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Clinical Hemodialysis Cases with Estimation of the Adequacy in Four Dogs

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Abstract : Four cases of acute or acute-on-chronic kidney injury were referred for hemodialysis therapy. All cases had a history of uremic syndrome including refractory vomiting, anorexia, diarrhea and depression. They already had been treated with conventional therapies but the intractable clinical signs were remained without response of medications. Intermittent hemodialysis (IHD) sessions were executed in four cases. This study describes the clinical signs and biochemical features of four hemodialysis patients with dialysis adequacy indexed by Kt/V. This report introduced the estimation of hemodialysis adequacy method with clinical cases for establishment of standardization of hemodialysis therapy assess in dogs.

Key words **:** Acute kidney injury, Chronic kidney disease, Dogs, Hemodialysis.

Introduction

The alternative therapies for acute kidney injury (AKI) or advanced chronic kidney disease (CKD) in dogs are limited (2). Hemodialysis is the most common method of renal replacement therapy for the majority of human patients with severe azotemia (6). Hemodialysis extends the expectation of survival time of patients with severe azotemia and extends the time of opportunity for recovery. Without hemodialysis, the patients with severe injury typically die from azotemia before alleviation can occur, in spite of the potential for reversible renal damage (10).

Renal replacement therapies include extracorporeal techniques as well as intracorporeal techniques. In clinical veterinary medicine, extracorporeal renal replacement therapies have begun to play an important role in the treatment of kidney disease (2). Although its effectiveness, hemodialysis is expensive and usually applied at a last stage of disease when conventional medical management has failed. In many cases, it would not be applied in a timely manner because of an uncertain result and prognosis (10).

Kt/V is a number used to quantify hemodialysis treatment adequacy. K means dialyzer clearance of urea, t means dialysis time and V means volume of distribution of urea, approximately equal to patient's total body water (3). K multiplied by t is a volume, and Kt can be thought of as the total volume of blood cleared of urea during the course of a single treatment. V also is a volume, expressed in mL or L. So the ratio of Kt/V is known as dimensionless ratio and can be thought of as a multiple of the volume of plasma cleared of urea divided by the distribution volume of urea (4).

This study describes the clinical signs and biochemical features of four hemodialysis patients with dialysis adequacy indexed by Kt/V. The dialysis adequacy was estimated each dialysis sessions.

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Case

Histories and clinical examinations

Four subjects were referred for hemodialysis therapy (Table 1). All cases had a history of uremic syndrome including refractory vomiting, anorexia, diarrhea and depression. All cases had been treated with conventional therapies including antiemetics, phosphate binding agents, probiotics and fluid therapy before refer to author's institution.

Result of blood examinations of the day of present were executed including complete blood cell count (CBC), serum biochemistry and blood gas analyzing. CBC examination revealed mild leukocytosis of the dogs of all cases. Serum biochemical examination revealed azotemia of all dogs as they were referred for hemodialysis treatment (Table 2). Despite of treatments prior to presenting, hyperphosphatemia was shown in all cases.

Treatments and prognosis

The IHD therapies were executed for each patient and several sessions were executed as occasion demand. Temporary double lumen hemodialysis catheters (GamCath^{TM}; GAMBRO, Sweden) were placed in the right jugular vein via the seldinger technique as previously describes. A hemodialysis machine (AK 95; GAMBRO, Sweden) was used with a low-volume extracorporeal circuit (BL 121P; GAMBRO, Sweden) and with different low-volume dialyzers. The low-volume, 0.6 m^2 surface area, polyamix membrane dialyzer (Polyflux 6H; GAMBRO, Sweden) and the very low-volume, 0.2 m^2 surface area, Helixon membrane dialyzer (Fx paed; Fresenius Medical Care, Germany) were used. The extracorporeal circuit was primed using 0.9% sodium chloride. Unfractionated heparin was used as the anticoagulant.

Table 1. Detailed clinical features and results of blood examination in each patient

Case Number	1	2	3	4	Mean ± S.D
Age	15y	9y	12y	9y	11.25 ± 2.87
Breed	Shih tzu	Cocker spaniel	Labrador Retriever	Schnauzer	
Diagnoses	AKI on CKD	CKD	Renal amyloidosis	AKI on CKD	
IRIS stage	III	IV	IV	IV	

AKI: acute kidney injury, CKD: chronic kidney disease, IRIS: international renal interest society, S.D : standard deviation

Table 2. Changes in blood serum chemistry levels including BUN and CREA before and after each hemodialysis sessions

Session		1st		2nd		3rd		4th	
		Before	After	Before	After	Before	After	Before	After
Case 1	BUN	60	41						
	CREA	2.7	1.8						
Case 2	BUN	109	76	101	35				
	CREA	6.7	4.4	5.7	2.1				
Case 3	BUN	97	81	88	70	83	55	82	56
	CREA	4.6	3.6	4.3	3.6	4.2	2.9	4.4	3.0
Case 4	BUN	63	48	75	25	59	17	44	23
	CREA	4.1	3.3	4.9	1.8	5.3	2.6	4.2	2.3

BUN: Blood urea nitrogen, CREA: Blood creatinine

Case 1

A dog weighing 6.02 kg was present for hemodialysis treatment. Before 2 years ago, the dog was diagnosed with CKD. Before presenting, conventional therapies including fluid therapy and diuretics, but the dog still had anuric state and profound anorexia and vomiting. Although azotemia was mild, IHD was executed. After IHD, the dog maintained the amelioration of clinical signs and azotemia following 3 days. The dog was discharged on day 4 of presentation.

Case 2

A dog weighing 7.22 kg was present for intractable clinical signs (anorexia, diarrhea and vomiting), despite of 13 days history of fluid therapy. On presentation, moderate azotemia and severe systemic hypertension (mean systolic 240 mmHg) were revealed. Two times of IHD improved clinical signs and azotemia (Fig 1). But the client of the dog decided to the abandonment of the serial treatment because of huge expenses.

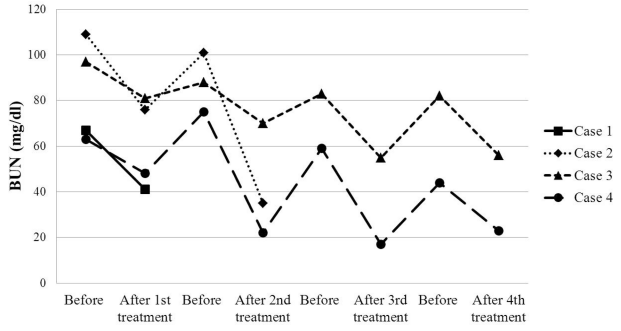

Fig 1. Changes of blood urea nitrogen values. Case 1 had hemodialysis session once, Case 2 had twice and Case 3 and 4 had four times of sessions. BUN: blood urea nitrogen.

Case 3

A weighing 31.5 kg dog was referred with a week history of depression and azotemia that had not responded to conventional therapy. Based on serial examinations, the dog was diagnosed with splenic mass with CKD associated glomerulopathy. Additional splenectomy and renal biopsy with histopathologic examination revealed renal amyloidosis with splenic hemangioma. Fourth times of IHD were executed, although azotemia was mildly ameliorated, the improvements of clinical signs were not significant. The dog died after 12 days of

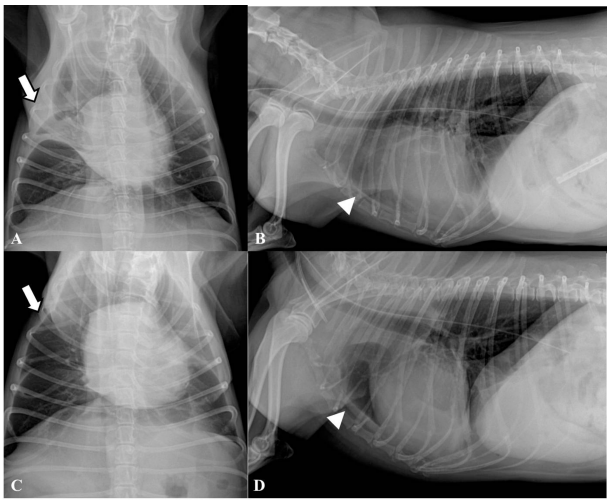

Fig 2. Thoracic radiographs of Case 4 dog. Before hemodialysis (A, B) right middle lung lobe (white arrow) was collapsed due to pleural effusion. After hemodialysis (C, D) thoracic radiographs showed amelioration of collapsed right mid lung lobe and decreased opacity (white arrow head) throughout the lung field.

Table 3. Hemodialysis adequacy of each hemodialysis sessions and total treatment

Case	1st HD		2nd HD		3rd HD		4th HD		Number of HD	Total Kt/V
	URR	Kt/V	URR	Kt/V	URR	Kt/V	URR	Kt/V		
1	0.32	0.13							1	0.13
2	0.30	0.17	0.65	0.66					2	0.83
3	0.16	0.07	0.20	0.10	0.34	0.13	0.32	0.14	4	0.44
4	0.24	0.27	0.67	1.08	0.71	1.19	0.48	0.45	4	2.99

HD: hemodialysis session, URR: urea reduction ratio, Kt/V: hemodialysis adequacy index

hospitalization with acute cardiopulmonary distress.

Case 4

A weighing 8.72 kg dog was present with a week of vomiting and anorexia, the dog was not responded to fluid therapy. Before presenting, the dog was turned to anuric state despite of aggressive fluid therapy and peritoneal dialysis. On physical examination revealed that the depressed dog was overhydrated with systemic hypertension (mean systolic 183 mmHg). Thoracic radiologic findings revealed large volume of pleural effusion (Fig 2). After hemodialysis with ultrafiltration, pleural effusion was resolved immediately on radiologic examination (Fig 2). Anuric state of the dog was resolved in 2 days after presentation. The four times of IHD significantly ameliorated azotemia (Fig 1) and clinical signs. The dog was discharged a week after present.

The adequacy of each hemodialysis sessions was estimated by urea reduction ratio (URR) and Kt/V (a number of dialysis adequacies) and additionally total Kt/V was estimated (Table 3). Estimation of dialysis adequacy revealed Case 4 treatment was the highest efficacy among the treatment cases.

Discussion

IHD is a renal replacement modality that is defined by short, efficient hemodialysis sessions with removing endogenous or exogenous toxins from the blood (5,8). No conventional medical therapies possible reproduce the efficacy of hemodialysis for correction of the stored biochemical substances associated with kidney failure (9). It provides the opportunity to give more support to a patient than conventional management. Hemodialysis can ameliorate life-threatening uremic complications and thus earn time for renal recovery (8).

Although massive fluid therapy and high dose of diuretics, the anuric patients were presented in case 1 and 4. They had not quite high value of blood urea nitrogen (BUN) in comparison with serum creatinine value. But the large quantity of infuse fluid made the patients be overhydrated. IHD resolved overhydrated patients immediately by ultrafiltration. Moreover the patients were relieved of anuric states.

Despite of 4 times of hemodialysis sessions, Case 3 patient was slightly improved of azotemia without significantly ameliorated clinical signs. In Case 3, estimation of adequacy showed very low value of hemodialysis sessions. According to human literatures, life expectation and the quality of life of dialysis patients with amyloidosis were poorer than those of general dialysis patients (7). The adequacy of hemodialysis values seemed to corresponding clinical consequences.

Prolongation of life is the best result for animals managed with hemodialysis. But survival is predicted on more than the adequacy of dialysis delivery and ultimately dependent on the diversity of the underlying risk factors including etiology, comorbidities, age, and residual renal function (10). Consequently, survival is a difficult outcome parameter to correlate specifically to dialytic interventions. Nevertheless the volume urea kinetic model has been reported to correlate independently with survival as a result in humans undergoing hemodialysis (4), and it is likely to demonstrate similar links to the adequacy of hemodialysis in animals (3).

There is another way of adequacy which is (URR), simple numerical value of hemodialysis sessions. The URR is also measured by the postdialysis and predialysis urea nitrogen levels in the blood, then -ln (1-URR) should be about Kt/V (4). The mathematic relation could not quite work out, and more complicated factors have been worked out to account for the ultrafiltration during dialysis as well as urea generation (4).

This report describes clinical cases the consequences and adequacies of IHD sessions with clinical signs and Kt/V. Consequently, Case 4 showed high values of Kt/V, improving clinical signs significantly. Beside, Case 3 showed low values of Kt/V without amelioration of clinical signs. From such results showed Kt/V could be a meaningful parameter of clinical hemodialysis consequences, as previous reported studies (4).

According to the human guidelines, for 3x/week dialysis a Kt/V should be 1.2 at a minimum with a target value of 1.4 (1). But Kt/V has been controverted because quite different levels can be obtained, particularly in smaller patients. Because of, the levels of Kt/V in smaller patients often can be achieved over 2 to 2.5 hours (1). In our study, the hemodialysis sessions were executed in 3 to 4 hours, because they were the dogs that weigh much less than human. Further studies should be done for applying the Kt/V to the dogs.

Conclusion

Hemodialysis prescriptions for animals have been derived empirically as consensus-based guidelines for a diverse array of animal types and clinical conditions. There has been little validation or standardization of dialysis therapy based on outcome assessment. Although small numbers of cases, this report introduced the estimation of hemodialysis adequacy and suggested revitalization of clinical hemodialysis applica-

tions. In author's knowledge, this is the first veterinary report of clinical hemodialysis cases with Kt/V.

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References

1. Beto JA, Bansal VK. Medical nutrition therapy in chronic kidney failure: integrating clinical practice guidelines. J Am Diet Assoc 2004; 104: 404-409.
2. Bloom CA, Labato MA. Intermittent hemodialysis for small animals. Vet Clin North Am Small Anim Pract 2011; 41: 115-133.
3. Cowgill LD. Urea kinetics and intermittent dialysis prescription in small animals. Vet Clin North Am Small Anim Pract 2011; 41: 193-225.
4. Depner TA. Assessing adequacy of hemodialysis: urea modeling. Kidney Int 1994; 45: 1522-1535.
5. Eatroff AE, Langston CE, Chalhoub S, Poeppel K, Mitelberg E. Long-term outcome of cats and dogs with acute kidney injury treated with intermittent hemodialysis: 135 cases (1997-2010). J Am Vet Med Assoc 2012; 241: 1471-1478.
6. Langston CE, Cowgill LD Spano JA. Applications and outcome of hemodialysis in cats: a review of 29 cases. J Vet Intern Med 1997; 11: 348-355.
7. Moroni G, Banfi G, Montoli A, Bucci A, Bertani T, Ravelli M, Pozzi C, Leonelli M, Lupo A, Volpi A. Chronic dialysis in patients with systemic amyloidosis: the experience in northern Italy. Clin Nephrol 1992; 38: 81-85.
8. Polzin DJ. Chronic kidney disease in small animals. Vet Clin North Am: Small Anim Pract 2011; 41: 15-30
9. Polzin DJ. Evidence-based step-wise approach to managing chronic kidney disease in dogs and cats. J Vet Emerg Crit Care (San Antonio) 2013; 23: 205-215.
10. Segev G, Kass PH, Francey T, Cowgill LD. A novel clinical scoring system for outcome prediction in dogs with acute kidney injury managed by hemodialysis. J Vet Intern Med 2008; 22: 301-308.

혈액투석 4마리 개의 증례에서 투석적절성 평가

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요 약 : 급성 또는 급성 악화 신장 손상으로 혈액투석을 위해 4마리의 개가 내원하였다. 모든 증례에는 난치성의 구토, 식욕 부진, 설사, 침울 등을 포함하는 요독증 증후군을 가지고 있었다. 기존의 일반적인 치료를 받았으나, 치료적 반응은 없었으며 심한 임상증상은 남아있었다. 4마리의 증례에서 간헐적 혈액투석(IHD)이 실시 되었다. 본 논문은 혈액투석을 실시한 4마리의 환자의 임상증상과 생화학적 특징을 Kt/V로 나타나는 투석 적절성에 대하여 기술하였다. 본 논문은 개에서의 혈액투석 치료의 표준화의 설정에 도움이 되기 위하여 실제 증례에서 투석 적절성을 평가하였다.

주요어 : 급성신장손상, 만성신질환, 개, 혈액투석