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Is a 12-hour fasting period sufficient to complete gastric emptying in horses?

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Summary: Up to now there is no standard protocol to prepare a horse for a gastroscopy. Therefore, the aim of the study was to find out whether a fasting period of 12 hours prior to gastroscopy would be sufficient for a complete emptying of a horse's stomach that allows a good visualisation of all gastric regions. Another aim was to measure the size of the stomach at ultrasonography by counting the intercostal spaces and investigate whether a sonographically large stomach prior to fasting influences the emptying of the stomach. The study was divided in two parts. In part 1, 10 horses belonging to the Institute of Animal Nutrition, Nutrition Diseases and Dietetics of the Faculty of Veterinary Medicine at the University of Leipzig, Germany, were examined four times, three weeks apart. Part 2 of the study included a total of 50 horses that were referred to the Equine Clinic Destedt GmbH and divided into two groups. Group A consisted of 34 of the 50 horses that had an empty stomach after 12 hours of fasting. Group B consisted of the other 16 horses that did not empty their stomachs within the fasting period of 12 hours. Transabdominal ultrasonography was performed on the left side of each horse 12 hours before gastroscopy, thus, at the beginning of the fasting period. The size of the stomach was determined by counting intercostal spaces where the stomach was visible at ultrasonography. The horses underwent gastroscopy after 12 hours of fasting. Gastroscopy was used to determine whether the stomach was empty or not. The stomach was declared empty if small and large curvature, margo plicatus, antrum pylori and pylorus could be visualised properly. In part 1, only one horse's stomach could not be properly examined once due to ingestion of faeces. In part 2 of the study, including 50 horses, a 12-hour fasting period led to sufficient emptying of the stomach in 68% of horses (group A). The stomachs of the remaining 16 horses (group B) were either filled with liquid (2 horses) or solid content (13 horses); one horse had residual food particles sticking to the mucosa. In part 1 (n = 10), the median size of the stomach was eight intercostal spaces (min: 4; max: 12). There is a need for more research to define the range of the size of the equine stomach because the size of stomachs that were measured in this study was larger than in recent studies. Additionally, the diagnosis of delayed stomach emptying should not depend on only one examination but should be repeated at least a second time. The median size of the stomach prior to fasting in part 2 of the study (n = 50) was seven intercostal spaces (min: 2; max: 12) in both group A and B. There was no correlation between the stomach size and delayed gastric emptying.

Keywords: stomach, equine, horses, gastroscopy, ultrasonography, fasting period, stomach emptying, stomach size

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Introduction

Gastric disorders are a very common condition in horses. Among other pathological alterations, gastric ulceration in both the squamous and glandular mucosa is a frequent condition in horses (*Murray* et al. 1989, *Murray* and *Eichorn* 1996, *Sykes* and *Jokisalo* 2014). Gastric pain has also been associated with poor performance in horses (*Sykes* et al. 2015), with a prevalence between 11 and 100% depending on the breed, type of exercise, training and localisation of the lesions (*Gehlen* et al. 2019). Gastric ulcerations may cause little or even no clinical symptoms (*Gehlen* et al. 2019) but frequently cause recurrent or acute colic episodes (*Murray* et al. 1989). This is one of the reasons why gastroscopy has become a standard procedure in equine medicine to investigate the stomach as no other method provides a precise status of the gastric mucosa of all regions. The prevalence of up to 58% erosions or ulcers in the antrum or pylorus (*Murray* et al. 2001) shows the importance of a complete emptying of the stomach, as even a small amount of residual food can make it difficult to enter and examine the pyloric antrum (*Sykes* and *Jokisalo* 2014). Nevertheless, there is no standard protocol for preparing a horse for gastroscopy. The duration of fasting before the gastroscopic examination varies greatly in different equine clinics. Horses undergo a dietary restriction between 6 and 23 hours (*Murray* et al. 2001, *Loftin* et al. 2017, *Gehlen* et al. 2019). *Sykes* and *Jokisalo* (2014) suggested that the duration of fasting depends on the horse's exercise and diet. These authors recommended a minimum of 16 hours for horses fed with a hay-based diet, whereas the duration of fasting for thoroughbred racehorses on high grain/low roughage diets appeared much shorter, with as little as 6–8 hours for complete gastric emptying (*Sykes* and *Jokisalo* 2014).

One aim of this study was to determine whether a 12-hour fasting period is sufficient to achieve complete gastric emptying in

order to establish a routine protocol for gastroscopic examination. Another aim was to evaluate whether a sonographically large stomach before the 12-hour fasting period has any clinical significance regarding gastric emptying disorders.

We hypothesized that a 12-hour fasting period leads to complete gastric emptying and, accordingly, horses that were not able to empty their stomachs entirely during this period might suffer from delayed gastric emptying.

Based on several clinical cases with gastric emptying disorders, we investigated whether the size of the stomach in a fed state in horses with gastric emptying disorders differed from horses with physiological gastric emptying.

Materials and methods

Animals

Part 1

A total of 10 Warmblood geldings aged from 8 to 24 years belonging to the Institute of Animal Nutrition, Nutrition Diseases and Dietetics of the Faculty of Veterinary Medicine at the University of Leipzig, Germany, were examined four times at intervals of three weeks to detect intraindividual differences and repeatability of the examination (Figure 1). The examination took place between October 2018 and December 2018. These 10 horses were clinically healthy. Each horse was starved in a box without bedding material and water was withheld in the last two hours before the gastroscopic examination. All experimental procedures were officially approved by the Leipzig District Government (No. TVV 45/18).

Part 2

A total of 50 horses (25 mares, 25 geldings) were referred to the Equine Clinic Destedt GmbH for further investigation of gastrointestinal problems and were examined between September 2018 and January 2021. The horses were of different breeds (43 Warmblood horses, 1 Haflinger, 1 Icelandic horse, 1 Frisian horse, 1 Pura Raza Española, 1 Quarter horse, 1 Rhenish German Coldblood and 1 German Riding Pony). The average age was 12 years (range 5–25 years). The horses were starved overnight in the clinic for a total of 12 hours with a muzzle. They were kept on their usual bedding material, either straw or shavings, and water was not withheld due to clinical routine. One horse of this group did not accept the muzzle and was placed in a box without bedding material.

A 12-hour period of feed restriction did not result in complete gastric emptying in 16 of the 50 horses. Based on these results, the group was divided into group A comprising horses in which a 12-hour fasting period was sufficient to empty the stomach completely and group B with horses in which a 12-hour fasting period was not sufficient to achieve adequate emptying of the stomach (Figure 1).

In addition, we compared the ultrasonographically measured size of the stomachs of both groups in a fed condition and determined whether a large stomach at ultrasound examination in a fed condition might be a sign of a gastric emptying disorder and could be used to diagnose delayed gastric emptying.

The reason for separating the study into two parts was to examine whether there is a difference in gastric emptying in clinically healthy horses (part 1) compared to horses with gastrointestinal disorders (part 2).

Chronological order of the examination

Each horse was examined by transabdominal ultrasonography immediately before the 12-hour fasting period. After 12 hours of fasting, gastroscopy was performed to determine whether a 12-hour fasting period was sufficient for the complete removal of feed from the stomach. The stomach was characterised as completely empty if the following regions were not covered and could be examined properly: the saccus caecus, greater and lesser curvature, margo plicatus, pyloric antrum and pylorus.

Ultrasound technique

An ultrasound technique was applied in the fed state to evaluate the size of the stomach by counting the intercostal spaces in which the stomach could be visualised ultrasonographically. Therefore, the left thoracic wall of the horse was sprayed with 90% isopropyl alcohol using a spray bottle to create an adequate contact with the transducer. The hair was not clipped as the horses in part 2 of the study were patients of the clinic and using alcohol provided adequate image quality. Although the latter was lower in adipose horses and horses with very thick and long hair, the stomach could be clearly visualised in all horses.

An Esaote® MyLabTM Delta with a 3.5 MHz convex probe was used for all transabdominal ultrasound examinations of the stomach in both part 1 and part 2. The viewing depth was set to 25 cm. The left thoracic wall was scanned from dorsal to ventral beginning in the 17th intercostal space and continuing cranially. The transducer was orientated slightly obliquely and transversely to the horse's trunk following the intercostal spac-

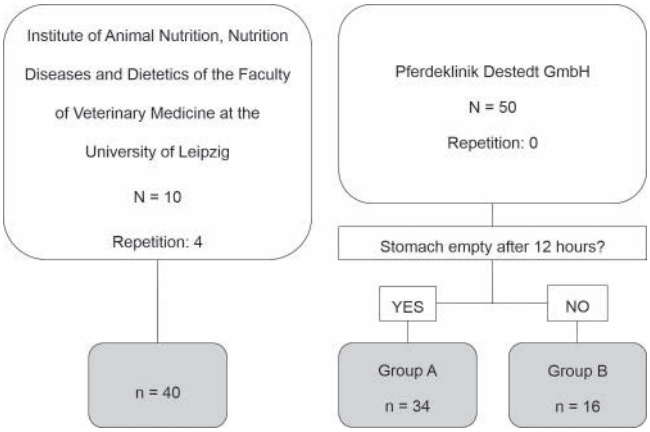

Fig. 1 Overview of the experimental horses. | *Übersicht über die Versuchspferde.*

es. Dorsal areas were located on the left side of the screen. Each intercostal space was examined from dorsal to ventral and the following anatomic structures were identified: lung, diaphragm, spleen, stomach and colon. The stomach wall was identified as a curvilinear hypoechoic line.

Gastroscopy

The horses were sedated with Butorphanol (Torbugesic® 10 mg/ml, Zoetis) and Detomidin (Detogesic® 10 mg/ml, Zoetis) in a dosage of 0.01–0.02 mg/kg bodyweight or Xylazine (Xylavet® 20 mg/ml, CP-Pharma) in a dosage of 0.6–1.0 mg/kg bodyweight for the gastroscopic examination. A nasogastric tube of 1 m length was inserted into either the left or right nostril after applying a nose twitch to the upper lip of the horse to prevent the gastroscope from potential damage. The stomachs of all horses in part 1 and part 2 of this study were examined with a 3 m flexible video endoscope 60130 PKS/NKS (Karl Storz GmbH & Co. KG, Tuttlingen). The endoscope was inserted through the nasogastric tube into the stomach and air was insufflated manually until the folds in the stomach wall crossed out. The stomach was declared empty if the saccus caecus, greater and lesser curvature, margo plicatus, pyloric antrum and pylorus could be examined.

Data Analysis

Data were analysed using descriptive methods. Data such as the stomach size were reported as medians with 1st and 75th percentile (25th and 75th percentiles). The η-coefficient was determined using SPSS. It was used as a non-parametric statistical test to determine the correlation between the size of the stomach and the results of the gastroscopy. P was calculated using a univariant ANOVA. SPSS was also used for the Mann–Whitney U test. Statistical tests were applied to compare the stomach emptying in dependence of stomach size. The level of significance was set at $P \leq 0.05$.

Results

12-hour fasting period

Part 1

The gastric emptying of all horses was complete after 12 hours of fasting at all four examinations, except once in one horse that had ingested faeces. Therefore, the gastric mucosa of this horse could not be examined completely because of sticking material. The nasogastric tube was placed and 6 litres of water were applied. The complete stomach could be examined two hours after the water application.

Part 2

A fasting period of 12 hours was sufficient for a complete gastric emptying in 34 of the 50 horses (68%), and the stomachs of those horses could be evaluated completely at gastroscopy (group A).

A 12-hour food restriction period did not result in an empty stomach in 16 of the 50 horses (group B).

The stomach in two of 16 horses was filled with liquid content and, therefore, the pylorus and parts of the small curvature could not be seen despite the air insufflation described above. In those horses, the stomachs could be examined completely after another two hours of fasting with the withdrawal of water. The stomach mucosa in 1 out of 16 horses could not be examined entirely because of small food particles that were attached to the mucosa which could not be rinsed away with water.

Thirteen horses in group B (n = 16 with incomplete gastric emptying) had a compact, ball-shaped filling of the stomach (Figure 2), due to which the stomach could not be examined properly. In these cases, water (4 to 8 litres, depending on the size of the horse) was administered through a nasogastric tube immediately after gastroscopy in order to accelerate further gastric emptying. The fasting period was prolonged for 4 hours and the horses were re-examined. The owner decided to interrupt fasting in 3 out of 13 horses. In 7 out of these 13, sufficient gastric emptying was achieved after a total of 16 hours of fasting. In 2 out of the 13, gastric emptying was achieved after another 24 hours of fasting. The stomach of one horse was not completely empty after 3 days of fasting. The examination was cancelled for welfare reasons and diagnosis of delayed gastric emptying was made.

Gastric lesions

Part 1

In part 1 of the study with a total of 10 horses in 4 examinations only 2,5% (1 out of 40) did not have any gastric lesions although they were clinically healthy. 47.5% (19 out of 40) did have lesions both in the glandularis and non glandularis region. 47,5% (19 out of 40) had lesions in the glandular mucosa and 2,5% (1 out of 40) had ulcerations in the non glandularis mucosa. In total the median score for lesions in the non glandularis mucosa was 0.5 (25th percentile = 0; 75th percentile = 1) with a maximum of 2. In the glandularis mu)

Fig. 2 Compact ball like content in a horse's stomach after a fasting period of 12 hours (group B) | *Kompakte ballartige Füllung eines Pferdemagens nach 12-stündiger Fastendauer (Gruppe B)*

cosa the score was 2 (25th percentile = 1; 75th percentile = 2) with a maximum score of 3 (Figure 3).

Part 2

Regardless of the degree of emptying, 98% of horses in part two (n = 50), except one (2%), had gastric mucosal lesions. In Group A (horses that emptied their stomachs within 12 hours) 53% (18 out of 34) had lesions in both non glandularis and glandularis. 35% (12 out of 34) had ulcerations in the glandularis and 9% (3 out of 34) in the non glandularis region. 3% (1 out of 34) did not have any lesions. The median score of all 34 horses' lesions was 1 (25th percentile = 0; 75th percentile = 2) with a maximum of 3. The median score of the glandular region was 2 (25th percentile = 1; 75th percentile = 2) with a maximum of 4. In Group B consisting of 16 horses, that did not empty their stomachs within 12 hours, the stomach of one horse could not be examined because of food residuals even after 3 days of fasting. As the mucosa could not be visualized the score could not be considered. 27% (4 out of 15) had lesions in both regions, 40% (6 out of 15) had lesions only in the glandular region of the stomach and the remaining 33% (5 out of 15) had gastric lesions in the non glandularis region. The median score of all 15 horses in the squamus region was 0 (25th percentile = 0; 75th percentile = 2) with a maximum of 3. The median score of the glandular region was 1 (25th percentile = 0; 75th percentile = 2) with a maximum of 2 (Figure 4).

Size of the stomach before fasting

The ultrasound examination was performed before the 12-hour fasting period.

The 10 horses' stomachs were examined 4 times in part 1. One horse's stomach was not completely empty in the second examination due to ingested faeces. The size of this horse's stomach was 11 intercostal spaces. The remaining 39 examinations resulted in a median of 8 intercostal spaces (25th percentile = 7; 75th percentile = 9) (Figure 5) regarding the stomach size. The results are shown in Figure 5 in order to compare the variation in stomach sizes in four examinations.

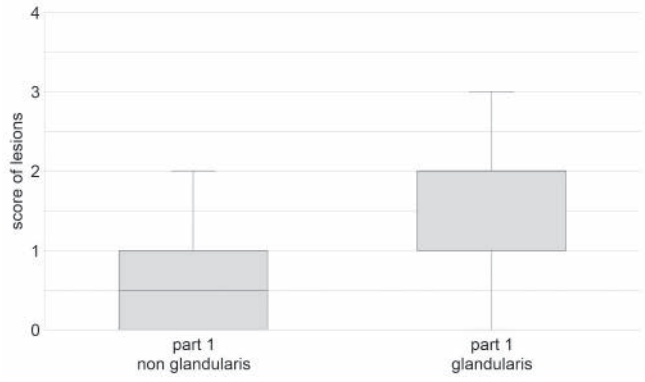

Fig. 3 Score of gastric lesions in all horses in part 1, separated by location of ulcerations: either pars non glandularis or pars glandularis. | *Score der Magenschleimhautläsionen aller Pferde in Teil 1, aufgeteilt nach Lokalisation des Ulcus: Pars nonglandularis oder Pars glandularis.*

The most cranial intercostal space where the stomach was visualised in part 1 was the 6th, and the most caudal intercostal space where the stomach could be visualised was the 17th. The coefficient of variation is shown in Table 1 in order to compare the individual variation in stomach size. In part 2 of the study, where 50 horses were examined, the median extension of the stomach in the fed state was 7 intercostal spaces (25th percentile = 5; 75th percentile = 8) (Figure6).

In group A, with horses with complete stomach emptying after a 12 hour fasting period, the median stomach extension before fasting was 7 intercostal spaces (25th percentile = 5; 75th percentile = 8.75) (Figure 6). The maximum number of intercostal spaces in this group was 10; the most cranial intercostal space in which the stomach was visualised was the 5th and the most caudal intercostal space was the 16th.

In group B, in which the horses were not able to empty their stomachs completely within 12 hours of food deprivation, the stomach extended over a median of 7 intercostal spaces (25th percentile = 4; 75th percentile = 8) (Figure 6). The maximum number of intercostal spaces in this group was 12, the most cranial intercostal space in which the stomach was displayed

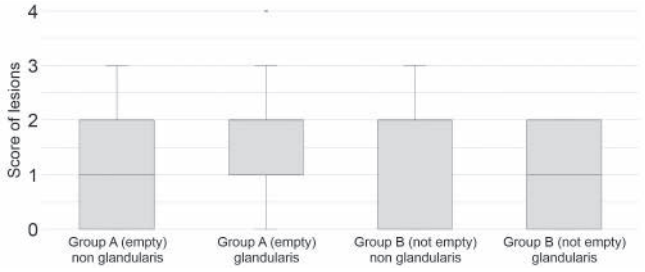

Fig. 4 Score of gastric lesions in all horses in part 2, separated by Group A and B and the location of ulcerations: either pars non glandularis or pars glandularis. | *Score der Magenschleimhautläsionen aller Pferde in Teil 2, aufgeteilt nach Zugehörigkeit zu Gruppe A bzw B und nach Lokalisation des Ulcus: Pars nonglandularis oder Pars glandularis.*

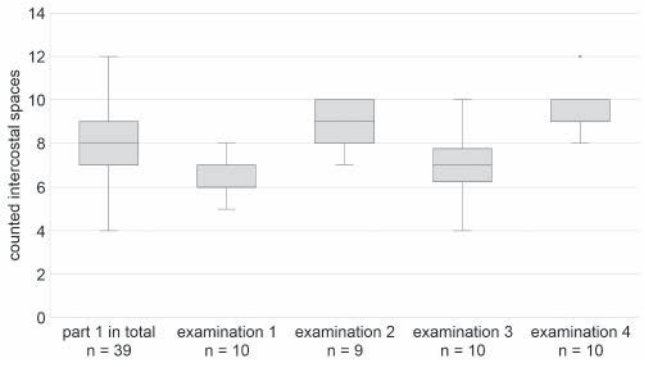

Fig. 5 Size of horses' stomachs in part 1 (10 horses, 4 examinations) measured by counting intercostal spaces at ultrasonography; the line in the boxplot represents the median; the limits of the boxplots represent the 25th and the 75th percentile; min and max are included as the end of the line above or below the boxplot; dots represent statistical outliers. | *Magengröße in Teil 1 (10 Pferde, 4 Wiederholungen), die Anhand des Zählens der Interkostalräume, in welchen der Magen ultrasonografisch darstellbar war, festgestellt wurde. Die Linie in der Kastengrafik repräsentiert den Median, die Begrenzungen stellen das 25. Und 75. Perzentil dar. Minimum und Maximum sind als Linie über beziehungsweise unter der Kastengrafik dargestellt, Punkte repräsentieren Ausreißer.*

was the 5th, and the most caudal intercostal space was the 17th.

The η-coefficient was used to test the correlation between the size of the stomach in part one of this study and the result in gastroscopy either empty or not. The η-coefficient equals 0.017. To test the significance, p was calculated using univariant ANOVA, P = 0.9. Therefore, there is no correlation between the stomach size and the filling state of the stomach after 12 hours of fasting.

The Mann-Whitney U test was calculated to test whether horses whose stomachs had not been empty were significantly bigger than horses that were able to empty their stomachs within 12 hours. The significance following the Mann-Whitney U test was P = 0.7. Therefore, horses that were not able to empty their stomachs within 12 hours did not have significantly larger stomachs than horses that were able to empty their stomachs.

Discussion

The function of gastric emptying is supposed to supply the duodenum with chyme at a rate and in a structure of the ingesta that optimises the digestion and absorption of nutrients and the transfer of the chyme to the large intestine for further digestion (*Wyse* 1999). Therefore, gastric emptying in horses has been examined with a variety of techniques (*Doherty* et al. 1998, 1999, *Lohmann* et al. 2000, *Sutton* et al. 2003). The effect of various drugs on gastric emptying has also been tested in horses (*Ringger* et al. 1996). Nevertheless, it is difficult to predict the time of complete gastric emptying as several factors, such as the composition of the food and the type of the meal, affect stomach emptying (*Wyse* 1999). Gastric emptying was reported to be significantly faster for horses consuming a meal lower in starch than one with a high starch content (*Métayer* et al. 2004). Apart from the amount of starch, several other factors have been discussed to affect stomach emptying, for example fibre intake, particle size or caloric content (*Read* et al. 1989, *Métayer* et al. 2004). *Argenzio* et al. (1974) compared gastric emptying in ponies depending on the particle size. These authors used polyethylene glycol as a marker for fluid passage and particulate markers prepared from radiopaque polyethylene tubes that were cut into different lengths to survey the gastric emptying of different particle sizes. The gastric emptying of liquids in horses is faster than solids. Liquids left the stomach rapidly, 75% of the liquid marker had reached the caecum within 2 hours, whereas longer particle markers remained in the stomach for a longer time period (*Argenzio* et al. 1974).

In the current study, 13 out of 50 horses, whose stomachs had not been completely empty after a fasting period of 12 hours, were suspected of having delayed gastric emptying because of the ball-like content detected at gastroscopy. Two out of 50 horses whose stomachs could not be examined completely due to fluid in the stomach might have consumed water immediately before the gastroscopic examination. These horses were examined completely after another 2 hours of starvation without access to water. Although food deprivation seems to decrease the water consumption (*Freeman* et al. 2020), withdrawal of water in the last 2–4 hours before a gastroscopic examination is recommended (*Kihurani* et al. 2009, *Loftin* et al. 2017). This recommendation is supported by the observation that a liquid filling of the stomach was not a problem in all four examinations in the 10 horses in part 1 of the study, where water was withheld in the last 2 hours before gastroscopic examination. However, considering the short period of 2 hours to empty 75% of the water in the stomach (*Argenzio* et al. 1974), longer withdrawal of water should be avoided.

In one horse in group B (horses that are not capable of emptying their stomachs in a 12 hour fasting period) with residual food particles attached to the mucosa, that could not be rinsed away with water, we hypothesize that this condition might be due to an insufficient mucus production or mucus of insufficient quality. A gastric emptying disorder cannot be as-

Table 1 Size of horses' stomachs in part 2 measured by the intercostal spaces counted and the coefficient of variation in %. | *Magengröße in Teil 2, gemessen anhand der gezählten Interkostalräume und deren Variationskoeffizient in %.*

	examination 1	examination 2	examination 3	examination 4	coefficient of variation (%)
horse 1	5	6	7	9	21.91
horse 2	7	8	10	9	13.15
horse 3	8	9	4	10	29.39
horse 4	6	7	7	10	20.00
horse 5	7	8	6	0	59.29
horse 6	6	7	6	9	17.50
horse 7	6	7	8	9	14.91
horse 8	6	7	7	9	15.03
horse 9	5	6	7	8	17.20
horse 10	8	9	10	12	15.17

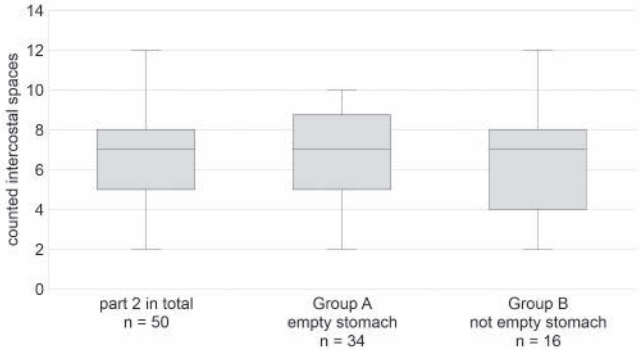

Fig. 6 Comparison of group A and B (part 2) regarding the size of the horses' stomachs measured by counting the intercostal spaces at ultrasonography; the line in the boxplot represents the median; the limits of the boxplots represent the 25th and the 75th percentile; min and max are included as the end of the line above or below the boxplot; dots represent statistical outliers. | *Vergleich von Gruppe A und B (Teil 2) anhand der Magengröße, die Anhand des Zählens der Interkostalräume, in welchen der Magen ultrasonografisch darstellbar war, festgestellt wurde. Die Linie in der Kastengrafik repräsentiert den Median, die Begrenzungen stellen das 25. Und 75. Perzentil dar. Minimum und Maximum sind als Linie über beziehungsweise unter der Kastengrafik dargestellt, Punkte repräsentieren Ausreiser.*

sumed here either because the motor function of the stomach was undisturbed in this horse.

Nevertheless, considering our classification of an empty stomach, those three horses (two with liquid filling and one with feed particles attached to the mucosa) could not be examined properly.

In our study, 26% (13 out of 50) of horses showed a delay in gastric emptying. If it is assumed that 12 hours are sufficient for physiological gastric emptying. There are some case reports describing the symptoms and possible treatment options for gastric impaction and dilatation (*Müller* et al. 1995, *Vainio* et al. 2011, *Bird* et al. 2012, *Klier* et al. 2017, *Bäuerlein* et al. 2019). Cases of gastric dilatation are mostly diagnosed in advanced stages (*Klier* et al. 2017) and more research needs to be done to fully understand the causes that lead to chronic gastric distension and detect gastric dilatation and gastric emptying disorders at an earlier stage.

Part 1 of the study, including 10 horses in 4 examinations showed the intraindividual repeatability of the gastric emptying. Although the stomachs were of a large size in a fed state (8 intercostal spaces on average and up to 12 intercostal spaces individually), all stomachs were completely empty after 12 hours of fasting. Different sizes of horse stomachs have been described when visualised by transabdominal sonography: the stomach, for example, between the 8th and 13th intercostal space (*Desrochers* 2005), over a total mean of 5.1 ± 0.9 intercostal spaces from the 8th to the 15th intercostal space (*Epstein* et al. 2008) or between the 9th and 12th intercostal spaces (*Holcombe* 2003). In the current study, the ultrasonographically measured size of the stomachs in a fed state differed significantly from other studies. The average stomach size in part 2 of this study was visualised over 6.7 intercostal spaces and the mean stomach size in part 1 was seen over 7.8 intercostal spaces. Some authors assumed that the maximum expansion of the stomach should not exceed 5 intercostal spaces, as this is associated with gastric distension (*Reef* 1998a, *Desrochers* 2005, *Epstein* et al. 2008). However, according to our results and to *Le Jeune* and *Whitcomb* (2014), greater expansion are seen routinely in ultrasound examinations of patients without colic and without gastric emptying disorder as reported here. *Epstein* et al. (2008) suggested that there is a conformational difference in stomach size and location between horses and ponies. In ponies, the stomach was visualised over a greater number of intercostal spaces and more caudal than reported in normal horses (*Epstein* et al. 2008). Due to the fact that most studies regarding the size of the stomach were performed in healthy horses, there might be a difference between horses suffering from gastrointestinal issues compared to healthy horses. In part 2 of our study, we examined horses referred to the clinic for evaluation which were suspected of gastrointestinal disorders. There was no significant difference in the size of the stomachs of horses in group A (empty) and those in group B (not empty) in a fed state. Therefore, a gastric emptying disorder cannot be the cause of this difference in size compared to other studies. The fact that the horses in part 1 had an average size of 8 intercostal spaces, which is also larger than that described in other studies, and the horses were clinically healthy, might be due to a large forage intake combined with no exercise.

Although the 10 horses in part one of the study were clinically healthy, they all had gastric lesions except one horse in one examination. Nevertheless, they all had an empty stomach within 12 hours. In part two with horses that showed symptoms of gastrointestinal problems only 68% of horses were able to empty their stomachs. In both groups only one horse out of 50 did not have any gastric lesions. Therefore a fasting period of 12 hours should be sufficient before gastroscopy in healthy horses. But an extension of the fasting period should possibly be considered because under normal circumstances only horses with gastrointestinal problems undergo gastroscopic examination and only 68% of horses in part two, with horses that were referred because of gastrointestinal issues, were able to empty their stomachs within 12 hours. At least horses should undergo ultrasonographic examination prior to gastroscopy to check the filling state of the stomach. In addition, 2 hours of water restriction before gastroscopy is recommended. In the case of a longer time period of complete stomach emptying, a disorder of the gastric emptying can be suspected but the horse should be examined at least a second time for a final diagnosis of delayed gastric emptying.

Conflict of interest

The authors declare that there are no conflicts of interest.

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