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## Comparison of the effects of enteral psyllium, magnesium sulphate and their combination for removal of sand from the large colon of horses



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### ABSTRACT

Prospective studies documenting the efficacy and side effects of medical treatment for colonic sand accumulation in horses are limited. The purpose of the study was to compare the effect of enteral administration of magnesium sulphate (MgSO<sub>4</sub>), psyllium mucilloid (psyllium), and a combination of MgSO<sub>4</sub> and psyllium on the evacuation of large accumulations of sand in the large colon of adult horses. Thirty-four horses with naturally acquired, large sand accumulations (>5 cm × 15 cm) identified on abdominal radiography were randomly allocated to one of three treatment groups: (1) 1 g/kg psyllium (*n* = 12); (2) 1 g/kg MgSO<sub>4</sub> (*n* = 10), or (3) their combination (*n* = 12). Treatments were administered once a day via nasogastric intubation and continued for a total of 4 days. Lateral radiographs of the ventral abdomen were repeated on day 4 of treatment. If the area of sand in the radiographic image was <25 cm<sup>2</sup> on day 4, the sand accumulation was considered resolved.

Of 12 horses treated with a combination of psyllium and MgSO<sub>4</sub>, nine evacuated the sand from the ventral colon within 4 days. In comparison, only 3/12 horses treated with psyllium and 2/10 horses treated with MgSO<sub>4</sub> resolved (both significantly different from the combination; *P* < 0.05). Large accumulations of sand in the large colon of horses can be treated medically. Administering a combination of psyllium and MgSO<sub>4</sub> via nasogastric intubation once daily for a total of 4 days was a more effective treatment than either constituent alone.

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### Introduction

Accumulations of sand in the large colon of horses and colic related to them are common in many areas of the world (Kaneene et al., 1997; Husted et al., 2005; Hardy, 2008; Hart et al., 2013). Other problems associated with sand accumulations include chronic, intermittent diarrhoea, and weight loss (Jones, 2010; Hart et al., 2013).

Radiography can be used to confirm a diagnosis of large colon sand accumulation and to estimate the amount of sand present (Ruohoniemi et al., 2001; Kendall et al., 2008; Keppie et al., 2008). A radiographic study by Kendall et al. (2008) supported the use of radiography as an objective means of documenting clinically relevant accumulations of sand in the large colon. In their study, horses with colic attributed to sand had median sand accumulations of 9 × 26.5 cm compared with asymptomatic control horses that had much smaller (median 0.9 × 8.3 cm) accumulations. Furthermore,

radiography has been reported to be a useful means of monitoring the resolution of sand accumulations in clinical cases (Ruohoniemi et al., 2001; Hart et al., 2013).

Common medical treatments used for removal of large colon sand accumulations include psyllium mucilloid (psyllium), magnesium sulphate (MgSO<sub>4</sub>), mineral oil and their combinations (Colahan, 1987; Ruohoniemi et al., 2001; Hotwagner and Iben, 2008; Blikslager, 2010; Hart et al., 2013). However, prospective studies documenting their efficacy and side effects are limited. Psyllium is widely recommended at a dose varying from 0.5 to 1 g/kg, (Blikslager, 2010) despite the findings of one experimental study that failed to demonstrate any significant effect of psyllium treatment on the evacuation of sand from the colon (Hammock et al., 1998). In a later study, with no untreated control group, researchers were able to demonstrate increased faecal excretion of sand in experimental horses when psyllium was combined with mineral oil compared to oil alone (Hotwagner and Iben, 2008).

Other treatments such as MgSO<sub>4</sub> or dioctyl sodium succinate (DSS) have also been recommended (Colahan, 1987). When healthy horses (without administration of sand) were given water, MgSO<sub>4</sub>

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or DSS via nasogastric tube, each treatment increased faecal output, faecal water content and number of defecations, although a 1 g/kg dose of  $MgSO_4$  was most effective (Freeman et al., 1992).

Considering the apparent benefits of these treatments for removal of sand accumulations from the large colon of horses, a combination of  $MgSO_4$  with psyllium has been used to treat clinical cases (Ruohoniemi et al., 2001; Hart et al., 2013) but, despite its widespread use, the dosage regimen has not been established and there is no clear recommendation on how often or for how long treatments should be administered. Furthermore, to the best of our knowledge, no prospective, controlled clinical trials have been performed in horses with naturally occurring large colon sand accumulations to evaluate its efficacy or safety.

The aim of this clinical trial was to compare the efficacy of enteral administration of psyllium,  $MgSO_4$  and their combination for the removal of large colonic sand accumulations in horses, and to observe the possible adverse effects.

### Materials and methods

This clinical study was prospective and randomised. The study protocol and medications were approved by the Finnish Medicines Agency. The animal welfare in the study was evaluated and accepted by the ethical committee of the University of Helsinki. Informed consent from the owner, or the trainer acting as an agent for the owner, was obtained at the time of enrolment to the study.

The routine workup in our hospital involved a radiological examination of the abdomen for horses with a history of recurrent colic, weight loss, mild chronic diarrhoea or observed sand eating. The duration of the sand impaction was not known, so horses could not be categorised based on the length of the problem. Abdominal radiographs were taken before the first treatment. Horses were sedated with detomidine 10 µg/kg IV (Domosedan, Orion Pharma) for radiography if required. The cranioventral abdomen of the horse was radiographed using a right-to-left standing lateral view, with the cassette placed in a ceiling-mounted wall stand with a grid. Routine cassettes (Fujifilm IP cassette, type C, size 35.4 cm × 43 cm) were used. The distance between the horse and the radiography tube was 1.5 m. Radiographs were taken with a computed radiography system (Shimadzu UD150B-40) and viewed with a commercial programme (Jivex, VISUS Technology Transfer). The exposure settings for radiography were a maximum tube voltage and current of 131 kV and 80 mAs, respectively. The edges of the sand accumulation were drawn individually to each radiograph, and the area of sand in the two-dimensional radiograph was calculated using the software of the apparatus (Figs. 1a–d).

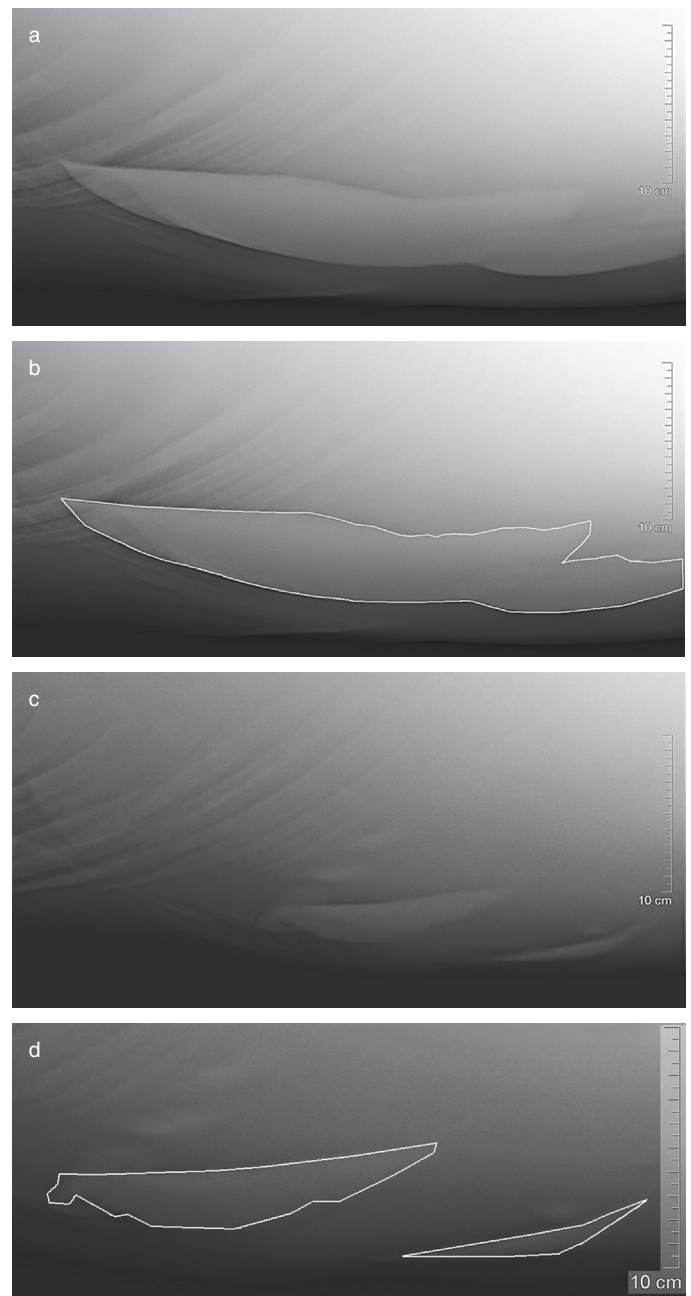
All radiographs were evaluated by the same observer (KN). Horses with large accumulations of sand in the large colon (minimum cross-sectional area 5 cm × 15 cm) identified on abdominal radiography were included in the study. Exclusion criteria were: (1) weight <300 kg, (2) signs of acute colic at the time of presentation, (3) administration of laxatives within the 24 h prior to commencement of the study or (4) serum magnesium concentration >1.20 mmol/L at the time of presentation.

Each included horse was randomly allocated to one of the three treatment groups: (1) 1 g/kg psyllium (Psyllium;  $n = 12$ ) (Laxamucil, Orion Pharma; Equilet Psyllium, Virbac); (2) 1 g/kg magnesium sulphate ( $MgSO_4$ ;  $n = 10$ ), and (3) 1 g/kg magnesium sulphate combined with 1 g/kg psyllium (Psyllium +  $MgSO_4$ ;  $n = 12$ ). Treating veterinarians were aware of which group each horse was assigned to. All medications were mixed with water (15 mL/kg), and were administered once a day (0800–1000 h) via nasogastric intubation and continued for a total of 4 days (i.e. four treatments). Water was available ad libitum and horses received a free choice of timothy hay, although this was withheld at the discretion of the treating veterinarian if signs of abdominal discomfort were observed.

All horses were housed in boxes with shavings during the study. The horses were allowed to go out to a concrete yard or were hand walked according to owner's preference. Monitoring included physical examination three times daily, haematology and determination of serum creatinine and magnesium on days 1 and 4. Horses were withdrawn from the study at any time if they (1) developed signs of acute colic or profuse diarrhoea, or (2) the owner elected to withdraw the horse from the study.

Abdominal radiographs were repeated on the afternoon of day 4. If the area of sand in the radiographic image was <25 cm<sup>2</sup> on day 4, the sand accumulation was categorised as resolved. Upon completion of the project owners took their horse home, or if needed, treatment was continued with the same treatment protocol or they were changed to a different treatment option at the treating veterinarian's discretion.

All radiographs were evaluated by one of the authors (KN) after completion of the study. Evaluation was not blinded. Only the area of sand accumulation was counted, but not the effect of possible magnification depending on which side of the abdomen the accumulation would be located. We considered differences between treatments to be clinically significant if 75% of the cases were resolved by day 4 with one treatment and 25% with another treatment. Using the 95% confidence interval



**Fig. 1.** (a and b) Abdominal radiograph of a horse before the treatment (a) and depicting measurement of the area of sand (b). (c and d) Same horse after 4 days of treatment with combination of psyllium and magnesium sulphate.

and a power of 80%, the patient number required per group was calculated at 11 for one-tailed and 13 for two-tailed analysis. As the data were not normally distributed, the differences between treatments were analysed with the Kruskal–Wallis and Mann–Whitney *U* test using SPSS (IBM Corporation) statistical software. Pearson's chi-squared test was used to compare the frequency of recovered horses between treatments on day four. A *P*-value of <0.05 was considered as statistically significant.

### Results

A total of 34 horses met the selection criteria and were included in the study. Detailed information on the patients and results is presented in Table 1. The area of the sand accumulation at the beginning of the treatment did not significantly differ between

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