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Parvoviral Enteritis: What's New?

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BACKGROUND

Canine parvovirus (CPV) is a preventable cause of morbidity in young dogs and causes hemorrhagic enteritis, leukopenia, sepsis, and cardiovascular compromise. The more virulent CPV strain (type-2) has undergone genetic alterations over the past four decades, with subsequent development of antigenically different subtypes (CPV-2a, CPV-2b, and CPV-2c). There is no significant difference in disease severity or outcome when comparing CPV-2b versus CPV-2c.

STRATEGIES FOR TREATMENT

Survival following CPV infection is dependent upon adequate production of antibodies, followed by recovery of lymphoid and intestinal crypt cells. The mortality rate for untreated cases of CPV approaches 90%, but hospitalization with aggressive supportive care reduces that mortality rate to < 10%. For dogs presenting with sepsis or septic shock, early resuscitative efforts are critical to survival. Immediate medical intervention should include cardiovascular stabilization using intravenous fluid (IV) resuscitation, correction of life-threatening electrolyte and glucose derangements, and prompt antimicrobial protection from bacterial translocation. Cardiovascular stabilization is achieved through IV access and fluid resuscitation. Fluid therapy is most effective when targeted to specific resuscitation endpoints, a concept referred to as early goal-directed therapy. Smaller aliquots (10 to 20 mL/kg IV over 10 minutes) of isotonic crystalloids are titrated until normalization of cardiovascular parameters. Isotonic crystalloids rapidly disperse from the intravascular to interstitial space, which may necessitate the use of other fluid types to optimize intravascular volume in CPV dogs. This includes the addition of colloidal support to the fluid therapy plan. One study in dogs with hemorrhagic diarrhea did not identify a clear benefit to the inclusion of synthetic colloids during fluid therapy.[1] Other information regarding adverse effects of hydroxyethylstarches (e.g., development of coagulopathy or acute kidney injury) has increased awareness regarding their use in the veterinary setting. In the author's experience, synthetic colloids may be used in CPV dogs in small amounts over short periods of time without clear adverse effects. Other options for colloidal support include natural sources of albumin, either as fresh frozen plasma or canine-specific albumin (CSA). Fresh frozen plasma has been found to improve select cardiovascular parameters (e.g., shock index and blood lactate concentration) in CPV dogs compared to an isotonic crystalloid fluid bolus.[2] Practitioners should aim to use a fluid or combination of fluids in a manner that meets targeted goals through establishment of acceptable perfusion parameters for the individual animal.

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Broad-spectrum antimicrobial therapy using bactericidal, parenteral products is indicated in neutropenic CPV dogs. Gram-negative and anaerobic bacterial flora from the intestinal tract cause secondary bacteremia, systemic inflammation, and septic shock. Traditional antimicrobial recommendations include extended spectrum penicillins, second generation cephalosporins, or a penicillin paired with a fluoroquinolone. Cefovecin demonstrates acceptable antimicrobial activity against *Escherichia coli* and *Clostridium* species, but its activity against these bacteria as enteropathogens has not been evaluated in CPV dogs. Use of cefovecin should be limited to select cases in which more traditional antimicrobials cannot be used (e.g., outpatient therapy).

Co-infection with other non-bacterial pathogens (canine circovirus, giardia, cryptosporidium, and coronavirus) can complicate treatment of CPV. These organisms highlight the possible interaction of coinfections on the morbidity and mortality observed with CPV.

The presence of more familiar intestinal

parasites should not be overlooked, as anthelmintic therapy has been associated with a decreased odds ratio (0.45) for CPV infection. Other recommended care for CPV includes antiemetics, analgesics, and early enteral nutrition. Maropitant should be avoided in puppies <8 weeks of age, as higher-than-recommended doses resulted in bone marrow hypoplasia during early clinical trials. Although maropitant may provide small amounts of visceral analgesia due to its neurokinin-1 antagonism, it is not enough analgesic for a majority of CPV cases.[3] Dogs presenting with CPV demonstrate moderate to severe visceral pain, and untreated pain further complicates disease while increasing the risk of severe infection and death. Given the debilitated nature of most CPV dogs, reversible opioids (e.g., fentanyl and hydromorphone) are typically preferred as a titratable constant rate infusion (CRI). For cases of mild visceral pain, partial opioid agonists (buprenorphine) or opioid agonist-antagonists (butorphanol) may be considered. In addition to opioids, other analgesics can be sequentially added to improve abdominal comfort. Lidocaine, although typically recognized as a local anesthetic, can be given IV as a CRI at low doses to enhance visceral analgesia. Ketamine may help reverse wind-up pain and an exaggerated central response to painful stimuli. Nonsteroidal anti-inflammatory drugs are contraindicated in the treatment of CPV. Likewise, α2-adrenergic agonists should be used with caution due to their adverse cardiovascular effects. Enteral nutrition should be provided as soon as cardiovascular status is stable and vomiting is controlled.[4] Enteral nutrition may be provided by syringe feeding or through a nasoesophageal or nasogastric tube. In circumstances where tube feeding is not possible, appetite may return more quickly with the use of oral recuperation fluids. These fluids aid in gastrointestinal tract healing and nutritionally assist dogs during the recovery phase of illness. Ancillary therapies may be considered when treating CPV, although most dogs positively respond to the supportive care. N-acetylcysteine [(NAC) 70 mg/kg IV q24h × 5 days], a precursor to glutathione and potent antioxidant, was recently found to help ameliorate oxidative stress in CPV dogs when compared to supportive treatment alone.[5] CPV dogs treated with NAC also experienced a more rapid return of leukocyte counts during the first 5 days of hospitalization, although the larger benefits of NAC (e.g., shorter duration of hospitalization) have yet to be established.

OUTPATIENT TREATMENT

Hospitalization with intensive care can quickly become resource-prohibitive, necessitating alternate strategies for providing medical management to critically ill CPV dogs. In these circumstances, a modified treatment protocol may be used in a shelter or low-cost setting.[6] Studies indicate that outpatient care is a viable option for committed owners who are willing to provide care at home and recheck regularly with their veterinarian. Outpatient care is best provided to puppies that initially receive IV fluid resuscitation and are cardiovascularly stable, as absorption of subcutaneous fluids and medications is optimized when the puppy is normovolemic and normothermic. During fluid resuscitation, life-threatening glucose or electrolyte derangements should also be addressed. The puppy is then transitioned to outpatient care once stabilized. Electrolyte abnormalities may

persist during outpatient care and require oral supplementation; approximately 50% of outpatient dogs will require dextrose supplementation, and 60% will require potassium supplementation. Routine supplementation is recommended due to the frequency of these electrolyte abnormalities. Regular veterinary evaluation is also recommended, as owners may not recognize clinical decompensation which may warrant aggressive intervention or euthanasia. Individual adjustments to the outpatient protocol may also be provided during these visits. Due to the infectious nature of CPV, bringing the veterinary staff out to the owner's vehicle for daily assessment of the puppy can help prevent clinic contamination.

OUTCOME

Prognosis for CPV is variable and dependent on several factors. Age, breed, vaccination history, concurrent illness, timing of medical intervention, and the level of medical care provided may all play a role in overall prognosis. A rebound in various leukocyte parameters during the first 24 hours of hospitalization has been associated with survival. Vaccination remains the safest and most cost-effective means for preventing CPV infection. Guidelines published through AAHA in 2017 recommend initiating CPV vaccination as early as 6 weeks of age and providing sequential doses every 2 to 4 weeks until a minimum age of 16 weeks. For dogs at increased risk of infection, AAHA now recommends an additional vaccination between 18 and 20 weeks of age.

REFERENCES

1. Sen C, Sharma AK, Dhaliwal PS. Comparative efficacy of crystalloid and colloidcrystalloid combination for the management of hemorrhagic gastroenteritis in dogs. Vet World 2014;7,12.
2. Acciacca RA, Sullivan LA, Johnson V, et al. Clinical evaluation of hyperimmune plasma for treatment of dogs with naturally occurring parvoviral enteritis. Accepted for publication January 2019, J Vet Emerg Crit Care.
3. Sullivan LA, Lenberg JP, Boscan P, Hackett TB, Twedt DC. Assessing efficacy of maropitant versus ondansetron in the treatment of dogs with parvoviral enteritis. J Am An Hosp Assoc 2018;54:338-343.
4. Mohr AJ, Leisewitz AL, Jacobson LS, et al. Effect of early enteral nutrition on intestinal permeability, intestinal protein loss, and outcome in dogs with severe parvoviral enteritis. JVIM 2003;17:791-798.
5. Gaykwad C, Garkhal J, Chethan GE, et al. Amelioration of oxidative stress using Nacetylcysteine in canine parvoviral enteritis. J Vet Pharmacol Therap 2018;41:68-75.
6. Venn EC, Preisner K, Boscan PL, et al. Evaluation of an outpatient protocol in the treatment of canine parvoviral enteritis. J Vet Emerg Crit Care 2017;27:52-65.

Additional references available from the author.