Canine Parvoviral Enteritis

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Canine parvovirus (CPV) is a highly contagious virus that commonly infects young dogs. The virus is very hardy in the environment, surviving for 6 months or longer. Transmission is via the fecal–oral route, with most infections occurring from environmental exposure, directly from a shedding dog, or through fomite exposure. Mainly young dogs, from 6 weeks to 6 months old, are affected. Most older dogs have immunity against the virus, either from appropriate vaccination or natural exposure. Without treatment, this virus can be deadly and has a survival rate of as low as 9%. With treatment, this figure increases substantially, with reported rates of anywhere from 64% to 96%. Treatment is primarily supportive, with antibiotics commonly administered to help stave off infection.

The virus itself invades rapidly dividing cells. In animals older than 8 weeks of age, these cells are primarily the intestinal crypt cells and the myeloid progenitor cells within the bone marrow. This distribution pattern explains the clinical signs associated with CPV infection (i.e., significant vomiting and diarrhea that is often bloody), as well as signs of sepsis because of the inability to defend the body against microbial invaders. The latter of these, the infection and subsequent systemic inflammatory response, is believed to be responsible for the high mortality rate of this disease.

Many options, such as antiendotoxin, interferon, and granulocyte colony-stimulating factor, have been investigated as therapies to help improve the survival rate as well as lessen patients' hospital time and therefore cost of therapy. Most of these treatment options have shown minimal to no advantage, with the exception of early institution of enteral nutrition. Recently, anecdotal reports of improved morbidity with the use of oseltamivir have sparked an interest in this antiviral agent as a possible treatment option. However, scientific support is lacking at this time.

**Diagnostic Criteria**

**Historical Information**

- Typically, younger dogs (<6 months) with an unknown or questionable vaccination history are affected. Direct exposure to other dogs shedding the virus or indirect exposure to a contaminated environment (public areas frequented by many dogs) precedes the onset of clinical signs by approximately 5 to 7 days.
- Dogs that have recovered from CPV enteritis are protected from further infection for at least 1 year and possibly for life; therefore, reinfection is very unlikely.

**Gender Predisposition**

- In dogs older than 6 months of age, intact males may be more likely to develop CPV enteritis because of their increased tendency to roam.

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**Editorial Mission**

To provide busy practitioners with concise, peer-reviewed recommendations on current treatment standards drawn from published veterinary medical literature.

This publication acknowledges that standards may vary according to individual experience and practices or regional differences. The publisher is not responsible for author errors.

Reviewed 2015 for significant advances in medicine since the date of original publication. No revisions have been made to the original text.

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**Key to Costs**

$ indicates relative costs of any diagnostic and treatment regimens listed.
Age Predisposition
- Most affected dogs are between 6 weeks and 6 months old.
- The most common ages are between 10 and 12 weeks, which is when maternal antibody levels begin to decrease and are no longer protective.
- Older dogs can be infected if they have not been protected by appropriate vaccination.

Breed Predisposition
- Rottweilers, American pit bull terriers, Doberman pinchers, and German shepherds have been reported to be at increased risk.

Owner Observations
- Anorexia and lethargy are usually the first signs noted.
- Gastrointestinal (GI) signs (vomiting with or without diarrhea) often follow quickly. Diarrhea may not be present initially. Only 60% of dogs in one study had diarrhea on presentation.
- Diarrhea, if present, may or may not initially contain blood and typically has a characteristic malodor.

Other Historical Considerations/Predispositions
- Unvaccinated dogs have been reported to be 12.7 times more likely to develop CPV enteritis than vaccinated dogs.
- Disease is more commonly seen in the warmer (but not hot) months from spring to early summer and in early autumn.
- Dogs with a heavy intestinal parasite load or that are subject to high levels of environmental stress (e.g., residing in puppy mills or animal shelters) may have a more severe form of the disease.

Physical Examination Findings
- Altered mentation ranging from depressed to comatose, depending on the severity of disease.
- Dehydration may be mild to severe.
- Ptyalism from nausea.
- Tachycardia (reference range, 80–160 bpm).
- Temperature may be increased, decreased, or normal (reference range, 99.5°–102.5°F).
- Painful on abdominal palpation.

Laboratory Findings
Complete Blood Count
Automated machines can be used to procure cell counts, or as a less expensive alternative, a blood smear can be manually evaluated to estimate the number of cells and their morphology.
- **Lymphopenia** (reference range, 1,000–4,000/µL) is the most consistent laboratory finding in CPV enteritis. It commonly precedes neutropenia and occurs because of lymphoid necrosis.
- **Leukopenia** (reference range, 6,000–17,000/µL) has been reported in 45% of dogs during the course of the illness.
- **Neutropenia** (reference range, 3,000–11,400/µL), which is reported in only 51% of dogs during the illness, is considered one of the hallmark signs of CPV enteritis.
- **Thrombocytopenia** (reference range, 160,000–500,000/µL) may be present because of effects in the bone marrow or more likely because of increased consumption from a hypercoagulable state.
- **Anemia** (reference range, 28% to 40% for puppies younger than 6 months of age) may be noted because of GI blood loss as well as frequent blood sampling in smaller patients.
- During recovery, white blood cell (WBC) counts are often increased because of bone marrow stimulation.

Chemistry Profile
- **Proteins** are often low from GI loss (reference ranges for puppies younger than 6 months of age: albumin, 2.2–3.5 g/dl; globulin, 2.0–5.0 g/dl; serum total protein, 3.8–5.3 g/dl).
- **Prerenal azotemia** (reference ranges: blood urea nitrogen [BUN], 10–25 mg/dl; creatinine, 0–1.3 mg/dl).
- **Low potassium** (reference range, 3.5–5.9 mEq/L) secondary to GI loss and decreased intake.
- **Low glucose** (reference range, 80–100 mg/dl) because of limited glycogen stores, immature liver enzyme systems, and an increased metabolic requirement for glucose.

CPV ELISA Fecal Antigen Test
- Positive test result.
- Test results may be negative because of neutralization of antigen by circulating antibodies in very bloody diarrhea. A negative test result may also occur if the test is run in the very early stages of the disease before the virus replicates in the gut epithelium. If clinical signs are consistent with CPV enteritis, therapy should be instituted and the dog retested in 24 to 48 hours. Negative test results may also be present in severe cases in which sloughing of the GI epithelial cells containing the virus has occurred by the time of testing.
- False-positive test results may occur between 5 to 10 days after vaccination with an attenuated live vaccine.

Urinalysis
- Increased specific gravity (>1.035).
- **Bacteriuria** may be present.

Other Diagnostic Findings
- Abdominal radiography: Generalized ileus with fluid-filled bowel may be evident. An obstructive pattern with significant gaseous or fluid distension of the bowel may be present if an intussusception has occurred secondary to motility disturbances of the bowel.
- **Abdominal ultrasonography** may show a thickened intestinal wall with maintenance of normal wall layering. Intussusception may be present secondary to CPV enteritis and is often recognized as double layering of the walls.
- **Histopathology**: Lesions are characteristically located in the ileum and jejunum with serosal hemorrhage or congestion. Necrosis of the crypt epithelium, collapse of the intestinal epithelium, and blunting and atrophy of intestinal villi.
may also be seen. Histopathology may be done via necropsy or exploratory surgery because of a negative test result or lack of consideration of disease and suspected foreign body or intussusception. $

Summary of Diagnostic Criteria
• Lack of appropriate or complete vaccination.
• Acute onset of vomiting or diarrhea.
• Neutropenia.
• Positive fecal antigen test result.
• Lethargy or depression.

Diagnostic Differentials
Gastrointestinal Foreign Body or Intussusception
• When intussusception is present, abdominal palpation may reveal a firm, tubular structure.
• An obstructive pattern may be seen on abdominal radiographs, which signifies significant gaseous or fluid distension of the intestines.
• Evidence on abdominal ultrasonography.
• Negative fecal CPV antigen test result or normal to increased WBC count.

Dietary Indiscretion or Toxicity
• History or suspicion of exposure.
• Negative fecal CPV antigen test result or normal to increased WBC count.

Other Intestinal Infections
• Fecal flotation revealing eggs, parasitic organisms (e.g., coccidia), or abnormal bacterial populations.
• Mild, self-limiting signs with coronavirus infection.
• Negative fecal CPV antigen test result.

Distemper
• Other systemic involvement (respiratory, neurologic).

Coronavirus
• Self-limiting disease process.
• Mild signs of GI upset.

TREATMENT RECOMMENDATIONS
Initial Treatment
Isolation
• The dog is isolated to avoid the spread of CPV and to protect the immunocompromised dog from exposure to a variety of infectious organisms.

Fluid Therapy
• IV fluids are best, but the SC route can be used for mild cases or outpatient treatment. The SC route must be used with caution. The immunosuppression frequently present with this disease process can increase the risk of infection and skin sloughing at the site of fluid administration. For pediatric patients or when vascular access cannot be obtained, the intraosseous route can be used temporarily. An alternative route should be used as soon as hydration is restored.
• Balanced electrolyte solutions (lactated Ringer’s solution, Normosol-R, Plasmalyte) are typically indicated.
• If the animal is in shock (significant depression or obtundation, tachycardia with weak pulses and hypotension, pale mucous membranes with prolonged capillary refill time), a fluid bolus should be given. One-third of the shock dose, 90 ml/kg, should be given as a bolus dose, and the animal should then be reassessed. If shock persists, more fluids should be given. If the animal responds favorably, the remainder of its fluid deficit should be replaced as described below.
• If the patient is dehydrated, a fluid deficit should be calculated and replaced over 2 to 6 hours (these dogs usually benefit from an aggressive fluid replacement approach), depending on the patient’s stability.

    Fluid deficit (L) = % Dehydration x Body weight (kg)

• A maintenance fluid requirement for young dogs is calculated as 60 ml/kg/day. The maintenance fluid rate must be calculated into the total hourly rate during rehydration.
• Ongoing fluid losses must be anticipated and calculated into the fluid therapy plan. It has been assessed that most dogs receive an average rate of 10 ml/kg/hr, but this number must be tailored to the individual patient.

Potassium Supplementation
• Potassium supplementation is frequently required. IV fluids can be spiked with potassium chloride at a concentration appropriate for the degree of hypokalemia. A maintenance supplemental amount is considered to be 20 mEq/L.
• If using a balanced electrolyte solution, the amount of potassium in the fluids should be considered in all calculations. To maintain normokalemia, supplementation should be continued as long as the dog is vomiting or is anorectic.
• To avoid toxic effects, the rate of potassium administration should not exceed 0.5 mEq/kg/hr.

Dextrose Supplementation
• Dextrose supplementation is also frequently required, especially in smaller breed puppies. Dextrose can be added to the IV fluids to make a concentration of 2.5% to 5%.
• Solutions containing dextrose should not be given subcutaneously because of their hypertonicity.
• Fluid lines and bags containing dextrose should be changed every 48 to 72 hours because of the risk of bacterial contamination. For 50% dextrose, 50 ml to 1 L makes a 2.5% solution.

Alternative/Optional Treatments/Therapy
Colloid Therapy
• Colloid therapy is indicated when total solids decrease below 3.5 to 4.0 mg/dl.
• When colloids are given, the crystalloid fluid rate should be decreased by 33%.
• Hetastarch and dextran-70 are synthetic colloids that may cause hypocoagulation at higher doses. The dosage is 10–20 ml/kg/day as an IV infusion, and 5–20 ml/kg as an IV bolus can be given to help treat animals in shock. $–$$
• Plasma can supply species-specific albumin, as well as clotting factors, immunoglobulins, and various serum proteases. The dosage is 10–20 ml/kg IV over 4 hours through an inline filter. $–$$
• Whole blood can be given to supply albumin and red blood cells to anemic animals. Two ml/kg increases the packed cell volume (PCV) by 1%. The target for PCV should be between 25% and 30%. $–$$

Oseltamivir $–$$
• Oseltamivir is an antiviral drug developed to treat human influenza, and it is now also used for avian influenza. It acts via inhibition of the neuraminidase enzyme. However, CPV does not rely on this enzyme for replication, so any beneficial effect of this drug is not believed to be caused by a direct effect on the virus itself. Rather, it is postulated that oseltamivir helps to decrease bacterial translocation in this disease process by preventing the neuraminidase action of the bacteria that is required to cross the mucin layer of the epithelial cells in the gut. If bacterial translocation is decreased, a reduction in the systemic inflammatory response that often leads to multiple organ dysfunction and death may be expected.
• The dosage is 2 mg/kg PO q12 for 5 days. The children’s suspension should be used to ensure accurate dosing.
• The side effect seems to be vomiting, likely caused by a direct effect on the gastric mucosa and from the bad taste of the drug. Administration of antiemetics at least 30 minutes before giving oseltamivir and diluting the suspension with water (1:1) right before administration seem to decrease this effect.
• There is no definitive evidence for benefit, but side effects are minimal.

Supportive Treatment
Antiemetics
• Metoclopramide, a prokinetic with some antiemetic effects, is most effective when administered as a constant-rate infusion at 1–2 mg/kg/day. Alternatively, intermittent dosing can be used at 0.2–0.4 mg/kg IV, SC, or IM q6–8h. The drug also acts as a promotility agent that can help to counteract ileus, which is often seen in these patients. $–$$
• Other antiemetics can be used in conjunction with metoclopramide if vomiting continues.
  — Chlorpromazine: 0.1–0.5 mg/kg SC q6–8h can cause sedation and hypotension secondary to vasodilation. SC administration is recommended to lessen these effects. In addition, this drug should not be used in dehydrated patients because of the risk of hypotension. $–$$
  — Dolasetron: 0.5–1.0 mg/kg IV, SC, or PO q24h. $–$$

CHECKPOINTS

The appropriate use of antibiotics to treat CPV enteritis is an area of debate. The typical argument against antibiotic usage results from a concern for altering normal bacterial flora. However, because the pathogenic bacteria in CPV enteritis are usually of enteric origin, this alteration may be beneficial. Most clinicians agree that there is a need for antibiotics in patients with a neutrophil count below 2500/µl. The choice of antibiotic tends to be based on clinician preference, but broad-spectrum coverage is recommended.

— Ondansetron: 0.11–0.22 mg/kg IV slow q6–12h or 0.1–1.0 mg/kg PO q12–24h. $–$$
— Maropitant is labeled for dogs older than 16 weeks of age. Use in younger animals should be done with caution. Although data are not available for its use in patients with CPV enteritis, it may still be a useful antiemetic. The dosage is 1 mg/kg SC q24h for up to 5 consecutive days or 2 mg/kg PO q24h for up to 5 consecutive days. $–$$

Antibiotics $–$$
A broad-spectrum, bactericidal antibiotic combination should be chosen.
• Ampicillin 22 mg/kg IV q8h and enrofloxacin 5 mg/kg IV q12h or 10 mg/kg q24h. Enrofloxacin has been associated with cartilage abnormalities in puppies. Use of this lower dose and for a limited time period (<5 days) appears to decrease this risk. IV use of enrofloxacin is also an off-label use of the drug. When administered, the drug should be diluted with saline 1:1 and given slowly over 20 to 30 minutes to decrease the risk of vomiting or inducing seizures.
• Amikacin 15–20 mg/kg IV, IM, or SC q24h and cefazolin 22 mg/kg IV q8h. Amikacin can be nephrototoxic and should only be given to hydrated patients. Dosing once daily also helps to decrease the risk of renal injury. Patients receiving this drug should have their urine sediment checked for casts at least every 48 hours. If casts are noted or if there is an increase in BUN or creatinine, amikacin should be discontinued.

Sucralfate $–$$
• Sucralfate 0.25–0.5 g PO q8h can be administered after vomiting is controlled to help treat for potential esophagitis and gastric ulceration. A solution is available (100 mg/ml), or a tablet can be broken up and mixed with water to make a slurry before administration.

Nutrition $–$$
• Early enteral nutrition has been shown to decrease the length of hospitalization. The previous recommendation of waiting 48 hours after vomiting has stopped is no longer strictly followed. Voluntary eating of bland, easily digestible food should be encouraged, and patients can often be fed despite mild vomiting.
Nasoesophageal or gastric tube feeding can be done when the patient can be closely monitored and personnel are comfortable with placement and continued management of these tubes.

**Anthelmintics**

- The presence of intestinal parasites can worsen the disease process and place extra stress on the body. Because parasites are common in younger dogs, treatment is usually indicated.
  - **Pyrantel pamoate**: 5–10 mg/kg PO once.
  - **Fenbendazole**: 50 mg/kg PO q24h for 3 days.
  - **Ivermectin**: 250 g/kg SC once for nonherding breeds.

**Patient Monitoring**

- The WBC count should be monitored for decline as well as recovery. Clinical improvement typically occurs as the WBC counts begin to return to normal.
- PCV and total solids should be monitored for decline and guide the need for transfusion or colloidal support.
- Electrolytes are commonly deranged and should be monitored to guide supplementation and fluid choice.
- Blood glucose levels may be low, especially in pediatric or small-breed patients. Levels should be checked daily to ensure proper supplementation.
- Hydration status and continued fluid losses must be frequently assessed to correctly guide fluid therapy.
- The patient’s weight should be monitored at least daily.

**Home Management**

- Easily digestible food should be given for the first few days after recovery before transitioning back to the normal diet.
- Shedding of the virus can continue for 3 to 10 days after infection. It is recommended to avoid taking the recovered dog to public places for at least 7 days to reduce the risk of spreading the virus.
- Because the dog can also shed the virus before the onset of clinical signs, the environment the dog was in before it became ill should be considered contaminated. A dilute bleach solution (1:32) should be used to clean what is possible. In addition, no unvaccinated dog or puppy should be allowed in the area for at least 6 months.

**Milestones/Recovery Time Frames**

- How severe CPV enteritis becomes and how long the clinical signs last vary from patient to patient. There are no proven predictors for prognosis or for the recovery time frame.
- The total WBC count and neutrophil count typically increase 1 day before clinical signs improve.
- The dog’s appetite should return as the dog improves.
- Diarrhea may take several days to completely resolve after recovery begins. Any blood in the diarrhea should resolve fairly quickly.

**Treatment Contraindications**

- Because of their effects on the GI system, nonsteroidal antiinflammatory agents should be avoided.
- Anticholinergics should not be used to treat diarrhea. These drugs cause ileus, which can increase the risks of intussusception and bacterial translocation.
- Barium was used in the past but is no longer recommended.

**PROGNOSIS**

**Favorable Criteria**

- Minimal clinical signs (e.g., vomiting, diarrhea).
- Retention of a normal neutrophil count.
- Return of appetite.

**Unfavorable Criteria**

- Severe, prolonged decrease in neutrophil count.
- Signs of sepsis unresponsive to aggressive medical management.
- Disseminated intravascular coagulation.
- Multiorgan dysfunction.

**RECOMMENDED READING**


