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Case Report: Effect of Oral Rehydration Solutions Added to the Conventional Treatment Protocol for the Treatment of Parvoviral Enteritis

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ABSTRACT

Highly contagious CPV-2c, third variant is an enteric pathogen affecting dogs across the world with high morbidity (100%) and frequent mortality (up to 10%). The effect of adding oral rehydration solution to conventional treatment protocol for the treatment of canine parvoenteritis was studied at a NPI veterinary teaching hospital in February, 2078.CPV infected dogs were brought to the hospital for treatment once a day. As per standard treatment protocols, antibiotics such as Amikacin, Metronidazole, and Ondem were given as an antiemetic and intravenous fluid therapy was administered.Administered IV fluid may not be able to maintain the dehydration & electrolyte loss from severe vomiting and diarrhea at home.In order to facilitate faster recovery and reduce mortality, we recommended oral rehydration solution in standard treatment protocols on next five clinical cases of canine parvoenteritis.The ORS corrects dehydration and electrolytes loses throw vomiting and diarrhea in parvoviral infected dog at home and may foster a more rapid return to voluntary appetite as well as improved caloric intake so that it prevents dogs from weakness and debility.Dogs consumed the ORS along with IV fluid demonstrated a more rapid return to normal phase Compared to treatment with only IV fluid therapy.This is only a case study so it is needed to do further statistically evaluate the efficacy of ORS during CPV recovery.

Keywords: Canine parvovirus, Dehydration, Fluid therapy and Rehydration solution.

INTRODUCTION

Canine parvoenteritis is highly contagious acute enteritis caused by canine parvovirus type 2 (Single-stranded, genetically compact DNA virus with a hairpin shape, the parvovirus has 5000 bases) has very low survival rates in untreated dogs (Mathios E Mylonakis, Iris Kalli, Timoleon S Rallis, 2016). This virus, which was first identified in 1967, is now a severe threat to the health of dogs (Ellen Malmanger, 2020). CPV2a and CPV2b viral strains were discovered in 1978 and 1984, respectively; whereas, CPV-2c, the third variant, was discovered in Italy and is slowly displacing other variants throughout the European Union, South America, North America, and Asia (Charles Hong, Nicola Decaro, Costantina Desario, 2007).

After an incubation period of 7–14 days, the virus has an affinity for and invades mitotic cells quickly, as demonstrated in the gut, bone marrow, and lymph nodes, which results in intestinal dysfunction (Foster, Smith, 2011). Anorexia, vomiting, severe dehydration, and bloody or mucoid foul-smelling diarrhea are hallmark signs and symptoms of the disease's (P. C. Meunier, B. J. Cooper, M. J. G. Appel, D.

O. Slauson, 1985).Without fluid therapy, canine parvovirus (CPV) infection is often a fatal disease ending in severe dehydration, endotoxemia or septic shock and multiple organ failure(Muley V.D., Dighe D.G., Velhankar R.D., Keskar D.V., 2009).Comorbid illnesses (such as intestinal parasites, viruses, or bacteria) or stressors (such as weaning, crowded living quarters, and unhygienic surroundings) may cause the disease to develop or worsen (Marcovich JE, Stucker KM, Carr AH, Harbison CE, Scarlett JM, 2012).

Oral rehydration solution (ORS) is an oral fluid whose formulation was created to enhance intestinal absorption of liquids and electrolytes (A. Atia, A.L. Buchman , 2009). Oral Rehydration Solution typically contains sodium, potassium, chloride, citrate and glucose (Alfred Musekiwa, Jimmy Volmink, 2011). Electrolytes are minerals with an electric charge when they dissolve into the body's fluids, such as potassium, sodium, calcium, magnesium, chloride, hydrogen phosphate, and hydrogen carbonate (Meixner, 2018).It may aid in blood clotting, in the formation of new tissue and the transmission of nerve signals(Jay, 2021).The goal of ORS is to fill up and replenish the body's fluid level and to replace the hospitalization treatment with at home treatment, to reduce the coast of treatment (Weatherspoon, 2022).

LITERATURE REVIEW

Canine parvovirus type 2

After the discovery of canine parvovirus infection in 1978, the illness quickly spread around the world (Carmichael, 2005). Mostly young puppies between 6 and 20 weeks of age and some older dogs get infected with this virus (Appel, M.J.G., Cooper,B.J., Griesen H. and Carmichael, 2020) Viruses can persist in the feces for up to two weeks after clinical symptoms appear (Foster, Smith, 2011). The clinical signs observed are in line with the classical signs of parvoviral enteritis (Debram, 2011). Clinical symptoms include severe nausea, vomiting, diarrhea, dehydration, anorexia, depression, and death occurs in very severe cases (Foster, Smith, 2011). In PVE, maintaining hydration and oncotic support as well as addressing acid-base and electrolyte imbalances is crucial (Mathios E Mylonakis, Iris Kalli, Timoleon S Rallis, 2016). Since vomiting is not a sign of canine coronavirus infection(S A Godsall, S R Clegg, J H Stavisky, A D Radford, G Pinchbeck, 2010), the systematic method for ruling out the differential diagnosis is based on the observation.

Treatment of CPV

There is no treatment of choice for Parvo viral infection. However, without fast symptomatic treatment, canine parvoviral infection is often a fatal disease ending in severe dehydration, endotoxemia or septic shock or multiple organ failure(Debram, 2011). In addition to treating symptoms including vomiting, diarrhea, and dehydration, antibiotics must be given to prevent sepsis(Hoskins, J. D., 1997).Strong antibiotic metronidazole is used as antidiarrheal to treat intestinal inflammation and it is effective against some protozoan infections such *Giardia*, *Trichomonas*, and *Balantidium coli* as well as anaerobic bacterial pathogens(Sarwar, 2021). For the management of bloody diarrheaTransamic acid isgiven at the dose rate of 10mg/kg is given by slow intravenous infusion (over15-20minutes)(Judge, 2020). Conciplex (Vitamin B-complex) help in strengthening the immune system, improve metabolism of the body, and help in the formation of red blood cells and enhance the absorption of iron in the body @ 3ml/ day(Uddab Poudel, Umesh Dahal, Arjun Aryal, 2020). Following healing from the enteritis, the dog's regular food should be gradually restored(Kenji ISHIWATA, Tomonori MINAGAWA, Tsunesuke KAJIMOTO, 1998). A dog with mild symptoms can recover in two or three days if IV fluids are started as soon as signs are observed & whereas puppies with more severe conditions may last from five days to two weeks, depending on the

therapy(Wikipedia, 2022). The dog has a survival rate between 75 and 80% if it is hospitalized, given extensive supportive care, and properly monitored(Ellen Malmanger, 2020). In the absence of prompt veterinary treatment or hospitalization with sufficient supportive care, survival is more difficult(Muley V.D., Dighe D.G., Velhankar R.D., Keskar D.V., 2009).

Oral Rehydration Solution

As a result of severe vomiting and diarrhea, electrolytes and fluids are lost, resulting in dehydration (Garcia, 2014).CPV infected dog exhibits abnormalities of the electrolytes such as hypokalemia, hyponatremia, and hypochloremia (Mathios E Mylonakis, Iris Kalli, Timoleon S Rallis, 2016). Treatment of dehydration in dogs with acute onset hemorrhagic diarrhea using an oral rehydration solution (ORS) would be safe, efficient, and less expensive (Garcia, 2014). Significant fluid and electrolyte lossescan be recovered by oral rehydration solution (Linklater, 2020). A poly ionic isotonic dextrose solution is administered intravenously, subcutaneously, or orally in less severe cases to restore the lost fluid effectively and sufficiently in the treatment of the sick puppy(Foster, Smith, 2011). Canine parvovirus (CPV) infection in dogs can cause severe enteritis that needs supportive care until voluntary food and water consumption resumes (Ellen Malmanger, 2020). Some dogs with CPV actively ingest an oral rehydration fluid during the disease' recovery phase, and that may encourage a quicker restoration of their voluntary appetite and an increase in calorie intake (Reut Tenne, Lauren A. Sullivan, Elena T. Contreras, Francisco Olea-Popelka, David C., 2016).

In order to get early recovery from CPV, an oral recuperation fluid (ORF) may be used(Reut Tenne, Lauren A. Sullivan, Elena T. Contreras, Francisco Olea-Popelka, David C., 2016). Oral rehydration does not require special equipment and is adequate for most cases of fluid and electrolyte loss as well as it is more convenience and relative safety in compared to IV fluid therapy (Garcia, 2014).

CASE REPORT

Case presenting site

The parvoenteritis cases in Nepal Polytechnic Institute were highly visible in February 2021 whilst ten dogs were used to make this case report. Five of the dogs receive the conventional treatment [Antibiotic, Antiemetic, Vitamin, IV fluid] and rest of the five dogs gets conventional treatment plus oral rehydration. The case is a client-owned dog with naturally occurring CPV that was seen at Nepal Polytechnic Institute Veterinary Hospital, Bharatpur, Chitwan.

Table 1: List of ten dogs with their general introductions:

S.N.	Owners name & address	Breed	Age	Sex	Weight
1.	Wishing lama [BMC-3, Chitwan]	German shepherd [A]	9 months	Male	20kg
2.	BijayaBikramDhakal [Kalika -3, Chitwan]	Labrador retriever [B]	8 months	Female	30kg
3.	SanjuGurung [Kalika-2]	Local [C]	4 months	Female	5kg

4.	Ramesh Shrestha [BMC-9, Chitwan]	[J. spitz + local] [D]	2 years	Male	16kg
5.	Kanchan Lama [Gaidakot]	Japanese spitz [E]	5 years	Male	9kg
6.	SudipChaudhari [BMC-6, Chitwan]	Japanese spitz [F]	2 years	Female	8.4kg
7.	DiwasBastola [BMC-12,Chitwan]	Local [G]	11 months	Female	12kg
8.	SaruShrestha [Gorkha-6, Gorkha]	Japanese spitz [H]	10 years	Female	10kg
9.	Bhim B.K. [BMC-11,Chitwan]	German shepherd [I]	9 months	Female	17kg
10.	NareshGurung [Kawasoti,Nawalpur]	Bhote[J]	6 months	Male	13kg

History of dogs

These dogs showed common signs of anorexia, vomiting, and 3 of them hadblood-tinged, foul-smelling diarrhea. Seven of the dogs are fully vaccinated whereas three dogs have no history of vaccination.

Clinical Diagnosis of canine PVE

The most common and easy method of diagnosing parvovirus infection is ICA, which is an immune-chromatographic assay test. Other clinical examinations include physical examination, a complete blood count (CBC) and biochemistry profile test to determine the severity of the disease (Foster, Smith, 2011) along with the history and major clinical sign & symptom.

1. Physical examination

Table 2: Results of physical examinations on 10 dogs suspected of having parvovirus infection. Normal Reference (John A. Bukowski, Susan Aiello, 2011):

Parameter	**Normal Reference Range**	**Abnormality**	**Number of dogs (%)**
Heart Rate	70-120 bpm	Tachycardia	2/10 [20]
Respiration Rate	18-34 respiratory cycleper minute	Tachypnea	1/10 [10]
		Dyspnea	3/10 [30]
Rectal Temperature	100.2-103.8°F	Hypothermia	1/10 [10]
		Fever	5/10 [50]
Capillary Refill	Normal 2 sec	Prolonged CRT	3/10 [30]

Time [CRT]		Diarrhea	9/10 [90]
		Vomiting	7/10 [70]
Skin tenting time	Less than 2 sec	Dehydration	5/10 [50]
Mucous Membrane	Pink	Pale mucosal membrane	3/10 [30]

The most common clinical signs of parvoenteritis observed in February 2021 at NPI veterinary teaching hospital were diarrhea and vomiting. After that, 50% of the total population of infected cases suffers from fever and dehydration. There is one case in which there is tachypnea & hypothermia, which may be related to the long-term severe symptoms of this disease.

2. Clinicopathologic abnormalities

a) Hematological examination of the diseased dogs

Number of dogs with abnormality (%) of dogs examined (%) with suspected parvovirus infection.

Table 3: List of ten dogs with their hematological Examination:

Parameter	**Normal Range**	**Abnormality**	**The percentage of dogs with abnormality**
1. Hemoglobin (g/dl)	➢ 11.9-18.9	1. Anemia [<8 g/dl]	➢ 3/10 [30%]
2. Leucocytes (%)	➢ 4.0-15.1	2. Leukopenia [<4%]	➢ 3/10 [30%]
3. Neutrophils	➢ 58-85	3. Leukocytosis [>15%]	➢ 1/10 [10%]
4. Lymphocytes	➢ 8-21	4. Neutropenia [<55%]	➢ 4/10 [40%]
5. Monocytes	➢ 2-10	5. Neutrophilia [>90%]	➢ 2/10 [20%]
6. PCV	➢ 35-57	6. Lymphopenia [<7%]	➢ 6/10 [60%]
		7. Lymphocytosis	➢ 0/10
		8. Monocytopenia [<2%]	➢ 2/10 [20%]
		9. Monocytosis [>10%]	➢ 3/10 [30%]
		10. Hemoconcentration[>55%]	➢ 5/10 [50%]

(Fielder, Hematologic Reference Ranges, 2015)

Lymphopenia is the most common hematological abnormality encountered in cases of parvoenteritis at NPI veterinary teaching hospital; whereas lymphocytosis is not seen in any admitted cases. Anemia, monocytosis and leukopenia occur in 30% of the infected population. Neutropenia is observed in 40% of the total infected population however neutrophilia&monocytopenia is observed in 20% of this infected population. Leukocytosis is the least common abnormality, accounting for 10% of the infected population.

b) Serum biochemical examination of the diseased dogs

Normal serum biochemicalparameters& number of dogs with abnormality (%) of dogs

examined with suspected parvovirus infection.

Table 4: Dog with their biochemical examination:

S.N.	Parameter	Normal Range	Abnormality	No. of dogs with abnormality parameter
1.	**Glucose**	76-119 mg/dl	Hypoglycemia [<75 mg/dl]	4/10 [40]
2.	**Albumin**	2.3-3.1 mg/dl	Hypoalbuminemia [<2 mg/dl]	3/10 [30]

(Fielder, Serum Biochemical Reference Ranges , 2015)

As a result of the disease and loss of appetite, 40% of infected dogs suffer from hypoglycemia. Whereas, 30% of the infected dogs suffer from hypoalbuminemia that may be due to bloody diarrhea.

3. Immunochromatographic assay (ICA)

The rapid test kit of Vet DiagnostixParvo (CPV) Ag was used for ICA. Ten positive samples were found in the month of February at NPI veterinary teaching hospital.

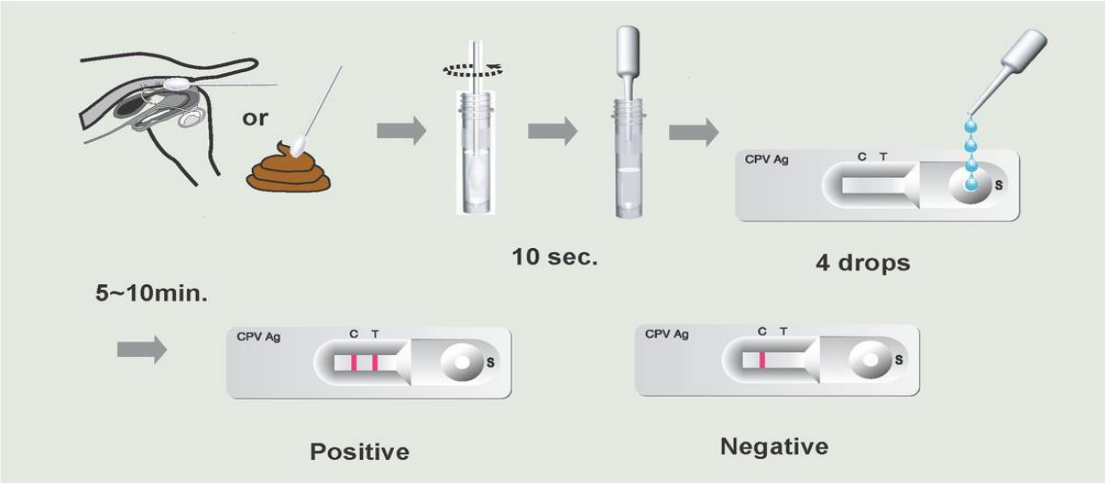

Figure 1: Test Procedure on Rapid Test Kit (Dan Scott and Associates, 2020).

TREATMENT

I. All dogs were treated with a convention treatment protocol:

a. Antibiotic: Amikacin is less harmful to the kidneys than gentamicin (Ahmira R. Torres, Kirsten Cooke, 2014) at the dose rate of @ 20 mg/kg.

b. Antidiarrheal: Strong antibiotic metronidazole used as antidiarrheal to treat intestinal inflammation (Sarwar, 2021) at the dose rate of 20mg/kg.

c. Antiemetic: Ondasetron @ 0.1–0.15 mg/kg/24 hours IV.

d. Polybion (Vitamin B-complex): @ 3ml/ day(Uddab Poudel, Umesh Dahal, Arjun Aryal, 2020)

e. Transamic acid: For the management of bloody diarrhea is given at the dose rate of @10mg/kg is given by slow intravenous infusion (Judge, 2020)

f. Fluid therapy: Ringer lactate solution(Ball, 2021)] @10-15 ml/kg body weight.We administered IV fluid based on dehydration measurementsapply the formula below:

- Hydration volume (in ml) = body wt. (kg) × % dehydration × total body water (0.6)

Indicators of dehydration include shrunken eyes, skin that remains tented, dry nose, weakness, paleness, and a capillary refill time that lasts longer than two seconds(Reisen, 2021)

In order to correct the ongoing loss of fluid and electrolytes, oral rehydration fluid (JibanjalPaani) is given to five dogs' i.e. dog number 6 (F) to dog number 10 (J).

II. Oral Rehydration Solution: The initial fluid of choice in cases of PVC infection is a balanced electrolytes solution. The route and rate of initial fluid therapy should vary with patient and susceptibility of the disease. Fluid replacement for losses incurred throw vomiting and diarrhea is the cornerstone of treatment of dogs with CPV enteritis and should be continued until oral intake is resumed.We choose the electrolyte as JibanjalPaani [JEEVANBAL: Each sachet of 20.5 gm contains sodium choloride 2.6gm, potassium chloride 1.5gm, sodium citrate 2.9gm, Dextrose anhydrous 13.5gm. So, adding of oral rehydration fluid with Jibanjal Paani is performed. Electrolytes regulate the amount of fluid in dog, help to blood clot, build new tissue, and transmit nerve signals & they also keep the pH of the blood in a normal range (Jay, 2021).

PROGNOSIS

The likelihood of survival usually depends on how serious the clinical signs and when treatment was started (Gallagher, 2020). Hypoalbuminemia, low protein levels, lymphocyte counts below 1000/L, hypovolemia, poor perfusion, and fever have all been linked to an increased risk of death (J P Schoeman, A Goddard, A L Leisewitz , 2013). Depending on the study, type of therapy, and personal patient reaction to treatment, the prognosis for survival can range from 60% to 90% (Mazzaferro, 2020).Vaccination and clinicopathological conditions resulted in a satisfactory prognosis in 7 of 10 dogs, while in 3 dogs, due to their age, lack of vaccination record & blood parameter the prognosis was poor.

RESULT

Based on analysis of data collected from CPV infected dogs at NPI Veterinary Hospital in February 2022, a significant outcome was found.Consequently, all clients' data is analyzed and the results are presented below.

Table 5: Analysis of recovery days in five dogs treated with the convention method:

S.N.	Dog's [Breed& weight]	Major abnormality	IV fluid RL	Recovery days	Result
1.	German shepherd **[A]** (20kg)	[Anemia & Leukopenia] + Hypoalbuminemia	200ml I.V. ×O.D.	9 days	-ve rapid kit + normal feces+ palatability ↑
2.	Labrador retriever **[B]** (30kg)	Neutrophilia,Leukopenia,Hemoconcentration&Hypoalbuminemia	450ml I.V. × O.D.	8 days	-ve rapid kit + normal feces+ palatability ↑

3.	Local **[C]** (5kg)	Leukopenia, Lymphopenia, Anemia& Hypoglycemia	50ml I.V. × O.D.	7 days	-ve rapid kit+ normal feces+ palatability↑
4.	J. spitz + local **[D]** (16kg)	Lymphopenia, Monocytopenia, Neutropenia&Hemoconcentration	160ml I.V. × O.D.	7 days	-ve rapid kit + normal feces+ palatability↑
5.	Japanese spitz**[E]** (9kg)	Lymphopenia,Monocytopenia& Hypoglycemia	90ml I.V. × O.D.	8 days	-ve rapid kit + normal feces+ palatability↑

Table 6: Analysis of recovery days in five dogs treated with the convention method in conjunction with ORS:

S.N.	**Dog's [Breed& weight]**	**Major abnormality**	**IV fluid RL**	**ORS [BID]**	**Recovery days**	**Result**
1.	Japanese spitz**[F]** (8.4kg)	Hemoconcentration, NeutropeniaMonocytosis& Leukocytosis	130ml I.V. × O.D.	160 ml	5 days	-ve rapid kit + normal feces+ palatability↑
2.	Local **[G]** (12kg)	Hemoconcentration, Neutrophilia& Hypoglycemia	180ml I.V. × O.D.	215 ml	4 days	-ve rapid kit + normal feces+ palatability↑
3.	Japanese spitz**[H]** (10kg)	Lymphopenia, Monocytosis, Neutropenia& Hypoglycemia	100ml I.V. × O.D.	190 ml	5days	-ve rapid kit + normal feces+ palatability↑
4.	German shepherd **[I]** (17kg)	[Anemia &Lymphopenia] +Hypoalbuminemia	170ml I.V. × O.D.	290 ml	7 days	-ve rapid kit + normal feces+ palatability↑-
5.	Bhote**[J]** (13kg)	Neutropenia, LymphopeniaMonocytosis&Hemoconcentration	200ml I.V. × O.D.	240 ml	5 days	-ve rapid kit + normal feces+ palatability↑

After receiving an oral rehydration solution in conjunction with conventional treatment, those 5 dogs (F-J) recovered quickly as compared to 5 dogs (A-E) that had been given a single IV fluid therapy that is part of conventional treatment. So it was found that the average recovery day for dogs (F-J) receiving ORS along with conventional treatment is around 5 days. Using conventional methods alone, 5 dogs (A-E) took more than 7 days to recover.

CASE DISCUSSION

Early ORS and enteral nutrition added to the standard treatment protocol for parvoenteritis infected dogs helps promote intestinal regeneration and prevent enterocyte atrophy.This analysis supports the theory of(Reut Tenne, Lauren A. Sullivan, Elena T. Contreras, Francisco Olea-Popelka, David C., 2016) that said an oral recuperation fluid (ORF) might speed up CPV recovery in general and with(Foster, Smith, 2011) who said that effective and enough fluid replacement is necessary for an CPV infected puppy to recover. This may encourage a quicker restoration of their voluntary appetite and an increase in their caloric intake. Also the findings from this study suggest that assessment of ORS could play a supporting role in ongoing treatment of dogs infected with parvovirus. Those dogs exhibit a survival rate of100% afterthey were hospitalized and given extensive supportive care andaddition of oral rehydration solution at home which is more than that of (Ellen Malmanger, 2020). The recommend ORS has potential to correct electrolyte loss that occurs by severe vomiting & diarrhea at home. Electrolyte solutions maintain hydration levels as well as provide significant potential to balance the body's electrolytes (Erica L. Reineke, Karie Walton, Cynthia M. Otto, 2013). We should pay attention to the composition of oral electrolytes and their impact on dogs during parvovirus infection (Erica L. Reineke, Karie Walton, Cynthia M. Otto, 2013). Early recovered of those dogs after providingORS at home may offer advantages such as lower owner-related veterinary expenses and reduced staff time needed for treatment (Garcia, 2014).

Some authors suggest that if electrolyte is not lost or the diagnosis of CPV is incorrect, then ORS is ineffective and may not be safe for dogs (Joseph Wakshlag, Justin Shmalberg, 2014). Parvoenteritis infected dogs may benefit from ORS with standardized treatment protocols. It is necessary to do more scientific research to fully evaluate the impact of this ORS during CPV recovery. Perhaps only IV fluid at a time might be unable to maintain the body's electrolytes in an ongoing manner. So, considering they bring their pet once a day, we recommended providing Jibanjalpaani (ORS) twice daily. It may aid in blood clotting, in the formation of new tissue and the transmission of nerve signals (Jay, 2021) that might be a reason for early recovery.

CONCLUSION

This study indicates that a standardized treatment protocol in conjunction with ORS results in a quicker recovery as compared to treatment with conventional treatment only. This study finds out the supporting role of ORS to combat acute electrolyte loss by diarrhea & vomiting. It had reduced owner-related veterinary expenses as well as the amount of staff time necessary for treatment, which was an advantage.

SUGGESTION

- Periodic vaccination against parvo virus
- In the absence of veterinary hospitals or veterinary personnel, oral rehydration solution may be advisable for the primary treatment of parvovirus infection at home.
- Aanemichypoproteinemic dogs needed whole blood transfusion
- Not anemic hypoproteinemic dogs needed plasma transfusion
- Any commercial products for parenteral nutrition contain amino acids, glycerol and electrolytes is suitable for these cases
- The young, aged dogs may have temporary intestinal malabsorption and protein losing enteropathy until intestinal villi are repaired, so initial feeding should consist of small amount of an easily digestible low fat diet feed frequently

- Many young, aged dogs with PVC septic enteritis may have hypoglycemia. Following rehydration 5% dextrose can be added to the balanced electrolyte solution (100 ml of 50% dextrose added to 1 liter of balanced electrolyte solution can make 5% solution)
- Colloid fluid is indicated to maintain intravascular oncotic pressure in a hypoalbuminemic dogs.

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