ISSN: 2640-1223

MEDDOCS Open Access Publisher

Journal of Veterinary Medicine and Animal Sciences

Open Access | Case Report

Combined Use of Computed Tomography and Endoscopy for Diagnosis of Cecocolic Intussuception in a Dog

Takeshi Tsuka*; Tomohiro Osaki; Yoshiharu Okamoto; Takehito Morita; Yuji Sunden; Kazuo Azuma; Masamichi Yamashita; Takao Amaha; Norihiko Ito; Yusuke Murahata; Tomohiro Imagawa

Joint Department of Veterinary Medicine, Faculty of Agriculture, Tottori University, Japan.

***Corresponding Author(s):** Takeshi Tsuka
Veterinary Diagnostic Imaging, Joint Department of Veterinary Medicine, Faculty of Agriculture, Tottori University, 4-101, Koyama-Minami, Tottori, Japan.
Tel: +81-857-31-5435; Email: tsuka@tottori-u.ac.jp

Received: Oct 26, 2020
Accepted: Dec 04, 2020
Published Online: Dec 10, 2020
Journal: Journal of Veterinary Medicine and Animal Sciences
Publisher: MedDocs Publishers LLC
Online edition: http://meddocsonline.org/

Keywords: Cecocolic intussusception; Computed tomography; Dog; Endoscopy.

Abstract

An 8-year-old male West Highland white terrier dog presented with a 2-month history of hematochezia. No anemia was evident. The intestinal lesion was imaged as a soft-tissue opacity near the right of the first and second lumbar vertebrae on dorsal radiography, and as a structure of multiple concentric rings on transverse ultrasonography of the right abdomen. These radiographic and ultrasonographic findings suggested intestinal intussusception near the ileocecocolic junction. Computed Tomography (CT) provided clearer evidence, showing invagination of one intestinal segment into the lumen of the ascending and transverse colon within the ileocecocolic junction. Subsequent endoscopy revealed: 1) protrusion of the mass from the cecocolic orifice (located near the closed ileocolic orifice) into the lumen of the colon; and 2) mobility of the mass. These CT and endoscopic findings were indicative of cecocolic intussusception relating to incomplete intestinal obstruction. At 6 days after these examinations, this case was treated with cecectomy, resulting in intact recovery. Multiple uses of CT as well as radiography, ultrasonography, and endoscopy proved very useful for reliable diagnosis of cecocolic intussusception, and judgment of the degree of clinical severity, based on comprehensive evaluation of the resulting images.

Introduction

Intussusception is defined as invagination of one segment of intestine within another segment [1]. Involvement within the ileocecocolic junction is most frequent, estimated to represent 51% of intestinal intussusceptions [1,2]. Intestinal intussusceptions within the ileocecocolic junction are mainly divided into three types: ileocolic; cecocolic; and colocolic [1,3]. Comparing the three types of intestinal intussusceptions, ileocolic and colocolic types predominate in small animals [1,3]. Cecocolic intussusception (cecal inversion) appears to be rare in cats and uncommon in dogs [4].

Simple diagnostic methods to differentiate among various types of intestinal intussusceptions include the clinical appearance in the affected animals [1,4]. However, the common clinical signs among these diseases are frequently not useful for differential diagnosis [1,2]. Imaging greatly contributes to reliable diagnosis of gastrointestinal disorders including intestinal intussusceptions, involving the use of ultrasonography, contrast radiography, and endoscopy in small animal practice [4,5]. Ultrasonography can provide the specific finding of a multilayered structure in the longitudinal view, and the appearance of multiple concentric rings (target sign) in the transverse view [1,3]. However, even if these imaging modalities are used alone or in combination, detecting the location of the region affected by intestinal intussusception is frequently difficult [1,4].

Computed Tomography (CT) is predicted to prove useful in the diagnosis of intestinal intussusceptions, with comparable or superior utility to routine imaging tools including radiography, ultrasonography, and endoscopy in veterinary practice, based on the recent practical utility of this modality in human medicine [6,7]. However, relatively few clinical reports have described the use of CT for diagnosing intestinal intussusception [6]. The purpose of this study was to describe the clinical utilization of CT together with radiography, ultrasonography, and endoscopy for diagnosing cecocolic intussusception in a dog, and to review the importance of comprehensive evaluations of these images.

Case presentation

An 8-year-old male West Highland White Terrier dog was brought in with a 2-month history of hematochezia. During this period, soft or watery stools were evacuated every day, but no constipation was apparent. The patient did not evince abdominal pain during evacuation. Appetite was normal, and no vomiting was seen with commercial dried food given twice a day. Palpation did not identify any hard masses in the abdomen. Rectal examination revealed no polypoid or nodular masses within the rectal walls digitally palpable from the anus, and small amount of soft stool was collected. In this examination, an enlarged prostate was palpated. Cytological examination of the collected stool revealed a small amount of erythrocytes and no eggs. Blood hematological examinations revealed no anemia, and a slightly high platelet count (Table 1) [8]. In serum biochemistry, the high values were measured moderately in Alkaline Phosphatase (ALP) level, and slightly in aspartate aminotransferase and alanine aminotransferase levels [8]. Prothrombin time, and activated partial thromboplastin time were within the reference normal ranges [9].

A radiography device (Regius model 110; Konica Minolta Inc.) was applied for the abdomen. On the ventral-dorsal view, a soft tissue opacity mass was visualized slightly to the right of the first and second lumbar vertebrae (Figure 1A). No gas was visible into the mass lumen.

A 7.5 MHz convex transducer in an ultrasonography device (HI VISION Preirus; Hitachi-Aloka Medical) was applied for the right caudal abdomen. Abdominal ultrasonography revealed a structure appearing as multiple concentric rings in the transverse view, suggesting one inner intestinal structure dislocated into the lumen of an outer intestinal structure (Figure 2A). The dislocated inner intestinal structure was imaged as having an indistinct, five-layered wall and hyperechoic contents in the lumen. Edge shadowing was seen on the edges of the rounded ring-like structure. On longitudinal view, a multilayered structure was seen running cranio-caudally (Figure 2B). During this examination, it was not determined which part of the intestinal tract was affected, because of unclear anatomical continuity between the lesion and intestinal structures located proximal or distal to the lesion.

CT and endoscopic examinations were performed under general anesthesia with 1-2% isoflurane (IsoFlo; Zoetis Japan, Tokyo, Japan) via a tracheal tube inserted after pre-medication with a combination of butorphanol (0.2 mg/kg, Vetorphale; Meiji Seika Pharma, Tokyo, Japan), midazolam (0.2 mg/kg, Dormicum; Astellas Pharma, Tokyo, Japan), and propofol (4 mg/kg, PropoFlo28; Zoetis Japan, Tokyo, Japan). A helical CT scanner (Pronto SE, Hitachi Co. Ltd, Tokyo, Japan) was used for an animal in supine position. Dorsal reconstructed CT scanned after intravenous injection of iopamidol (2 mg/kg; Oypalomin, Fuji Pharma Co., Ltd., Tokyo, Japan) revealed the presence of a lesion within the ileocolic junction, located in contact with the right kidney slightly to the right of midline in the abdomen (Figure 1B). CT characteristics of the lesion suggested two parts: a cranial part invaginated into the lumen of the colon; and a caudal part imaged as a comparatively homogeneous mass with rough margins. Contrast enhancement was seen within all areas of the mass, identical to those of the intestine. The wall of the colon receiving the mass was comparatively thickened, and was imaged by the same contrast enhancement as other regions of colon. Gas filled the lumen of the ileum running proximal to the mass, and of the colon running distal to the mass. A large amount of gas also filled the gastric lumen. Homogeneous contrast enhancement was seen in the slightly enlarged liver and spleen, and the normal-sized and -shaped kidneys. Swelling of the lymph nodes was not evident in the abdomen.

An endoscope device (VO-2A, Olympus Corporation, Tokyo, Japan) was used to observe inside the lumens of the upper gastrointestinal tract through the mouth, and of the lower intestinal tract through the anus. Mucosal walls of the stomach and duodenum were colored pink and smooth without formation of polyps or ulceration. Colonoscopy revealed no bleeding, formation of polyps, or ulceration in the mucosal wall of the rectum. Advancing the endoscope toward the colon allowed visualization of the mass occupying the intact lumen of the transverse colon (Figure 3A). The mass was predicted to represent a protruding lesion derived from the proximal intestinal structure. The margin of the mass was imaged as smooth, circular, and pink in color. The surface of the mass resembled the mucosal wall of the intestine. During this observation, the mass was moved forward and backward, and these movements were attributed to intestinal peristalsis. When the surface of the mass was pushed using biopsy forceps (FB-38W-1, Olympus Corporation, Tokyo, Japan) under endoscopic observation, the mass was easily advanced toward proximal region of the colon (Figure 3B). Pressure on the mass in a proximal direction resulted in the diagnostic endoscopic view that the mass was protruding from the opening of the cecocolic orifice (Figure 3C). The closed opening of the ileocolic orifice was also seen near the wider opening of the cecocolic orifice.

Cytological examination of a surface sample of the mass, collected using biopsy forceps under endoscopic observation, revealed an aggregate of normal epithelial cells and a few inflammatory cells (including neutrophils). No atypical cells were evident.

Laparotomy performed 6 days after these examinations under general anesthesia with 0.5-2% inhalation of isoflurane via tracheal tube and continuous infusion of fentanyl (5-10 µg/kg/hour, Fentanyl injection; Janssen Pharmaceuticals Inc., New Jersey, USA) after pre-medication with a combination of propofol (4 mg/kg) and fentanyl (5 µg/kg). The skin was incised in the right-side paramedian and ventral planes of the abdomen. The bursiform structure of the cecum was present within the normal anatomical site near the region of the ileocolic junction, but was macroscopically observed as an irregular, and dark-red-colored protrusion (Figure 4). The antimesenteric wall of the colon was incised longitudinally near the protrusion. The inverted cecum was seen in the lumen of the colon from the incised opening. No discoloration or necrotic changes were evident in the serosal or mucosal walls of the cecum. The cecum was removed by extending the incision from the opening of the colon to the base of the cecum. The opening wall of the colon was sutured with a monofilament suture (3-0PDSII; Johnson & Johnson, Tokyo, Japan), and the sutured region was covered with omentum. The animal was medicated postoperatively with intravenous injection of cefmetazole (cefmetazole sodium injection, Nichi-Iko. Pharmaceutical Co., Ltd., Toyama, Japan) and 7-day administration of oral cephalexin (Larixin, Toyama Chemical Co., Ltd., Toyama, Japan). The animal showed normal appetite at 1 day after surgery. No postoperative complications or infection developed, and hematochezia disappeared.

Histology of the mass revealed that the spindle cells containing fibrillar cytoplasm were proliferated together with peripheral nerve bundles, and vascular plexus. Vascular structures were dilated or had irregularly thickened walls, and bundles of unmyelinated nerve fibers accompanied by ganglion cells were observed. Immunohistochemistry revealed positive reactions in the spindle-shaped cells with fibrillar cytoplasm with anti-α-SMA antibody, the atypical vascular structures with both anti-α-SMA and anti-vWF antibodies, and the unmyelinated nerve fiber bundles with anti-NF antibody. Based on the histopathological findings, this case was diagnosed as neuromuscular and vascular hamartoma of the cecum resulting in cecocolic intussusception [10].

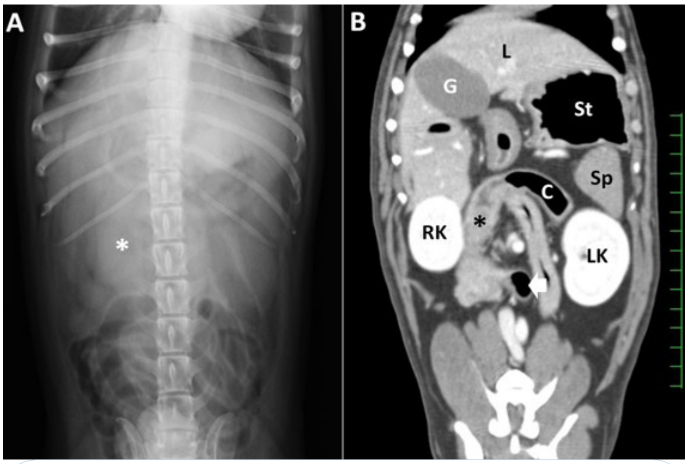

Figure 1: Dorsal radiography **(A)** and reconstructed computed tomography (CT) **(B)** of the abdomen. **(A)** A soft-tissue opacity mass (asterisk) is seen to the right of the first and second lumbar vertebrae; **(B)** Invagination of the lesion (asterisk) into the lumen of the ascending colon is seen within the ileocecocolic junction. Filled gas (arrow) is visible in the lumen of the ileum running proximal to the mass. C: colon; G: gallbladder; L: liver; LK: left kidney; RK: right kidney; Sp: spleen; St: stomach. Scale = 10 mm on CT.

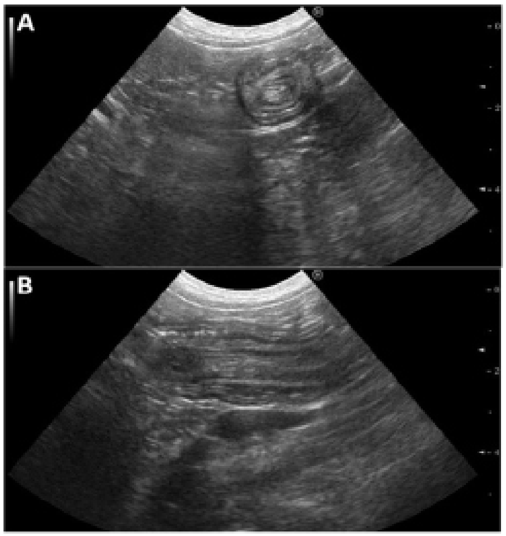

Figure 2: Transverse **(A)** and longitudinal **(B)** ultrasonograms obtained from percutaneous scanning of the right abdomen.

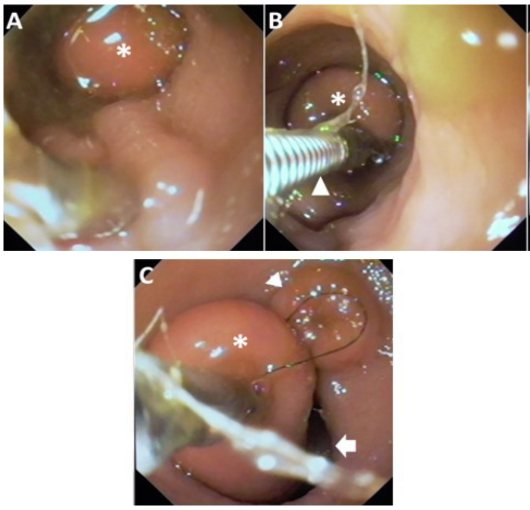

Figure 3: Endoscopy views of the mass. **(A)** The mass (asterisk) occupies the intact lumen of the transverse colon; **(B)** The mass (asterisk) can be moved proximally toward the colon by pushing with biopsy forceps (arrowhead); **(C)** The mass (asterisk) is protruding from the wider opening of the cecocolic orifice (arrow), located near the closed ileocolic orifice (arrowhead).

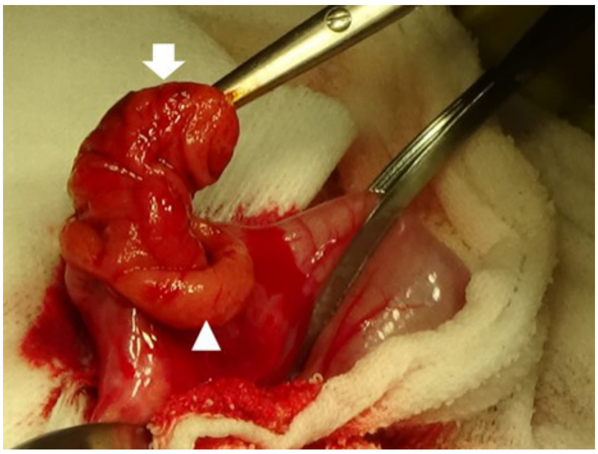

Figure 4: Intra-operative view of cecocolic intussusception within the ileocecocolic junction. The inverted cecum (arrow) is seen in the lumen of the ascending colon from the incised opening of the ileocecocolic junction (arrowhead).

Table 1: Hematological and serum biochemical values.

Variable	This case	Reference values [8,9]
Red blood cell count (×10⁴/µl)	631	680 ± 70
White blood cell count (/µl)	8,700	12,500 ± 3,000
Hemoglobin (g/dl)	14.7	16.0 ± 1.7
Hematocrit (%)	33.8	46.0 ± 4.6
Platelet count (×10⁴/µl)	51	32 ± 12
Total protein (g/dl)	7.0	6.0 ± 0.4
Albumin (g/dl)	3.7	3.0 ± 0.3
Urea nitrogen (mg/dl)	10.3	11.4 ± 4.3
Creatinine (mg/dl)	0.6	0.8 ± 0.2
Alkaline phosphatase (U/l)	420	32.0 ± 11.7
Aspartate aminotransferase (U/l)	36	13.0 ± 2.9
Alanine aminotransferase (U/l)	38	10.0 ± 4.6
Total cholesterol (mg/dl)	231	199.1 ± 41.0
Glucose (mg/dl)	103	83.9 ± 9.0
Prothrombin time (second)	7.2	6.9 - 8.8
Activated partial thromboplastin time (second)	13.7	13.1 - 17.2

Discussion

The most common type of intussusception in dogs is intestinal intussusceptions [1]. Common clinical signs associated with intestinal intussusception include vomiting, diarrhea, hematochezia, anorexia, and weight loss [1,4]. Hematochezia is the major clinical sign of cecocolic intussusception [11]. However, the signalments are commonly nonspecific, because of the overlap of clinical signs among intestinal diseases [1,2]. The severity and duration of clinical findings (ranging from 1 to 90 days) may be related to the location of intestinal intussusceptions [1]. This case presented with chronic evacuation of soft or watery stools including fresh blood, but no severe depression of body condition. Involvement of the gastrointestinal tract within the proximal intestinal tract tends to induce more severe clinical signs than that within the distal intestinal tract [1]. Clinical examinations are required to achieve a more indicative of intestinal intussusception, because the variety of clinical signals exhibited may be related to low reliability as diagnostic evidence.

Abdominal palpation is commonly very valuable for diagnosing intestinal intussusception in animals, based on induction of abdominal pain and detection of abdominal mass [1,12]. Hard masses can be palpated mainly in the craniad abdomen in 50-70% of animals with intestinal intussusception [1,2,12]. However, cecocolic intussusceptions are rarely palpated in dogs, as in this case [4,11]. Blood examinations seem to provide effective evidence. Canine cases of cecocolic intussusception typically exhibit anemia, due to continuous bleeding into the intestinal lumen [11]. Anemia may also suggest complete intestinal obstruction and contribute to the judgment of severity in animals with intestinal intussusception, in which intra-intestinal blood loss and long duration of anorexia frequently occur [12]. Other blood abnormalities are hypoproteinemia and hypoalbuminemia due to extravasation of protein from the damaged mucosa and increased secretion of albumin [12]. In this case, no blood abnormalities were evident beyond a high level of ALP, elevation of which possibly indicates intestinal ischemia [12]. Blood abnormalities were typically less frequent in animals affected by cecocolic intussusception [4]. The variety of abnormal blood values may be greatly associated with the severity of intestinal intussusception [1], but cannot always be utilized as reliable diagnostic evidence. Cecocolic intussusception may occur secondary to whipworm-induced typhlitis, although the mechanisms involved are unclear [4,11]. This indicates the necessity for parasitic fecal analysis, although negative results were obtained for eggs in the stool for this case [4].

Imaging can contribute to the differentiation of cecocolic intussusception from other intestinal intussusceptions and colic diseases. Intestinal intussusception represents a lesion comprising two abnormal structures: the portion of displaced intestinal tract within the lumen of another segment of intestine is referred to as the intussusceptum, while the portion of outer intestinal tract receiving the intussusceptum is referred to as the intussuscipiens [1,6]. Among intestinal intussusceptions involving the ileocecocolic junction, around which these diseases most frequently occur [1], the intussuscipiens is the colon, and the intussusceptum is one of three proximal structures, including the ileum, the cecum, and the colon itself [3]. Reliability in diagnosis of intestinal intussusception can thus be obtained by visualization of locational interaction between the intussusceptum and intussuscipiens on imaging. Moreover, on the imaging of intestinal intussusception, differential diagnosis of cecocolic intussusception is possible from evidence showing that the intussusceptum is the cecum.

Ultrasonography is one of most reliable diagnostic tools for diagnosing intestinal intussusception in the veterinary field [1]. Intestinal intussusception appears as a multilayered structure in the longitudinal view, and as multiple concentric rings (the target-sign) in the transverse view [1,3]. This ultrasonographic finding represents dislocation of the intussusceptum into the intussuscipiens, and is almost always indicative of intestinal intussusception. However, it is difficult to detect the derivation of the intussusceptum in intestinal intussusceptions within the ileocecocolic junction [1,4]. Nyland gives a point of differentiation between ultrasonographic images for ileocolic and cecocolic types; the ileocolic type is seen within the ascending and transverse colon, and may extend distally into the descending colon, while the cecocolic type may be localized into a small area of cecum and the proximal ascending colon [3]. In addition, cecocolic intussusception may be suggested when the walls of concentric rings at the level of the ileocecocolic junction appear thickened on imaging [4]. Use of ultrasonography in this case revealed a comparatively short lesion, but this finding did not represent sufficient clinical evidence for diagnosis of cecocolic intussusception. Ultrasonography is also superior to radiography and CT in differentiating intestinal lesions derived from the mucosa, muscles, and serosa, based on collapse from the normal five-layered ultrasonographic appearance of the intestinal wall layer represented by the hyperechoic mucosal surface, the hypoechoic mucosa, the hyperechoic submucosa, the hypoechoic muscles, and the hyperechoic serosa [3,13]. In addition, evaluation of blood flow within the intussusceptum may predict severity and after-surgical reducibility of the intussusceptum [14].

Abdominal plain radiography commonly depicts the affected region of intestinal intussusception as a soft-tissue opacity [12]. An abnormal intestinal gas and fluid pattern was suggestive of mechanical obstruction in approximately 42% of canine cases [2]. The location of the soft-tissue opacity may be utilized for diagnostic suspicion of cecocolic intussusception; the cecum is anatomically located to the right of the median plane [15]. However, plain radiography is unlikely to prove diagnostic for intestinal intussusception, because the soft-tissue opacity cannot be divided into the intussuscipiens and intussusceptum on this image [1,4]. Gastrointestinal contrast radiography for small animal cases allows more presumptive diagnosis of intestinal intussusception than plain radiography [1,4]. Enema with contrast medium may provide diagnostic evidence for identification of ileocolic, cecocolic, or colocolic types as the cause of intestinal intussusception affecting the ileocecocolic junction, because contrast media clearly outlines the intussusceptum within the lumen of the intussuscipiens [1,11]. In addition, clinical information obtained from the use of contrast radiography includes the completeness of the obstruction, and the presence of significant intestinal ileus as well as location of the lesion, all of which are utilized for therapeutic planning [1]. On the other hand, for detecting mechanical intestinal obstructions associated with various intraluminal lesions in dogs, the diagnostic sensitivity and specificity of contrast-enhanced or plane radiography (79.2% and 69.4%, respectively) have been reported as inferior to those from CT (95.8% and 80.6%, respectively) [16].

CT can provide detailed images of intestinal obstructions without interruption by various factors, including large patient size and intraluminal gas, which are the frequent causes of misdiagnosis from radiography and ultrasonography [13]. In human medicine, CT is routinely used as the imaging modality of choice for diagnosing intestinal intussusceptions, providing wide-ranging sensitivity of 58-100% and specificity of 57-71% [7]. Use of CT in this case showed invagination of one intestinal segment into the lumen of the ascending and transverse colon near the ileocecocolic junction, with a soft-tissue opacity imaged on coronal radiographs. This indicated intestinal intussusception within the ileocecocolic junction, although CT could not provide significant evidence for whether the ileum or cecum represented the intussusceptum. Despite the predictive applicability of CT to diagnose intestinal intussusception in the veterinary field [4], few previous reports have described the clinical utilization of CT. A bovine clinical report noted that transverse CT showing a round mass including a central, hypointense structure was helpful for diagnosing ileocecocolic intussusception [7], resembling the target sign indicative of intestinal intussusceptions on ultrasonography [6]. Various functions of CT can be expected to be utilized in the diagnosis of intestinal intussusceptions in the veterinary field [13]. (1) Structures of the intestinal wall (comprising the mucosa, muscles, and serosa) and the gas-filled lumen are distinguishable on CT of the intestine. This is greatly helpful for detecting abnormalities of the intestine, including swelling, and formation of masses, polyps, and intussusceptions [13]. (2) Observation from multiple directions using reconstructed CT allows pursuit of a proximal-to-distal course of the intestine on abdominal images. This utilizes estimation of the size and region of intestinal intussusception [6,13]. (3) Contrast enhancements due to CT angiography can differentiate various intestinal lesions, including intraluminal hemorrhage, inflammation (frequently shown with diffuse, uniform, and heterogeneous enhancements), mass, and mesenteric ischemia in human medicine [13].

Endoscopy is a useful diagnostic imaging tool along with ultrasonography and contrast radiography, but is not always used for animals with intestinal intussusceptions because of the requirement for deep anesthesia [4]. Use of colonoscopy in this case led to two important lines of evidence: (1) the inverted cecum was the origin of the mass based on protrusion of the mass from the cecocolic orifice near the closed ileocolic orifice; and (2) invagination of the cecum into the lumen of the colon caused incomplete obstruction, because the protruded mass could be pushed back from the transverse colon to the region of the ileocecocolic junction under endoscopic observation. This indicates that colonoscopy is more reliable for differentiating between ileocolic and cecocolic types of intestinal intussusception affecting within the ileocecocolic junction, and the diagnostic efficacy is supported by a previous canine report showing an ileocolic type endoscopically diagnosed based on protrusion of the terminal ileum into the lumen of the colon through the ileocecal orifice [17]. Another aspect of the efficacy of colonoscopy in this case is visualization of mobility of the intussusceptum, which represents accurate evidence for predicting postoperative outcome and prognosis [2]. In addition, endoscopy-guided biopsy to collect a sample of the protruding mass may appear as the cause of intestinal intussusception via subsequent cytological or histopathological examinations [17], although this case could not have been diagnosed as a neuromuscular and vascular hamartoma of the cecum based on the cytological findings.

Conclusion

In this study, reliable diagnosis of cecocolic intussusception was possible from CT and endoscopy, as well as radiography and ultrasonography. In human medicine, comprehensive evaluations of these images have recently been recommended. In examinations using both CT and endoscopy, images from CT can be evaluated in combination with endoscopic images to clarify mural and extramural abnormalities, and collaboration between virtual endoscopic CT and endoscopic images is also possible [13]. Multiple options for diagnostic imaging devices to depict intestinal intussusceptions in the veterinary field will inevitably contribute to the availability of quality evidence for use in therapeutic planning and selection, and predicting prognosis.

References

1. Applewhite AA, Cornell KK, Selcer BA. Diagnosis and treatment of intussusceptions in dogs. Comp Cont Educ Pract. 2002; 24: 110-127.
2. Levitt L, Bauer MS. Intussusception in dogs and cats: A review of 36 cases. Can Vet J. 1992; 33: 660-664.
3. Nyland TG, Neelis DA, Mattoon JS. 'Gastrointestinal tract', in JS. Mattoon and TG. Nyland, eds. Small Animal Diagnostic Ultrasound, Third edition: Elsevier Inc. 2015; 468-500.
4. Boland L, Lindsay S, Brunel L, Podadera J, Bennett P. Caecocolic intussusception associated with a caecal polyp and concurrent hepatocellular carcinoma in a cat. JFMS Open Rep. 2017; 3: 2055116917706652.
5. Tsuka T, Okamoto Y, Osaki T, Morita T, Sunden Y, et al. Computed tomographic findings of abdominal granulomas in three Miniature Dachshund dogs. J Anim Sci Res. 2019; 3.
6. Lee DB, Shin SM, Lee KC, Lee HB, Kim MS, et al. Surgical management of an ileocecocolic intussusception in a Korean native calf: A case report. Vet Med. 2013; 58: 645-649.
7. Amr MA, Polites SF, Alzghari M, Onkendi EO, Grotz TE, et al. Intussusception in adults and the role of evolving computed tomography technology. Am J Surg. 2015; 209: 580-583.
8. Lumsden JH, Mullen K, McSherry BJ. Canine hematology and

biochemistry reference values. Can J Comp Med. 1979; 43: 125-131.

9. Geffre A, Grollier S, Hanot C, Vergez F, Trumel C, et al. Canine reference intervals for coagulation markers using the STA Satellite(R) and the STA-R Evolution(R) analyzers. J Vet Diagn Invest. 2010; 22: 690-695.

10. Yamashita M, Sunden Y, Osaki T, Tsuka T, Morita T. Neuromuscular and vascular hamartoma of the cecum in a dog. Jap J Vet Res. 2019; 67: 247-251.

11. Willard MD. 'Digestive system disorders', in RW. Nelson and CG. Couto, eds. Small Animal Internal Medicine, Third edition: Elsevier Inc. 2003; 343-471.

12. Singh T, Verma P, Raghunath M, Mohindroo J, Singh SS, et al. Intussusception in dogs: diagnosis and surgical management. Indian Vet J. 2015; 92: 74-78.

13. Wisner ER, Zwingenberger AL. 'Abdomen', in ER. Wisner and AL. Zwingenberger, eds. Atlas of Small Animal CT and MRI: John Wiley & Sons, Inc. 2015; 489-614.

14. Patsikas MN, Papazoglou LG, Jakovljevic S, Dessiris AK. Color Doppler ultrasonography in prediction of the reducibility of intussuscepted bowel in 15 young dogs. Vet Radiol Ultrasound. 2005; 46: 313-316.

15. Evans H, de Lahunta A. 'The digestive apparatus and abdomen', in HE. Evans, ed. Miller's Anatomy of the Dog, Fourth edition: Elsevier Inc. 2013; 281-337.

16. Drost WT, Green EM, Zekas LJ, Aarnes TK, Su L, et al. Comparison of computed tomography and abdominal radiography for detection of canine mechanical intestinal obstruction. Vet Radiol Ultrasound. 2016; 57: 366-375.

17. Garcia-Sancho M, Rodriguez-Franco F, Rodriguez-Bertos A, Carrasco V, Villaescusa A, et al. Transient ileocolic intussusception in a dog with histiocytic ulcerative tiflocolitis: a case report. Vet Med. 2012; 57: 434-438.