TURKISH JOURNAL OF VETERINARY RESEARCH
TJVR 2017;1(1):16-19
Published online at www.dergipark.gov.tr/tjvr
Research Article

Application of Peritoneal Dialysis in Companion Animals with Kidney Failure

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Received: 12.11.2017 Accepted: 01.12.2017

ABSTRACT

Objectives: The objective of this study was to assess the renal function in animals with renal failure after peritoneal dialysis.

Materials and Methods: Animals with kidney failure presented to veterinary teaching hospital at Ankara University consisted of 4 dogs and one cat. Animals with kidney failure were treated with peritoneal dialysis application.

Results: Concentration of serum urea in all patients significantly decreased after the second attempt of peritoneal dialysis but, not serum creatinine. When peritoneal dialysis procedures (4 to 10 times) completed, the concentrations of serum urea and creatinine were significantly decreased in all animals. Complications identified during PD were peritonitis, hypoalbuminemia, hypokalemia, dialysate retention or leakage from the catheter site, edema and pleural effusion/chylothorax.

Discussion: In the present study, it was concluded that peritoneal dialysis procedure was a life-saving, easily applicable, and cost effective clinical procedure for companion animals with renal failure.

Keywords: Peritoneal dialysis, dog, cat, ARF, CRF

INTRODUCTION

Kidneys maintain hemostasis by excreting the waste products in the liquid form called urine as well as regulating renal hormones and acid base balance (Ross and Finco, 1981; DiBartola and Westropp, 2014). One of the most common life-threatening disease in dogs and cats is renal failure occurring when ⅔ of total nephrons lost their functions (Hughes et al, 2002). Moreover, when ¾ of total nephrons become unfunctional, azotemia occurs (Ross and Finco, 1981; DiBartola and Westropp, 2014).

Renal failure can be seen as acute or chronic. It is important to determine whether the renal failure is acute or chronic for the treatment approach as well as the clinical outcomes in animals (DiBartola and Westropp, 2014; Labato, 2000; Ross and Labato, 2006).

Acute renal failure (ARF) is defined as sudden reduction in renal function due to several factors (dehydration, nephrotoxic agents, infections, multiple organ disease, ureteral and/or urethral obstruction, etc.) effecting kidneys (Worwag and Langston, 2008; Holloway and O'Brien, 2007). On the other hand, if ARF lasts between one to three months, then it will be called as chronic renal failure (CRF) by the International Renal Interest Society (IRIS) (Elliot and Watson, 2016). Patients with ARF are usually oliguric/anuric while those with CRF are polyuric

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(Worwag and Langston, 2008; Holloway and O'Brien, 2007).

Treatment options for the renal failure patients in both human and veterinary medicine are hemodialysis (HD), peritoneal dialysis (PD), and renal transplantation (RT) (Cooper and Labato, 2011). PD is inexpensive and easily applicable procedure while HD and RT require advanced equipment and experience as well as the costly procedures in veterinary medicine.

The objective of the present study is to prove the effectiveness of PD in companion animals with renal failure.

Number of Application	Dog-I Serum Urea/ Serum Creatinine (mg/dl)	Dog-II Serum Urea/ Serum Creatinine (mg/dl)	Dog-III Serum Urea/ Serum Creatinine (mg/dl)	Reference Range (mg/dl) Serum Urea/ Serum Creatinine (mg/dl)
Before PD	277,8/ 13,06	480/19,1	229,4/ 9,68	59,9/ 1,5
1	225,6/ 17,13	148,9/21,88	232,6/ 7,78	59,9/ 1,5
2	122,6/ 18,79	110,1/18,1	186,6/ 7,65	59,9/ 1,5
3	169,1/ 17,32	80,1/17,5	195,1/ 7,46	59,9/ 1,5
4	231,4 /14,3	70,1/17,6	135,4/ 6,1	59,9/ 1,5
5	151,1/ 6,06		127,5/ 6,92	59,9/ 1,5
6	107,5/ 3,53		140,4/ 8,1	59,9/ 1,5
7	101,7/ 2,89		155,7/ 9,3	59,9/ 1,5
8	43,4/ 1,22		151/ 7,12	59,9/ 1,5
9			150/ 6,66	59,9/ 1,5
10			135,5/ 5,25	59,9/ 1,5

Table 1: Serum urea and serum creatinine levels of dogs with ARF before and after peritoneal dialysis application.

MATERIALS AND METHODS

Study materials consisted of five animals (4 dogs and one cat) with renal failure presented to veterinary teaching hospital at Ankara University between June 30, 2014 and June 29, 2015. Inclusion criteria for renal failure were based on physical examination of anorexia, lethargy, frequency of urination, uremic halitosis, elevated serum urea and creatinine levels, and decreased specific gravity urine in the urine analysis.

Number of Application	Dog Serum Urea/ Serum Creatinine (mg/dl)	Reference Range (mg/dl) Serum Urea/ Serum Creatinine (mg/dl)	Cat Serum Urea/ Serum Creatinine (mg/dl)	Reference Range (mg/dl) Serum Urea/ Serum Creatinine (mg/dl)
Before PD	150,9/ 3,81	59,9/ 1,5	210/ 8,9	64,2 /1,8
1	145,4/ 3,7	59,9/ 1,5	190/ 8,3	64,2/ 1,8
2	124,7/ 2,68	59,9/ 1,5	84/ 4,52	64,2/1,8
3	145,5/ 3,7	59,9/ 1,5	155,5/ 4,43	64,2/ 1,8
4	168,7/ 2,52	59,9/ 1,5	159,8/ 4,18	64,2/ 1,8
5	183,4/ 4,44	59,9/ 1,5	129,1/ 3,17	64,2/ 1,8
6	167,8/ 2,88	59,9/ 1,5	116,1/ 3,5	64,2/ 1,8
7	173,9/ 3,06	59,9/ 1,5	127,3/ 3,24	64,2/ 1,8
8	152,8/ 3,05	59,9/ 1,5	137,7/ 2,88	64,2/ 1,8
9			150,8/ 3,41	64,2/ 1,8
10			199,2/ 3,41	64,2/ 1,8
11			197,2/ 4,84	64,2/ 1,8

Table 2: Serum urea and serum creatinine levels of a dog and cat with CRF before and after peritoneal dialysis application.

PD was performed by placing a swan neck catheter into the abdomen attached to a closed collection system. Animals were sedated with acepromazin maleat at 1-3 mg/kg PO[a] and SC local lidocaine[b] injection at 1-5 mg/kg. Under aseptic conditions, the swan neck catheter inserted to the abdomen via medial or paramedial approach at the level of umbilicus through an incision and the catheter directed caudally as described previously (Labato, 2000; Holowaychuk, 2006). After the catheter tunneled subcutaneously for 5 cm, it is secured by Roman Sandal sutures and protected by abdominal bandage to prevent cross-contamination. Dialysate[c] (1,36% glucose anhydrate, NaCl, sodium lactate, $CaCl_2$, $MgCl_2$, injectable water with osmolality of 344 mOsm/l) was infused at rate of 30 to 40 ml/kg into the abdomen, then it was allowed to dwell for 30 to 60 minutes, and then was drained. All dialysate given were completely drained in all animals except cat with CRF (not more than 50%). Supportive treatment including iv fluid therapy at 60 ml/kg/day, gastrointestinal protection (ranitidine: 0,5 to 1,0 mg/kg IV q12h), furosemide[e] (2–8 mg/kg IV q1–2h), and amoxicillin–clavulanic acid[f] (10–22 mg/kg

q12h) applied before and during the procedure. In addition, complete blood transfusion was performed twice for the treatment of anemia accompanied with erythropoietin[g] (75 units/kg, 3 times in a week) injections for patients with CRF.

RESULTS

A total of 5 animals with renal failure consisted of 4 dogs and 1 cat. Of 4 dogs, 3 were with ARF of ethylene glycol toxicity (n=1) and ingestion of unknown plants (n=2), and one was with CRF. One cat was with CRF. Of 3 dogs with ARF, one was male-intact Labrador Retriever, one was male-intact German Shepherd mix, and one was female-spayed Chihuahua mix. Only one dog with CRF was male-intact Cocker Spaniel. Only one cat with CRF was male- intact Persian cat. The body weights of dogs with ARF ranged from 7,8 to 35 kg while the dog and cat with CRF were weighting 12 and 3 kg, respectively. The mean age was 7,1 in dogs with ARF. The dog with CRF was 12 years old while the cat was 3 years old.

The physical examination revealed oliguria/anuria, lethargy, anorexia and vomiting in patients with ARF while polyuria, polydipsia, anemia, lethargy, cachexia and poor hair coat in patients with CRF. Mean urine specific gravity in patients with renal failure was 1015 (range from 1010 to 1020).

PD was applied once a day. Concentration of serum urea in all patients significantly decreased after the second attempt of PD, but not serum creatinine. When PD procedures completed (ranged 4-10 times), the mean concentrations of serum urea and creatinine were consistently decreased from 329,06 to 83 mg/dl and from 13,94 to 7,29 mg/dl in ARF group, respectively (Table 1). However, in dog with CRF, the concentrations of serum urea and creatinine varied (Table 2). Although the concentrations of serum urea and creatinine were decreased with PD application, these values increased after emergency splenectomy procedure in this dog.

In cat with CRF, the concentrations of serum urea and creatinine were consistently decreased. However, proteinuria was progressed despite of AcE inhibitor usage in this patient and his clinical condition was deteriorated as well as the anemia. Even though, blood transfusion was performed twice, leukocytosis and chylothorax were developed. Ultrasound guided chylothorax aspiration was performed but after 3 days of the procedure, the patient was lost.

Complications identified during PD were peritonitis (n=4), hypoalbuminemia (n=4), hypokalemia (n=3), dialysate retention or leakage from the catheter site (n=3), edema (n=2) and pleural effusion/chylothorax (n=2).

DISCUSSION

The results of present study revealed that application of PD significantly reduced the concentrations of serum urea and creatinine, and improved clinical conditions in patients with renal failure. These findings are consistent with previous reports of Beckel and O'Toole (2005), and Dorval and Boysen (2009). Beckel et al (2005) reported that 80% of dogs with ARF caused by leptospirosis were recovered with PD. Similarly, Dorval and Boysen reported that 83% of the cats with ARF were recovered with PD. Although there are not many reports available regarding the PD application in dogs and cats with CRF, results of these studies (Crisp et al., 1989; Vitalaru and Petrescu, 2016) are similar to present study findings by increasing the life span and quality in patients with CRF.

The most common complications of PD reported are peritonitis, hypoalbuminemia, dialysate retention / catheter obstruction, and subcutaneous leakage of dialysate (Cirsp et al., 1989; Beckel and O'Toole, 2005; Dorval and Boysen, 2009). A previous study reported a positive correlation between risk of peritonitis development and increased number of PD application (Crisp et al, 1989). Similarly, results of present study indicated that peritonitis increased with the repeat of PD application. On the other hand, intravenous antimicrobial injections during PD procedure in the present study was decreased the risk of peritonitis.

Hypoalbuminemia in PD application can be caused by albumine loss with dialysate, insufficient dietary protein intake, or protein loss by gastrointestinal or renal tracts (Pendse et al., 2007). Although prescription of AcE inhibitors decreased the progression of hypoalbumineamia in the present study, edema was developed in two animals due to increased albumine loss. Therefore, it would be very critical to replace albumine in these patients by feeding adequate protein as well as iv infusion of human plasma (Holowaychuk et al., 2006).

Pleural effusion in PD application has been reported few in both veterinary and human medicine in the previous studies (Rudnick et al. 1979; Dorval and Boysen, 2009; Cooper and Labato, 2011). A plausible explanation in the previous reports was indicated that hypoalbuminemia and/or retention of dialysate in the abdominal cavity passing into pleural space by diaphragmatic lymphatics may resulted in pleural effusion[12]. The results of present study were also consistent with these previous reports by determination of pleural effusion in a cat with CRF and a dog with ARF. Moreover, pleural effusion in the cat of present study was confirmed as a chylothorax. It could be concluded that hypoalbuminemia and

retention of dialysate resulted in chylothorax by the passage of hypertonic dialysate through diaphragm and accumulated in the thorax which possibly pulled the chylo from its vessel in the present study.

As a conclusion, results of our study proved that PD is an effective method improving renal failure as well as inexpensive-easily applicable procedure.

Acknowledgements: A portion of this study was presented as a oral presentation at the American College of Veterinary Internal Medicine (ACVIM) Forum, June 7-10, 2017, Oxon Hill, MD, USA.

Conflict of Interest: No conflict of interest was declared by the authors

Financial Disclosure: The authors declared that this study has received no financial support.

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