The Survival and Its Associated Factors among Patients with Diabetic Kidney Disease on Continuous Ambulatory Peritoneal Dialysis: Three -Year Experience in Maharat Nakhon Ratchasima Hospital.

Waraporn Liawnoraset, M.D.*, Suchart Jenkriangkrai, M.D.*,
Warunee Svetamal, B.N.S.*, Sirilak Suttharattanakun, B.N.S.*

Objective: To evaluate the patient survival and the influencing factors in continuous ambulatory peritoneal dialysis (CAPD) patients with diabetic kidney disease at Maharat Nakhon Ratchasima Hospital. **Patients & Methods:** Medical records of diabetic CAPD patients in Maharat Nakhon Ratchasima Hospital during January 1, 2008-December 31, 2010 were reviewed. The collected data included demographic details, underlying diseases, body mass index (BMI), laboratory findings, peritonitis episodes, and outcome of therapy on December 31, 2010. **Results:** One hundred and eleven diabetic CAPD patients were analysed. There were 57.7% male, mean age was 51.9±14.4 years (range 15.3-78.6 years). The CAPD patients had anemia (67.3%), hypokalemia (36.3%) and hypoalbuminemia (66.3%). In the follow up period, total observation period was 977.4 patient-months. Patient survivals at 1, 2 and 3 years were 64.4%, 47.5% and 47.5%, respectively. The mean patient survival time was 25.6 months. The influencing factors that lowered patient survival were age above 60 years, serum potassium below 3.5 mEq/L and serum albumin <3.5 g/dL. Peritonitis rate was 21.2 patient-months per episode. *Streptococcus spp.* and *Staphylococcus aureus* were common causative organisms. Mean patient survival in no-peritonitis group was higher than peritonitis group, without statistic significance. At the end of study, the patients continued on CAPD (60.2%), switched to hemodialysis (4.6%), were referred to another center (0.9%), and died (34.3%). **Conclusion:** Diabetic CAPD patients had had high incidences of hypokalemia and hypoalbuminemia that influenced the survival of these patients. The peritonitis was not significant influencing factors for patient survival. So there was importance to improve patient survival by correcting the influencing factors and nutritional status in diabetic CAPD patients.

Keywords: Continuous ambulatory peritoneal dialysis, Diabetic kidney disease, Survival, Influencing factors affecting survival

---

* Renal Unit, Department of Medicine, Maharat Nakhon Ratchasima Hospital, Nakhon Ratchasima 30000

บทคัดย่อ การรอดชีวิตและปัจจัยที่มีผลต่ออัตรารอดชีวิตในผู้ป่วยโรคไตเรื้อรังจากเบาหวานที่ล้างไตทางช่องท้อง: ประสบการณ์ 3 ปีในโรงพยาบาลมหาราชนครราชสีมา

วราภรณ์ เลียวนรเศรษฐ, พ.บ.*, สุชาติ เจนเกรียงไกร, พ.บ.*, วารุณี เศวตมาลย์, พย.บ.*, สิริลักษณ์ สุทธรัตนกุล, พย.บ.*

*หน่วยไต กลุ่มงานอายุรกรรม โรงพยาบาลมหาราชนครราชสีมา นครราชสีมา 30000

เวชสารโรงพยาบาลมหาราชนครราชสีมา 2554; 35: 13-21.

วัตถุประสงค์: เพื่อประเมินอัตรารอดชีวิตและปัจจัยที่มีผลต่ออัตรารอดชีวิตในผู้ป่วยโรคเบาหวานและได้รับการรักษาด้วยการล้างไตทางช่องท้องในโรงพยาบาลมหาราชนครราชสีมา **ผู้ป่วยและวิธีการ:** ศึกษาข้อมูลผู้ป่วยโรคเบาหวานที่ได้รับการรักษาด้วยการล้างไตทางช่องท้องในโรงพยาบาลมหาราชนครราชสีมาตั้งแต่ 1 มกราคม 2551 ถึง 31 ธันวาคม 2553 โดยเก็บข้อมูลพื้นฐาน, ดัชนีมวลกาย, ผลตรวจทางห้องปฏิบัติการ, อัตราการติดเชื้อในช่องท้องและผลการรักษาเมื่อวันที่ 31 ธันวาคม 2553 **ผลการศึกษา:** ผู้ป่วยโรคเบาหวานที่ล้างไตทางช่องท้องจำนวน 111 ราย เป็นเพศชายร้อยละ 57.7, อายุเฉลี่ย 51.9±14.4 ปี (พิสัย 15.3-78.6 ปี) ผู้ป่วยมีภาวะซีดร้อยละ 67.3, ภาวะโปแตสเซียมต่ำร้อยละ 36.3 และภาวะไข่ขาวในเลือดต่ำร้อยละ 66.3 ระยะเวลาในการศึกษาทั้งหมด 977.4 ผู้ป่วย-เดือน อัตรารอดชีวิตผู้ป่วยที่ 1 ปี, 2 ปี และ 3 ปีเท่ากับร้อยละ 64.4, 47.5 และ 47.5 ตามลำดับ ค่าเฉลี่ยอัตรารอดชีวิตเท่ากับ 25.6 เดือน ปัจจัยที่มีผลต่ออัตรารอดชีวิตต่ำได้แก่ อายุมากกว่า 60 ปี, ระดับโปแตสเซียมต่ำกว่า 3.5 มิลลิอิคิวาเลนท์/เดซิลิตร, ภาวะไข่ขาวในเลือดต่ำกว่า 3.5 กรัม/เดซิลิตร อัตราการติดเชื้อในช่องท้องเท่ากับ 21.2 ผู้ป่วย-เดือนต่อครั้ง พบว่าเชื้อสเต็ปโตคอคคัสและเชื้อสแตฟไฟโลคอคคัส ออเรียส เป็นสาเหตุของการติดเชื้อในช่องท้องที่พบได้บ่อย ผู้ป่วยที่ไม่มีการติดเชื้อในช่องท้องมีอัตรารอดชีวิตสูงกว่ากลุ่มที่มีการติดเชื้อในช่องท้องแต่ไม่แตกต่างอย่างมีนัยสำคัญ เมื่อสิ้นสุดการศึกษาพบว่าผู้ป่วยที่ยังคงรักษาด้วยการล้างไตทางช่องท้องร้อยละ 60.2, เปลี่ยนไปฟอกเลือดร้อยละ 4.6, ส่งต่อไปรักษาที่อื่นร้อยละ 0.9 และเสียชีวิตร้อยละ 34.3 **สรุป:** ผู้ป่วยเบาหวานที่ล้างไตทางหน้าท้องมีอุบัติการณ์การเกิดภาวะโปแตสเซียมและไข่ขาวในเลือดต่ำสูงซึ่งปัจจัยดังกล่าวมีผลต่ออัตรารอดชีวิตในผู้ป่วยล้างไตทางช่องท้อง อุบัติการณ์การติดเชื้อในช่องท้องไม่มีผลต่ออัตรารอดชีวิตในผู้ป่วยโรคเบาหวานที่ล้างไตทางช่องท้องอย่างมีนัยสำคัญ ดังนั้นการแก้ไขปัจจัยดังกล่าวและภาวะโภชนาการมีความสำคัญต่ออัตรารอดชีวิตในผู้ป่วยเบาหวานที่ล้างไตทางหน้าท้อง

คำสำคัญ: การล้างไตทางหน้าท้อง, โรคไตเรื้อรังจากเบาหวาน, อัตรารอดชีวิต, ปัจจัยที่มีผลต่ออัตรารอดชีวิต

Introduction

Incidence of end stage renal disease (ESRD) has increased every year in the world[1,2]. The standard treatment of ESRD is renal replacement therapy (RRT) such as hemodialysis (HD), continuous ambulatory peritoneal dialysis (CAPD) and kidney transplantation (KT)[3-5]. Maximum annual growth of CAPD in the world has been reported from Asian countries. Several reports have shown patient survival rate in peritoneal dialysis is better than HD in the first 2 years, and then they are similar in long term survival[6-8]. There were many factors including old age, comorbid diseases especially diabetes mellitus (DM), malnutrition had affected morbidity and mortality in CAPD patients. DM

is common cause of ESRD and one of influencing factors for patient survival[8-10].

In Thailand, ESRD patients who underwent CAPD modality were increased every year. In Maharat Nakhon Ratchasima Hospital, we had started 'PD first' program since 2008, all of diabetic-ESRD patients under UCS who were registered to CAPD in Maharat Nakhon Ratchasima Hospital were recruited for the analysis of factors that influenced the patient survival, during January 1, 2008-December 31, 2010.

Materials and Method

Medical records of 111 adult diabetic patients with newly diagnosed ESRD who underwent CAPD under UCS in Maharat Nakhon Ratchasima Hospital during January 1, 2008-December 31, 2010 were reviewed.

Inclusion criteria: All of adult diabetic ESRD patients under UCS who were registered, performed CAPD and followed up since January 1, 2008 at Maharat Nakhon Ratchasima Hospital until death, change to hemodialysis or kidney transplantation modalities, referral to other centers, or until December 31, 2010. Technique failure was defined by changing the treatment to hemodialysis or removal of the Tenchkoff catheter.

Exclusion criteria: CAPD patients' age below 15 years, no diabetes mellitus and refusal to follow up at CAPD clinic in Maharat Nakhon Ratchasima Hospital.

Data collection consisted of demographic details, underlying diseases; diabetes mellitus, body mass index (BMI) classification by Asian-pacific criteria[21,22], laboratory findings including hemoglobin, hematocrit, serum potassium, serum calcium, serum phosphate, serum albumin, parathyroid hormone (PTH) and peritonitis episode.

Statistical analysis

All data were expressed as percentage, mean and standard deviation (SD). Comparisons were performed using the Student's t or Chi-squared tests. Patient survival was performed using Kaplan-Meier analysis. Comparison of the survival curves was made using log rank test and it would be considered statistical significant if p was < 0.05 ($p<0.05$).

Results

One hundred and eleven diabetic CAPD patients were analysed. Sixty-four patients were male (57.7%) and forty-seven patients were female (42.3%), mean age was 51.9±14.4 years (range 15.3-78.6 years). Mean body mass index (BMI) was 23.0±3.5 kg/m^2 (range 16.2-31.9). Sixty-six patients (67.3%) had hemoglobin below 10 g/dL. Thirty-three patients (36.3%) had serum potassium less than 3.5 mEq/L. Sixty-Three patients (66.3%) had serum albumin levels below 3.5 g/dL. Six patients (9.4%) had parathyroid hormone levels below 150 pg/dL while nineteen patients (29.7%) had parathyroid hormone levels above 300 pg/dL (Table 1). Total observation period was 977.7 months (mean 9.1±7.9 months). The patient survival in diabetic CAPD patients was 64.4%, 47.5% and 47.5% (at 1 year, 2 years and 3 years, respectively), mean duration of patient survival was 25.6 months.

The subgroup univariate analysis for factors affecting patient survival in diabetic CAPD patients was shown as Table 2. The factors that lowered patient survival in diabetic CAPD patients were old age (mean patient survival in group age ≥60 years vs. group age <60 years was 11.7 vs. 28.1 months: p=0.015) (Figure 1), hypokalemia (mean patient survival in group serum

Table 1 Laboratory findings in diabetes mellitus (DM) group.

Variables	Patients (%)	Range
BMI: mean±SD (kg/m^2)	23.0±3.5	16.2-31.9
<18.5	9 (11.2%)	
18.5-23.0	34 (42.5%)	
>23.0	37 (46.2%)	
Hemoglobin: mean±SD (g/dL)	9.3±1.7	4.5-12.8
<10	66 (67.3%)	
≥10	32 (32.7%)	
Serum potassium: mean±SD (mEq/L)	3.7±0.8	2.2-6.0
<3.5	33 (36.3%)	
≥3.5	58 (63.7%)	
Serum albumin: mean±SD (g/dL)	3.2±0.5	1.9-4.1
<3.5	63 (66.3%)	
≥3.5	32 (33.7%)	
Serum calcium: mean±SD (mg/dL)	8.7±1.0	5.4-12.7
<8.9	60 (61.9%)	
9.0-10.9	36 (37.1%)	
≥11.0	1 (1%)	
Serum phosphate: mean±SD (mg/dL)	4.4±1.4	1.6-8.2
<4.5	54 (56.8%)	
4.5-5.5	22 (23.2%)	
≥5.5	19 (20.0%)	
Parathyroid hormone (pg/ml)	243.8±235.9	11.2-1343.5
<150	6 (9.4%)	
150-299.9	39 (60.9%)	
≥300	19 (29.7%)	

Table 2 Factors affecting mean patient survival time in diabetes mellitus group (DM)

Factors	Mean patient survival (Months)	*p*-value
Mean patient survival	25.6	
Age:		
<60 years	28.1	0.015
>60 years	11.7	
BMI:		
<18.5 kg/m^2	11.4	0.117
18.5-23.0 kg/m^2	24.5	
>23.0 kg/m^2	18.7	
Hemoglobin:		
<10 g/dL	13.2	0.113
≥10 g/dL	29.2	
Serum potassium:		
<3.5 mEq/L	10.6	0.001
≥3.5 mEq/L	31.6	
Serum albumin:		
<3.5 g/dL	12.9	0.015
≥3.5 g/dL	34.9	
Serum calcium:		
<8.9	12.4	0.110
9.0-10.9	29.6	
≥11.0	9.1	
Serum phosphate:		
<4.5 mg/dL	15.5	0.609
4.5-5.5 mg/dL	14.7	
≥5.5 mg/dL	22.0	
Peritonitis		
absence	29.6	0.123
presence	12.8	

potassium <3.5 mEq/L vs. group serum potassium ≥3.5 mEq/L was 10.6 vs. 31.6 months: p=0.001) (Figure 2) and hypoalbuminemia (mean patient survival in group serum albumin <3.5 g/dL vs. group serum albumin ≥3.5 g/dL was 12.9 vs. 34.9 months: p=0.015). (Figure 3)

There were 46 peritonitis episodes. Twenty-eight episodes (60.9%) had negative culture, eleven episodes showed gram positive cocci and seven episodes showed gram negative bacilli. The most common causative organism was gram positive cocci such as *Streptococcus*

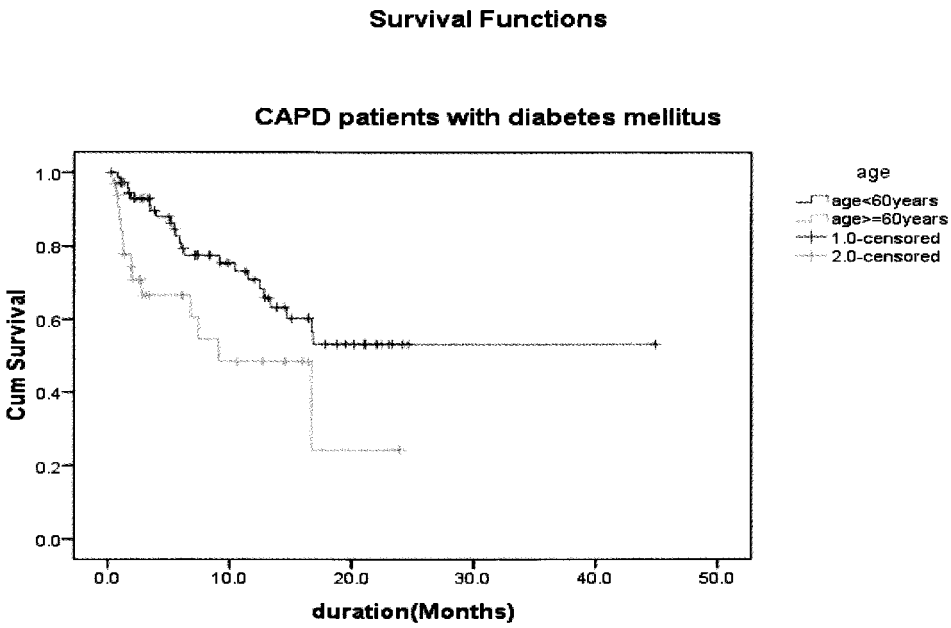

Figure 1 The survival in diabetic CAPD patients according to age group by Kaplan-Meier

spp. (13.0%) and *Staphylococcus aureus* (10.8%) in this study. (Figure 4) Mean peritonitis rate was one episode per 21.2 patient-months. The peritonitis group had shorter mean patient survival than no-peritonitis group, but there was no significant difference. (Table 2)

At the end of study, sixty-five patients (60.2%) were ongoing CAPD modality, five patients (4.6%) shifted to hemodialysis modality, thirty-seven patients (34.3%) died and only one patient was referred to another center. (Figure 5)

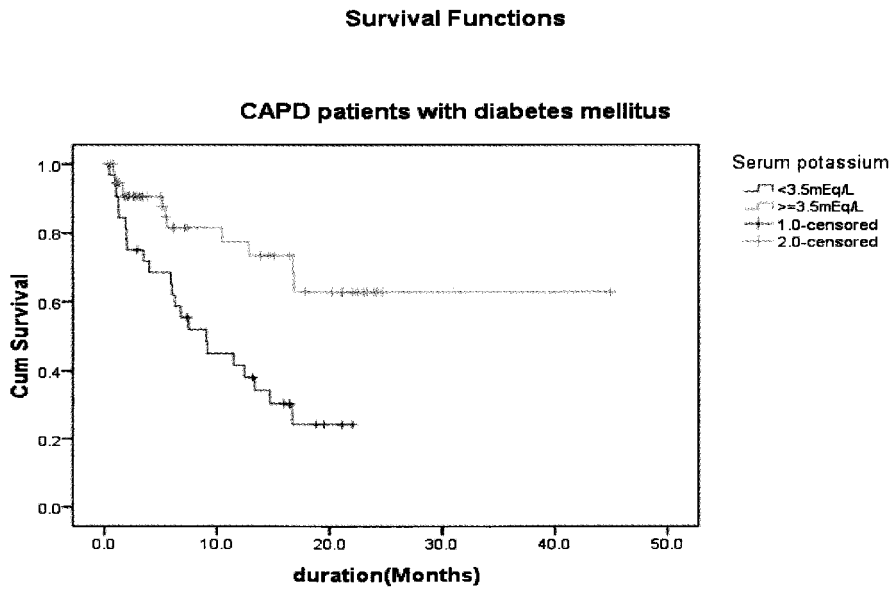

Figure 2 The survival in diabetic CAPD patients according to serum potassium by Kaplan-Meier

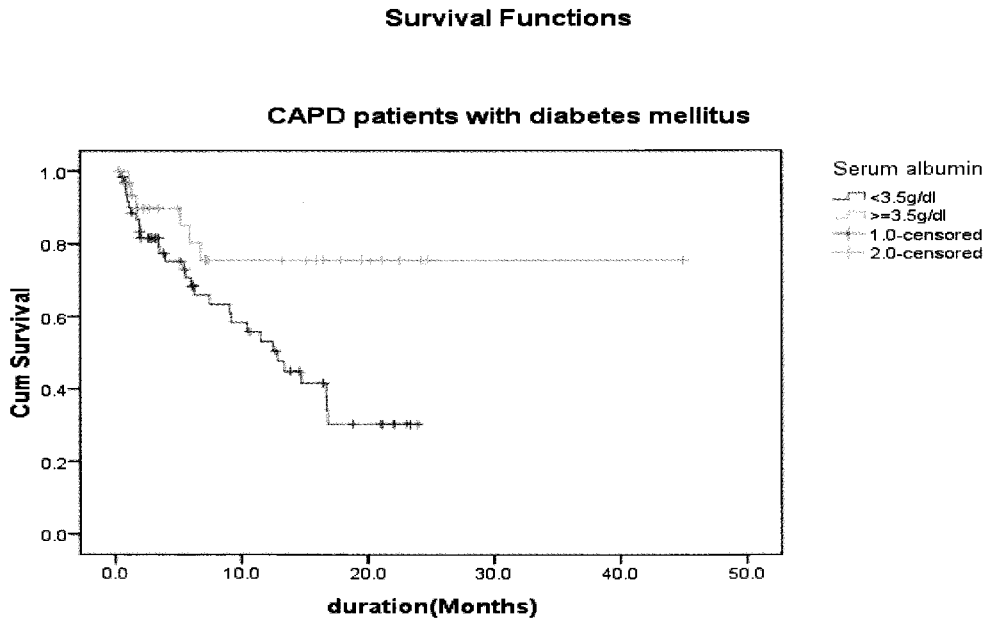

Figure 3 The survival in diabetic CAPD patients according to serum albumin by Kaplan-Meier

Discussion

Incidence of end stage renal disease (ESRD) has increased every year in the world[1,2]. DM is common cause of ESRD and one of influencing factors to patient survival[8-10]. The factors that increased mortality rate were diabetes mellitus, old age, hypoalbuminemia[10-12].

Median survival in diabetic CAPD patients was significantly inferior to that in non-diabetic patients. Patient survival of diabetics was 85%, 62%, 48% at 1, 2, and 3 years, respectively[14]. In the previous study, we reported the overall outcome of CAPD therapy. There was rather poor outcome in the first year of 'PD'

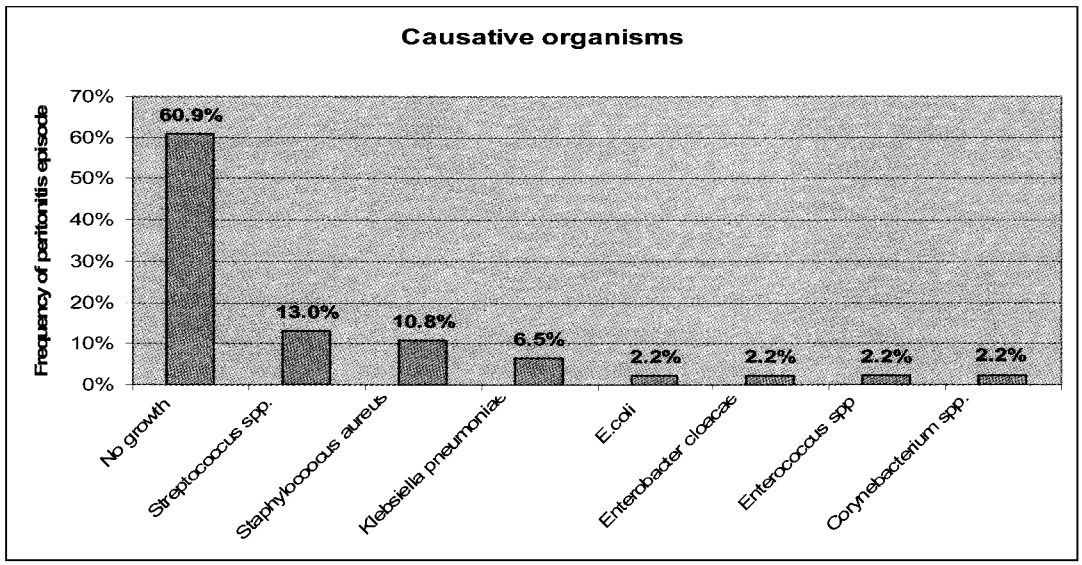

Figure 4 Result of peritoneal dialysate fluid culture in diabetic-CAPD patients with peritonitis

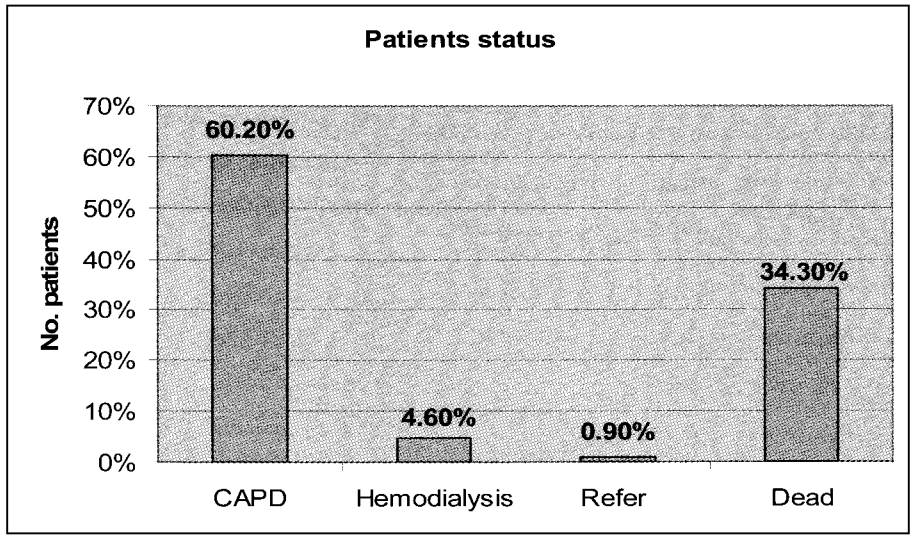

Figure 5 Status of diabetic-ESRD Patients on CAPD (at the end of study)

program in our center[11]. We studied the factors affecting the patient survival in ESRD patients with DM undergoing CAPD at our center for 3 year-experience in this study. We found that the patient survival rates in diabetic CAPD patients were 64.4%, 47.5% and 47.5% at 1, 2 and 3 years, respectively. There were lower survival rate in our CAPD patients in the first year and similar survival rate at 3 years of treatment. In subgroup univariate analysis, elderly patients (age above 60 years), hypokalemia (serum potassium below 3.5 mEq/L) and hypoalbuminemia (serum albumin below 3.5 g/dL) were significant factors that lowered mean patient survival more than others. As several previous studies, diabetes mellitus, old age, hypoalbuminemia were risk factors that increased mortality rate[10-12]. There was high prevalence of high transporters in DM patients and it was the significant predictor for patient survival in the previous study[28]. But peritoneal equilibrium test (PET) was not performed in this study, so the prevalence of high transporter was not performed in our patients.

The previous study presented that lower BMI could increase relative risk of death in CAPD patients[7,27] while the obesed patients had equivalent survival to the patients with normal BMI[15,16]. In our study, there was no significant difference in patient survival due to BMI variable, it may be from the difference in BMI category and in ethnics in each study (Caucasians and Asians population[21,22])

In the past, peritonitis was a leading cause of mortality (about 0.8%-12.5%) and one of causes of technique failure in CAPD patients[17]. The factors that were associated with increased risk of peritonitis were low baseline serum albumin[12,17,18] and anemia[19]. Mutiple studies have shown high prevalences of malnutrition and hypoalbuminemia in CAPD patients[12,20,24]. Espinosa et al found that DM patients showed a significantly poorer nutritional status than non-DM patients[23]. Nakamoto et al showed the incidences of hypoproteinemia and protein loss in DM were higher than that in non-DM patients, probably due to high

permeability of peritoneal membrane in DM patients[25,26].

In our study, peritonitis rate was one episode per 21.2 patient-months. The most common causative organism was gram positive cocci, no evidence of fungal peritonitis in this study. Mean patient survival of CAPD patients with peritonitis group was shorter than that of no-peritonitis group but there was no statistic significance. This result was differed from other study. Because almost all care-givers were PD exchangers. But in this study, comparison between DM and non-DM groups, data of care-givers were not analysed.

Conclusion

This study was performed among diabetic ESRD patients who were on CAPD, it was shown that the old age (more than 60 years), poor nutritional status (hypoalbuminemia and hypokalemia) were significant factors that lowered the patient survival than other factors. The elderly diabetic CAPD patients require special attention to improve nutritional status more than non-DM group. For our CAPD patients, we need to evaluate the peritoneal function and to improve nutritional status in the further study.

References

1. Perkovic V, Cass A, Patel AA, Suriyawongpaisal P, Barzi F, Chadban S, et al. High prevalence of chronic kidney disease in Thailand. Kidney Int 2008; 73: 473-9.
2. Coresh J, Astor BC, Greene T, Eknoyan G, Levey AS. Prevalence of chronic kidney disease and decreased kidney function in the adult US population: Third National Health and Nutrition Examination Survey. Am J Kidney Dis 2003; 41: 1-12.
3. Levey AS, Coresh J, Balk E, Kausz AT, Levin A, Steffes MW, et al. National Kidney Foundation practice guidelines for chronic kidney disease: evaluation, classification, and stratification. Ann Intern Med 2003; 139: 137-47.
4. National Kidney Foundation. K/DOQI Clinical practice guidelines for chronic kidney disease: evaluation, classification, and stratification: update 2002. Am J Kidney Dis 2002; 39: S1-S266.
5. Peritoneal Dialysis Adequacy Work Group. Clinical practice guidelines for peritoneal dialysis adequacy. Am J Kidney Dis 2006; 48: S98-S129.
6. Huang CC, Cheng KF, Wu HD. Survival analysis: comparing peritoneal dialysis and hemodialysis in Taiwan. Perit Dial Int 2008; 28: S15-S20.
7. Stack AG, Murthy BV, Molony DA. Survival differences between peritoneal dialysis and hemodialysis among "large" ESRD patients in the United States. Kidney Int 2004; 65: 2398-408.
8. Cueto-Manzano AM, Quintana-Pina E, Correa-Rotter R. Long-term CAPD survival and analysis of mortality risk factors: 12-year experience of a single Mexican center. Perit Dial Int 2001; 21: 148-53.
9. Johnson JG, Gore SM, Firth J. The effect of age, diabetes, and other comorbidity on the survival of patients on dialysis: a systematic quantitative overview of the literature. Nephrol Dial Transplant 1999; 14: 2156-64.
10. Stein G, Funfstuck R, Schiel R. Diabetes mellitus and dialysis. Minerva Urol Nefrol 2004; 56: 289-303.
11. Liawnoraset W, Jenkriangkrai S, Kanokkantapong C, Svetamal W, Suttharattanakun S. The outcome of continuous ambulatory peritoneal dialysis therapy under the universal coverage scheme in Maharat Nakhon Ratchasima Hospital: the first year of peritoneal dialysis policy. Maharat Nakhon Ratchasima Hosp Med Bull 2010; 34: 25-31.
12. Spiegel DM, Anderson M, Campbell U, Hall K, Kelly G, McClure E, Breyer JA, et al. Serum albumin: a marker for morbidity in peritoneal dialysis patients. Am J Kidney Dis 1993; 21: 26-30.

13. Pongskul C, Sirivongs D, Keobounma T, Chanlertrith D, Promajuk P, Limwatananon C. Survival and technical failure in a large cohort of Thai CAPD patients. J Med Assoc Thai 2006; 89: S98-S105.
14. Prasad N, Gupta A, Sinha A, Singh A, Sharma RK, Kumar A, et al. A comparison of outcomes between diabetic and nondiabetic CAPD patients in India. Perit Dial Int 2008; 28: 468-76.
15. Abbott KC, Oliver DK, Hurst FP, Das NP, Gao SW, Perkins RM. Body mass index and peritoneal dialysis: "exceptions to the exception" in reverse epidemiology? Semin Dial 2007; 20: 561-5.
16. McDonald SP, Collins JF, Rumpsfeld M, JohnsonDW. Obesity is a risk factor for peritonitis in the Australian and New Zealand peritoneal dialysis patient populations. Perit Dial Int 2004; 24: 340-6.
17. Chow KM, Szeto CC, Leung CB, Kwan BC, Law MC, Li PK. A risk analysis of continuous ambulatory peritoneal dialysis-related peritonitis. Perit Dial Int 2005; 25: 374-9.
18. Wang Q, Bernardini J, Piraino B, Fried L. Albumin at the start of peritoneal dialysis predicts the development of peritonitis. Am J Kidney Dis 2003; 41: 664-9.
19. Sirivongs D, Pongskul C, Keobounma T, Chunlertrith D, Sritaso K, Johns J. Risk factors of first peritonitis episode in Thai CAPD patients. J Med Assoc Thai 2006; 89: S138-S145.
20. Harty J, Gokal R. Nutritional status in peritoneal dialysis. J Renal Nutr 1995; 5: 2-10.
21. Choo V. WHO reassesses appropriate body-mass index for Asian populations. The Lancet 2002; 360: 235.
22. WHO expert consultation. Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. Lancet 2004; 363: 157–63.
23. Espinosa A, Cueto-Manzano AM, Velazquez-Alva C, Hernandez A, Cruz N, Zamora B, et al. Prevalence of malnutrition in Mexican CAPD diabetic and nondiabetic patients. Adv Perit Dial 1996; 12: 302-6.
24. Prasad N, Gupta A, Sinha A, Sharma RK, Saxena A, Kaul A, et al. Confounding effect of comorbidities and malnutrition on survival of peritoneal dialysis patients. Renal Nutrition 2010; 20: 384-91.
25. Nakamoto H, Suzuki H; Japan PDC Study Group. Hypoproteinemia in patients with diabetes undergoing continuous ambulatory peritoneal dialysis is attributable to high permeability of peritoneal membrane. Perit Dial Int 2003; 23: S72-S78.
26. Nakamoto H, Imai H, Kawanishi H, Nakamoto M, Minakuchi J, Kumon S, et al. Effect of diabetes on peritoneal function assessed by personal dialysis capacity test in patients undergoing CAPD. Am J Kidney Dis 2002; 40: 1023-54.
27. Pliakogiannis T, Trpeski L, Taskapan H, Shah H, Ahmad M, Fenton S, et al. Reverse epidemiology in peritoneal dialysis patients: the Canadian experience and review of the literature. Int Urol Nephrol 2007; 39: 281-8.
28. Park HC, Kang SW, Choi KH, Ha SK, Han DS, Lee HY. Clinical outcome in continuous ambulatory peritoneal dialysis patients is not influenced by high peritoneal transport status. Perit Dial Int 2001; 21: S80-S85.