A. Ü. Vet. Fak. Derg.
34 (3) : 467-478, 1987

PERITONEAL DIALYSIS OF TWO DOGS WITH EXPERIMENTALLY INDUCED UREMIA

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Eksperimental üremi oluşturulan iki köpekte periton diyalizi

Özet: *Sağlıklı üç adet köpekte, üreterleri ligatüre edilerek üremi oluşturuldu. Köpek* 1 *kontrol olarak kullanıldı ve diyaliz uygulanmadı. Ölene kadar beklenildi. Diğer iki köpekte Stylet-kateteri kullanarak akut böbrek yetmezliği için alternatif bir tedavi olan periton diyalizi uygulandı. Deneyden önce hayvanların tam klinik, hematolojik muayeneleri ve serum üre nitrojen, kreatinin, klor, potasyum ve sodyum değerleri saptandı. Yukarıdaki muayeneler ve ölçümler köpek* 1*'de deneysel operasyondan sonra* 6, 24, 30, 48 *ve* 54. *saatlerde yapıldı ve köpek* 60. *saatte öldü. Köpek* 2 *ve* 3*'te periton diyalizi ile tedavi operasyondan* 48 *saat sonra başlatıldı. Köpeklerde üremi, yüksek kreatinin konsantrasyonu, hipokloremi, hiperkalemi ve hiponatremi tesbit edildi. Köpekler dehidrasyon, depresyon, anoreksi ve hareket güçlüğü semptomları gösteriyorlardı. Diyaliz köpek* 2*'de* 15 *senas, köpek* 3*'te* 20 *seans uygulandı. Peritoneal diyaliz süresince kan ve peritoneal diyazilat örnekleri* 5, 10, 15 *ve* 20. *diyaliz seanslarında alındı. Periton diyalizi sonunda her iki köpek canlı ve hareketliydi. Köpek* 2*'de kreatinin ve BUN konsantrasyonları normalden çok az yüksek olmasına karşın, köpek* 3*'te kanın kimyasal ve elektrolit değerleri normaldi.*

Summary: *Uremia was performed ligaturing the both ureters in three healthy dogs. One dog (Dog* 1*) was used as control, and dialysis was not applied. He was kept till he died. In the other two dogs (Dog* 2 *and Dog* 3*), peritoneal dialysis were used as an alternative treatment for acute renal failure using Stylet-Catheter. Before the experimentations, complate clinical examination, hemogram and serum urea nitrogen, serum creatinin, serum chloride, serum potassium and serum sodium concentrations were performed. In Dog* 1*, above*

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examinations and measurements were detected at 6, 24, 30, 48 *and* 54 *hours and he died at* 60 *hours after surgical operation. In the Dog* 2 *and Dog* 3, *therapy with peritoneal dialysis was started at* 48 *hours after surgical operation. In these dogs were at this point detected uremia, hypercreatinin concentrations in blood, hypochloremia, hyperkalemia and hyponatremia. The dogs were dehydrated and showed CNS depression, anorexia, increasing reluctance to walk. Dialysis was done for* 15 *times in Dog* 2 *and* 20 *times in Dog* 3. *During the peritoneal dialysis, blood samples and peritoneal dialysate samples were collected at the time of* 5, 10, 15 *and* 20 *dialysis. At the end of the peritoneal dialysis, both dogs became alert and stood. Whereas creatinin and BUN concentrations were slightly higher than the normal values in Dog* 2, *blood chemistry and electrolyte values were normal in Dog* 3.

Introduction

Peritoneal dialysis is the recommended treatment for patient with acute reversible renal failure, during the period of compromised renal fonction. This procedure avoids the progressive uremic state and allows the kidneys to regenerate and regain their fonction (2, 5, 12, 13, 15). Pleural dialysis has been described in dogs (9, 10).

Hemodialysis technique is preffered for managing acute renal failure in human medicine. However, it's implementation in Veterinary medicine has been limited, because of cost, technical complexity of equipment needed and dependency on trained and experienced personnel (4, 5, 11).

In small animal practice peritoneal dialysis has proved to be the method of choice for artifically providing kidney fonction. Peritoneal dialysis also can be used for the treatment of a variety of drug toxities, peritonitis and ruptured bladder in foal (5, 6, 12, 13).

In this method, the patient's own peritoneum serves as a semipermeable membrane across which a transfer of solutes from the blood into the dialysate occur. Instillment of a hypertonic dialysate solution in the peritoneal cavity creates a concentration gradient between peritoneal blood vessels and dialysate solution through which substances like urea, creatinin and potassium are cleared from plasma into the dialysate by osmosis. The large surface area and intrincis semipermeability of the peritoneum make peritoneal dialysis clearence very efficient. Because of the large pore size of the peritoneum, large mo-

lecules (500 to 3000 daltons) can be easily cleared. Many of the uremic toxins are tought to be that size range (2, 5, 12).

In this procedure, dialysate solution is instilled in peritoneal cavity via abdominal catheter. Uremic toxins diffuse across the parietal peritoneum into the dialysate which is removed after a prescribed dwell time via the same catheter (2, 5, 6, 12, 13, 15).

In this study, we described the use of peritoneal dialysis as an alternative treatment for acute renal failure using Stylet-Catheter in two dogs with experimentaly induced uremia.

Materials and methods

Three healty mixed-breed male dogs weighing 15–20 kg each were used. Uremia was induced experimentally in these dogs; one dog (Dog 1) was used as control and dialysis was not applied while other two dogs (Dog 2, Dog 3) were treated by peritoneal dialysis. Dog 1 was kept till he died.

As begining the experiments, the following examinations and measurements were performed: complate clinical examination, hemogram and serum urea nitrogen, serum creatinin, serum chloride, serum potassium and serum sodium concentrations.

Before surgical operation, food was witheld from the dogs overnight, but they were allowed free exccess to water. Preanesthetic medication consisted of Rompun[a] (1.5 ml/10 kg weight). Anestheisa was induced with Rompun (1 ml/kg weight) and Ketalar[b] (15 mg/kg). Intravenous fluid was not given during the surgical operation or throughout the experiment.

Both ureters were exposed by midline laparatomy and ligatured with two tick silk ligateres at the closest part of ureters to kidneys. Antibiotics were not injected. After surgical operation, the dogs were kept metabolism cage. Vital sings were recorded twice in a day.

In the Dog 1, blood samples for determination of hemogram, serum urea nitrogen, serum cretainin, serum chloride, serum potassium and serum sodium concentrations were collected at 6, 24, 30, 48 and

a– % 2 Xylazine hydrochloride, Bayer.

b– Cetamine hydrochloride, Parke-Davis

54 hours until he died. Survival time after surgical operation was recorded and necropsy was performed.

In the Dog 2 and Dog 3, therapy with peritoneal dialysis was started at 48 hours after surgical operation. An 8-by-8 cm area on the ventral midline, half-way between the umblicus and prupuce, was clipped and prepared for aseptic surgery. The area was infiltrated with a local anesthetic agent. Before the catheter was placed, 500 ml dialysate solution had been given intraperitoneally. A stab incision was made in the skin. Than, Stylet- Catheter[c] was placed in the stab incision and forced in to the abdomen. When the catheter forced in to the abdomen, the rigid stylet was removed. The winged retainer on the catheter were placed at skin level and sutured to the skin, fixing the catheter in place. After one liter of the peritoneal dialysis solution had been given, the dialysis catheter was clamped for 15 minutes and then opened and allowed to drain. After all dialysis solution had been drained, 1 L dialysis solution was given again. Dialysis was done in this manner for 15 times, over a 12 hours period, using a total of 15 L of dialysate in dog 2 and 20 times over a 15 hours using a total of 20 L of dialysate in Dog 3 (Fig. 1). During the peritoneal dialysis, blood samples and peritoneal dialysate samples were collected at the time of 5, 10, 15 and 20 dialysis, The blood samples were examined for determination of hemogram, urea and creatinin concentrations of sera and dialysate samples were measured by established method (3, 8), serum potassium and sodium concentrations were analysed by flame photometer[d], serum chloride concentrations by the method of Schales and Schales (8).

Peritoneal dialysis solution was preparaed by adding 1 g of NaCl per liter to commercial peritoneal dialysis solution[e] for human. Just before the dialysis procedure, 250 IU of heparin and 4 mg of Gentamycin were added to the per liter of dialysis solution warmed at 38'C. After 6th dialysis each dialysis solution was supplemented with 3 mEq of potassium per liter.

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c- B. Braun – Fraba GmbH 2.5 x 3.5 x 280 mm, No: 702903/9

d- Dr. Lange Flammenphotometer M-7D

e- Kod. No: 86040-Bax_9-PD_1, Baxter (Eczacıbaşı)

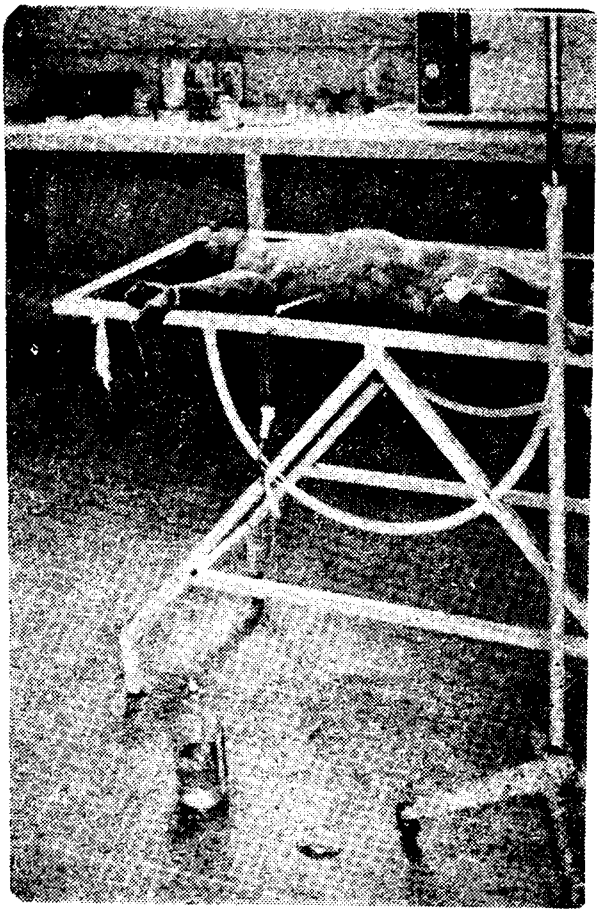

Fig. 1. The position of Dog 3 during the peritoneal dialysis.

Results

In Dog 1 used as control death occured at 60 hours. The rectal temperature of Dog 1 decreased to 37.2 at 54 hours. The rectal temperature of Dog 2 and Dog 3 varied from 38.6 to 39.5 during the experiments. Temperature could not be corelated with the severity of azotemia. Respiration and pulsation rates increased and cardiac arrythmias were detected while urea nitrogen concentrations of blood increased. Urination were not observed.

The clinical sings of all the dogs were similar after 12 hours; CNS depression, anorexia, insreasing reluctance to walk. The average time to onset of vomiting after surgical operation was 15 hours. The dogs consumed large quantities of water and usually vomited soon after drinking. Dehydration determinated by skin turgor progressed in all dogs, and especially after 48 hours was progressive and severe in Dog 1.

The PCV of Dog 1 increased markedly to 48 at 54 hours. In the Dog 2 and Dog 3, PCV increased to 42 and 41 at 48 hours respectively (Fig. 2). During the peritoneal dialysis PCV of Dog 2 and Dog 3 decreased to 41 and 40 at 5 dialysis, to 40.5 and 39.5 at 10 dialysis, to 40 and 39 at 15 dialysis, respectively. In the Dog 3, PCV decreased to 38.5 at 20 dialysis.

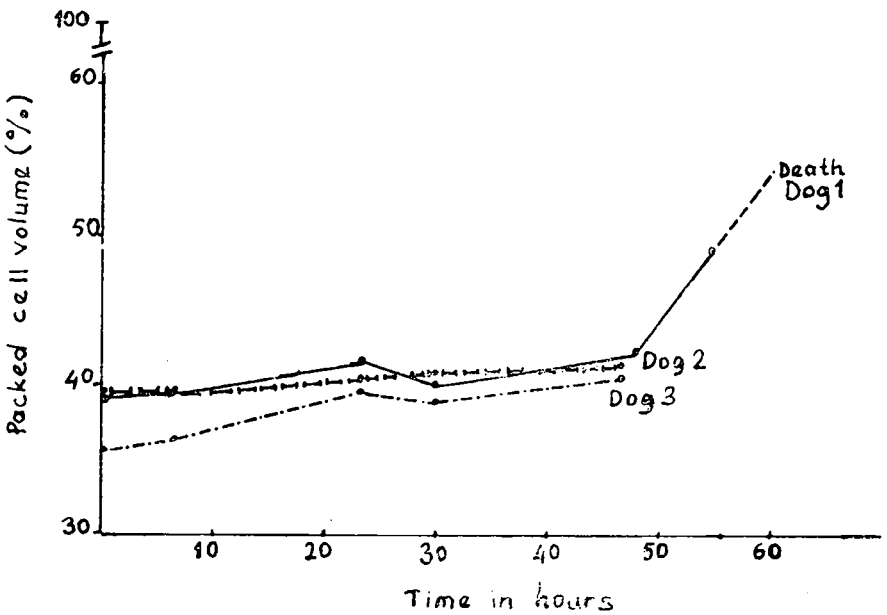

Fig. 2. Mean packet cell volume in dogs with experimentally induced uremia.

In all the dogs WBC count was slightly increased at 24 hours after surgical operation, than desreased to normal. The WBC count of the Dog 2 and Dog 3 were 14976 and 13894 at 48 hours, respecti-

vely. Neutrophils accounted for the major portion of this response, increasing from 76 to 91 over the 38 hours period. During the peritoneal dialysis WBC and neutrophil counts remained unchanged.

The blood chemistry and electrolyte values of the dogs are shown in Table 1 and Table 2. Serum creatinine, serum potassium and BUN concentrations were markedly increased, whereas serum sodium and chloride concentrations were decreased. At the end of peritoneal dialysis, serum creatinine and BUN concentrations were slightly higher than the normal values in Dog 2, blood chemistry and electrolyte values were normal in the Dog 3. After 10th dialysis, both dogs became alert and stood. A slight amount of subcutaneous and preputial edema developed after of the catheter in Dog 3.

In dog 1, necropsy revealed hydronephrosis, tubulonephrosis and uremic gastritis. Both kidneys were generally congested, tubular epithelium was characterized by multifocal degenerations, necrosis and atrophy.

In the Dog 2 and Dog 3, the volume of given and drained dialysis solution and determined value of urea nitrogen creatinine concentrations in drained samples at 5, 10, 15 and 20 dialysate are shown in Table 3. Drained fluid volumes ranged from 550 to 1240 ml. Urea nitrogen and creatinine concentrations in drained dialysis samples

Table 1- Hematological and electrolyte values in Dog 1

Item	Before surgical operation	After surgical operation				
		Hour 6	Hour 24	Hour 30	Hour 48	Hour 54
Blood urea nitrogen mg/100 ml	21.84	26.40	55.75	64.24	86.21	122.33
Serum creatinin mg/100 ml	0.91	1.01	3.46	4.13	6.29	6.67
Serum chloride mEq/L	124	121	109	97	90	87
Serum potassium mEq/L	4.61	5.11	7.48	7.51	7.63	8.16
Serum sodium mEq/L	141	139	134	133	131	126

Table 2. Hematologic and electrolyte values in Dog 2 and Dog 3.

Item	Before Surgical Operation		After surgical operation								During the peritoneal dialysis							
			Hour 6		Hour 24		Hour 30		Hour 48		5th		10th		15th		20th	
	D2	D3	D2	D3	D2	D3	D2	D3	D2	D3	D2	D3	D2	D3	D2	D2	D2	D3
Blood urea Nitrogen mg/100ml	11.6	17.1	18.1	25.1	49.0	45.4	54.6	59.6	97.5	102	69.5	72.9	59.7	55.7	40.0	41.1	—	22.1
Serum creatinin mg/100 ml	0.42	0.51	0.54	0.71	1.94	1.62	3.25	2.86	4.71	4.68	3.04	2.96	2.14	1.64	1.66	1.13	—	0.78
Serum chloride mEq/L	114	105	110	104	100	102	98	100	96	92	98	97	101	101	112	104	—	107
Serum potassium mEq/L	4.62	4.73	4.79	4.85	5.41	5.67	5.68	6.62	6.71	7.41	5.85	5.92	5.51	5.66	5.18	5.19	—	4.80
Serum sodium mEq/L	135	133	134	131	130	128	128	127	124	123	125	124	126	130	135	135	—	138

Tablo 3. The value of given and drained peritoneal dialysate and determined BUN and Creatinin concentrations.

Dialysis number	Given Dialysis sol. D2 (ml)	Drained dialysis sol. D2 (ml)	BUN D2 mg/100 ml	Creatinin D2 ml/g100 ml	Given dialysis sol. D3 (ml)	Drained dialysis sol.D3 (ml)	BUN D3 mg/100 ml	Creatinin D3 mg/100 ml
0	500	–		–	500	–	–	–
1	1000	1240	36	3.1	1000	1100	32.5	3.3
2	1000	1050			1000	750		
3	1000	950			1000	550		
4	1000	980			1000	900		
5	1000	890	33	2.8	1000	1300	32.4	3.1
6	1000	650			1000	700		
7	1000	800			1000	800		
8	1000	820			1000	900		
9	1000	950			1000	750		
10	1000	750	31.9	2.3	1000	750	21.6	2.7
11	1000	800			1000	750		
12	1000	700			1000	700		
13	1000	850			1000	800		
14	1000	750			1000	750		
15	1000	850	30.8	2.1	1000	850	20.8	2.2
16	–	–	–	–	1000	650		
17	–	–	–	–	1000	800		
18	–	–	–	–	1000	950		
19	–	–	–	–	1000	750		
20	–	–	–	–	1000	800	17.9	1.8

decreased to 30.8 mg/100 ml and 2.1 mg/100 ml by order in the Dog 2 and to 17.9 mg/100 ml and 1.8 mg/100 ml in the Dog 3, respectively. These values could be corelated with blood values. No organisms were isolated in drained dialysis samples. The both dogs were euthenasiaed at 24 hours after dialysis.

Discussion

Several methods of establishing normal fluid and electrolyte balance to correction in dogs with reversible renal failure have been reported (2, 5). These include intravenous administration of hypertonic or isotonic NaCl solution, and dextrose therapy to lower serum potassium concentrations. None of the reports decument the change in electrolyte values associated with the various treatments used. Unlike other treatments, peritoneal dialysis reliably corrects the electrolyte and metabolic distirbances without causing rapid changes. Extremely rapid changes in serum electrolytes or urea may cause gradient effects across the blood brain barrier, leading to seizures or other signs of CSN disease (7). In Dog 2 and Dog 3, Before peritoneal dialysis, detected cardiac arrythmias were attributed to the associated hyperkalemia; signs of CNS dysfunction were attributed to the associated uremia on the basis criteria previously reported (2, 5, 12). After peritoneal dialysis, these signs were absent. Both BUN and serum potassium concentrations decreased to normal values (table 2).

In this study, commercial peritoneal dialysis solution made for human patients was used, but were lower in both sodium and chloride ions concentrations (140 mEq/L and 101 mEq/L) as compared to normal dog plasma (sodium 150 mEq/L and chloride 112 mEq/L). For this reason, 1 gr NaCl was added to per liter of dialysis solution. After 6th dialysis 3 mEq potassium ion was added to per liter of dialysis solution to prevent lost of potassium ion, because potassium ion was absent in dialysis solution. To maintain catheter patency 250 IU heparin was added to each liter dialysis solution. And 4 mg Gentamicin was also added to each liter minimize the risk of peritonitis, because much of the work on antibiotic treatment of the peritoneum has centered on gentamicin pharmacokinetics (13, 14).

The volume, temperature and flow rate of the dialysate affected solute clearence has been discussed (12). Because of this, 1 liter dialysate solution warmed at the each time of dialysis.

Complications associated with peritoneal dialysis include peritonitis, electrolyte imbalance, and subcutaneous edema around the catheter side (6, 7, 12). In this study, in Dog 3 did only develop subcutaneous and scrotal edema when the dialysis catheter was removed, but it resolved over a 24–hour period. The major problem of dialysis is the difficulty to retrieve the instilled dialysate solution due to obstruction of the abdominal catheter by omentum, abdominal fat, and intestines (12). The Stylet-Catheter showed to largely overcome this problem.

This technique is amenable to use in private practice, relatively inexpensive and it can be proposed as an alternative treatment of acute renal failure.

Acknowledgment

We are greateful to Serdar Diker, Mehmet Sağlam, Figen Ünlü Erkoç, Eser Turgut for their technical assistance.

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