THE ROLE OF AN INTEGRATED CARE MODEL FOR KIDNEY DISEASE IN THE DEVELOPMENT OF PERITONEAL DIALYSIS: A SINGLE-CENTER EXPERIENCE IN CHINA

Xiaohui Zhang, Zhangfei Shou, Zhimin Chen, Ying Xu, Fei Han, Xiaohong Yin, Jun Lin, Haiyan Pan, Peipei He, and Jianghua Chen

Kidney Disease Center, The First Affiliated Hospital, College of Medicine, Zhejiang University, P.R. China

Peritoneal dialysis plays a crucial role in the integrated care of patients with end-stage renal disease (ESRD). In this paper, we retrospectively analyzed the quality indicators of peritoneal dialysis (PD) in 712 patients from our center who underwent PD between 2004 and 2011. In 43% of patients, follow-up was undertaken every 3 months at our outpatient department, and 54% patients were followed up by both our hospital and other local hospitals. The patient survival rate at 1, 3 and 5 years was 96.3%, 85.4% and 76.2%, respectively. The technique survival (excludes death/transplantation) at 1, 3 and 5 years was 95.1%, 87.7% and 79.6%, respectively. Fluid overload occurred in 29.2% of patients and was one of the major reasons for discontinuing PD. The peritonitis rate in our center decreased to 0.16 episodes/year in 2011. In addition, since our center is one of the largest integrated-treatment centers for ESRD in China, we have developed a multilevel care program in Zhejiang Province, which resulted in rapid growth of PD in our province in recent years.

Perit Dial Int 2014; 34(S2):S55–S58 www.PDIConnect.com
doi: 10.3747/pdi.2013.00124

KEY WORDS: Integrated care model; peritoneal dialysis; technique survival.

Chronic kidney disease has become an important public health problem in China with an estimated incidence of 10.8% (1–5). It is likely that between 1 and 2 million people in China have end-stage renal disease (ESRD). The mainstay of therapy for this indication includes peritoneal dialysis (PD), hemodialysis (HD) or renal transplantation. Hemodialysis needs to be undertaken in hospital, whereas PD can be performed at home. Peritoneal dialysis

protects residual renal function better than HD, and this modality is also associated with reduced costs. Patient survival rates with PD were recently reported as similar to those with HD (6).

Renal transplantation improves the quality of life and the prognosis of ESRD but is not readily available to all patients (7). The therapeutic challenge is, therefore, to develop an integrated care model that will improve the long-term survival of patients with ESRD. The Kidney Disease Center, First Affiliated Hospital, School of Medicine, Zhejiang University is one of the largest integrated-treatment centers for ESRD in China. It is involved at all stages of disease management, from early diagnosis and intervention to the implementation of replacement therapy and kidney transplantation. Over a number of years we have developed an integrated care model for patients with kidney disease, and as a result of this approach, the use of PD has steadily increased.

In this paper, we retrospectively analyzed the quality indicators for PD based on data from our center over an 8-year period from 2004 to 2011. We also described the management model that we have adopted over this time frame.

MATERIALS AND METHODS

A total of 712 patients with ESRD (398 male and 314 female) began PD between 1 January 2004 and 31 December 2011. The patients were on PD for at least 3 months.

The PD quality indicators included patient survival and technique survival at 1, 3 and 5 years. The incidence of PD-related peritonitis, the incidence of anemia and malnutrition, and the adequacy of PD were also monitored. Technical failure was defined as the need to transfer a patient from PD to HD for any reason (8). The definition of PD-related peritonitis was based on International Society of Peritoneal Dialysis guidelines (9). Dialysis adequacy was evaluated according to residual renal function, urea

Correspondence to: Jianghua Chen, Kidney Disease Center, The First Affiliated Hospital, College of Medicine, Zhejiang University, #79 Qingchun Road, Hangzhou, Zhejiang Province, P.R.China, 310003.

chenjianghua@zju.edu.cn

Received 8 May 2013; accepted 15 December 2013.

clearance index per week (Kt/V) and creatinine clearance per week (10). Assessment of the nutritional status included a subjective global nutritional assessment (SGA), biochemistry tests and standard protein nitrogen appearance rate (nPNA) (11–12).

Statistical analysis was undertaken using SPSS version 19.0 software (SPSS Inc. Chicago, IL, USA). Results were expressed as means and standard deviations ($\pm$ SD). Survival analysis was performed using the Kaplan-Meier method. Values of $p < 0.05$ were considered statistically significant.

RESULTS

The baseline data for the patients included in the study are shown in Table 1. Chronic glomerulonephritis and diabetic nephropathy were the 2 most common underlying conditions resulting in ESRD. The 712 patients included 19 patients already undergoing PD. The average residual glomerular filtration rate at the start of PD treatment was 4.13 mL/min.

A total of 256 patients discontinued PD during the 8-year period: 115 patients received kidney transplantation (45%), 72 patients were transferred to HD and 69 patients died. Patient survival at 1, 3 and 5 years was 96.3%, 85.4% and 76.2%, respectively (Figure 1). Technical survival was 95.1%, 87.7% and 79.6% respectively (Figure 2). Cardiovascular and cerebral diseases were the major causes of death (27.5 and 23.2%, respectively) and PD-related peritonitis (32.3%) was the primary reason for technical failure (PD transfer to HD). Fluid overload due to poor volume control was also a major reason for discontinuing PD (29.2% of patients).

TABLE 1
Baseline Characteristics of All Patients (2004–2011)

Characteristic	N=712
Mean age $\pm$ SD, years	52.0 $\pm$ 19.3
Male, %	56.0
Diabetes mellitus, <i>n</i> (%)	112 (15.7)
Causes of ESRD, <i>n</i> (%)	
Chronic glomerulonephritis	508 (71.3)
Diabetic nephropathy	83 (11.6)
Hypertensive nephrosclerosis	61 (8.6)
Polycystic kidney disease	7 (1.0)
Other	50 (7.0)
Unknown	3 (0.4)
Residual renal function as GFR (mL/min/1.73 m ² BSA)	4.13 $\pm$ 2.58

SD = standard deviation; ESRD = end-stage renal disease; GFR = glomerular filtration rate; BSA = body surface area.

As of 31 December 2011, there were 456 surviving patients who had been followed on PD for 3 to 162 months. Among these, 43% (307/712) were followed up every 3 months at our outpatient clinic, and 54% (384/712) patients were followed up by our hospital and local hospitals due to geographical distance, and visited our outpatient department every 6 to 12 months. An additional 3% (21/712) of patients were followed up by local hospitals under the supervision of doctors and nurses in our PD team, and data was reported to our center.

Clinical data at each patient's latest or last follow-up on PD are shown in Table 2. The average level of hemoglobin was 10.2 $\pm$ 2.4 g/dL and average albumin was 3.8 $\pm$ 0.5 g/dL. In total, 72% of patients achieved dialysis adequacy (weekly total Kt/V > 1.7). The average nPNA (0.96 $\pm$ 0.25/d) was lower than the guideline standard (10) but the incidence of malnutrition by SGA score was only 13.5%. The incidence of PD-related peritonitis decreased progressively from 0.28 episodes/year in 2004 to 0.16 episodes/year in 2011.

DISCUSSION

Although the survival rate of patients undergoing PD has steadily improved in recent years, the number of PD patients remains below that of HD on a worldwide basis. The reasons for the relative underuse of PD include inadequate patient knowledge, and exclusion of this treatment from medical insurance (13–14).

Among the 3 renal replacement therapies, kidney transplantation provides the best therapeutic effect in terms of improving patients' prognosis and quality of life. At our center, we perform more than 100 cases of kidney

Figure 1 — Actuarial patient survival.

Figure 2 — Technique survival. Note: technical failure was defined as need to transfer a patient from PD to HD for any reason. PD = peritoneal dialysis; HD = hemodialysis.

transplantation each year, with a 10-year survival rate of close to 85.9%. Based on unpublished data from our center, more than half of the patients discontinue PD due to kidney transplantation. This group has the best quality of life and highest long-term survival rate among patients receiving renal replacement therapy. In our opinion, PD and HD should be regarded as complementary rather than competitive renal replacement therapy options. Each year we switch certain patients between PD and HD with the aim of improving survival. For example, during 2011, 144 of the 348 new ESRD dialysis patients started on HD and 204 on PD. Out of these, 6 patients were switched from HD to PD and 31 from PD to HD within 2011.

The establishment of a specific team to manage the integrated care of patients with ESRD since 2004 has greatly improved the management and quality of PD. This, in turn, has led to increased use of PD, such that currently more than 100 patients accept PD every year. Patient and technique survival at 1, 3 and 5 years at our center are similar or even exceed those reported in other more developed regions (15).

In order to further improve quality of care, such as peritonitis rate, we have implemented a PD training and management system. All patients undergoing PD (or their carers) undertake a 7-day training course conducted by full-time nurses competent in PD. The patients are not allowed to self-administer PD unless they pass the training examination. During the first 6 months of PD, patients

TABLE 2
Clinical Parameters of the 712 Patients in our Center
at Last/Latest Visit

Parameter	Mean±SD
Hemoglobin (g/dL)	10.2±2.4
Serum albumin (g/dL)	3.8±0.5
Weekly total Kt/V urea	2.04±0.81
Total creatinine clearance (L/week/1.73 m ²)	72.6±31.9
D/P creatinine	0.63±0.17
nPNA (g/kg body weight per day)	0.96 ±0.25
Malnutrition by SGA score (%)	13.5
Total fluid removal (mL/day)	638±352

SD = standard deviation; D/P creatinine = dialysate to plasma creatinine ratio; nPNA = normalized total protein equivalent of nitrogen appearance; SGA = subjective global assessment; total fluid removal refers to 24-hour urine volume and ultra-filtration.

are followed up every 1 to 2 months; thereafter, they are seen at 3 to 6 month intervals. The patients maintain a paper record of their treatment which is entered into the hospital database at each follow-up visit. These data are analyzed and discussed each month as part of an initiative to ensure continued quality improvement. The policies have led to a significant decrease in the peritonitis rate between 2004 and 2011.

Only 24% of the 712 PD patients in our center are local residents; more than half of them (53%) are from rural or remote areas. For the latter categories, the treatment cost is paid for primarily by the rural cooperative medical insurance, other medical insurances, or privately. These patients are unable to attend regular follow-ups because of the distances involved. To resolve this, we have established a multilevel care system for PD patients in the Zhejiang Province, using the basic model shown in Figure 3. Within this model, our center acts as a quality control and training center that provides an ongoing 3-month healthcare education program for workers in regional centers. We provide guidance and assistance to the regional-level hospitals in terms of dialysis quality management and patient follow-up. The regional hospitals support the county hospitals, and the county hospitals support the town-level hospitals and health centers to carry out PD. A medical service platform with PD databases has been established at all levels to ensure that the units remain closely linked and able to manage their role in training, quality control, follow-up management and scientific research cooperation. This approach means that patients are able to receive healthcare services at a local hospital

Figure 3 — Multilevel care model for peritoneal dialysis. PD = peritoneal dialysis.

and, even if they are unable to be followed directly at our center, we are able to track and control PD quality through the network or by telephone. All hospitals involved in this network provide summaries of their PD data every 3 months and attend a quality control seminar every 6 months.

Although rapid development in PD has been achieved through these initiatives, there are still certain shortcomings. Specific details of the multilevel care system require ongoing improvement, especially in terms of clarifying the responsibilities of departments at each level. In addition, close collaboration needs to be maintained to avoid a decline in the quality of PD that might cause patients to discontinue this form of treatment.

CONCLUSION

In the Zhejiang Province of China, there has been a rapid growth of PD in recent years, partly due to the development of an integrated care model for patients with ESRD which monitors the quality of PD on an ongoing basis.

ACKNOWLEDGMENT

We would like to thank Dr. Anders Tranaeus and Baxter China for their contribution to the manuscript.

DISCLOSURES

The authors have no financial conflicts of interest to declare.

REFERENCES

1. Zhang L, Wang F, Wang L, Wang W, Liu B, Liu J, *et al.* Prevalence of chronic kidney disease in China: a cross-sectional survey. *Lancet* 2012 Mar 3; 379(9818):815–22.
2. Imai E, Matsuo S. Chronic kidney disease in Asia. *Lancet* 2008 June 28; 371:2147–8.
3. Nugent RA, Fathima SF, Feigl AB, Chyung D. The burden of chronic kidney disease on developing nations: a 21st century challenge in global health. *Nephron Clin Pract* 2011; 118:c269–77.
4. Agarwal SK, Dash SC, Irshad M, Raju S, Singh R, Pandey RM. Prevalence of chronic renal failure in adults in Delhi, India. *Nephrol Dial Transplant* 2005; 20:1638–42.
5. O'Donnell JK, Tobey M, Weiner DE, Stevens LA, Johnson S, Stringham P, *et al.* Prevalence of and risk factors for chronic kidney disease in rural Nicaragua. *Nephrol Dial Transplant* 2010; 26:2798–805.
6. Yeates K, Zhu N, Vonesh E, Trpeski L, Blake P, Fenton S. Hemodialysis and peritoneal dialysis are associated with similar outcomes for end-stage renal disease treatment in Canada. *Nephrol Dial Transplant* 2012; 27(9):3568–75.
7. US Renal Data System: USRDS 2006 Annual Data Report. Available at: http://www.usrds.org/adr_2006.htm. Accessed June 19, 2007
8. Han SH, Ahn SV, Yun JY, Tranaeus A, Han DS. Mortality and technique failure in peritoneal dialysis patients using advanced peritoneal dialysis solutions. *Am J Kidney Dis* 2009 Oct; 54(4):711–20.
9. Li PK, Szeto CC, Piraino B, Bernardini J, Figueiredo AE, Gupta A, *et al.* Peritoneal dialysis-related infections recommendations: 2010 update. *Perit Dial Int* 2010 Jul-Aug; 30(4):393–423.
10. Watson PE, Watson ID, Batt RD. Total body water volumes for adult males and females estimated from simple anthropometric measurements. *Am J Clin Nutr* 1980; 33:27–39.
11. Canada-USA (CANUSA) Peritoneal Dialysis Study Group. Adequacy of dialysis and nutrition in continuous peritoneal dialysis: association with clinical outcome. *J Am Soc Nephrol* 1996; 7:198–207.
12. Bergström J, Heimbürger O, Lindholm B. Calculation of the protein equivalent of total nitrogen appearance from urea appearance. Which formulas should be used? *Perit Dial Int* 1998; 18: 467–73.
13. Jain AK, Blake P, Cordy P, Garg AX. Global trends in rates of peritoneal dialysis. *J Am Soc Nephrol* 2012; 3:533–44.
14. Chaudhary K, Sangha H, Khanna R. Peritoneal dialysis first: rationale. *Clin J Am Soc Nephrol* 2011; 2:447–56.
15. Lo WK. Peritoneal dialysis utilization and outcome: what are we facing? *Perit Dial Int* 2007; 27(Suppl 2):S42–7.