Case Report

Rare form of gastrointestinal intussusceptions:

Report of two challenging canine cases

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Abstract

A 6-year-old crossbred dog and a 10-year-old Shih Tzu were presented with vomiting and were both diagnosed with intussusception in the gastroduodenal part via an ultrasonographic finding. In the first case, invagination of the pylorus, proximal duodenum and a segment of the right pancreatic limb into the gastric body were found following a laparotomy as a duodenogastric intussusception, whereas in the second case, the pyloric antrum was prolapsed into the proximal duodenum as a gastroduodenal intussusception. A manual reduction and a duodenopexy were performed in both cases. The tumor was excised from the proximal duodenum in the second case and the histopathological result was consistent with adenocarcinoma. Both cases made complete recoveries without the recurrence of intussusception within 24 months and 15 months, respectively, of the follow-up processes. While the first case continued well, recurrence and the metastasis of the intestinal tumor were addressed with a second round of surgery in the second case and the dog was euthanized. This report describes the unique case of canine duodenogastric intussusception with a pancreatic involvement and it is the first report of a canine gastroduodenal intussusception with an associated intestinal tumor in the veterinary literature, with surgical treatment being accomplished in both cases.

Keywords: dog, duodenogastric intussusception, gastroduodenal intussusception, intestinal tumor, pancreas

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Introduction

Intussusception is uncommon in adult dogs clinically and upper gastrointestinal involvement is an extremely rare (Barreau, 2008; Ragni and Moore, 2012). While there have been many medical reports indicating that the lead points of human upper intussusception are usually both benign and malignant gastroduodenal tumors (Behrooz and Cleasby, 2018; Chahla *et al*., 2014; Gyedu *et al*., 2011; Prakash *et al*., 2016; Rittenhouse *et al*., 2013; Sankaranunni *et al*., 2001; Vinces *et al*., 2005; Yildiz *et al*., 2016), the predisposing factors have been variable in canine cases. Gastrointestinal outflow obstruction is the most common sequential event which exhibits as a clinical sign**.** Because of its rarity, the treatment for this problem cannot be guided by formal information in veterinary medicine. The outcomes are variable depending on the severity of vascular compromise, abdominal organ association and the underlying cause. However, about one-half of the previous canine upper intussusception cases involved death postoperatively or euthanization (Bowersox *et al*., 1991; Lee *et al*., 2005; Lideo *et al*., 2010; Marks, 1983; Watson, 1997). To date, only two cases of pancreatic involvement in duodenogastric intussusception (Allman and Pastori, 2013; Bowersox *et al*., 1991) and one case of non-tumorous gastroduodenal intussusception (Watson, 1997) have been reported in the veterinary literature. With the rarity and poor prognosis of upper intussusception in dogs, the current study aimed to report the challenging case of duodenogastric intussusception with a prolapsing pancreas and also to discuss the first case report of gastroduodenal intussusception with a duodenal tumor, both being managed using surgical treatment. The outcomes are discussed in terms of treatment and recurrent prevention.

Clinical Description

Case 1

A 6-year-old intact female crossbred dog was presented at the emergency unit of the Kasetsart University Veterinary Teaching Hospital (KUVTH), Bangkhen campus, Thailand with a 5-day history of severe vomiting and anorexia. Despite normal abdominal ultrasonography, serum biochemistries were noted of remarkable elevations in blood urea nitrogen and creatinine in the referral information.

On physical examination, the dog was clinically lethargic with abdominal pain on palpation from the cranial-to-mid region. Diagnoses of acute pancreatitis and chronic kidney disease were made based on the laboratory results of complete blood count, serum biochemistry, venous blood gas, urinalysis and canine pancreatic lipase immunoactivity testing (SNAP® cPL™ test kit).

Supportive therapy was provided. The dog was admitted to the critical care unit to receive continuing treatment and stabilization on the day following presentation. During the 48 hours of monitoring, the vital signs were stable but severe vomiting still occurred after meals. Repeated abdominal ultrasonography was performed identifying the invagination of the proximal duodenum and surrounding mesentery into the dilated, fluid-filled gastric body (Figure 1). Multiple concentric hyperechoic and hypoechoic rings were presented. The gastric wall had severe thickening and a hypoechoic region was detected with suspected severe edema. No ultrasonographic evidence of pancreatitis was noted. A diagnosis of duodenogastric intussusception was made and abdominal exploration was elected to confirm the initial diagnosis and to provide treatment.

A duoneogastric intussusception was presented with the pylorus, proximal duodenum and right limb of the pancreas invaginated into the gastric body (Figure 2). Other abnormalities were not found. Manual traction was placed gently on the duodenal portion adjacent to the intussusception while the gastric body was milked at the tip of the intussusceptum. Following reduction, the intussuscepted organs were examined, indicating that the pyloric wall had thickened and the intussuscepted pancreatic segment was congested. The stomach was examined externally using digital palpation on the serosa wall. A small, incisional, full-thickness pyloric biopsy was performed on the thickened region. A digit was inserted inside to examine the mucosa and to evaluate the gastroduodenal outflow tract. No polyp was found within the stomach. The intussuscepted portion and the thickened wall did not compromise the outflow. The incisional area was closed with 3-0 polydioxanone in a simple interrupted pattern. A duodenopexy was performed with a 3 cm incision in the seromuscular layer of the antimesenteric border of the proximal duodenum at 3 cm caudal to the intussuscepted portion and a 3 cm incision was made on the musculo-peritoneum of the right dorsolateral abdominal wall. Both incisional lines were sutured to each other using a simple continuous pattern with 3-0 polydioxanone. The abdominal cavity was aseptically irrigated with warm isotonic saline solution and closed in a routine fashion.

The dog recovered well and admission was continued with the treatment of the concurrent disease. IV fluid was applied. Postoperative analgesia was provided using 0.3 mg/kg morphine (morphine sulfate, M & H Manufacturing Co., Ltd., Thailand) SQ every 4 hours for the first two days. This was followed by 5 mg/kg tramadol (Trosic, General Drugs House Co., Ltd., Thailand) IV every 12 hours with 100 mg/kg gabapentin (Vultin, Unison Laboratories, Co., Ltd., Thailand) orally every 12 hours. The empiric antimicrobial treatment was administered using a combination of metronidazole (Metrolex®, Siam Bheasach Co., Ltd., Thailand) IV 15 mg/kg every 12 hours and imipenem-cilastatin (Sianem, Siam Pharmaceutical Co., Ltd., Thailand) IV 5mg/kg every 8 hours. The injectable metronidazole was discontinued after 3 days and replaced with a metronidazole tablet 15 mg/kg orally every 12 hours. The dog was also given hyoscine (hyoscine-N-butylbromide, GPO, Thailand) IV 0.5 mg/kg every 12 hours, ondansetron (Onsia, Siam Pharmaceutical Co., Ltd., Thailand) IV 0.5 mg/kg every 12 hours, omeprazole (Solcer, Mylan Laboratories, Ltd., India) IV 1 mg/kg every 24 hours, meropitant (Cerenia, Zoetis, Belgium) SC 1 mg/kg every 24 hours and sucralfate (Ulsanic™, Siam Bheasach Co., Ltd., Thailand) PO 50

mg/kg every 8 hours.

A small amount of water was offered 12 hours after surgery and followed by multiple small amounts of a low-fat diet component food 12 hours later, which the volume was calculated based on the caloric density. At commencement, the food was introduced with one-third of the resting energy requirement (RER) and divided into four meals per day then gradually increased in volume daily. The dog's normal diet including cooked skinless chicken and boiled egg was slowly reintroduced combined with the prescription diet at four days postoperative. No vomiting occurred and soft stool defecation was noted during post-operative hospitalization.

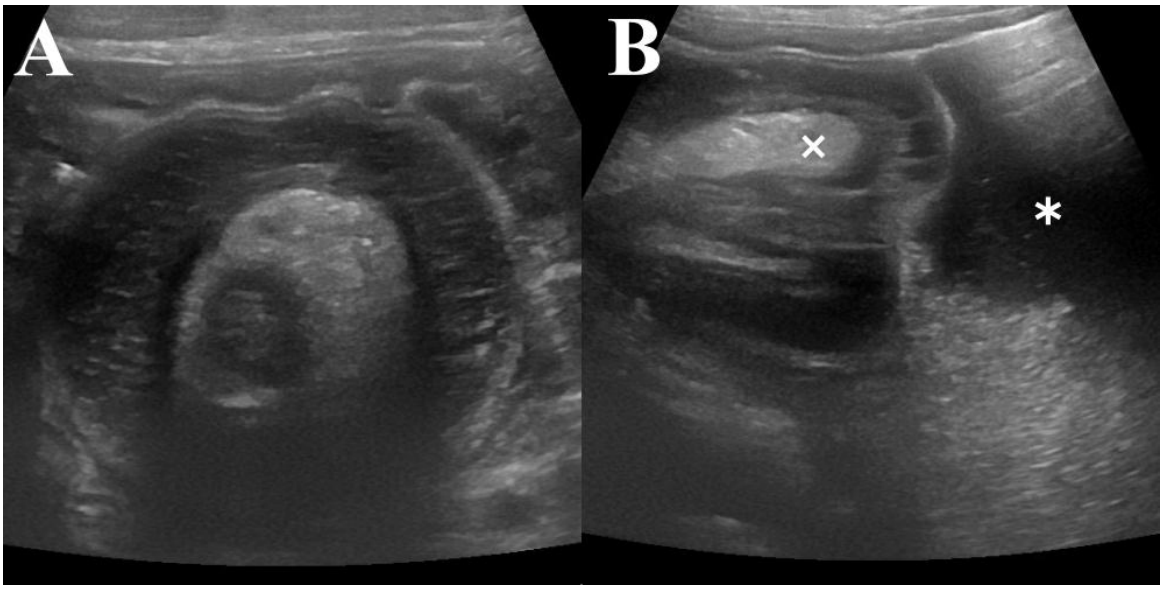


Figure 1 Transverse (A) and longitudinal (B) ultrasonographic images of gastroduodenal portion of a 6 year-old intact female crossbred dog with severe vomiting (case 1), demonstrating multiple concentric hyperechoic and hypoechoic rings in the gastroduodenal portion and the proximal duodenum and surrounding mesentery (X marker) prolapsed into the gastric body (asterisk).

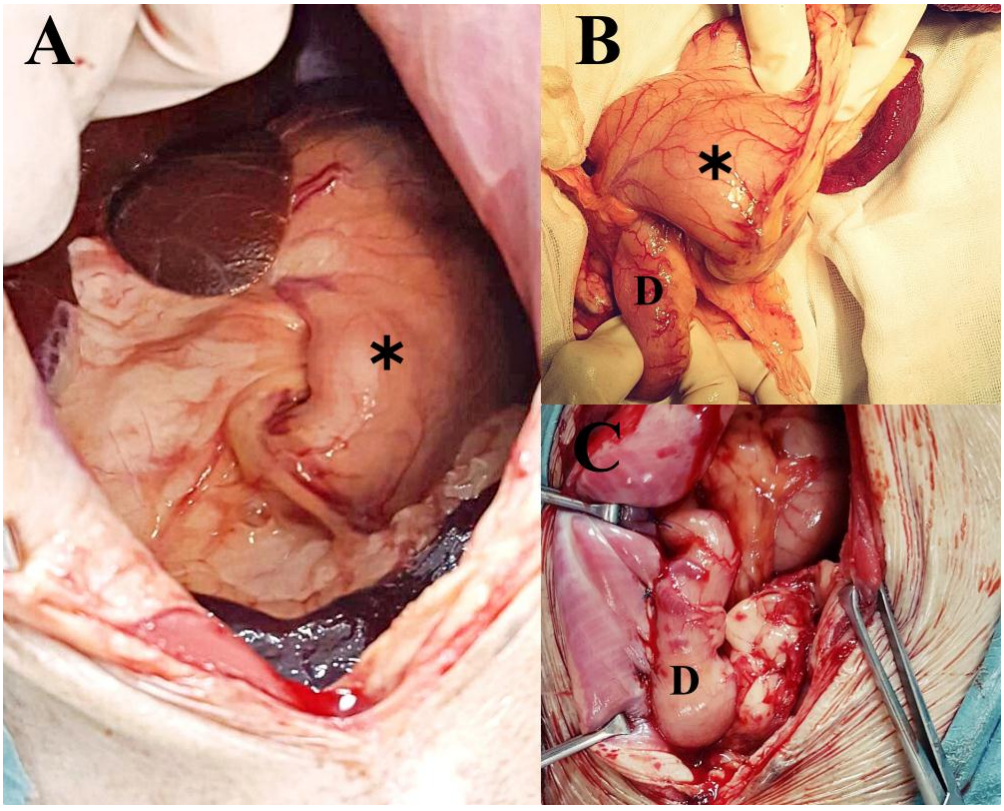


Figure 2 Intraoperative view of the duodenogastric intussusception in case 1.
(A) Pylorus, proximal duodenum and right limb of pancreas invaginated into the stomach.
(B) Manual reduction performed.
(C) Duodenopexy at the right dorsolateral abdominal wall.
The asterisk indicates the stomach and the D marker indicates the remaining duodenal portion external to the intussusception.

Histopathological examination revealed edematous of the pyloric submucosa. no evidence of a tumor was found. The dog was discharged in an improved state at nine days after surgery. The dog has been presented for regular follow-up treatment of the concurrent disease and to monitor clinical signs. After two years of follow-up, the dog has shown no symptoms of a recurrence.

Case 2

A 10-year-old intact male Shih Tzu was presented to KUVTH for evaluation after A 1-month history of anorexia and intermittent vomiting. A small volume of vomitus was presented about twice a day intermixed with episodic normal clinical signs.

On physical examination, the dog was moderately dehydrated and was tense upon abdominal palpation. Based on laboratory studies of complete blood count, serum biochemistry and venous blood gas, blood glucose concentration, urinalysis and the coagulation profile, abnormalities were noted of leukocytosis with toxic neutrophils, increased alanine transaminase, increased alkaline phosphatase, and mild prolongation of PT and TT.

Supportive treatment was provided using intravenous fluid therapy to correct the hydration and to maintain the fluid status. Antiemetic drugs were administered. The electrolyte and acid-base status were monitored. Vomiting did not occur during the 24 hours of treatment. Abdominal ultrasonography was performed on the next day. A mass was found at the gastric antrum and showed multiple layers of the gastrointestinal wall inside, which was possibly an intussusception (Figure 3). The gastric wall was prominent and the pancreas was swollen with heterogenous hyperechoic surrounding fat.

On abdominal exploration, a gastroduodenal intussusception was found with the pyloric antrum displacing into the proximal duodenum (Figure 4). There was also distal common bile duct dilatation secondary to the gastroduodenal outflow obstruction. The reduction was done manually. The survey examination was performed and a ~3 cm intraluminal mass was found on the antimesenteric side of the proximal duodenum. The dog underwent mass excision with resection of the affected intestinal wall. The tissue was submitted for histopathological evaluation and the proximal duodenum was closed transversely with 4-0 polydioxanone in a simple interrupted pattern. A duodenopexy was performed to the right dorsolateral abdominal wall using a similar procedure to that in case 1 above. The pancreatic parenchyma was firm and a biopsy was also taken. The rest of the exploratory examination was within normal limits. The abdominal cavity was aseptically irrigated using warm isotonic saline solution and closed in a routine fashion.

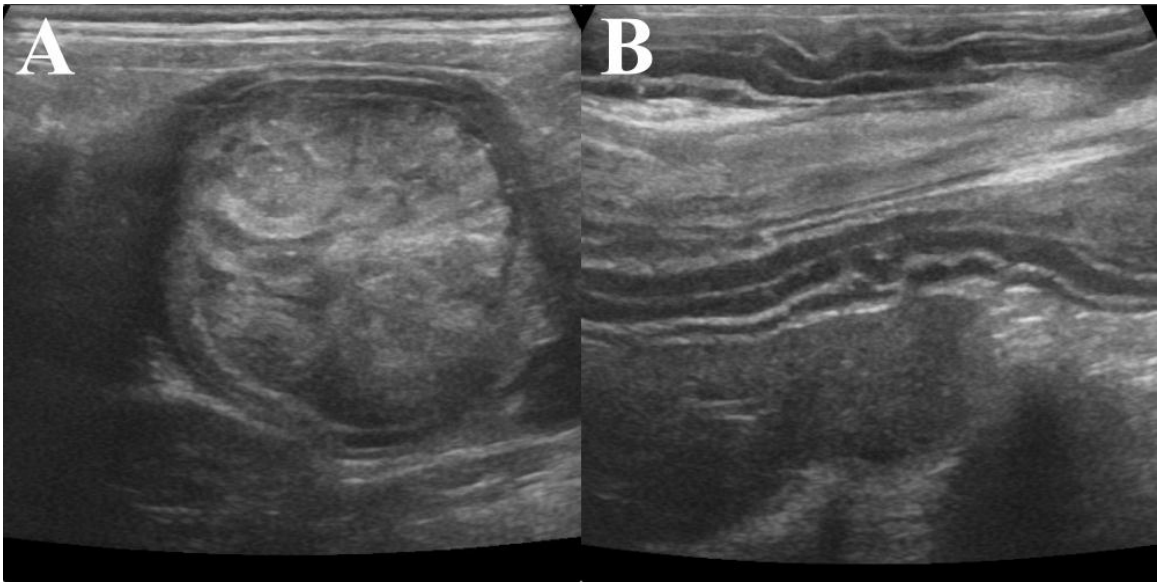


Figure 3 Transverse (A) and longitudinal (B) ultrasonographic images of gastroduodenal portion of a 10 year-old intact male Shih Tzu with intermittent vomiting (case 2), indicating a large soft tissue mass located in the pyloric region and multiple concentric hyperechoic and hypoechoic lines identified in both views of the gastroduodenal portion.

The dog recovered uneventfully from the surgery. IV fluid was continued and postoperative analgesia was provided using 0.2 mg/kg morphine (morphine sulfate, M & H Manufacturing Co., Ltd., Thailand) SQ every 4 hours in the first day. This was followed by 5 mg/kg tramadol (Trosic, General Drugs House Co., Ltd., Thailand) SC every 8 hours. The empiric antimicrobial treatment was administered using a combination of metronidazole (Metrolex®, Siam Bheasach Co., Ltd., Thailand) IV 20 mg/kg every 12 hours and imipenem-cilastatin (Sianem, Siam Pharmaceutical Co., Ltd., Thailand) IV 5 mg/kg every 8 hours. The injectable metronidazole was discontinued after 2 days and replaced with a metronidazole tablet 20 mg/kg orally every 12 hours. The dog was also given hyoscine (hyoscine-N-butylbromide, GPO, Thailand) IV 0.5 mg/kg every 12 hours during the 72 hours after surgery.

Twelve hours after surgery, a small amount of water was offered and followed by a brand diet with one-third of RER 12 hours after. The food was divided into four meals per day and was gradually increased in volume daily.

However, during the postoperative period the dog developed worsening anemia requiring a blood transfusion; vomiting was not observed during admission and the animal was discharged in improved condition on day 12.

The histopathological findings revealed duodenal adenocarcinoma with the tumor cells only invading mucosal layers (Figure 5). The pancreatic biopsy showed hemorrhagic foci at the periphery of the pancreas and moderate-to-locally-extensive chronic necrotizing pyogranulomatous cellulitis of adipose tissue.

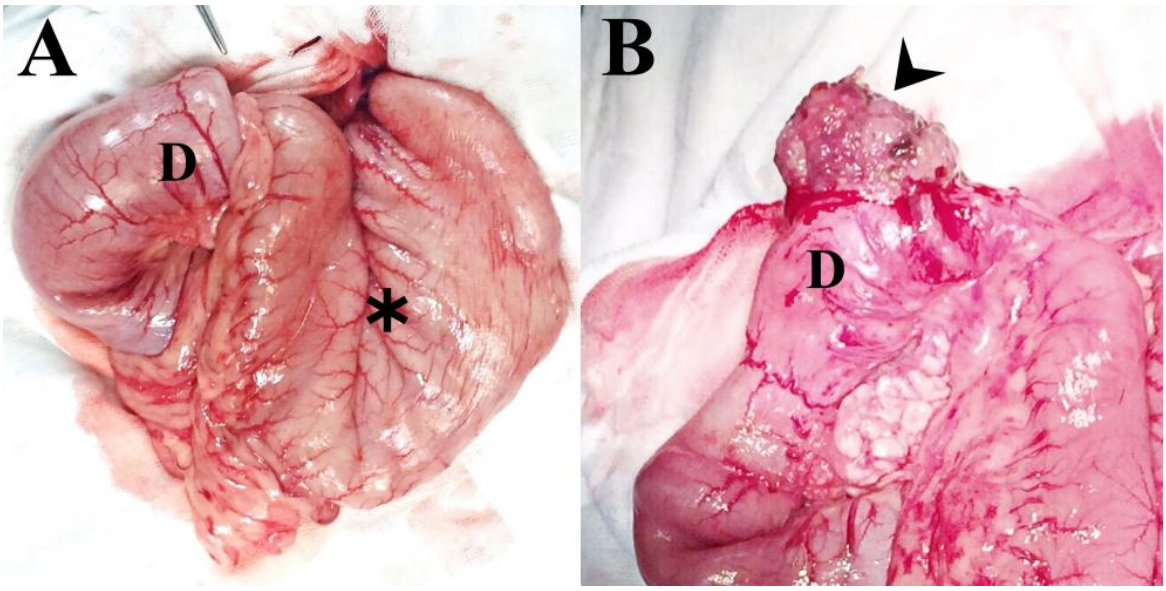


Figure 4 Intraoperative view of the gastroduodenal intussusception in case 2.
(A) Pylorus invaginated into the proximal duodenum (D marker). The asterisk indicates the body of the stomach.
(B) Intraluminal mass (arrowhead) on the antimesenteric side of the proximal duodenum (D marker).

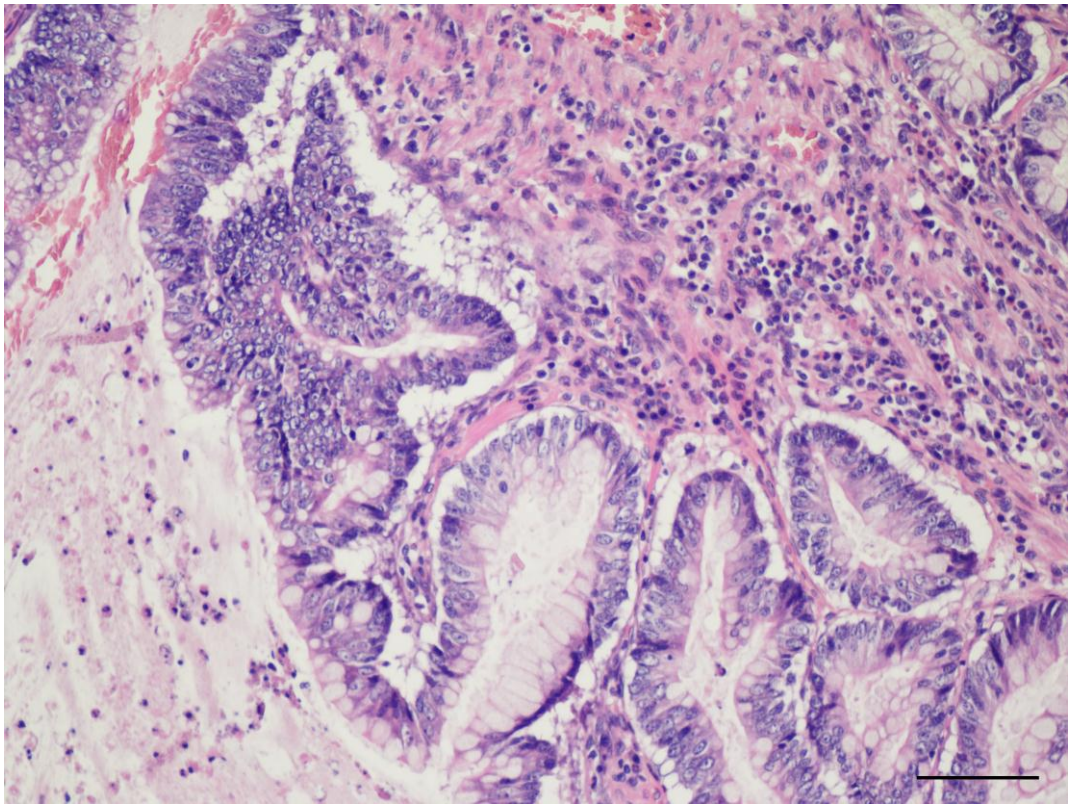


Figure 5 Photomicrograph of a section of the duodenal mass in case 2, revealing atypical hyperplastic epithelial cells arranged in tubules with papillary projection toward the luminal center. These mucosal layers are lined by single-to-multiple layers of atypical epithelial cells. Some normal epithelial cells were noted adjacent to cancerous cells. Tumor cells had a high n/c ratio, scant cytoplasm and a large vesicular nucleus with prominent nucleolus with moderate hyperchromasia, anisocytosis, and anisokaryosis. The mitotic figure was approximately 3/hpf. Tumor cells only invaded mucosal layers. Infiltration of lymphocytes and plasma cells was noted in lamina propria. Taken together, this tumor was characterized as a duodenal adenocarcinoma, tubulopapillary type with T1NxMx. H&E stain; bar = 50 μm.

Over the following period, the dog's clinical condition improved without any recurrent evidence of the gastroduodenal intussusception. Abdominal ultrasonography was provided routinely for monitoring. Fifteen months after surgery, the dog had intermittent vomiting. Abdominal ultrasonography and a CT scan indicated an enhanced mass at the proximal duodenum where it had been previously removed and the recurrence of intestinal adenocarcinoma was suspected. A second abdominal exploratory incision was performed revealing metastases on the duodenal loop extending to the pyloric antrum with the common bile duct and hepatic duct dilatation due to severe biliary obstruction. The pancreas was firm and congestion suggested tumor metastases. With the owner's consent, the dog was eventually euthanized.

Discussion

In dogs, intussusceptions frequently occur in the young age group, being located in the jejunum, proximal ilium and ileocecal junction (Barreau, 2008; Ragni and Moore, 2012). Adult canine intussusception is uncommon and intussusception at a gastroduodenal region is extremely rare. Duodenogastric intussusception (DGI) is a retrograde invagination of the duodenal segment into the gastric body while gastroduodenal intussusception (GDI) is a normograde type. Unlike in humans, etiologies of adult canine upper gastrointestinal intussuceptions are variable regarding non-tumor factors including dietary indiscretion and foreign bodies (Allman and Pastori, 2013; Applewhite *et al*., 2001; Bowersox *et al*., 1991; Marks, 1983). Some are due to unknown causes (Choi *et al*., 2012; de Brito Galvao *et al*., 2011; Lideo *et al*., 2010). In addition, other concurrent diseases associated with severe gastroenteritis have been advocated as predisposing factors (Huml *et al*., 1992; Lee *et al*., 2005; Watson, 1997). The precise etiology has been unclear due to the low number of reported cases. Our first case shared similarities with previous reports in the predisposing factor. Chronic renal failure and pancreatitis cause severe vomiting due to gastritis and the release of inflammatory mediators which are the lead points. However, there was an important difference with regard to the tumorous lesions in the second case for which there have been no previous reports in the veterinary field. We suggest a pathophysiological mechanism of the etiology that may lead to the upper intussusception, in which any conditions that alter the normal gastrointestinal motility or outflow could be a contributing factor and aggravate the severity of this problem.

The symptoms are not disease-specific but most of them, including those in the current report, presented with similar obstructive signs such as severe vomiting, abdominal pain and anorexia (Allman and Pastori, 2013; Applewhite *et al*., 2001; Bowersox *et al*., 1991; Choi *et al*., 2012; de Brito Galvao *et al*., 2011; Huml *et al*., 1992; Lee *et al*., 2005; Lideo *et al*., 2010; Marks, 1983; Watson, 1997). Abdominal ultrasound was valuable in identifying the location, reaching a diagnosis and providing adequate details for an effective treatment plan as was performed in the two cases in the current study. However, in humans, computed tomography has been used for entire, comprehensive abdominal screening and has revealed the relationships among the other organs in upper intussusception cases (Behrooz and Cleasby, 2018; Chahla *et al*., 2014; Prakash *et al*., 2016; Rittenhouse *et al*., 2013; Vinces *et al*., 2005; Yildiz *et al*., 2016). Endoscopy was one of the choices for diagnosis and treatment in previous reports in both dogs and humans. This allows the evaluation of intraluminal gross appearances, the collection of specimens and noninvasive reduction from the inside area (Allman and Pastori, 2013; Chahla *et al*., 2014; de Brito Galvao *et al*., 2011; Prakash *et al*., 2016; Vinces *et al*., 2005; White *et al*., 1991). If these procedures have been or are unlikely to be accomplished, surgical intervention should be considered for patients with severe outflow obstruction.

Canine GDI/DGI have only been noted in case reports in the veterinary literature. With the reported variable outcomes, it is difficult to recommend suitable treatment and prognosis. There have been two cases of pancreatic involvement in DGI (Allman and Pastori, 2013; Bowersox *et al*., 1991) and one of them was euthanatized due to subsequent abdominal soft tissue trauma with severe necrosis (Bowersox *et al*., 1991). Furthermore, only one case of GDI has been published to date which was also euthanatized perioperatively because of a duodenal perforation under manipulation and a critical fragile necrotic area (Watson, 1997). Other reports of upper intussusceptions have also shown a high rate of poor prognosis with 40% mortality including severe conditions such as abdominal tissue necrosis, electrolyte imbalances, uncontrolled cardiovascular status and suffering from an underlying disease which contributed to death or being euthanized (Lee *et al*., 2005; Lideo *et al*., 2010; Marks, 1983). Conversely, some cases reported spontaneous reduction within the treatment period (Choi *et al*., 2012; Lee *et al*., 2005).

A few treatment options have been applied for treating DGI/GDI. In our cases, the choice of surgery was influenced by prior information from the imaging and clinical findings that included expanding the investigation to any associated abdominal organs. Of concern was that pancreatic prolapsing was found perioperatively in case 1. It was presumed to have compromised the pancreatic duct outflow and led to pancreatitis. Moreover, not undertaking any treatment carries a high risk of severe inflammation and necrotic progression in the surrounding abdominal organs, resulting in life-threatening conditions. Manual reduction was successful in our cases due to early detection and there being less vascular compromise. Some cases performed a gastrotomy to facilitate the reduction (Applewhite *et al*., 2001; Choi *et al*., 2012; Huml *et al*., 1992; Marks, 1983) and a partial gastrectomy was provided for the necrotic area in one case (Choi *et al*., 2012). For better outcomes, after initial stabilization, emergency surgery should be followed for every intussusception of the upper gastrointestinal tract that causes severe outflow obstruction.

Although there are no reported cases of recurrent GDI/DGI without surgical treatment in veterinary literatures (Choi *et al*., 2012; de Brito Galvao *et al*., 2011; Lee *et al*., 2005) and complications of gastrointestinal

tract plications should be of concern, duodenopexy was recommended in our two cases. This decision was based on the concurrent problems of chronic renal disease with pancreatitis in case 1 and a gastrointestinal tumor in case 2, in which vomiting occurred. Severe vomiting is the identifiable condition and the predisposing factor in terms of both the primary cause and the expectable cause of recurrent evidence of intussusception. In addition, with the unknown duodenal mass at the time of the first exploration in case 2, the recurrence of that tumor could act as a lead point for future recurrent intussusception. With these unpredictable postoperative outcomes, plication of the duodenum was expected as a prophylactic treatment.

Case 2 is the first report of an upper gastrointestinal intussusception associated with a gastrointestinal tumor in the veterinary literature. Conversely, in humans, there have been many reports of upper intussusception (in which the majority of cases were caused by gastric tumors) and many reports of pancreatitis with GDI induced by gastrointestinal obstruction due to a pedunculated lesion of the lumen (Behrooz and Cleasby, 2018; Chahla *et al*., 2014; Gyedu *et al*., 2011; Prakash *et al*., 2016; Rittenhouse *et al*., 2013; Sankaranunni *et al*., 2001; White *et al*., 1991; Vinces *et al*., 2005; Yildiz *et al*., 2016). Evidence was obtained from biopsy in our two cases from the questionable area perioperatively. In case 2, the tumorous lesion was found arising from the mucosa of the proximal duodenum and expanding to the intraluminal area. The histopathological result was adenocarcinoma. This could cause a mechanical outlet obstruction and compromise normal peristalsis where the intussusception was induced. In addition, the intussusception might have been a result of severe vomiting from acute pancreatitis with the mass causing compression of the common bile duct and the pancreatic ducts at the duodenal papillae.

Adenocarcinoma is one of the most common intestinal malignancies leading to intussusception in middle-to-old-aged dogs and originates in both small intestine and large intestine. Furthermore, a pyloric antrum is a common occurrence with this type of tumor. Gastrointestinal adenocarcinoma tends to invade locally with slow progression. The clinical signs are not specific depending on the size of the mass, the location, the metastases and the associated organs. Accordingly, most of the cases are asymptomatic in the early stage and the tumors are only detected when an outflow obstruction occurs. Abdominal radiography, contrast radiography, ultrasonography, CT scanning, endoscopy and laparoscopy can provide details of the tumor, the metastases and assist in sample collection (Culp *et al*., 2012; Frgelecová *et al*., 2013; Head *et al*., 2002; Paoloni *et al*., 2002; Selting, 2012; Swann and Holt, 2002; Withrow, 2007).

In case 2, the local resection of the duodenal tumor was attempted over a wide excision or via bypass procedures due to the consideration of postoperative complications, the current condition and the intussusception. With a questionable outcome, the likelihood high of morbidity was a concern in this case peri-to-post operatively. Clinical improvement was noted in the postoperative follow-up period for more than a year. Thus, in considering the appropriate surgical procedures regarding a proximal duodenal tumor in each case, the surgeon should weigh up the future benefits against possible complications. Hydration, electrolyte, and acid-base abnormalities should be corrected and monitored in both preoperative and postoperative treatment.

The recurrence of clinical signs in case 2 occurred 15 months after the first surgery, which was at the upper end of the survival time previously reported of 3-15 months following surgical treatment. The median survival time of intestinal adenocarcinoma is 12 days in untreated dogs. Most previously cases reported either a recurrence or metastasis, with 40% of cases reporting metastasis at the time of diagnostic exploration. The 1 year survival rate was 20% and 66.7% with and without lymph node metastasis, respectively (Birchard *et al*., 1986; Crawshaw *et al*., 1998; Selting, 2012). Similarly, the prognosis of gastric adenocarcinoma was not good in the long-term results with survival of only up to 8 months in surgically treated dogs and less than 3 months without treatment (Swann and Holt, 2002). In the second exploratory in case 2, complete excisions were considered, including a partial gastrectomy with pylorectomy, resection of the proximal duodenum and a total pancreatectomy, followed by gastrojejunostomy and cholecystojejunostomy. The dog was euthanized because of the high mortality and mobility rates of these risky surgical procedures with the assumed poor prognosis based on the type of tumorous metastases.

In conclusion, we presented two cases of rare canine upper intussusception; one involving DGI with pancreatic invagination and the other one being the first report of canine GDI occurring with intestinal malignant neoplasm in the veterinary field. Both cases were treated successfully using surgery. Thus, duodenogastric and gastroduodenal intussusception should be listed as differential diagnoses in any ages of dogs with a clinical finding of upper gastrointestinal obstruction. Regardless, either pancreatic involvement or a gastrointestinal tumor should be included in the investigation. Rapid identification and treatment are necessary to achieve remarkable success.

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