feed in horses is considered a predisposing factor for gastric ulceration since it is related to high and constant levels of blood gastrin, and because it contains high amounts of non-structural carbohydrates. As concentrate can ferment in the stomach, high levels of volatile fatty acids (VFA) decrease gastric pH, leading to ulceration (Andrews *et al.,* 2005). Risk of developing gastric ulcer ≥ 2 (regarding severity) on the squamous mucosa was higher for animals eating concentrate compared to horses consuming only green forage. Feeding hay instead of concentrate can prevent ulcer development in horses (Nadeau *et al.,* 2000). This can be due to higher production of saliva, stimulated by chewing fibrous food (hay), which acts as a buffer in the stomach (Merritt, 1999).

Changes in VFA proportions —which decrease gastric pH, are ulcerogenic by altering sodium transport from cells in the gastric epithelium and causing edema (Nadeau *et al.,* 2000). Bile salts of duodenal reflux also participate in the electrolytic homeostasis, contributing to the appearance of ulcers in the gastric squamous epithelium (Berschneider *et al.,* 2010). Duodenal reflux was observed in the pyloric antrum of all individuals, in some cases in amounts that made it difficult to observe the glandular mucosa and the pyloric antrum. Some lost data from this region were recorded in Table 2. This latent ulcerogenesis mechanism could have been present in this study.

Future studies should pay detailed attention to the diet, since some horses consumed additional feedstuffs

to those reported by the owners (evidenced during endoscopy). In particular, carrot supplementation should be considered because of its high calcium level, which is protective for the squamous mucosa (Nadeau *et al.*, 2000; Andrews *et al.*, 2005; Crayg, 2007; Reese and Andrews, 2009; Videla and Andrews, 2009).

Fasting can predispose to EGUS because horses constantly secrete HCl and bile salts (Murray and Eichorn, 1996). Some experimental models have used prolonged fasting periods and NSAIDs to produce gastric ulcers (Martínez *et al.,* 2015; Zuluaga *et al.*, 2016), suggesting that both act synergistically. HCl in the presence of bile salts together with depletion of cytoprotective mechanisms derived from prostaglandins and increased oxidative stress can cause permanent damage to the mucosa. Although we did not evaluate the effects of fasting on gastric ulcers, 8-h intervals between rations are common for stabled horses, while grazing horses did not suffer from such restrictions. This reflects the lower prevalence and variety of ulcerative lesions in grazing horses.

The fasting stomach can collapse bringing the squamous mucosa and pyloric antrum (with its enzyme-rich gastroduodenal reflux) in close contact. As the gastroduodenal reflux is influenced by duodenal motility, diet and other chemical and nervous conditions affecting duodenum peristalsis should be evaluated (Merritt, 1999). Gastric emptying time also deserves attention, since factors such as exercise can slow it down, facilitating the appearance of ulcerative lesions (Camacho and Andrews, 2015). Unfortunately, we did not study the possible relationship between physical activity and EGUS due to lack of reliable information, as mentioned above.

A mechanical effect observed in high-performance athletic horses is the increase of abdominal pressure during physical activity, rising the gastric filling line and EGUS frequency in the squamous region of the gastric mucosa (Lorenzo-Figueras *et al.,* 2002). The low frequency of ulcerations observed in the present study compared to the literature was possibly due to the type of activity of the animals. However, this frequency was higher than that reported for horses performing recreation, show, and police patrol activities (McClure *et al.,* 1999; Wiedner *et al.,* 2008; Martínez *et al.,* 2014). This indicates the need to evaluate factors such as breed and type/intensity of exercise in the horses under investigation.

The BCS was associated with ulcerative lesions of glandular mucosa (p = 0.025). This relationship could be explained because EGUS induces weight loss through gastro-enteropathy with loss of proteins. Although no factors were associated with ulcerative lesions in the pyloric antrum, it should be taken into account that NSAIDs usage was not considered in the present study. In contrast, correlation between clinical signs and ulcer intensity is variable (Murray and Grodinsky, 1989), therefore, the clinical manifestation may be absent.

In agreement with Al-mokaddem *et al.* (2015), the most important finding was MP hyperkeratosis. Additionally, microscopic examination of the squamous portion revealed acanthosis with "nailing" through to the *lamina propia*, as well as vacuolar degeneration (Al-mokaddem *et al.,* 2015). In contrast to other studies, no evidence of erosion and ulceration was found for histological sections, probably because we did not perform multiple biopsies of each gastric portion.

Differing from findings by Al-mokaddem *et al.* (2015), no leukocyte infiltrate in the squamous mucosa was observed. However, 50% of the glandular mucosa fragments showed some type of leukocyte infiltrate compatible with chronic (mononuclear) inflammatory processes, a figure similar to that found in Egyptian donkeys (49%; Al-Mokaddem *et al.*, 2015). Evidently, histological findings and macroscopic lesions did not show correspondence. Some fragments with no abnormal findings corresponded to gastric portions that were macroscopically slightly/severely injured. On the contrary, portions not showing serious lesions at endoscopy had histological findings corresponding to degenerative or inflammatory processes (Figure 3). This coincides with Pietra *et al.* (2010), who reported a correlation between microscopic findings of tissue damage and the appearance of pro-inflammatory cytokines, a correlation that was not repeated with the macroscopic diagnosis of EGUS. This suggests that, although there is macroscopically evidence of EGUS, pre-ulcerous lesions —when analyzed early, could indicate proximal damage to the epithelium and appearance of gastric lesions.
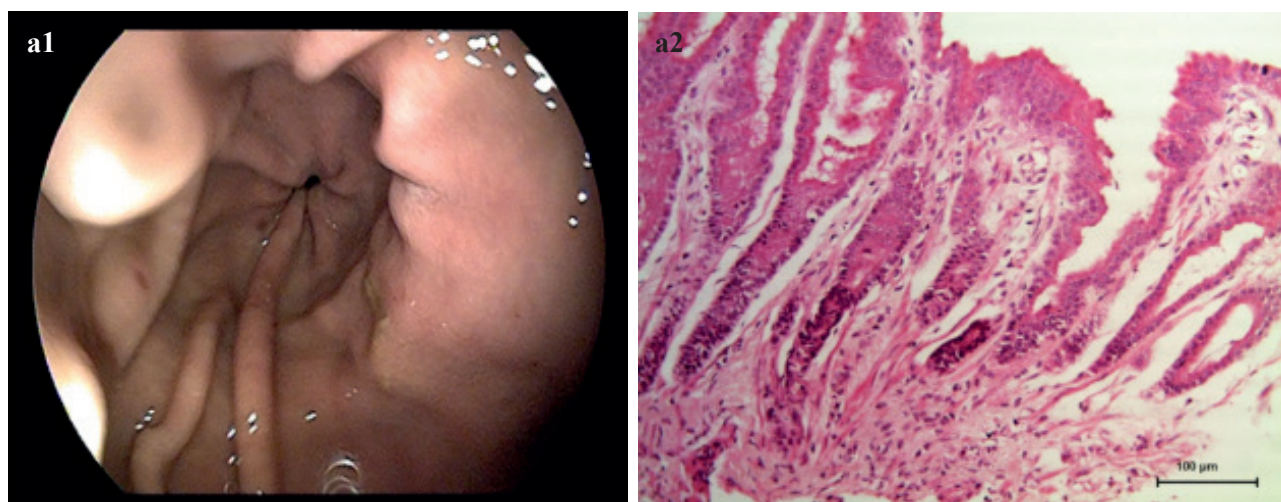
Figure 3. Endoscopic image of the equine stomach and histological section of a gastric biopsy. a1. The pyloric antrum evidences grade 1/5 lesions (regarding severity). a2. Microphotography of a fragment of pyloric antrum of a1, where glandular hyperplasia and lymphocytic infiltrate are evident.

Not all samples were subjected to histopathological evaluation because only a few were suitable for paraffin fixation, once the size of the biopsy forceps did not exceed 3 mm and the nature of the tissue did not allow its processing.

Different from other studies (Al-Mokaddem *et al.,* 2015), no gastric parasites were found. This was possibly due to the use of different exploration methods, conduction of euthanasia, and removal of the organ, facilitating a more detailed inspection. This situation should be considered as a limitation of the gastroscopic evaluation described in equines (Rodríguez *et al.,* 2009). Additionally, antiparasites are frequently used in this region to maintain adequate BCS. This could be associated with the absence of gastric parasites in these animals.

The limitations already described in this paper, such as a new categorization and separation of gastric mucosal diseases suggested by the European consensus (Sykes *et al*., 2015; Monki *et al.,* 2016) should be applied in future studies.

Acknowledgments

Conflicts of interest

The authors declare they have no conflicts of interest with regard to the work presented in this report.

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