

## Brief Communication

### Analysis of factors related to patient peritoneal dialysis drop out rates

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At present, dialysis registration data have shown that patients on peritoneal dialysis (PD) have a higher survival rate than those undergoing hemodialysis (HD) therapy during the initial 3 years for a better protection of residual renal function. Therefore, PD has become a preferred treatment of renal replacement therapy in addition to renal transplantation for patients with end stage renal disease (ESRD). Many patients drop out of PD due to death or conversion to HD, which seems to be abnormal and not conducive to the patients in PD center in China except for the choice of renal transplantation during the early years. Clinical data on PD were collected and evaluated to identify the cause of withdrawal from treatment, and to explore the strategies of prolonging the use of PD as a facile, effective, hypo-cost renal replacement therapy.

One hundred and sixty-seven patients were diagnosed with chronic kidney disease and underwent PD between January 2009 and June 2012 in our renal PD center in Yichang City, Hubei, China. After approval from the local ethics committee, the study was conducted according to the principles of the Helsinki Declaration. Written consent was obtained from all study participants. Our single-center retrospective study enrolled a total of 43 patients including those who dropped out of PD treatment among the 167 patients in our unit. A total of 20 patients died while on PD (46.5% of dropouts), and 21 patients transferred to HD (48.8% of dropouts). The detailed records were explored for basic diseases, age, dialysis duration, dialysis scheme, death, causes for converting to HD, infection related pathogenic bacteria, and complications. The patients were divided into different study groups based on the reasons for their final outcome.

The average age of the 167 patients with PD was  $51.5 \pm 33.1$  years, and ranged from 18-83 years. The male-to-female ratio was 0.855:1. Primary renal diseases

included chronic nephritis (CN: 75.4%), diabetic nephropathy (DN: 12.6%), nephrosclerosis (4.8%), polycystic kidney (1.8%), obstructive nephropathy (1.8%), systemic lupus erythematosus (SLE 0.6%) and unspecified or other conditions (3%). Forty-three (25.7%) of these patients did not continue with PD. These patients had a mean age of  $58.6 \pm 19.1$  years, with a range of 35-83 year and included 29 males and 14 females during the follow-up period. Among the 43 cases, 20 (46.5%) died while undergoing PD, and 21 (48.8%) converted to HD, one case (2.3%) underwent renal transplantation and one case (2.3%) was lost. Thirteen cases (30.2%) stopped PD within one year, including 5 deaths, and 7 cases that converted to HD (3 cases developed abdomen-thorax fistula diagnosed by angiography, and 4 cases acquired a lower medical insurance reimbursement ratio on PD compared with HD), one case received renal transplantation while 30 cases (69.8%) stopped PD one year later, including 15 deaths, 14 cases converted to HD, and one case lost.

The 20 deceased PD patients, including 14 males and 6 females, had undergone continuous ambulatory peritoneal dialysis (CAPD) treatment using Baxter peritoneal dialysate (Baxter, Shanghai, China) 4000-8000 mL/day. Their average age was  $60.9 \pm 18.3$  years, and ranged from 44-83 years. The average PD duration was  $25.8 \pm 24.9$  months. The shortest PD duration was 2 months and the longest was 78 months. Fourteen cases were of CN, with 3 cases of DN, 2 cases of hypertensive renal sclerosis, and one case of polycystic kidney disease comprising the primary disease. The 21 PD patients that converted to HD included 13 males and 8 females. All these patients underwent CAPD using Baxter peritoneal dialysate 6000-8000 mL/day. Their average age was  $50.1 \pm 19.8$  years and ranged from 35-78 years. Primary renal diseases were CN: 61.9%, DM: 9.5%, nephrosclerosis: 4.8%, obstructive nephropathy: 4.8% and unspecified or other condition in 14.3%.

Descriptive statistic analysis was applied to the survey data. The statistical analysis was carried out using the Statistical Package for Social Sciences (SPSS Inc., Chicago, IL, USA) 15.0 software for windows. All results are expressed as mean  $\pm$  SD. The ANOVA test was used to compare individual groups, and the comparison rate was analyzed using chi-square test.

From the 20 patients that died, 6 died of congestive heart failure after inadequate dialysis due to heavy medical costs, one case developed fungal peritonitis, 6 cases presented serious cardiovascular events (5 cases of congestive heart failure and one case of ischemic heart disease), 2 cases of lung infection with cerebrovascular

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event, one case of fungal peritonitis with paralytic ileus, one case of fungal peritonitis with metabolic encephalopathy, one case of fungal sepsis, one case of lung infection with gastrointestinal bleeding, and one case of trauma. The patients with fungal infections included 2 cases of *Candida parapsilosis*, one case of smooth candida species, and one case of cryptococcus. Culture of the sputum of the 5 cases with lung infection revealed 2 cases of mixed bacteria and fungal, one case of *Escherichia coli*, one case of bowel coccus, and one case of *Pseudomonas aeruginosa*.

The fatality rate was different among the groups. The fatality rate from chronic glomerulonephritis was 11.1% (14/126), while in patients with diabetes mellitus the mortality was 14.3% (3/21). There was no statistically significant difference in the fatality rate between the 2 groups ( $p=0.915$ ). The male patients' mortality was 19.5% (15/77) and the female patients' mortality was 5.6% (5/90). There was a statistically significant difference in the fatality rate between the male and female groups ( $p=0.020$ ). The 15 male patients that died comprised 6 cases caused by economic factors (family primary labor lost), 5 cases developed cardio cerebrovascular events due to poor salt and water control, 3 cases of peritonitis due to careless operation during PD, and one case of trauma.

The nutritional status and the calcium phosphorus metabolism of 20 patients that died were analyzed. The nutritional status was evaluated by the levels of hemoglobin (Hb) and serum albumin (ALB). The average level of Hb was  $74.3 \pm 10.1$ g/L with a range from 56-103g/L. The patients with a level of Hb <90g/L accounted for 70% (14/20). The average level of ALB was  $23.9 \pm 6.1$ g/L with a range from 18.5g/L-33.3g/L. The patients with a level of ALB <30g/L accounted for 75% (15/20). Twelve cases with calcium phosphorus metabolism disorder accounted for 60% (12/20). Comparison of the nutritional status, calcium, and phosphorus metabolism indicators among the deceased

group (DG), switched to HD group (SHDG), and PD group (PDG) is summarized in Table 1.

Twenty-one patients converted from PD to HD. One case due to poor function of the PD catheter, 2 cases due to inadequate PD, 3 cases due to abdomen-thorax fistula, 4 cases acquired a lower medical insurance reimbursement ratio with PD than HD, and 11 cases of peritonitis. All the 11 patients with peritonitis were given an etiological examination. Seven cases of fungal infection (3 cases of nearly smooth monilia, 2 cases of similar yeast-like bacteria, one case of high measuring monilia, and one case of cryptococcus), 3 cases of bacterial infection (2 cases of *Staphylococcus epidermidis*, one case of *Escherichia coli*), and one case without a certain pathogenic bacteria. Ten cases were found pathogen positive among the 11 patients with PD related peritonitis, accounting for 91% (10/11). Seven cases diagnosed with fungus infection converted to HD immediately after pulling out the dialytic canal, 2 cases with a diagnosis of broad spectrum antibiotic resistant bacteria, and one case with repeating attacks of peritonitis, with purulent secretion discharged observed near the second Dacron cuff on operation. Five cases of PD related peritonitis were concomitant with intestinal fungal infections accounting for 45.5% (5/11).

An increasing number of patients with ESRD undergo PD, and many dropout of treatment. The dropout rate is 25.7% in our PD center, and the major reasons for death are infection and cardiovascular events. The high medical expenses and medical insurance policy are also important reasons for the patients not continuing with PD. Infection is the leading cause of death, and the common sites are the respiratory tract and the abdominal cavity. The United States dialysis registration data showed that the overall incidence rate of pulmonary infection was 18.2% in PD patients,<sup>1</sup> and pulmonary infection often induces other systemic diseases, especially cardiovascular disease, rapid decline of residual kidney function and inadequate dialysis,

**Table 1** - Comparison of the indicators among the 3 groups of peritoneal dialysis patients (mean±standard deviation).

Group	n	Age	GFR (ml/min)	Hb (g/L)	ALB (g/L)	iPTH (pg/ml)	Calcium x P
PDG	124	58.6±19.1	8.1±2.7	79.0±17.3	27.7±5.7	254.7±131.0	44.2±2.9
DG	20	60.9±18.3	4.9±3.1*	74.3±10.1	23.9±6.1*	396.8±193.2*	55.0±3.7*
SHDG	21	57.9±16.8	5.3±2.9*	77.4±11.4	21.5±7.1*	260.7±123.1	45.9±3.4
P <sub>PDG/DG</sub>			0.0000054	0.2184212	0.0097932	0.0000454	0.0000000
P <sub>PDG/SHDG</sub>			0.6689769	0.5000033	0.1804055	0.0023027	0.0000000
P <sub>DG/SHDG</sub>			0.0000378	0.7143872	0.0000158	0.8579162	0.0268195

PDF - peritoneal dialysis group, DG - deceased group, SHDG - switched to hemodialysis group  
GFR - glomerular filtration rate, Hb - hemoglobin, ALB - albumin, iPTH - parathyroid hormone, P - Phosphorus,  
\*significant when compared with the peritoneal dialysis group

causing patients to die. It is important for those elder PD patients to receive intensive treatment of an early lung infection and choose proper antibiotics according to the germ culture and hypersensitivity test results in order to improve the cure rate. Both domestic and foreign research indicates that low serum ALB levels and low HB level account for a high failure rate of PD treatment, and a high mortality of PD patients.<sup>2</sup> Serum ALB level is applied for evaluating PD treatment as an independent risk factor. There is a significant positive correlation between serum ALB level and endothelial function disorder. It is one of the key risk factors influencing endothelial dysfunction of PD patients. The failure rate of PD technology decreased correspondingly with the ALB concentration. Our study found that the deceased PD group had a lower serum ALB level than the PD group. These deceased patients often presented with severe anemia and poor nutrition, and were prone to infection, including lung infection, intestinal infection, and infection of multiple parts. Malnutrition increased the difficulty of treating the infection and the death risk of patients. We also observed that cardiac vascular disease is another important cause of death among the PD patients, which is consistent with previous study.<sup>3</sup>

According to statistics of the American Kidney Medical Records in 1999<sup>5</sup> chronic heart disease accounted for 45% of dead patients with ESRD. The subsequent randomized controlled trial proved that PD is characterized by a high mortality rate, much of which is the result of cardiovascular diseases.<sup>4</sup> Cardiovascular diseases are closely related to volume overload caused by sodium and water retention as the peritoneal function is damaged gradually. Many clinical investigations have shown that exposure of the peritoneal membrane to high glucose concentrations and high osmotic pressure contributes to both structural and functional deterioration in the dialyzed peritoneal membrane. Recent studies<sup>6</sup> have confirmed that there is a vicious cycle of malnutrition, inflammation, and atherosclerosis (MIA syndrome) and the cause of inflammation in PD patients is probably multifactorial. Metastatic calcification of blood vessels is also responsible for the increasing incidence of cardiovascular diseases. The results of our study also showed that cardiovascular diseases, especially congestive heart failure, are the leading cause of death among PD patients. Most of our patients came from the countryside, their lack of education, and intense physical labor lead to poor control of salt and water intake, so they developed cardiac dysfunction due to increased blood pressure, ventricular hypertrophy, and arrhythmia. Compared with the PD group, these patients had a rapid decline in residual kidney function,

heavy anemia, and low serum ALB levels, which also indicated that poor nutrition is a leading cause of heart failure and infection. These patients had poor control of the high calcium-phosphorus product and high parathyroid hormone levels, which caused them to develop a variety of complications. The declining residual renal function also increased the mortality of PD patients and shortened the dialysis duration. As a whole, to reduce the mortality and the dropout rate of PD patients, we should pay attention to the following treatment measures including treating the original disease, limiting the sodium intake, maintaining the balance of capacity, controlling blood pressure, choosing a rational dialysis method, elevating dialysis sufficiency, reducing the attacks of peritonitis, improving the protein and carbohydrate intake, correcting metabolic acidosis, and protecting renal function, which would better protect the residual renal function. It has been suggested that the survival rate would be improved when the PD patients convert to HD because of complications related to PD.<sup>7</sup>

Peritonitis is still an important factor for withdrawal from PD therapy accounting for 52.4%. Celiac infection is caused by a number of reasons, in which relaxed aseptic operation could be responsible for most of the celiac infections, so the procedure of sterile operation should be strengthened and the ability to identify celiac infection improved. Some celiac infections are induced by the intestinal fungal infection, accounting for 45.5% (5/11). In our study, 7 cases had fungal infection among the 11 cases of celiac infections, and converted to HD. Therefore, it is an effective method of decreasing the incidence of peritonitis. First, we should make nurses and patients cooperate with each other, providing the patients with regular training, following strict protocols for the aseptic operation, and performing close follow-up. Second, we should monitor the data regularly, rectify anemia and hypoproteinemia in a timely fashion and treat for implications including infection and intestinal infection actively. Third, we need to apply the appropriate antibiotics by improving the detection rate of the pathogen. Our study showed that there was no difference in the nutritional status between the patients that converted to HD and the deceased patients, and a significant difference in serum ALB level between the 2 groups. The low serum ALB level is closely related to the poor nutrition, the low immunity, the intestinal flora imbalance, and the occurrence of PD related peritonitis.

Although our study was a small sample, it has allowed us to adjust the treatment strategies for PD on the basis of the study. A larger sample and a longer

multicenter study should be carried out in the future, and evaluation of dialysis adequacy and nutritional status should be strengthened.

In conclusion, infection and cardiovascular diseases are the main reasons for death in PD patients, and this was related to poor nutritional status and calcium and phosphorus disorders. Peritoneal dialysis related peritonitis is still the main reason for PD patients converting to HD therapy. Economic conditions and health insurance policy are also important reasons for the withdrawal of PD patients. In China, we should reduce the dropout rates and improve the PD duration by adjusting their PD schemes to obtain the adequate dialysis, reinforcing follow-ups, and increasing the awareness of strict aseptic technique to reduce the incidence of peritonitis of CAPD patients, improving the detection rate of pathogens, timely treatment of anemia, hypoalbuminemia, calcium phosphate disorders and malnutrition, and increasing the reimbursement proportion of medical insurance for PD treatment.

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