

*Short Communication*

## CLINICAL MANIFESTATION OF CANINE CORONAVIRUS ENTERITIS AND INTESTINAL INTUSSUSCEPTION AS ITS COMPLICATION

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**ABSTRACT:** *Canine Coronavirus (CCV)* is an important pathogen of dogs within the scope of canine enteritis complex, especially in puppies and young dogs, which may result in intestinal position changes such as invagination and/or intussusception. In this report, a 3-month-old male mixed breed dog with non-specific complaints such as loss of appetite, vomiting, hemorrhagic diarrhea, and suspected intestinal intussusception as a result of abdominal palpation was presented. Clinical examinations included physical, laboratory, radiographic, and ultrasonographic examinations. As a result of laboratory and ultrasonographic examinations, metabolic acidosis, hyperlactatemia, severe hypochloremia, anemia, and ileocecolic intussusception were determined. Also, rapid diagnostic test results were negative for *Canine Parvovirus (CPV)* and *Giardia* but positive for CCV. In order to confirm the diagnosis of ileocecolic intussusception, an exploratory laparotomy was performed. After the preparation and appropriate disinfection and sterilization procedures of the abdominal region, jejunocolic entero-anastomosis was performed as a surgical intervention. The dog was re-evaluated after 12 hours of hospitalization period after the operation. It was determined that vital and blood parameters were within reference ranges. As a result, it was concluded that clinicians should be vigilant of possible CCV infections where CPV has been ruled out and life-threatening conditions such as intestinal intussusceptions can occur as a result of CCV infection.

**Key words:** Complication, Intussusception, Laparotomy, Radiography, Ultrasonography.

Acute enteritis is a life-threatening condition, especially in puppies, when results in hypovolemia, anemia, and severe dehydration (El-Baky *et al.* 2017, Kumar *et al.* 2014, Evermann *et al.* 2005). Acute enteritis may arise from viral agents such as *Parvovirus* and *Coronavirus* (Gulersoy *et al.* 2020, Hoskins 1997, Evermann *et al.* 2005); bacterial agents such as *Salmonella*, *Escherichia coli* (Prada *et al.* 1991); parasites such as *Dipylidium caninum* and *Ancylostoma* (Kumar *et al.* 2014) and/or intestinal position changes such as invagination and/or intussusception (Cerna *et al.* 2019). The importance of concurrent viral infections such as *Canine Parvovirus (CPV)*, *Canine Rotavirus*, and *Canine Coronavirus (CCV)* as a cause of severe fatal enteritis in dogs was initially speculated based on case investigations. However, CCV was generally regarded

as a mild and usually sub-lethal viral infection of young dogs (Evermann *et al.* 2005).

Intussusception is defined as a prolapse of a part of the intestine into the lumen of an immediately adjoining part (Cerna *et al.* 2019, Lideo *et al.* 2010). In dogs and cats, it was reported that intussusceptions most commonly occur at the ileocecolic junction and puppies and kittens have a higher incidence than adults (Lideo *et al.* 2010). Intussusception of the organs generally leads to an interruption in arterial blood supply leading to cyanosis and necrosis thereby (Bisla *et al.* 2022).

Although intestinal parasites, linear foreign bodies, and enteritis due to viral agents are considered predisposing factors in the formation of this condition, most cases in young animals are reported to be idiopathic (Lewis and Ellison 1987). Common clinical findings are regurgitation, vomiting, dyspnoea, hematemesis, flatulence, and dilated

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bowels which may vary depending on the severity, duration, and degree of intussusception. In addition to the aforementioned non-specific findings, the most important clinical finding is palpable sausage-like bowel segments in the form of cylinders. If the intussusception is in the ileocecolic junction, this area can be palpated from the cranial abdomen (Cerna *et al.* 2019, Lewis and Ellison 1987).

In this report, the clinical manifestation of CCV infection, which is considered to be milder than CPV infection within the scope of canine enteritis complex, laboratory analyses, diagnosis, and surgical treatment of ileocecolic intussusceptions that occurred as a complication of CCV infection are presented. Thus, it was aimed to emphasize the clinical importance and complications of CCV infection in young dogs.

### Case study

The case of this report involved a 3-month-old, male, mixed breed dog who was admitted to the Animal Hospital of the Faculty of Veterinary Medicine, Harran University with non-specific complaints such as loss of appetite, vomiting, and hemorrhagic diarrhea. Anamnestic data revealed that the dog was adopted from a shelter 10 days ago and had had hemorrhagic diarrhea since the day he was adopted. In addition, before admitting to the Animal Hospital, the owners reported that fluid therapy (0.9% NaCl solutions) was administered to the dog in a private vet clinic for hemorrhagic diarrhea.

### Clinical Examinations

Respiratory rate (64 breaths/minute), heart rate (136 beats/minute), and body temperature (39.6 °C) measurements along with lymph nodes and abdominal palpations were performed. Crackle sounds were evident during lung auscultation. Although no murmur was heard on heart auscultation, the dog was normocapnic with an irregular rhythm. The lymph nodes were determined to be painless and normal in size while sausage-like, cylindrical dilated bowel segments were quite prominent in the abdominal palpation.

### Laboratory Examinations

Following the clinical examination, blood gas and complete blood count (CBC) analyses (Epoch, Siemens, USA for blood gas and Sysmex pocH-100, Canada for hemogram analysis) were performed. Also, for the determination of the etiology of hemorrhagic diarrhea, rapid diagnostic tests (Anigen®, CPV/CCV/Giardia Antigen rapid test, Korea, chromatographic immunoassay for the qualitative detection of *Canine Parvovirus*,

*Canine Coronavirus*, and *Giardia* antigen in canine feces. For CPV; Sensitivity: is 100% specificity: of 98.8%, and for CCV; Sensitivity: is 93.1% specificity: 97.5% compared to PCR. For *Giardia*; the detection limit: 125/100 µl) and microscopic fecal examinations (multiple fecal flotation method, x100 magnification) were performed.

In addition to the clinical and laboratory examinations, radiographic and ultrasonographic examinations were performed for further diagnosis. Left latero-lateral radiographic examination revealed abdominal effusion and a gas-filled distended colon (Fig. 1). On ultrasonographic examination (5 MHz convex probe) “target” or “bull’s eye” -like sign in the ileocolic region was observed (Fig. 2).

As a result of blood gas and CBC analyses, metabolic acidosis (pH: 7.2, BE: -15.2 mmol/L, HCO<sub>3</sub>: 13.1 mmol/L), hyperlactatemia (11.1 mmol/L), severe hypochloremia (83 mmol/L) and anemia (RBC: 5.13 M/mm<sup>3</sup>, Hct: 34%, Hb: 10.2 g/dl) were determined. Rapid diagnostic test results were negative for CPV and *Giardia* but positive for CCV. Microscopic examination revealed the absence of parasitic eggs in the feces. Blood gas and CBC analysis results are presented in Table 1. As a result of clinical, laboratory, radiographic, and ultrasonographic examinations, ileocecolic intussusception was suspected and exploratory laparotomy was decided.

### Treatment and outcome

Before the surgical intervention, intravenous fluid therapy (60 ml/kg 0.9% NaCl solution mixed with 1 to 5 mEq/kg of body weight sodium bicarbonate) was administered to correct dehydration and electrolyte imbalance. The anesthesia protocol consisted of 6 mg/kg propofol (Propofol 1%®, Fresenius Kabi, Australia) and Sevoflurane (Sevorane®, USA) administrations along with oxygen therapy (22 ml/kg/min). The abdominal region was prepared for surgical intervention (clipping the area in the pre-operating room and sterilization of the area with appropriate disinfection and sterilization procedures). After that, the dog was placed on the operating table in the dorsal recumbency and the abdominal region was prepared for the operation (appropriate disinfection and sterilization procedures were repeated). A skin incision of 10-12 cm longitudinal, 5-6 cm caudally to the xiphoid process of the sternum was made. The abdominal cavity was reached by excluding the skin, subcutaneous connective tissue, and abdominal muscles using sterile blunt scissors. Incision lips were grasped and fixed with toothed forceps. The intestinal loops were carefully manipulated along a borderline of the ileocecal structure until the invaginated area. A moderately enlarged colon

with proximal to distal invagination, including the ileum, caecum, and a part of the ascending colon, was observed (Fig. 3). During manual reduction, it was determined that the intussusceptum was swollen and ruptured. Hence, resection and anastomosis were performed as the manual reduction was not possible. Accordingly, jejunocolic enteroanastomosis was performed using an absorbable suture with a 4-0 (polyglycolic acid - PGA) thread in a Lembert suture pattern. After repositioning the intestine in the abdominal cavity, the incision line was closed with a simple interrupted suture pattern using suture 2-0 PGA.

After the laparotomy, the dog was taken to an intensive care unit with adjustable temperature and oxygen levels. In the context of post-operative care, fluid therapy (Lactated Ringer's solution®, Eczacıbası, 40 ml/kg, IV), vitamin-amino acid supplementation (Duphalyte® Zoetis, 5 ml/kg IV), and gentamicin sulfate (Gentivet® 2 mg/kg IV) administrations were made. Blood gas and CBC analyses were repeated 12 hours after the laparotomy and it was observed that the vital and blood parameters were within reference ranges (Table 1). The dog was discharged from the hospital after a 24-hour hospitalization period in the intensive care unit and it was learned from the owners with a phone call that the dog started to consume liquid foods slowly after 24 hours.

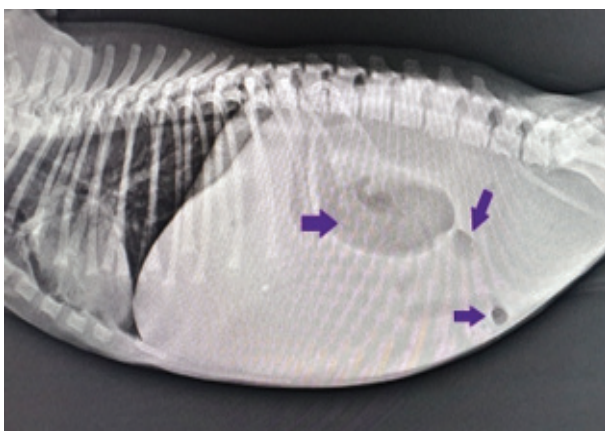
### Discussion

This report highlights a case of severe enteritis due to CCV alone and ileoceccocolic intussusception as its complication. Although CPV comes to mind first in the clinical manifestation which is characterized by vomiting and hemorrhagic diarrhea in unvaccinated young puppies (Evermann *et al.* 2005), it was determined that the dog was infected with CCV as a result of rapid diagnostic

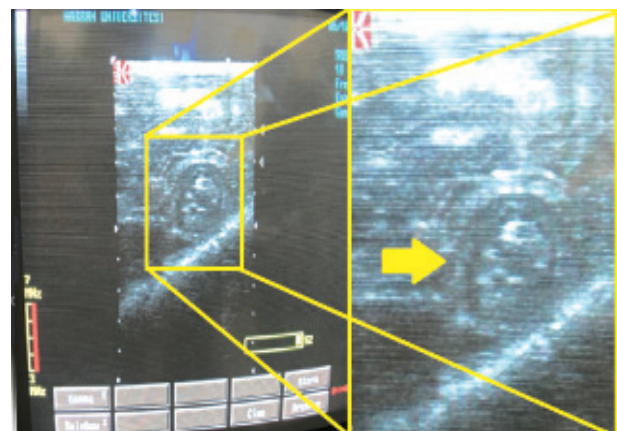
tests. Also, the clinical, laboratory, radiographic, and ultrasonographic examination findings of the dog in the present report were consistent with previous reports (El-Baky *et al.* 2017, Lewis and Ellison 1987, Perisé-Barrios *et al.* 2021).

*Canine coronavirus* (CCV) is an important pathogen in dogs worldwide, especially in animal shelters. Although it rarely causes fatal systemic diseases, gastrointestinal symptoms such as vomiting and hemorrhagic diarrhea, as well as systemic findings such as serosanguinous effusion in the abdominal cavity have been reported (Perisé-Barrios *et al.* 2021). Haematologically, regenerative anemia, neutrophilic leukocytosis, or leukopenia with lymphopenia, thrombocytopenia, and monocytosis have been reported (Castro *et al.* 2013). Due to vomiting and hemorrhagic diarrhea, dehydration, acid-base imbalances such as severe base deficit, hyperlactatemia, and hypochloremia have also been reported (Cerna *et al.* 2019, Lewis and Ellison 1987). In the present report, it was interpreted that pre-operative laboratory results such as severe metabolic acidosis was resulting from loss of bicarbonate due to hemorrhagic diarrhea (Gulersoy *et al.* 2020, Kumar *et al.* 2014); hypochloremia resulting from decreased intestinal absorption due to ileoceccocolic intussusception and vomiting (Lewis and Ellison 1987); low hematocrit and erythrocyte with high mean corpuscular volume levels was resulting from intestinal bleeding (Hoskins 1997) and hyperlactatemia was resulting from hypo-perfusion and necrosis of the intussusception area (Cerna *et al.* 2019, Lewis and Ellison 1987).

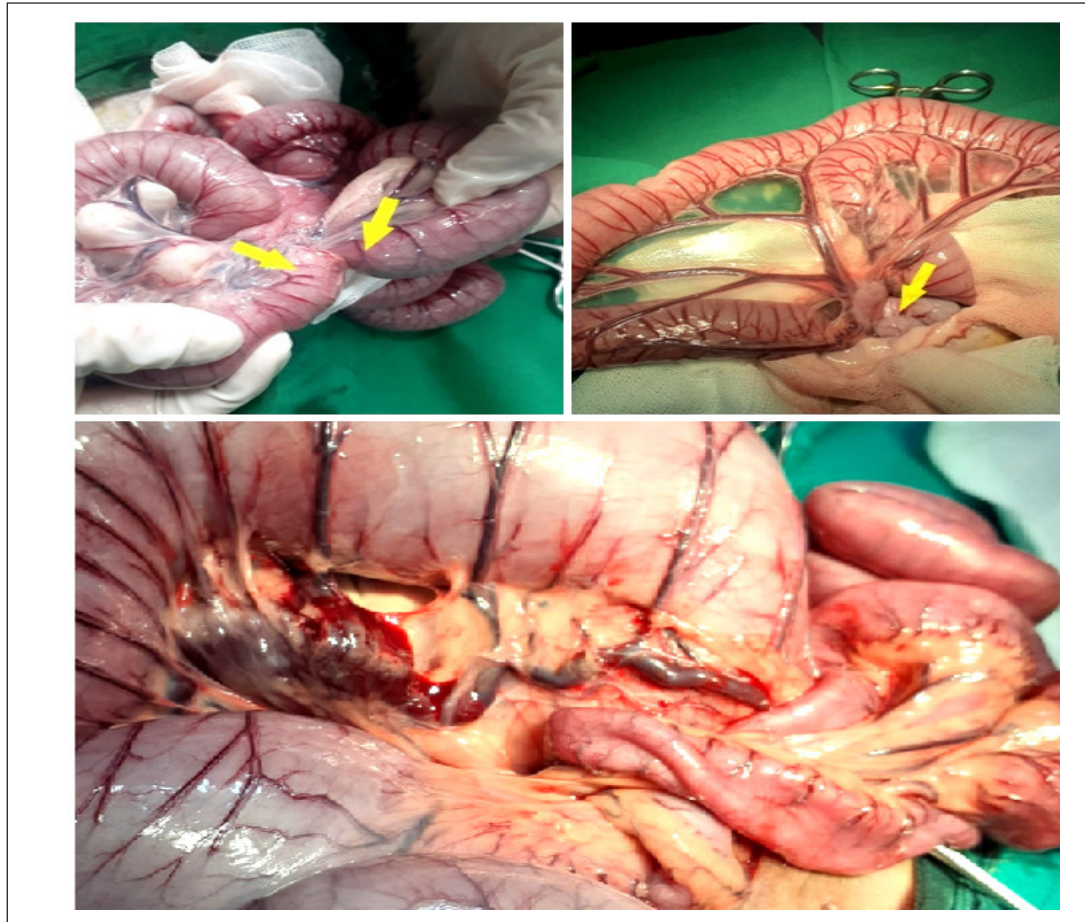
Intussusceptions, which are common in puppies and young dogs, can occur anywhere in the digestive tract and most cases are in the normal peristaltic direction



**Fig. 1.** Latero-lateral abdominal radiography (arrows indicate gas-filled loops of the intestine).



**Fig. 2.** Ultrasonographic image of the intestinal intussusception (yellow arrow indicates target-like or bull's-eye appearance).



**Fig. 3. Findings observed during laparotomy.** [From left to right] 1. Intestinal intussusceptions around the invaginated part. 2. Invaginated intestinal segment. 3. Close up image of the invaginated segments and evident necrosis (Yellow arrows indicate the relevant region).

(Cerna *et al.* 2019). Although the etiology is generally not known, enteritis (viral or parasitic), neoplasia, and the presence of foreign bodies are accepted as possible predisposing factors (Cerna *et al.* 2019, Lewis and Ellison 1987). The prognosis of intestinal intussusception depends on the anatomical location of the intussusception, duration, and completeness of the obstruction. Depending on the underlying aetiological diseases such as CPV or CCV enteritis, morbidity and mortality of intestinal intussusception may even increase (Lewis and Ellison 1987). Interestingly, it has been reported that cases of intussusceptions can occur in Crohn's and ulcerative colitis diseases, especially in humans, and a spontaneous recovery rate of 87.5% is observed (Maconi *et al.* 2007). However, in dogs, spontaneous recovery has been reported rarely in intussusception cases (Garcia-Sancho *et al.* 2012). In this report, considering the clinical findings that had existed for more than 10 days before admission, it was concluded that spontaneous recovery is difficult without surgical intervention.

Intussusception in companion animals is difficult to definitively diagnose, even when there is a palpable mass on abdominal palpation (Lee *et al.* 2013, Patsikas *et al.* 2008). The distinctive ultrasonographic appearance, which is called a "target" or "bull's eye" - like sign in transabdominal and transrectal ultrasonographic findings is not a confirmatory diagnosis of intestinal intussusception as they can be seen in any case of intestinal ileus (Braun *et al.* 1995, Karapinar and Kom 2007). Therefore, exploratory laparotomy is required for a definitive diagnosis (Lee *et al.* 2013). Although the clinical, radiological, and ultrasonographic examination findings in the present case are considered to be sufficient to suspect intestinal intussusception, the diagnosis of ileoceocolic intussusception was confirmed by experimental laparotomy. In previous studies, it has been reported that in the absence of surgical intervention and medical treatment, death may occur in 72-96 hours due to sepsis as a result of transmural migration of toxins into the peritoneal space, hypovolemia, acid-base imbalance,

**Table 1. Blood gas and CBC findings before and after the operation.**

Parameters	Blood Gases		Parameters	CBC	
	Pre-op Values	Post-op Values		Pre-op Values	Post-op Values
pH	7.23	7.36	WBC m/mm <sup>3</sup>	16.19	12.08
pCO <sub>2</sub> mmHg	32.6	34.9	Lym m/mm <sup>3</sup>	3.20	5.16
pO <sub>2</sub> mmHg	31.6	28.8	Mon m/mm <sup>3</sup>	0.47	0.20
K mmol/L	4.9	3.8	Gra m/mm <sup>3</sup>	12.52	6.78
Na mmol/L	111	141	RBC M/mm <sup>3</sup>	5.13	6.56
Cl mmol/L	83	110	MCV fl	66.4	58.8
Lac mmol/L	11.1	1.8	Hct %	34	41.78
BE mmol/L	-15.2	-4	MCH pg	23.7	23.8
HCO <sub>3</sub> mmol/L	13.1	21.2	Hb g/dl	10.2	13.18

(pH: Power of hydrogen, pCO<sub>2</sub>: partial pressure of carbondioxide, pO<sub>2</sub>: partial pressure of oxygen, K: potassium, Na: sodium, Cl: chlorine, Lac: Lactate, BE: Base excess, HCO<sub>3</sub>: bicarbonate, WBC: leukocyte, Lym: lymphocyte, Mon: monocyte, Gra: granulocyte, RBC: red blood cells, MCV: mean corpuscular volume, Hct: hemotocrit, MCH: mean corpuscular haemoglobin, Hb: haemoglobin).

electrolyte disorders and disruption of the intestinal mucosal barrier (Cerna *et al.* 2019, El-Baky *et al.* 2017, Lewis and Ellison 1987). In the present report, as a result of the appropriate surgical intervention and supportive treatment, it was observed that the vital and blood parameters were returned to the reference ranges (Table 1). Also, prominent clinical improvement was evident.

The limitations of this report are the lack of histopathological examination and the inability to perform contrast radiography due to abnormal lung sounds and respiratory distress.

Over the past years, the etiology of canine enteritis complex has changed as variants of CPV have become more adapted to the gastrointestinal tract and have become less virulent, and are carried in a higher percentage of dogs. In contrast with CPV, the virulence of CCV was not observed to change as rapidly (Evermann *et al.* 2005). However, reports from several countries have indicated that CCV appeared to be more virulent than was previously recognized (Pratelli *et al.* 2003). Therefore, in this report, the clinical importance and complications of CCV infection are emphasized. As a result, it was concluded that clinicians should be vigilant of possible CCV infections where CPV has been ruled out and life-threatening conditions such as intestinal intussusceptions can occur as a result of CCV infection. Also, it was determined that appropriate treatment protocols including fluid-electrolyte therapy and antibiotic administrations with surgical intervention are important in the management of this condition, and blood gas and CBC analysis have prognostic importance.

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