

Predisposing factors for small colon impaction in horses and outcome of medical and surgical treatment: 44 cases (1999–2004)

Lisa M. Frederico, DVM; Samuel L. Jones, DVM, PhD, DACVIM; Anthony T. Blikslager, DVM, PhD, DACVS

Objective—To identify factors associated with development of small colon impaction in horses and with selection of medical versus surgical treatment and to determine the prognosis for affected horses following medical or surgical management.

Design—Retrospective case series.

Animals—44 horses with primary impaction of the small colon.

Procedures—Medical records were reviewed for signalment, history, clinical findings, treatment (medical vs surgical), hospitalization time, and outcome. For comparison purposes, the same information was collected for 83 horses with primary impaction of the large colon.

Results—Diarrhea was the only factor found to be associated with development of small colon impaction. Horses with small colon impaction were 10.8 times as likely to have diarrhea at the time of initial examination as were horses with large colon impaction. Abdominal distension was the only factor associated with use of surgical versus medical treatment. Horses with small colon impaction that were treated surgically were 5.2 times as likely to have had abdominal distension at the time of admission as were horses with small colon impaction that were treated medically. Overall, 21 of 23 (91%) horses treated medically and 20 of 21 (95%) horses treated surgically survived to discharge.

Conclusions and Clinical Relevance—Results suggest that diarrhea may be a risk factor for development of small colon impaction and that horses with small colon impaction that have abdominal distension at the time of initial examination are more likely to require surgical than medical treatment. (*J Am Vet Med Assoc* 2006;229:1612–1616)

Small colon impaction is one of the most common disorders of the small colon in horses, accounting for 34% of all cases of small colon disease,¹ yet only 2.5% of all horses with colic have small colon impaction. Because of the low incidence of small colon impaction, sparse and conflicting information exists regarding predisposing factors, the underlying pathogenesis, and the prognosis after medical or surgical treatment. One study,¹ for instance, found that ponies and American Miniature Horses were more likely to develop small colon impaction than were horses of other breeds, that females were more likely to develop small colon impaction than were males, and that yearling miniature

From the Department of Clinical Sciences, College of Veterinary Medicine, North Carolina State University, Raleigh, NC 27606. Address correspondence to Dr. Blikslager.

horses and ponies and horses > 15 years old were more likely to develop small colon impaction than were horses in other age groups. However, 2 other studies^{2,3} found no age, breed, or sex predilections among horses with diffuse impaction of the small colon.

Previous authors have speculated that poor dentition or decreased small colon motility may play a role in the pathogenesis of small colon impaction in older horses.¹ Consumption of bedding, foreign materials, and poor-quality feed has also been implicated as a potential causal factor.³ In addition, a significant seasonal distribution of cases has been identified,^{1,3} with most cases of small colon impaction seen at referral centers in the fall or early winter, suggesting a possible association with decreased water consumption. Colitis is often diagnosed concomitantly with impaction of the small colon, suggesting an association between these diseases; however, it is unknown whether small colon impaction leads to development of colitis or vice versa.

Previous reports also provide conflicting data on outcome after medical and surgical treatment. One study³ reported survival rates of 100% after medical management and 47% after surgical management of horses with small colon impaction, whereas another study² reported survival rates of 73% and 75%, respectively, after medical and surgical treatment of horses with small colon impaction.

The purposes of the study reported here, therefore, were to identify factors associated with development of small colon impaction in horses, identify factors associated with selection of medical versus surgical treatment in horses with small colon impaction, and determine the prognosis for affected horses following medical or surgical management.

Criteria for Selection of Cases

Medical records of the North Carolina State University Veterinary Teaching Hospital were searched to identify all horses evaluated because of signs of abdominal pain between 1999 and 2004. Horses in which small colon impaction had been diagnosed by means of palpation per rectum, exploratory celiotomy, or necropsy were included in the study. Horses were excluded from the study if small colon impaction was not the primary diagnosis, if signs of abdominal pain had not been apparent, if the horse had been admitted because of primary colitis, or if the horse had been admitted because of diarrhea without signs of abdominal pain. For comparison purposes, information was also obtained for horses in which large colon impaction had been diagnosed by means of palpation per rectum, abdominal ultrasonography, exploratory celiotomy, or necropsy.

Procedures

Data recorded for all cases included history; signalment; duration of colic prior to admission; treatment prior to admission; physical examination findings prior to and at the time of admission; whether the horse had diarrhea at the time of admission; whether medical or surgical treatment was administered and, for horses that underwent surgery, time from admission to surgery and surgical findings; time from admission to resolution of the impaction; outcome; and complications. Fever was defined as rectal temperature $\geq 38.3^{\circ}\text{C}$ (101.0°F). For horses treated medically, time of resolution of the impaction was defined as the time that the impaction could no longer be palpated per rectum. For horses treated surgically, time of resolution of the impaction was defined as the time of surgery. Short-term survival was defined as discharge from the hospital. Long-term survival was defined as survival at least 1 year after treatment for small colon impaction.

For all horses included in the study, information on the following environmental factors was also collected: activity level of the horse, types of hay and concentrates fed, deworming program, history of travel off the farm, type of terrain on which the horse grazed, whether the horse was turned out in a group, and time spent turned out each day. Information on dental problems, history of dental floating, and water source was not collected because this information was not consistently available in the medical records. Information on whether horses had diarrhea prior to examination at the Veterinary Teaching Hospital was obtained from the referring veterinarian, owner, trainer, or farm manager; therefore, the type of diarrhea could not be further defined. Following admission to the Veterinary Teaching Hospital, horses were considered to have diarrhea if they had > 2 bowel movements that were sufficiently liquid that most of the fecal material did not remain on the surface of the bedding.

Statistical analysis—Patient's age, time of onset of clinical signs, heart rate, respiratory rate, rectal temperature, and time from resolution of impaction to first feeding were compared between groups with the Student *t* test (for normally distributed data) or the rank sum test (for data that were not normally distributed). For comparison of the distribution of sex, breed, and horse use between groups, the χ^2 test was used. All analyses were performed with standard software^a; values of $P < 0.05$ were considered significant.

Logistic regression[†] was used to determine whether any demographic or clinical variables were associated with development of small colon impaction or the decision to use surgical versus medical treatment. For logistic regression analyses, variables were divided into 2 nominal groups. Continuous variables were categorized into nominal groupings on the basis of established normal values for the North Carolina State University Veterinary Teaching Hospital. Demographic factors and clinically derived values were grouped on the basis of perceived clinical relevance and hypotheses on the part of the investigators. Variables were initially subjected to univariate analyses. Those variables with an odds ratio > 1 were subse-

quently subjected to forward stepwise multiple logistic regression modeling. The resulting models were evaluated according to changes in the estimated SE of the maximum likelihood coefficients. Adjusted odds ratios and corresponding 95% confidence intervals were estimated from the maximum likelihood coefficients⁵ with a commercial software package.^a

Results

Forty-four cases of small colon impaction met the criteria for inclusion in the study. For comparison purposes, information was also obtained for 83 cases of large colon impaction. Horses in both groups had been referred to the Veterinary Teaching Hospital because of signs of mild or moderate abdominal pain that had not improved after medical treatment or because impaction warranting intensive fluid therapy that could not be performed at the farm had been diagnosed. None of the horses included in the study had been admitted for colitis and subsequently developed small colon impaction while hospitalized.

Of the 44 horses with small colon impaction, 20 (45%) were females, 19 (43%) were geldings, and 5 (11%) were sexually intact males. Of the 83 horses with large colon impaction, 40 (48%) were geldings, 37 (45%) were females, and 6 (7%) were sexually intact males. Sex distribution was not significantly different between groups. In addition, mean age of the horses with small colon impaction (mean \pm SD, 10.4 ± 6.5 years) was not significantly different from mean age (13.8 ± 6.5 years) of the horses with large colon impaction. The horses with small colon impaction included 20 Quarter Horses or American Paint Horses, 5 Thoroughbreds, and 19 horses of other breeds. Horses with large colon impaction included 28 Quarter Horses, 26 Thoroughbreds, and 29 horses of other breeds. Breed distribution was not significantly different between groups. Of the horses with small colon impaction, 11 were performance horses, 10 were pastured or used for pleasure riding, and 3 were used for breeding (use of the remaining 20 horses was not recorded). Of the horses with large colon impaction, 27 were performance horses, 33 were pastured or used for pleasure riding, and 2 were used for breeding (use of the remaining 21 horses was not recorded). Use distribution was not significantly different between groups.

Diarrhea was the only environmental or clinical factor found in univariate analyses to be significantly associated with small colon impaction (Table 1). Horses with small colon impaction were 10.8 times as likely to have diarrhea at the time of initial examination as were horses with large colon impaction.

For 19 of the 44 (43%) horses with small colon impaction, the diagnosis had been made by means of palpation per rectum prior to referral to the Veterinary Teaching Hospital. Of the 18 horses with small colon impaction that had diarrhea prior to referral, the diagnosis was made by means of palpation per rectum in 7 prior to referral.

For the 44 horses with small colon impaction, the diagnosis was made at the Veterinary Teaching Hospital by means of palpation per rectum in 35 (80%), exploratory celiotomy in 7 (16%), and necropsy in 2 (5%). For the 83 horses with large colon

Table 1—Results of univariate logistic regression analysis of factors potentially associated with small colon impaction in horses.

Variable	Category	No. (%) of horses with small colon impaction	No. (%) of horses with large colon impaction	OR	95% CI
Season	Sep–Feb	30 (68)	50 (60)	1.4	0.3–5.0
	Mar–Aug	14 (32)	33 (40)		
Diarrhea*	Yes	18 (41)	5 (6)	10.8	3.6–32.0
	No	26 (59)	78 (94)		
Use	Pleasure, pet, or breeding	13 (54)	36 (58)	1.2	0.4–3.0
	Show or racing	11 (46)	26 (42)		
Turned out in a group	Yes	3 (14)	7 (14)	1.0	0.2–4.1
	No	18 (86)	44 (86)		
Fever†	Yes	15 (34)	21 (27)	1.4	0.6–3.1
	No	29 (66)	56 (73)		
Travel off farm	Yes	7 (32)	20 (43)	0.6	0.2–1.8
	No	15 (68)	26 (57)		

Data represent information for 44 horses with small colon impaction and 83 horses with large colon impaction. For some variables, information for some horses was not available. The OR represents the odds that a horse with small colon impaction would have the factor of interest, compared with the odds that a horse with large colon impaction would.

*Diarrhea at the time of initial examination. †Rectal temperature $\geq 38.3^{\circ}\text{C}$ (101.0°F) at the time of initial examination.

OR = Odds ratio. CI = Confidence interval.

impaction, the diagnosis was made at the Veterinary Teaching Hospital by means of palpation per rectum in 72 (87%), exploratory celiotomy in 10 (12%), and abdominal ultrasonography in 1 (2%).

Twenty-three of the 44 horses with small colon impaction were treated medically, and 21 were treated surgically. Sixty-two of the 83 horses with large colon impaction were treated medically, and 21 were treated surgically. Surgery was performed because of a lack of response to medical treatment, persistent signs of abdominal pain despite medical treatment, or a clinical impression that the impaction was severe enough that it would not respond to medical treatment. Large colon impaction was identified during surgical correction of small colon impaction in 6 horses, although small colon impaction remained the primary diagnosis in these horses.

Mean time from the onset of clinical signs to admission to the Veterinary Teaching Hospital was 33.2 hours (range, 4 to 72 hours) for horses with small colon impaction treated medically, 38.2 hours (range, 8 to 72 hours) for horses with small colon impaction treated surgically, 25.8 hours (range, 4 to 120 hours) for horses with large colon impaction treated medically, and 26.5 hours (range, 3 to 96 hours) for horses with large colon impaction treated surgically. None of these times were significantly different from the others.

Mean heart rate, respiratory rate, and rectal temperature at the time of admission were not significantly different between horses with small colon impaction and horses with large colon impaction.

Of the factors examined, abdominal distension was the only one significantly associated in univariate analyses with whether horses with small colon impaction were treated medically or surgically (Table 2). Horses

with small colon impaction that were treated surgically were 5.2 times as likely to have had abdominal distension at the time of admission as were horses with small colon impaction that were treated medically.

Mean time from admission to resolution of the impaction was 54.4 hours (range, 2 to 168 hours) for horses with small colon impaction treated medically, 44.7 hours (range, 2 to 144 hours) for horses with small colon impaction treated surgically, 24.5 hours (range, 2 to 96 hours) for horses with large colon impaction treated medically, and 5.6 hours (range, 2 to 16 hours) for horses with large colon impaction treated surgically.

Mean times between resolution of the impaction and when horses were first fed bran mash, grass, or pelleted feed were similar for horses with small colon impaction treated medically or surgically (1.4 days) and for horses with large colon impaction treated medically or surgically (1.2 and 1.4 days, respectively). For horses treated medically, mean times between resolution of the impaction and when horses were first fed hay were 3.3 days for horses with small colon impaction and 2.2 days for horses with large colon impaction. Mean time between resolution of the impaction and when horses were first fed hay was significantly longer for horses with small colon impaction that underwent surgery (10 days) than for horses with large colon impaction that underwent surgery (2.6 days).

Postoperative diarrhea occurred in 17 of 21 (81%) horses with small colon impaction that underwent surgery and in 16 of 21 (76%) horses with large colon impaction that underwent surgery. Diarrhea occurred after treatment in 12 of 23 (52%) horses with small colon impaction treated medically and 33 of 50 (66%) horses with large colon impaction treated medically.

Table 2—Results of univariate logistic regression analysis of factors potentially associated with use of surgical versus medical treatment in horses with small colon impaction.

Variable	Category	No. (%) of horses treated surgically	No. (%) of horses treated medically	OR	95% CI
Duration of clinical signs	≥ 24 hours	16 (76)	15 (68)	1.7	0.8–3.7
	< 24 hours	5 (24)	7 (32)		
Fever*	Yes	10 (48)	4 (17)	1.7	0.8–3.8
	No	11 (52)	19 (83)		
Tachycardia†	Yes	5 (24)	7 (30)	1.2	0.8–3.0
	No	16 (76)	16 (70)		
Abdominal distension‡	Yes	5 (24)	1 (4)	5.2	1.6–17.1
	No	16 (76)	22 (96)		

Data represent information for 21 horses with small colon impaction treated surgically and 23 horses with small colon impaction treated medically. The OR represents the odds that a horse treated surgically would have the factor of interest, compared with the odds that a horse treated medically would.

*Rectal temperature ≥ 38.3°C (101.0°F) at the time of initial examination. †Heart rate ≥ 60 beats/min at the time of initial examination. ‡Clinical evidence of abdominal distension at the time of initial examination.

See Table 1 for remainder of key.

Results of bacterial culture of fecal samples for *Salmonella* spp were positive for 2 of 23 (9%) horses with small colon impaction. Seven horses with small colon impaction treated surgically, 6 horses with large colon impaction treated surgically, and 2 horses with large colon impaction treated medically had an episode of colic after resolution of the initial impaction. Reimpaction was documented in 2 of the horses with small colon impaction treated surgically, 1 of the horses with large colon impaction treated surgically, and 1 of the horses with large colon impaction treated medically. Fifteen of 21 (71%) horses with small colon impaction treated surgically and 16 of 21 (76%) horses with large colon impaction treated surgically developed a fever (ie, rectal temperature ≥ 38.3°C [101°F]) after surgery. Three of 23 (13%) horses with small colon impaction treated medically and 17 of 50 (34%) horses with large colon impaction treated medically developed a fever after resolution of the impaction.

Short-term survival rates (ie, percentage of horses discharged from the hospital) were 91% (21/23) for horses with small colon impaction treated medically and 100% (62/62) for horses with large colon impaction treated medically. Short-term survival rates were 95% (20/21) for horses with small colon impaction treated surgically and 100% (21/21) for horses with large colon impaction treated surgically. Seven of the horses with small colon impaction that were discharged from the hospital were lost to follow-up, but long-term (ie, ≥ 1 year after discharge) follow-up data were available for the remaining 34 (18 that had been treated medically and 16 that had been treated surgically). All were alive except for 1 that had been treated surgically and was euthanatized 3 years after discharge from the hospital because of recurrent colic.

Mean durations of hospitalization were 7.6 days (range, 0.33 to 21 days) for horses with small colon impaction treated medically and 4.8 days (range, 1.25 to 16 days) for horses with large colon impaction treated medically. Mean durations of hospitalization were 12.8 days (range, 6 to 30 days) for horses with small

colon impaction treated surgically and 9 days (range, 4.5 to 20 days) for horses with large colon impaction treated surgically. Mean costs of medical treatment were \$1,688 (range, \$559.85 to \$4,880.10) for horses with small colon impaction and \$1,152 (range, \$109.46 to \$5,026.09) for horses with large colon impaction. Mean costs of surgical treatment were \$5,017 (range, \$2,122.88 to \$9,624.80) for horses with small colon impaction and \$3,725 (range, \$2,567.14 to \$7,053.35) for horses with large colon impaction.

Discussion

Results of the present study suggest that diarrhea may be a risk factor for development of small colon impaction in horses, in that diarrhea was the only factor that was found to be significantly more common among horses with small colon impaction than among horses with large colon impaction. Further, results suggest that in horses with small colon impaction, those that have abdominal distension at the time of initial examination are more likely to require surgical than medical treatment. Finally, regardless of whether medical or surgical treatment is required, the prognosis appears to be good for horses with small colon impaction, in that 21 of 23 (91%) horses treated medically and 20 of 21 (95%) horses treated surgically survived to discharge.

Previous studies^{2,3} have suggested that diarrhea develops secondary to small colon impaction in horses. In contrast, in the present study, we found that horses with small colon impaction were more likely to have diarrhea at the time of initial examination than were horses with large colon impaction, suggesting that diarrhea may be a risk factor for development of small colon impaction. However, for horses in the present study, it was impossible to determine whether diarrhea developed before or after small colon impaction because both conditions were present at the time of admission in many horses. Furthermore, horses examined because of diarrhea or primary colitis were excluded from the study population, so our results may be biased. Eighteen of 44 (41%) horses with small colon impaction in the present study had diar-

rhea at the time of initial examination, and 15 (34%) had a fever, suggesting that small colon impaction may develop as a sequela to colitis, possibly as a result of pathophysiological factors such as mucosal inflammation or motility disorders. Unfortunately, the true number of horses that were febrile could not be determined because some horses were treated with flunixin meglumine prior to referral and information on rectal temperature prior to referral was typically not available. Importantly, a diagnosis of small colon impaction was made by the referring veterinarian in only 7 of the 18 horses with diarrhea, whereas the diagnosis of small colon impaction was made at the Veterinary Teaching Hospital by means of palpation per rectum in 35 of the 44 (80%) horses overall. This may suggest that some horses with diarrhea did not have small colon impaction when examined by the referring veterinarian and developed it later. However, it is also possible that small colon impaction was identified more often during rectal palpation at the Veterinary Teaching Hospital because conditions were more conducive for thorough examination (ie, horses were sedated and restrained in stocks) or clinicians at the Veterinary Teaching Hospital were more experienced. A previous study² did suggest that colitis could be a predisposing factor for small colon impaction in horses. In that study, 34% of horses examined because of diarrhea developed small colon impaction. It is possible that in horses with diarrhea, prostaglandins and other inflammatory mediators alter gastrointestinal tract motility, secretion, and absorption, leading to luminal obstruction.⁶ Given the disparity in luminal diameter, impaction would be more likely in the small than in the large colon.

For 2 of 23 (9%) horses with small colon impaction in the present study, results of bacterial culture of fecal samples for *Salmonella* spp were positive. Because of the low number of horses with positive results, further analysis to determine what role, if any, *Salmonella* infection plays in small colon impaction was not possible.

In logistic regression analyses in the present study, abdominal distention was found to be the only factor significantly associated with whether horses with small colon impaction were treated surgically instead of medically. This is consistent with results of previous studies,^{3,7} which also found that abdominal distention was suggestive of the need for surgical intervention. However, unlike other gastrointestinal tract disorders requiring surgical intervention, small colon impaction was not found in the present study to be associated with signs of unrelenting pain or high heart rates. Often, horses with small colon impaction have anorexia, dull mental status, and signs of mild abdominal pain with decreased or no fecal output,⁸ rather than signs of severe abdominal pain. The clinical condition of these patients typically deteriorates slowly, as it takes more time for luminal distention to develop orad to the obstruction in these patients than in patients with an obstruction in the more proximal portion of the gastrointestinal tract.

Previous studies^{2,3} have indicated that rectal palpation is an accurate method of diagnosing small colon

impaction in horses, which is consistent with results of the present study, in that small colon impaction was diagnosed by means of rectal palpation in 35 of the 44 (80%) horses. In horses suspected to have small colon impaction, therefore, results of rectal palpation and the presence of abdominal distention may be the most sensitive indicators of the need for exploratory celiotomy.

Quarter Horses and Thoroughbreds were the predominant breeds for horses with small colon impaction in the present study, and there was no evidence of a breed or sex predisposition. We also did not find a seasonal predisposition in the present study, which differs from results of previous studies,^{2,3} which found that cases of small colon impaction were seen more often during the fall and winter. The lack of an apparent seasonal predilection in the present study may have been due to the milder climate, with less seasonal variation, for the region in which the present study was performed, although one of the previous studies¹ was conducted in Georgia. Because large colon impaction is more common during the winter, the use of horses with large colon impaction as the comparison population in the present study may have limited our ability to detect a seasonal predilection for small colon impaction.

Mean hospitalization time for horses with small colon impaction that were treated surgically was significantly longer than mean hospitalization time for horses with large colon impaction that were treated surgically in the present study. This difference could have been attributable, in part, to the longer time required to establish the diagnosis of small colon impaction and determine that surgery was required following admission to the Veterinary Teaching Hospital. The longer time between surgery and when horses were first fed hay after surgery also contributed. Horses with small colon impaction that were treated surgically also had longer hospitalization times than did horses treated medically, largely because of the time involved for horses to recover from surgery.

a. Sigmapstat 2005, Systat Software, Point Richmond, Calif.

References

1. Rhoads WS, Barton MH, Parks AH. Comparison of medical and surgical treatment for impaction of the small colon in horses: 84 cases (1986–1996). *J Am Vet Med Assoc* 1999;214:1042–1046.
2. Dart AJ, Snyder JR, Pascoe JR, et al. Abnormal conditions of the equine descending (small) colon: 102 cases (1979–1989). *J Am Vet Med Assoc* 1992;200:971–978.
3. Ruggles AJ, Ross MW. Medical and surgical management of small-colon impaction in horses: 28 cases (1984–1989). *J Am Vet Med Assoc* 1991;199:1762–1766.
4. Hosmer DW, Lemeshow S. *Applied logistic regression*. Toronto: John Wiley & Sons Inc, 1989;8–18, 25–76, 88–175.
5. Schlesselman JJ. *Case control studies*. New York: Oxford University Press, 1982;254–259.
6. Jones SL, Spier SJ. Pathophysiology of colonic inflammation and diarrhea. In: Reed SM, Bayly WM, eds. *Equine internal medicine*. Philadelphia: WB Saunders Co, 1988;660–662.
7. Schumacher J, Mair TS. Small colon obstructions in the mature horse. *Equine Vet Educ* 2002;14:19–28.
8. Argenzio RA. Physiology of digestive, secretory, and absorptive processes. In: White NA, ed. *The equine acute abdomen*. Philadelphia: Lea & Febiger, 1990;25–35.