

Signalment, history, and outcome of cats with gastrointestinal tract intussusception: 20 cases (1986–2000)

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Objective—To determine signalment, history, and outcome of cats with gastrointestinal tract intussusception and to identify physical examination, diagnostic imaging, surgical, histologic, and necropsy findings in affected cats.

Design—Retrospective case series.

Animals—20 cats with intussusception.

Procedures—Medical records were evaluated for information on signalment; history; physical examination, diagnostic imaging, surgical, histologic, and necropsy findings; and outcome.

Results—Ten cats were < 1 year old, and 9 were ≥ 6 years old. Anorexia (14/17), lethargy (12/17), and vomiting (12/17) were the most common reasons for examination. Dehydration (13/18), poor body condition (12/18), signs of abdominal pain (8/18), and an abdominal mass (8/18) were the most common physical examination findings. Abdominal radiography revealed intestinal obstruction in all 10 cats in which it was performed; abdominal ultrasonography revealed intussusception in all 7 cats in which it was performed. The most common intussusception was jejuno-jejunal (8/20), and no intussusceptions were found proximal to the duodenum. Eleven of 13 cats that underwent laparotomy required intestinal resection and anastomosis. Histologic examination revealed intestinal lymphoma or inflammatory bowel disease in 7 of 8 cats ≥ 6 years old and idiopathic intussusception in 7 of 8 cats < 1 year old.

Conclusions and Clinical Relevance—Results suggested that in cats, intussusception has a bimodal age distribution, is most commonly jejuno-jejunal, often requires surgical resection and anastomosis, is often associated with alimentary lymphoma or inflammatory bowel disease in older cats, and is readily diagnosed by means of ultrasonography. (*J Am Vet Med Assoc* 2009;234:771–776)

Gastrointestinal tract intussusception in dogs has been well characterized in the veterinary literature. Intussusception is most common in young dogs,^{1–6} with the German Shepherd Dog being the most commonly reported breed,^{2,5–8} although a true breed predisposition has not been proven. In dogs, intussusception has been associated with intestinal parasitic infestation,^{2,6,9–11} alimentary foreign bodies,^{1,3–6,12} viral enteritis,^{2–5,7,13} intestinal masses,^{1,3,6,14,15} recent abdominal or extra-abdominal surgery,^{1–3,6,9,16} and nonspecific gastroenteritis.^{1,2,6,7,9} However, many previous studies^{2,4,5} have reported that most cases of intussusception involving dogs are idiopathic. It appears that most intussusceptions in dogs are enterocolic,^{2–8} although some studies^{1,9} report a higher prevalence of enteroenteric intussusceptions. Correction of

ABBREVIATION

IBD Inflammatory bowel disease

intussusception usually requires surgery, and recurrence rates in dogs of up to 27% have been reported, even after surgical correction of the intussusception.³

Less information is available in the literature regarding intussusception in cats. The largest case series published to date included only 12 cats,¹⁷ and most publications describing intussusception in cats have been individual case reports or small case series.^{18–36} As in dogs, intussusception has been reported most commonly in cats ≤ 1 year old^{2,17,26,31,35}; however, many cases involving older cats have also been reported.^{2,23,24,32,34,36,37} Most cats in previous reports^{2,17,26} have been domestic shorthairs, but Siamese^{2,5,31,35,37} and Burmese^{17,19,28} cats may be overrepresented. Predisposing factors for intussusception in cats are poorly described, although many of the underlying causes reported in dogs have also been identified in cats.^{17,37} The ileocolic junction is the most commonly reported site in cats with intussusception,^{2,17,31,37} but 4 of 5 queens in a previous report²⁶ had enteroenteric intussusception, and case reports^{18,27,33,34,38} of gastroesophageal intussusception in cats have also been published.

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Given the paucity of published information on intussusception in cats, additional study of predisposing factors, clinical abnormalities, and outcome of treatment is needed. The purposes of the study reported here were to determine signalment, history, and outcome of cats with gastrointestinal tract intussusception and to identify physical examination, diagnostic imaging, surgical, histologic, and necropsy findings in affected cats.

Materials and Methods

Criteria for case selection—Medical records and necropsy reports of cats examined at the Veterinary Hospital of the University of Pennsylvania between January 1986 and September 2000 were searched to identify cats in which a diagnosis of gastrointestinal tract intussusception had been made. Cats were included in the study only if the diagnosis had been confirmed during surgical exploration or necropsy and were excluded if the diagnosis had been made on the basis of physical examination or diagnostic imaging findings alone.

Medical records review—Medical records of cats included in the study were reviewed for information on signalment; history; initial physical examination, fecal examination, plain and contrast radiographic, abdominal ultrasonographic, surgical, histologic, and necropsy findings; and outcome. Information was recorded on a standardized spreadsheet.

Historical information that was recorded included duration and type of clinical signs and any medical conditions that had been identified in the preceding 30 days. Initial physical examination findings that were recorded included vital signs, hydration status, body condition, results of abdominal palpation, and any other physical abnormalities recorded in the medical record. Hydration status had been subjectively classified at the time of initial examination by selecting 1 of 3 options (ie, good, fair, or poor) on the intake physical examination form. For purposes of the present study, the terms adequately hydrated, moderately dehydrated, and severely dehydrated were used to categorize hydration status. Similarly, body condition had been subjectively classified by selecting 1 of 5 options (cachectic, underweight, normal, overweight, or obese) on the intake physical examination form. For purposes of the present study, any cat categorized on the initial physical examination form as cachectic or underweight was classified as underweight, and any cat categorized as overweight or obese was classified as overweight. This classification system was used for the present study because some intake physical examination forms had > 1 of the 5 options circled.

A single board-certified radiologist (HMS) reviewed all abdominal radiographs, and abnormalities were recorded on a standardized spreadsheet. During the time of the study, abdominal ultrasonography routinely involved imaging of all intra-abdominal organs, the peritoneal cavity, and intra-abdominal lymph nodes. All ultrasound examinations had been performed with commercially available units.^{a,b} Written reports and recorded still images were reviewed by the same board-certified radiologist (HMS), and abnormalities were recorded on a standardized spreadsheet. Identification

of 1 gastrointestinal tract segment invaginating into an adjoining portion of the gastrointestinal tract was considered consistent with intussusception.

In all cats that underwent exploratory surgery, a ventral midline laparotomy with routine examination of the gastrointestinal tract and abdominal viscera had been performed. Intussusceptions were characterized on the basis of location, length, associated lesions, and (in most instances) whether they could be manually reduced. Method of correction of the intussusception (ie, simple reduction, reduction followed by resection and anastomosis, or resection and anastomosis without reduction) was recorded, along with whether enteroplication was performed. Other atypical findings identified during exploratory surgery were also recorded.

All necropsies were performed within 24 hours after death, and location and length of the intussusception, along with any associated lesions, were recorded, along with results of histologic examination of intussuscepted bowel and other grossly abnormal tissues collected during surgery or necropsy.

Results

Medical records for 21 cats in which a diagnosis of intussusception had been made were identified, but 1 cat was excluded from the study because the diagnosis had been made on the basis of results of abdominal palpation only. Therefore, 20 cats met the criteria for inclusion in the study, of which 18 had been brought to the veterinary teaching hospital for evaluation and treatment and 2 had been brought for necropsy only. There were 11 domestic shorthair cats, 3 Siamese, 2 domestic longhair cats, 2 Oriental Shorthairs, 1 Persian, and 1 Himalayan. Five of the cats were sexually intact males, 6 were neutered males, 5 were sexually intact females, and 4 were spayed females. Median age was 1.5 years (range, 11 weeks to 16 years), but there was a bimodal age distribution with 10 cats < 12 months old and 9 cats ≥ 6 years old. The remaining cat was 2 years old.

Historical information was available for 17 cats. Median duration of clinical signs was 5.5 days (range, 1 to 30 days). The most common historical findings were poor appetite (14 cats), lethargy (12), and vomiting (12). Other signs included weight loss (7 cats), diarrhea (6), polydipsia (6), melena or hematochezia (2), decreased fecal output (2), nasal or ocular discharge (2), regurgitation (2), and polyphagia, polyuria, hypersalivation, and increased borborygmus (1 each).

Fourteen cats reportedly had had medical conditions in the preceding 30 days. Two cats had chronic diarrhea of unknown origin, and a third cat was being treated for intestinal neoplasia, although gastrointestinal tract signs were not specified in the history. Two cats were lactating, having queened within the previous 6 weeks. Two cats had clinical signs of upper respiratory tract infection, 1 was being treated for bronchopneumonia, and 1 had a 10-day history of regurgitation, wheezing, and cough. Conditions in the remaining 5 cats included multiple oral and foot abscesses, fever of unknown cause, dermatophytosis, vaccination, and general anesthesia within the past month.

Information on initial physical examination findings was available for all 18 cats that had been brought

to the veterinary teaching hospital for diagnosis and treatment. Twelve of these cats were underweight, 4 had normal body condition, and 2 were overweight. Seven cats were severely dehydrated, 6 were moderately dehydrated, and 5 were adequately hydrated. Median rectal temperature was 38.0°C (100.4°F; range, < 32.2° to 39.1°C [$< 90.0^{\circ}$ to 102.4°F]). Eight cats were hypothermic (ie, rectal temperature < 37.8°C [100.0°F]) and 10 were normothermic (ie, rectal temperature between 37.8° and 39.2°C [100.0° to 102.5°F]); none of the cats was febrile. Seventeen of the 18 cats had abnormalities evident during abdominal palpation, including a discrete abdominal mass or single thickened bowel loop (8 cats), signs of abdominal pain (8), distended or diffusely thickened intestinal loops (5), abdominal distention (3), and findings consistent with free peritoneal fluid (1). Five cats had signs consistent with shock, including abnormal heart rate, poor pulses, prolonged capillary refill time, and obtundation; all 5 of these cats had rectal temperatures $\leq 37.2^{\circ}\text{C}$ (99°F). Other physical examination findings included dyspnea (3), peripheral lymphadenopathy (1), a palpable thyroid nodule (1), small kidneys (1), cranial abdominal organomegaly (1), and a heart murmur (1). One cat had multiple additional physical examination abnormalities, including oral ulcers, a soft, pliable hemi-mandible, an abscess on a rear paw, icterus, and ataxia.

A fecal examination for parasites was performed in 2 cats, and results were negative in both. Both of these cats were > 1 year old, and both were determined to have intestinal lymphoma on the basis of results of histologic examination of resected bowel segments.

Abdominal radiographs from 10 cats were available for review, and all 10 had radiographic abnormalities. Small intestinal distention or dilation was identified in all 10 cats. Four cats had foreign material visible in the small intestines. Two cats each had gastric dilation, poor peritoneal detail, and a small intestinal mass effect. Intussusception could not be definitively diagnosed on survey radiographs from any of the 10 cats. In 3 cats, radiographs had been obtained following administration of barium. In all 3, contrast radiography confirmed the small intestinal obstruction suspected on the basis of survey radiography, but results of contrast radiography were specific for intussusception in only 1 cat.

Intussusception was evident on ultrasound images from all 7 cats for which abdominal ultrasonographic images were available for review (Figure 1). Other clinically important ultrasonographic findings included intestinal mass or focal thickening (3 cats), mesenteric lymphadenopathy (2), and abdominal effusion (1). A hepatic mass was identified in 1 cat.

Thirteen of the 18 cats brought to the veterinary teaching hospital for evaluation and treatment underwent laparotomy. Of these, 5 were < 1 year old, 1 was 2 years old, and 7 were ≥ 6 years old. Manual reduction of the intussusception was possible in 7 of the 13 cats that underwent surgery and impossible in 4; whether the intussusception could be reduced was not recorded for the remaining 2 cats. Median duration of clinical signs was 7 days (range, 1 to 19 days) in the 7 cats in which the intussusception could be reduced and 12 days (range, 2 to 30 days) in the 4 cats in which the in-

tussusception could not be reduced. Manual reduction alone was performed in 2 of the 13 cats that underwent surgery, and resection and anastomosis were performed in the remaining 11. Reasons for intestinal resection and anastomosis included an inability to reduce the intussusception (4), intestinal mass or mural thickening (3), vascular compromise (2), and intestinal wall defect (1). The reason for resection and anastomosis was not recorded in 2 cats. Enteroplication was performed in 3 cats. Additional intraoperative findings included mesenteric lymphadenopathy (5 cats), a hepatic mass (1), hepatomegaly (1), and a darkened liver with multifocal discoloration (1).

The intussusception was jejunio-jejunal in 8 of the 20 cats, ileo-colic in 5, ileo-ileal in 2, ileo-cecal in 2, and jejunio-ileal, jejunio-ileo-colic, and duodeno-jejunal in 1 cat each. None of the cats had gastroesophageal intussusception. Overall, therefore, 12 of the 20 cats had an enteroenteric intussusception, and 8 had an enterocolic intussusception. Length of the intussusception ranged from 2 to 15 cm (median, 6.8 cm). None of the cats had an intestinal foreign body or gross evidence of parasitism.

In 8 of the 10 cats that were < 1 year old and 8 of the 9 cats that were ≥ 6 years old, a portion of the affected intestine had been submitted for histologic examination. Histologic findings included lymphoma (5 cats) and changes consistent with IBD (3). Intussusceptions in the remaining 8 cats were considered idiopathic because histologic examination revealed either normal intestinal morphology or inflammatory change considered secondary to the intussusception. This included 5 cats with enteroenteric intussusception and 3 cats with enterocolic intussusception. Intussusceptions were considered idiopathic in 7 of the 8 cats that were < 1 year old and secondary to lymphoma in 1. Four of the 8 cats that were ≥ 6 years old had alimentary



Figure 1—Ultrasonographic transverse view of gastrointestinal tract intussusception in a cat.

lymphoma, 3 had IBD, and only 1 had an idiopathic intussusception. Intussusceptions were enteroenteric in 2 of the cats with lymphoma and enterocolic in 3; intussusceptions were enteroenteric in 2 of the cats with IBD and enterocolic in 1.

Of the 8 cats with idiopathic intussusception, 5 had conditions that may have predisposed to intussusception. Two cats were lactating, having queened within the previous 2 months; 1 cat had multiorgan thrombosis and infarctions; 1 cat had severe pneumonia with pulmonary abscesses; and 1 cat was being treated orally with griseofulvin and trimethoprim-sulfonamide because of dermatophytosis and a nasal discharge and was found to have bilateral otitis media at necropsy. No plausible predisposing historical or physical conditions could be identified in the remaining 3 cats with idiopathic intussusceptions.

Twelve of the 13 cats that underwent surgery survived through the immediate postoperative period. The remaining cat was euthanized at the time of surgery because of diffuse thickening of the intestines. Two of the 3 cats in which enteroplication was performed developed severe, generalized ileus, as determined by means of abdominal radiography and ultrasonography, after surgery. One of these cats died 4 days after surgery, and the other was euthanized 6 days after surgery. Neither of these 2 cats underwent a necropsy, and the cause of the ileus was not identified in either cat. None of the remaining 10 cats that survived the immediate postoperative period developed clinical evidence of ileus, and all 10 were discharged from the hospital. Five of the cats that were discharged reportedly did not have a recurrence of intussusception; the other 5 were lost to follow-up.

Discussion

The age distribution of cats in the present study was bimodal. In contrast, in most previous reports,^{2,17,19-22,25-28,30,31} cats with intussusception were primarily young, often < 1 year of age. Older cats with intussusception may have been underreported previously because they were euthanized owing to advancing age or an anticipated poor prognosis. Alternatively, the fact that our study population consisted of cases from a referral center may have skewed the age distribution in the present study. In 3 previous reports,^{2,5,31} Siamese cats were the most common breed of cat affected, whereas in other studies,^{17,19,28} Burmese cats were most common. We did not identify a breed predisposition in the present study, but our study population was small.

The most common owner complaints in the present study were largely consistent with those in other reports. Together, these findings suggest that cats with intussusception may have diarrhea less often than dogs.² Other than hypothermia, physical examination findings in the present study were also consistent with findings in previous reports^{17,19-22} and generally were consistent with the pathophysiology of intussusception. Previous reports^{20,22} have reported fever more frequently than hypothermia, but cats in the present study may have been sicker than those described in previous reports because the veterinary teaching hospital is a referral center. Hypothermia in some cats in the present study

may have been due to disease severity, shock, or sepsis.³⁹ There was no clear relationship between rectal temperature and age or between rectal temperature and underlying disease process.

The ultrasonographic appearance of intestinal intussusception in dogs and cats has been described,^{1,8,37} and intussusception was evident on ultrasound images from all 7 cats in the present study for which such images were available for review. Consistent with findings in previous reports,^{2,17} abdominal radiography was useful in recognizing intestinal obstruction in cats in the present study. However, intussusception could not be definitively diagnosed on survey radiographs from any of the 10 cats in which it was performed, and results of contrast radiography were specific for intussusception in only 1 of 3 cats. Therefore, abdominal ultrasonography appeared more likely than radiography to provide a specific diagnosis of intussusception.

Twelve of the 20 cats in the present study had enteroenteric intussusceptions. This finding was in contrast to findings in most previous reports,^{2,17,31,37} which indicated that ileocolic intussusception was the most common. A previous study⁵ suggested that idiopathic intussusceptions were ileocolic, whereas intussusceptions with an identified underlying cause were more likely to be enteroenteric. In the present study, however, there was no clear relationship between underlying cause and anatomic site of intussusception.

No intussusceptions involving the stomach or esophagus were identified in the present study. A search of the PubMed database performed in January 2008 for the term cat or feline paired with intussusception yielded a total of 65 cases reported prior to the present study, 5 (8%) of which involved cats with intussusceptions proximal to the duodenum.^{18,27,33,34,38} Therefore, gastroesophageal intussusception appears to be uncommon in this species. Although there have been reports of intussusception proximal to the duodenum in dogs,⁴⁰⁻⁴⁵ a proximal location is reportedly uncommon in dogs as well.^{2,5}

Only 8 of the 16 cats for which histologic data were available in the present study were considered to have idiopathic intestinal intussusception. Seven of the 8 cats with idiopathic intussusceptions were < 1 year old, whereas 7 of the 8 cats ≥ 6 years old had IBD or alimentary lymphoma, suggesting that as is the case in dogs, young cats may be more likely to have idiopathic intussusception, and older cats with intussusception may be more likely to have primary gastrointestinal tract disease.

Five of the 8 cats with idiopathic intussusception in the present study had physical or medical conditions that may have predisposed them to intussusception. Development of intussusception in cats with severe non-gastrointestinal tract disease is consistent with previous reports^{2,3,5,6} of intussusception in dogs associated with systemic disease or recent extra-abdominal surgery. As was the case for 2 cats in the present study, intussusception has been reported previously in cats within 2 months after parturition.²⁶ Possibly lactation and weaning predispose to endocrine-mediated changes in gastrointestinal tract motility, which may predispose to intussusception.

Ten of the 13 cats that underwent surgery in the present study were discharged from the hospital, and

this short-term survival rate was similar to the rate (80%) reported in a previous study.¹⁷ Owing to the time period of the present study, obtaining long-term follow-up information was difficult. Recurrence rate was difficult to assess because 5 of the 10 cats that were discharged were lost to follow-up. However, none of the 5 cats for which follow-up information was available had a recurrence of intussusception. Others have reported low recurrence rates in cats,² but recurrence rates as high as 20% have also been reported.¹⁷

The role of enteroplication in the surgical management of cats with intussusception is poorly characterized.² In the present study, the only 2 cats that died in the immediate postoperative period had undergone enteroplication and developed severe ileus, whereas all 9 cats without enteroplication survived to the time of discharge. The 2 cats that didn't survive were in different age groups, and neither cat had any confirmed predisposing cause for the intussusception. Whether enteroplication predisposes cats to ileus is unknown, and because diagnostic imaging was not performed in cats without postoperative complications, we do not know whether ileus occurred in those cats that did not undergo enteroplication. Owing to the small number of cats in the present study that underwent enteroplication, it is impossible to draw any conclusions regarding this technique in cats. Others have reported complications associated with enteroplication in cats.²⁸

Major limitations of the present study were the lack of fecal parasite examinations in most cats and the fact that fecal samples were not submitted for bacterial culture. Previous studies^{2,17,19} have found intestinal infection or infestation associated with intussusception in dogs and cats. However, no gross or histologic evidence of infection was reported in any of the 16 cats in which biopsy samples were submitted for histologic examination. An additional limitation was the requirement that the diagnosis had to have been confirmed at surgery or necropsy for cats to be included in the study. Spontaneous reduction has been reported in dogs with intussusception,⁴⁶ and cats with intermittent intussusception may have been excluded from the present study. The referral nature of the veterinary teaching hospital may also have skewed the study population toward more severely affected cats, and the postoperative survival rate may have been exaggerated owing to the availability of 24-hour intensive care. Furthermore, because of the small sample size, the investigation had insufficient statistical power to make meaningful statements about statistical associations between risk factors and outcome in cats with intussusception.

In conclusion, results of the present study suggested that cats with intussusception may have a bimodal age distribution and that IBD or alimentary lymphoma may be an important underlying cause in older cats with intussusception. Further investigation into the role of nongastrointestinal tract diseases and metabolically stressful events in the development of intussusception in cats is warranted. The most common site of intussusception in cats remains unclear, although intussusceptions proximal to the duodenum appear uncommon in this species. Abdominal ultrasonography is likely the

most accurate presurgical method for the diagnosis of intussusception in cats.

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- a. Aloka 650, 5.0-MHz convey array, 7.5-MHz mechanical array, Aloka Co Ltd, Wallingford, Conn.
 - b. ATL Ultramark 9 HDI, C7-4 curved array, L10-5 linear array, Advanced Technology Laboratories Inc, Bothell, Wash.
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Effect of long-term dietary supplementation with clinoptilolite on performance and selected serum biochemical values in dairy goats

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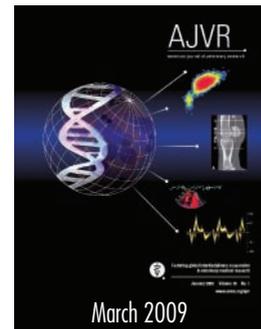
Objective—To determine the effect of dietary supplementation with clinoptilolite on health and production as well as serum concentrations of fat-soluble vitamins, macroelements and trace elements, and activities of hepatic enzymes in dairy goats.

Animals—72 Saanen-cross dairy goats.

Procedures—Goats were randomly assigned to 1 of 2 groups. The clinoptilolite group (n = 36) received concentrate feed, of which 2.5% contained clinoptilolite; the control group (36) received unsupplemented feed. The experiment began 8 weeks before parturition and continued to the beginning of the next nonlactating period (280 days of lactation). At the day of parturition, kids were weighed. Milk yields were recorded at day 60 of lactation and thereafter at monthly intervals. Milk percentages of fat, protein, and lactose and somatic cell count (SCC) were evaluated at the same points. Blood samples were obtained at the beginning of the experiment, the day of parturition, and thereafter at monthly intervals to measure serum concentrations of fat-soluble vitamins, macroelements and trace elements, and activities of hepatic enzymes.

Results—Birth weights of triplets and quadruplets were significantly higher in clinoptilolite-treated goats versus control goats. Milk fat percentage was significantly higher and SCC was significantly lower in clinoptilolite-treated goats, compared with respective values in control goats. However, no changes in serum concentrations of any variable were detected.

Conclusions and Clinical Relevance—In the context of this experiment, clinoptilolite supplementation of concentrate feed at 2.5% improved milk fat percentage in dairy goats, without adverse effects on the serum variables evaluated. Furthermore, the reduction of SCC achieved with clinoptilolite supplementation provided some evidence of improved milk hygiene. (*Am J Vet Res* 2009;270:346–352)



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