Peritoneal Dialysis in China: Meeting the Challenge of Chronic Kidney Failure

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China is a developing country with the world’s largest population (>1.3 billion). It has an increasing prevalence of end-stage kidney disease and relatively insufficient medical and economic resources, particularly in rural and remote areas. Providing dialysis treatment to patients with end-stage kidney disease is a public health challenge that puts a large economic burden on individuals and health care resources.

Peritoneal dialysis (PD) is a well-accepted dialysis modality that is less expensive than in-center hemodialysis (HD) and has been developed and used for more than 30 years in China to treat patients with end-stage kidney disease. Several national PD centers of first-rate scale and quality have sprung up, but the development of PD varies widely among geographic regions across China. The Chinese government has dedicated itself to continually increasing the coverage and level of medical service for patients with end-stage kidney disease. Under the guidance of the government and because of promotion by kidney care professionals, presently there are more than 40,000 prevalent PD patients in China, representing approximately 20% of the total dialysis population. Recently, a National Dialysis Unit Training Program for countywide hospitals has been initiated. Through the efforts of programs like this, we believe that awareness of PD and advances in the underlying technology will benefit more patients with end-stage kidney disease in China.

CHRONIC KIDNEY DISEASE IN CHINA

Results of a multicenter cross-sectional study of chronic kidney disease (CKD) estimated the CKD prevalence at 10.8% in China. Based on these data, there are up to 119.5 million patients with CKD in the country. However, prevalence varies significantly from region to region across China due to the variability in lifestyles and economic development. For example, the prevalence of adult CKD has been reported to be 13.0% in Beijing,1 11.8% in Shanghai,2 and 19.1% in Tibet.3 In a rural and urban epidemiology survey in Guangdong Province, we found that the prevalence of CKD is 10.1%
in urban populations\textsuperscript{5} and up to 13.6\% in rural areas.\textsuperscript{6} Chronic glomerulonephritis currently is the most common cause of CKD in China.\textsuperscript{7,8} As the way of life changes and the population ages, prevalences of diabetes, hypertension, and obesity are increasing very quickly. It has been reported that the total prevalence of diabetes is 9.7\% in China.\textsuperscript{9} A shift in the epidemiology of kidney disease also has been reported: the leading causes of CKD among elderly Chinese patients now are diabetes mellitus and hypertension, rather than glomerular diseases.\textsuperscript{10} These epidemiologic changes have been exacerbating the burden of CKD in China, a trend that will continue in the future.

Even with optimal treatment, a significant portion of patients with CKD progress to end-stage kidney disease, and the estimated prevalence of end-stage kidney disease in China is about 200 to 250 cases per million population.\textsuperscript{11} The increasing incidence of end-stage kidney disease has a major impact on the need for dialysis, including maintenance HD and PD. In China, the cost of treatment for a patient with end-stage kidney disease is approximately CN \textsterling90,000 to \textsterling100,000 (equivalent to US $13,850-15,380) a year,\textsuperscript{12} which puts a large economic burden on individuals and health care resources. Due to the country’s limited economic and medical resources coupled with restricted health insurance coverage, the prevalence of dialysis is very low in China relative to many developed countries.\textsuperscript{7} A survey by the Chinese Society of Blood Purification showed that at the end of 2008, there were 102,863 patients with end-stage kidney disease treated by HD or PD, and the point prevalence was estimated to be 79.1 per million population in mainland China.\textsuperscript{13} At the end of 2013, according to data from the Chinese Renal Data Registration System, the number of patients in mainland China receiving dialysis was 326,000 (280,000 HD patients and 46,000 PD patients), accounting for \textasciitilde 20\% of the global end-stage kidney disease population.\textsuperscript{14} Given the high prevalence and extensive treatment costs, end-stage kidney disease has become a major public health problem for the Chinese government.\textsuperscript{7,15}

**CHINESE GOVERNMENT POLICY REGARDING THE TREATMENT OF END-STAGE KIDNEY DISEASE**

The Chinese government has paid increasing attention to the treatment available for patients with end-stage kidney disease in the past few years. Uremia is 1 of 8 major serious diseases covered by National Social Medical Insurance.\textsuperscript{16} A joint document developed in 2012 by relevant government departments specified that coverage provided by the New Rural Cooperative Medical Care plan should reach 70\% of the total medical costs of these major diseases.\textsuperscript{17} Recently, with the advancement of health care system reform in China, basic medical insurance now covers \textasciitilde95\% of urban and rural residents, and a high-reimbursement policy for catastrophic diseases including end-stage kidney disease has been established.\textsuperscript{14} These improvements in health care policy have challenged the Chinese nephrology community to strengthen kidney disease care by finding ways to take advantage of limited resources so that more patients with end-stage kidney disease can obtain appropriate renal replacement therapy.

As a renal replacement therapy, PD has many advantages compared to in-center HD. It is home based, offering a more independent lifestyle and greater freedom of movement. The modality is characterized by comparatively slow decreases in residual kidney function, generally stable hemodynamics, and good clearance of middle molecules. In addition, PD patients are less likely to acquire hepatitis or experience delayed recovery of kidney function after kidney transplantation. The medical resources required, including labor, space, and equipment, are relatively minimal, and accordingly, the treatment cost is significantly lower than that of HD.\textsuperscript{12,18,19}

A report assessing dialysis options and costs of end-stage kidney disease in China from the National Health Development Research Center showed that the annual cost of PD is about CN \textsterling93,520 (US $14,380), whereas the cost of in-center HD is CN \textsterling103,416 (US $15,910).\textsuperscript{12} The report further discussed the particular benefits offered by PD for patients in China’s vast rural areas, in that home-based treatment minimizes the impact on their lives by reducing the inconvenience and financial burdens of traveling to and from the hospital. By reducing patients’ dependence on medical institutions, PD treatment also helps minimize the burden on China’s developing health care system.\textsuperscript{12} Because of these unique advantages, PD therapy is highly valued by the Chinese government. In order to pave the way to end-stage kidney disease care that takes account of the conditions in China, the past Minister of Health, Dr Chen Zhu, specifically advocated that China first vigorously promote PD and then construct a complementary system that combines PD with HD.\textsuperscript{11,20} These policies are meant to promote PD treatment technology in order to maximize the number of patients with end-stage kidney disease receiving renal replacement therapy and benefit more patients.

**DEVELOPMENT OF A PD PROGRAM IN GUANGZHOU**

The Department of Nephrology of The First Affiliated Hospital of Sun Yat-sen University is one of the earliest free-standing
nephrology departments in Southern China. In 1963, Dr Shimei Li pioneered PD for treatment of acute renal failure in China. When Dr Jack W. Moncrief and Dr Dimitrios G. Oreopoulos initiated continuous ambulatory PD for the treatment of end-stage kidney disease in 1978, we introduced the concept and technology into China. In the past few years, our PD center has established a new management system and standardized operating procedures for PD, including catheter insertion, patient education, training, treatment, and follow-up. The number of PD patients followed up in the center quickly surged from 297 in 2005 to more than 1,000 in 2012. In our department, the PD population (1,051 patients) is far larger than that of HD (280 patients), and >80% of incident patients with end-stage kidney disease select PD as their first choice of dialysis modality. At present, the center is one of the largest PD centers in the world. Key performance indicators show that in 2011, the catheter patency rate was 94% at 1 year, and the incidence of peritonitis was 0.14 episode per patient-year. In a prospective cohort study of 805 incident continuous ambulatory PD patients who used PD as their first dialysis modality and were treated in our center from 2006 to 2009, Kaplan-Meier analysis showed patient survival rates at 1, 2, 3, and 5 years of 94%, 87%, 81%, and 64%, respectively; the death-censored technique survival rates are 98%, 95%, 91%, and 86%, respectively (the corresponding rates without death censoring are 92%, 82%, 75%, and 55%; Table 1). For more complicated patients, for example, those with diabetes and those older than 65 years, the 3-year technique survival rate (with death censoring) was 90% to 91%, whereas patient survival rates at this time were 63% in the diabetic group and 56% in the 65-and-older group, indicating favorable results for the use of PD for the treatment of patients with end-stage kidney disease (Table 1).

In managing a rapidly growing PD program with more than 1,000 patients, we face multiple challenges, including labor constraints, logistics, and considerable geographic distances. Based on our experience, there are several critical factors for a successful PD program (Box 1). The fundamental requirement is an excellent and well-trained PD team that is passionate and dedicated to PD therapy. A well-designed practical PD catheter insertion program also is important. In our center, >90% of our PD patients need urgent catheter insertion and immediate initiation of PD therapy. As a consequence, it is necessary to set up a standard and practical protocol for catheter insertion performed by experienced nephrologists to ensure successful catheter insertion and avoid catheter-related complications. Another key requirement is a well-designed patient training program that is suitable for patients from different cultures and social backgrounds. Both patients and their caregivers, including spouses, relatives, and other assistants, are trained and evaluated. Equally important is a comprehensive follow-up program, including regular visits to the PD center, a 24-hour on-call program, home visits, and a satellite PD program. We have 13 PD satellite centers, including 26 PD nephrologists and 32 nurses who have participated in this program and received free training in the Sun Yat-sen University PD center. This program has increased the number of PD patients and improved medical service in Guangdong Province. Other critical factors include clinical governance, continuous quality improvement, and clinically driven research to optimize the PD program. Our researchers focus on peritoneal fibrosis, PD related-peritonitis, and risk factor intervention to improve clinical outcomes of PD patients. High-quality research not only improves medical service, but also helps avoid PD staff “burnout” in this high-pressure work environment.
PD STATUS IN CHINA

Under the guidance of the government, supportive policies, and promotion by professionals, use of PD has substantially increased recently in China. Currently, approximately 1,024 hospitals offer PD to more than 40,000 patients with end-stage kidney disease throughout the nation, accounting for ~20% of the total patients with end-stage kidney disease receiving dialysis in China.\(^4\) Renji Hospital in Shanghai has become the country with the largest number of PD patients in the world. At present, most PD solutions are manufactured by Baxter in China, with some supplies produced by local Chinese companies. A few PD patients (0.2%) are treated with automated PD. Newer PD solutions such as icodextrin, low-glucose-degradation-product solutions, etc, have not been available in China until recently.

Besides Guangzhou, major hospitals in Shanghai, Beijing, and other cities also have successfully established their own high-quality PD centers. Renji Hospital in Shanghai has reported patient survival rates at 1, 2, 3, and 5 years of 90%, 79%, 71%, and 64%; death-censored technique survival rates of 97%, 93%, 90%, and 88%, respectively; and incidence of peritonitis of 0.198 per patient-year.\(^5\) A report from Peking University People’s Hospital showed 1-, 2-, and 3-year survival rates of PD patients with diabetes of 96%, 69%, and 60%.\(^6\) These centers are excellent examples for other PD centers throughout the nation in terms of PD center management and clinical practice. However, the utilization and quality of PD vary tremendously in China. In underdeveloped regions such as northwest and southwest China, overall numbers of PD patients and the quality of PD treatment are far from encouraging.\(^7\) Across China, the average time on therapy is around 25 months, but this metric varies from fewer than 10 to more than 40 months, depending on the center.\(^2,4,22\) The reasons for these differences include disparities in patients’ socioeconomic status, dissimilar access to health care in rural and urban areas, and insufficient training, education, and quality control systems in most parts of the country.\(^7\)

In order to enhance awareness and clinical level of PD treatment across the country, the Chinese Society of Nephrology has organized 22 training programs for PD standard operating procedures throughout the nation since 2011, and around 4,000 nephrologists have been trained to date.\(^7\) On behalf of the Chinese Nephrologists Association, we recently initiated a National Dialysis Unit Training Program for county hospitals. The core idea of the project, which went through a strict application and review process before being implemented, is to reinforce standardized management and quality control of dialysis at county hospitals. The program is meant to enhance quality of treatment for patients with end-stage kidney disease using the basic principles of standardized management, highlighting of priorities, strengthening implementation, and integrating prevention. The ultimate goal is to establish an integrated network for the prevention, diagnosis, and treatment of end-stage kidney disease and strengthen the important role of county hospitals in the primary medical and health service system.\(^4\)

PROSPECTS AND CHALLENGES

China is a developing country with the largest population in the world and relatively insufficient medical and economic resources. The rapid growth of the end-stage kidney disease population has put a greater social and economic burden on Chinese government. As a home-based therapy, PD offers many inherent advantages, including its simplicity, minimal requirements for medical resources, and lesser expense than in-center HD. The high prevalence of end-stage kidney disease coupled with limited resources in China highlights the need for strategies to maximize the use of PD. The Chinese government is dedicated to continually increasing the coverage and level of medical service for end-stage kidney disease. Improved awareness of PD and technique advances will help increase the use of PD in China, particularly in countryside and remote areas, and we believe that the penetration of PD will increase in the near future. However, ensuring adequate quality of PD throughout the country remains a big challenge and will require further efforts from the government, nephrology associations, hospitals, and industry.

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